Module 1

Awareness Raising and Understanding of AR

AUREA
4RURAL
augmented reality
for rural tourism

AUREA4RURAL

augmented reality for rural tourism

MODULE 1:
AWARENESS RAISING AND UNDERSTANDING OF AR

Erasmus+

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Module Introduction

This module introduces the basics of augmented reality and its surrounding context - how and why it was developed, and how it compares to and differs from virtual reality.

The module will provide brief information about the hardware needed to view AR content and will explain the different types of AR (marker-based AR, markerless AR). It also introduces how people are already using AR today.

Some insight is given into development costs of an AR solution and security and privacy issues are briefly covered.

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Unit 1
Introduction to Augmented Reality (AR)

The popularity of augmented reality (AR) is growing rapidly. It is used to bring elements of the virtual world into the real world and this enhances the things that we can see, hear, and feel.

There are different terms used, with each standing for a somewhat different type of a reality technology – virtual, augmented and mixed reality.

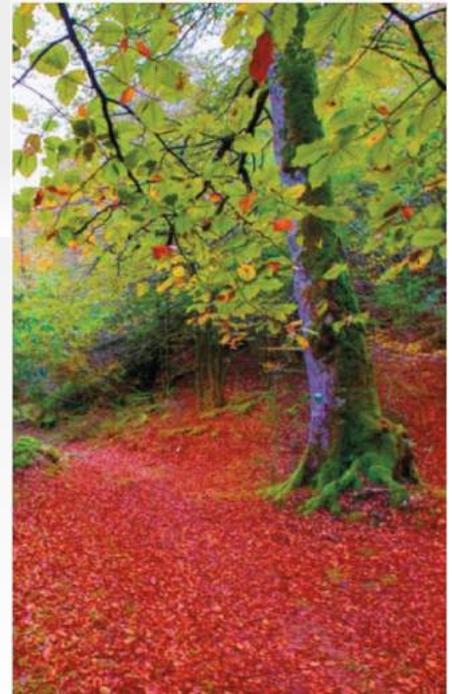What is meant by each one of them is described below.

Augmented, virtual and mixed reality in short

Augmented reality brings virtual information to the real environment. This enhances the experience of the real environment with additional virtual information. The difference to information boards and the like is that AR primarily reacts to the real environment and/or to the user.

A simple example is the broadcasting of a football match, where the location of team members throughout the football field is displayed in AR - the video image has been supplemented with virtually existing information.

Virtual reality is a situation where reality is replaced by a virtual environment. Virtual reality creates a whole new and different experience that does not have to depend on the surrounding environment. Virtual reality involves applications that separate the user from real experiences in order to add new experience.

A simple example is putting on 3D glasses to look at the daily work of a fire-fighter through the eyes of the fire-fighter. The user's current environment is replaced by a virtual environment.

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Augmented reality starts from a real situation or position, and then enhances this reality. It is meant to assist the user in real-life situations, rather than putting him in a different universe as virtual reality does.

There is also a form of reality called mixed reality – it is categorized into the grey area between augmented reality and virtual reality. In this form, the information or object that exists in the virtual world is brought into the real world.

The user experience is not only supplemented but also partially replaced. In this example, without virtual reality, the user would not be able to experience the experience, but regardless of virtual reality, the user mostly stays in a genuine (not virtual) environment.

A good example is a hologram that introduces the sights in a museum - both the genuine ones as well as the ones created by holograms. The virtual world and the real world are connected and complement each other.

Augmented reality can be created by a wide variety of tools. In this training material we focus mainly on smart devices - as these are the most common hardware devices for the general public.
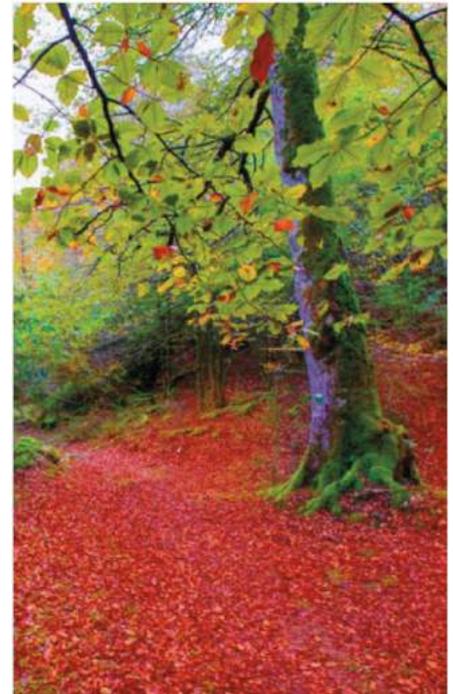
1.1. DIFFERENT TYPES OF REALITY TECHNOLOGIES – VIRTUAL REALITY, AUGMENTED REALITY, MIXED REALITY

Virtual Reality (VR) literally allows one to experience anything, anywhere, anytime. It is the most captivating one of reality technologies, making your brain believe that it is somewhere where it really isn't. To create an entirely immersive experience of VR, it is common to use head mounted displays with headphones and hand controllers. There are also holographic rooms, suits one can wear and other solutions to remove a person from the real world and to bring him/her in the middle of the virtual world.

There are numerous possible definitions for VR, e.g. the one provided by RealityTechnologies:

"A realistic three-dimensional image or artificial environment that is created with a mixture of interactive hardware and software, and presented to the user in such a way that any doubts are suspended and it is accepted as a real environment in which it is interacted with in a seemingly real or physical way."

To put it in simple words as possible, VR in principal means using computer technology to create a simulated environment. Virtual reality is a moment in time, where the user is not present in the real world any more, but is totally in the virtual world. When the user is removed from the real world and when he/she is given information, during the use of which the user does not experience the environment of the real world any more, it is virtual reality.

Augmented Reality (AR) is closely connected to virtual reality and can be seen as connecting the virtual world with the real world. It could be even said that it lies between the real world and the virtual world. The technology is becoming more and more popular in our everyday lives, as it works well with everyday mobile devices and at any place. The technology puts computer-generated information on the user's view of the real world.

Techopedia gives the following definition: "Augmented reality (AR) is a type of interactive, reality-based display environment that takes the capabilities of computer-generated display, sound, text and effects to enhance the user's real-world experience."

A simplified definition of AR would be - AR adds virtual information to the normal reality. The idea of AR is not to replace the using experience, but to provide more information to add to the experience. A good example of this is showing the location of team members during a football match – the audience

can quickly find out where the players of the team which he/she supports are located and will be able to follow the game to a much bigger extent.

Mixed Reality (MR) is the result of blending the physical world with the digital world, combining the best of both virtual reality and augmented reality. It covers all possible variations and compositions of real and virtual objects. The definition of MR by Reality Technologies is:

"The predominantly virtual spaces where real world objects or people are dynamically integrated into virtual worlds to produce new environments and visualizations where physical and digital objects co-exist and interact in real time."

To put it in more simple words: mixed reality is the combination of two realities – an object from the virtual world is brought to the sight of a person and it will exist there. For example, when repairing a car then the virtual glasses will display the location of all components. In augmented reality the location is displayed temporarily, in virtual reality permanently, until the user places the car part into the correct place.

Read more:
www.realitytechnologies.com

www.augrealitypedia.com

AR trends and predictions:
www.marxentlabs.com/trends-augmented-reality-virtual-2019/

https://thinkmobiles.com/blog/what-is-augmented-reality/

1.2. WHAT TO EXPECT FROM THE AUGMENTED REALITY EXPERIENCE?

AR technology comes in handy to manage and provide different kinds of "on-site" information to customers, which through other formats would be impossible or very time consuming to offer.

The user just needs to have a mobile device – be it either a mobile phone or a tablet. Using AR on mobile devices enables it to provide such information to users whereas previously print media or personal interaction were required. The advantages of AR include:

- Quick updates of information
- Immediate availability
- Portable
- Multilingual
- Easy and intuitive for the client

It also enables the ability to create new attractions and services at the tourism provider's property, such as:

- A guided tour to the place and its history
- Access to remote locations that are not on GPS maps
- Treasure hunting for specific segments (i.e. kids or adults)
- Possibility to watch a video or to combine moving animations and text.

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1.3. BRIEF INFORMATION ABOUT THE HISTORY OF AUGMENTED REALITY

Augmented reality has been around for longer than most people realize – already for several decades. The term AR was created back in 1990 by Boeing researchers. The technology found its first commercial uses in television and the military.

With the widespread use of the internet and smartphones, AR was on the rise again and is currently mostly related to the interactive concept. 3D models are directly projected onto physical things or fused together in real-time.

The most important historic development steps of AR, according to ThinkMobiles.com, that are worth mentioning are:

- In **2000**, a Japanese scientist Hirokazu Kato developed and published ARToolKit – an open-source software development kit (SDK). Through this software, one could capture real-world actions and combine them with interactions of virtual objects.

- In **2004**, Trimble Navigation presented an outdoor helmet-mounted AR system.

- In **2008**, Wikitude made the AR Travel Guide for Android mobile devices.

- In **2013**, Google beta tested the Google Glass – with internet connection via Bluetooth.

- In **2015**, Microsoft presented two brand new technologies: Windows Holographic and HoloLens (AR goggles with multiple sensors to display HD holograms).

- In **2016**, Niantic launched the Pokemon Go game for mobile devices. The game quickly became one of the most popular smartphone applications and, in turn, increased the popularity of augmented reality games.

- In **2017**, Magic Leap announced the use of Digital Lightfield technology embedded into the Magic Leap One headset. The creator's edition headset includes the glasses and a computing pack worn on your belt.

1.4. HOW DOES AUGMENTED REALITY DIFFER FROM VIRTUAL REALITY?

Augmented Reality is typically based on a real-life situation. It uses overlay imagery to bring non-existent objects into the real world. Virtual Reality, on the other hand, takes a person away from the real world by blocking his/her sight with a digital environment.

VR brings one to an entirely virtual environment, but AR uses the existing natural environment and places virtual information on top of it. As both virtual and real worlds exist together, the users of AR are able to experience a new and improved real world where virtual information is used as a tool to help them in their daily activities.

Application of AR can be very simple – perhaps just a text notification. Yet it can also be something very complicated – e.g. instructions on how to perform a difficult surgical procedure. What matters is that the provided information is topical and relevant to what a person is doing at that very moment and place.

Another important aspect is the fact that AR does not remove the user from the real environment, but instead gives additional information to better cope with or to better understand the surrounding environment. This is an especially important factor in the tourism sector (e.g. for adventure tourism, rural tourism, etc.).

A summarizing table to compare AR and VR is presented below:

AR (Augmented Reality)	VR (Virtual Reality)
Enhances the real world by superimposing virtual images and adding graphics, sounds, and smells to it.	Replaces the real world with the virtual world.
User maintains a sense of presence in the real world, can interact with it, and is not removed from it.	User cannot see the surrounding real world, is completely immersed into a virtual world, and removed from the real world.
Most suitable for marketing campaigns, product activations and launches, print advertising, etc.	May work better for video games and social networking in a virtual environment.
Can be used on smartphones and tablets.	Uses Head Mounted Displays (HMD).

Thanks to its features and ease of use, it is more appealing for the wider market to use AR than VR.

AR applications can be used with smart devices that people already have, but VR applications usually require more complicated and expensive equipment.

1.5. HOW DOES AUGMENTED REALITY WORK?

To have an understanding of how the AR technology works, it is important to be aware of its objective: bringing computer-generated objects or gathering information into the real world on a device that only the user can see.

The content of AR can be in different forms of data, such as: images, animations, videos, and 3D models. It can be displayed using different tools; for example, screens, monitors, handheld devices or glasses. Google Glass and other head-up displays (HUD) use glasses to put AR straight on our faces. Handheld devices like smartphones and tablets have small displays that fit in the users' hands. As reality technologies continue to advance, AR devices will gradually require less hardware and, in the future, may even be applied to things like contact lenses and virtual retinal displays.

AR does not necessarily have to be only visual, but reality can be complemented also by sound, smell, taste or vibrations. The goal of AR is to bring virtual information into the real environment in any possible format. The most common way, however, is to use visual information.

Additional information about different devices and the way how AR works on them can be found in Module 4.

1.6. WHY IS AUGMENTED REALITY IMPORTANT AND BECOMING TRENDIER?

Even though AR technology has been around for some time already, it has only recently become more widely used and, thus, reach more consumers. It is an entirely new dimension of customer interaction which can be used from person to person, business to business, business to consumer, etc.

Big technology companies have begun to implement built-in AR software and hardware into mobile devices in order to support AR advancements. In time, the technology is becoming more and more accessible and user-friendly.

It is expected to reduce or even replace traditional analogue or physical media, complement them with continuously updated information, and create new opportunities and solutions for communication and training.

The array of industries where AR can be applied to is large, for example:

- Fashion and Retail
- Real Estate
- Tourism and Navigation
- Training and Education
- Architecture and Construction
- Health Care
- Etc.

Unit 2
The technologies of Augmented Reality

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2.1. THE DIFFERENT TYPES OF AUGMENTED REALITY

AR apps most commonly connect digital animation to a special physical 'marker', or pinpoint it to a specific location using the help of GPS in mobile devices. Augmentation takes place in real time and within the context of the actual surrounding environment, e.g. overlaying scores to a live feed sports event.

There are 4 types of augmented reality described below, indicating their differences and main uses.

Marker-based AR

Marker-based AR is also called image recognition. It uses a camera and some kind of a visual marker (e.g a QR/2D code), producing a result when the reader senses the marker. The camera on the device is used to distinguish a marker from any other real-world object in the surrounding environment. Distinct, but simple patterns (such as a QR code) are best as markers.

These can be easily recognized and do not require a lot of processing power to read. The position and orientation are also considered as sometimes it is needed to be able to generate the overlay-AR on the original image in the correct position.

When the marker is found, information connected with the respective marker will be displayed. It is also possible to "paste" information on markers; for example, by pointing the camera of the smartphone on a marker, the screen will display an animated character on the marker.

Marker-based AR is when you get the information once you have arrived to the location. For example, you use marker-based AR when you enter the name of a shop to google maps. Google has attached coordinates to the name of the shop.

On the other hand, markerless AR is when in order to get the information the user has to do something additional, e.g. to look around. If instead of the name of the shop you use coordinates, it is markerless AR - there is no specific shop related to the coordinates in the app.

The computer checks in its database, that there is a shop at these coordinates existing, and offers a solution, which in its understanding is the best match (has the most similarities).

To have a better understanding of how the markers work, please consult modules 2 and 3.

Markerless AR

Markerless AR is also called location-based, position-based, or GPS augmented reality. It is one of the most widely used types of AR, which uses the picture of a camera and a GPS, digital compass, velocity meter, or accelerometer

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embedded in the device to provide data based on one's location and sensors. It is widely used, because smartphones and other devices with location detection features are widely available.

Markerless AR is most commonly used for mapping directions, finding nearby companies and for and other purposes where location is primary.
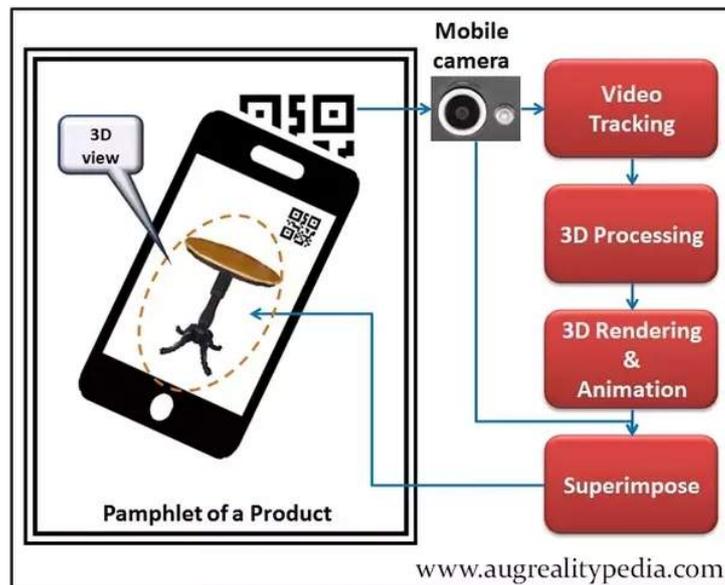
Markerless AR applications try to identify the location of the object. They also try to identify viewed objects based on parameters that have been given to them. For example, knowing the GPS coordinates of your smartphone and the name of the hotel you are looking for, the application will try to display the location of the hotel in relation to your present location and position.

The difference from marker-based AR is that the application does not know what exactly it is looking for (eg a certain 2D code) but is looking for similarities and after having found enough similarities will propose the location of the hotel.

Also, in this view, it is possible to add, for example, moving objects to the camera view or to create surrounding lines around the object that is being searched. An example of this use is digital cameras, which draw a rectangular line around a person's face – they do not know exactly what they are looking for (there is no marker), but they compare everything they see with the description in their database of what a person's face is like.
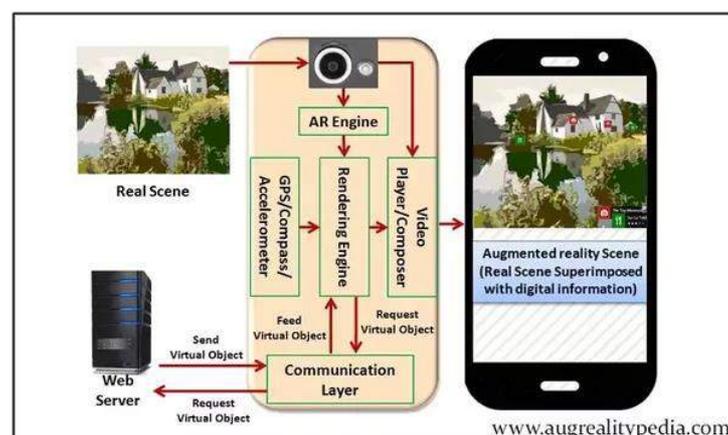
To sum up the first two types of AR and to make a clear distinction between them:

- In marker-based AR applications, the images to be recognized are provided beforehand, and content refers usually to the object they are placed on.
- Markerless AR applications recognize only the location and once reached or close to it, display the defined content.

Projection-based AR

Projection-based AR works by projecting artificial light onto real world surfaces. This AR technology sends light onto a real-world surface and then senses human interaction, i.e. touching the projected light. This touching is detected by differentiating between the known projection and the changed projection (caused by the user's interaction). Projection-based AR can also use laser plasma technology to project three-dimensional (3D) interactive holograms into mid-air.
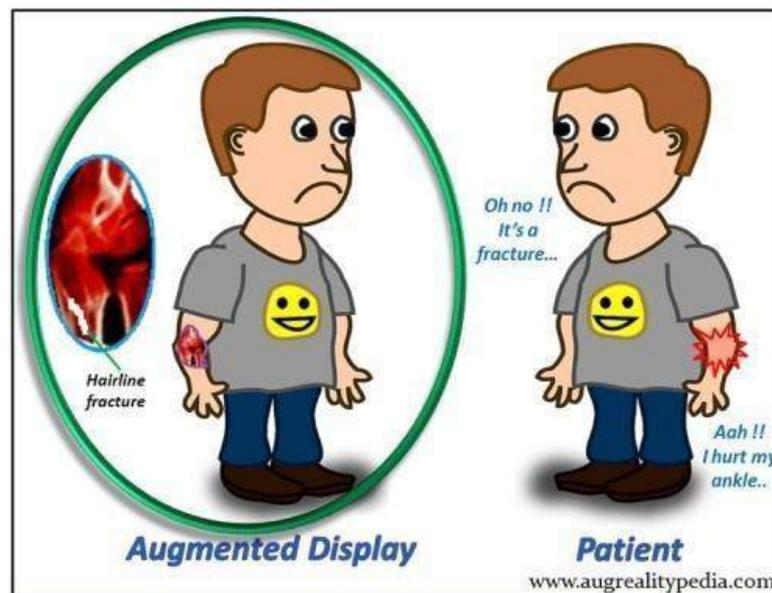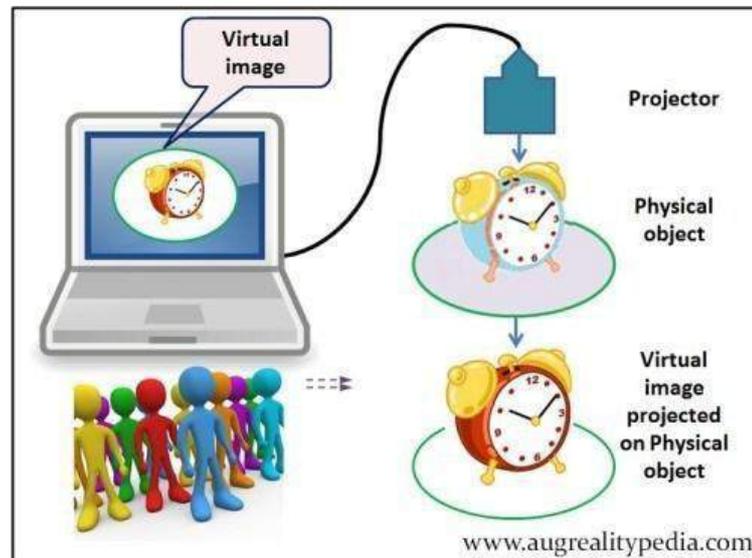
Superimposition-based AR

Superimposition-based AR replaces the original view of an object with a newly augmented view of the same object either partially or entirely. For example, the camera of a device looking at a cathedral triggers an AR content, augmenting a series of pictures of the different building stages of the cathedral during its history.

Or the view of a medieval city gate triggers an AR animation that recreates the activity at this gate 500 years ago. In superimposition-based AR, object recognition is crucial, as the app will not be able to replace the original view with an augmented one if it cannot detect which object it is.

More information about different markers and how to install them can be found in Module 4.

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2.2. PLATFORMS USED IN THE FIELD OF AUGMENTED REALITY

The most suitable Software Development Kit (SDK) for AR projects depends upon the exact requirements of the project. The most common SDKs for AR development are (in alphabetical order):

- ARCore
- ARKit
- ARToolKit
- Deep AR
- EasyAR
- Lumin (Magic Leap)
- MaxST
- NyARToolkit
- Onirix
- Pikkart AR SDK
- Vuforia
- Wikitude

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Unit 3
Augmented Reality and social media

AR is already influencing social media and, in the near future, is expected to play an important role in our everyday lives. Best known social networks such as Instagram, Facebook, Snapchat, etc. are encouraging people to not only use their AR features, but also to create and share their own AR experiences.

Some examples of how AR could be integrated into social media in the future:

- **AR virtual shops on social media:** it is already possible to buy things via social media, but using AR would make it into a more engaging experience.

- **AR and live events:** it is already possible to "attend" an event from the comfort of one's home. AR would enable the user to zoom, track a specific person or object at the event, or open up additional information such as lyrics, biographies, etc.

- **AR videos:** businesses will be able to further engage their target groups by creating interactive AR videos. These videos can be used, for example, to show customers how to use a product or how to make the most out of it. When selling a service, AR videos can show the user experience when buying the service.

- **More brand awareness:** if you create great AR experiences (e.g. lenses, games and other interactive AR experiences), people will want to share this with their audiences.

Unit 4
Examples of Augmented Reality solutions already in use
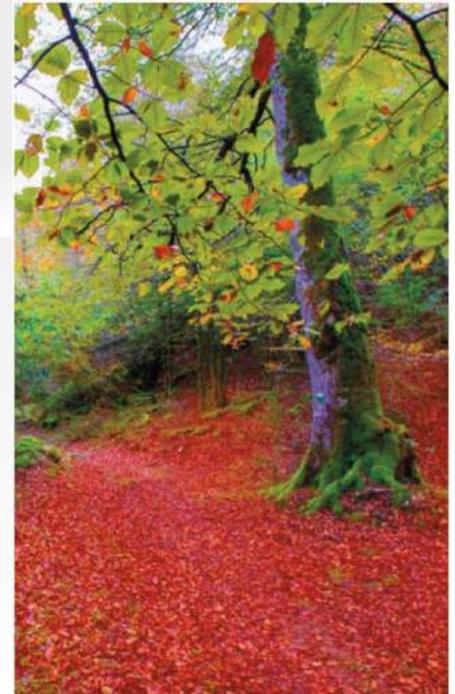
- **Virtual furniture app:** These applications work by adding virtual furniture digitally to the real space available in the room. There are many AR-based shopping applications available on the internet.

  For example: IKEA AR app, where you can place IKEA furniture in your home: https://www.youtube.com/watch?v=vDNzTasuYEw

- **Virtual dressing room:** Retail clothing stores have begun to integrate AR technology, using AR-mirrors and AR-based applications.

  One example of these apps is a virtual dressing room, which enables the user to try on online-selected clothes and accessories virtually without buying or trying them on physically.

  For example: Cisco's AR app, where a client can try on clothes in front of a "magic" screen: https://www.youtube.com/watch?v=XM9ZOWPeiAk

- **AR Business card:** One way to put a lot of information on a little piece of paper, including a video message. It is like virtually carrying a company presentation and product samples along and at the same time.

  It definitely impresses people and makes you stand out from others. Also, AR greeting cards have the same goal. AR business card example from YouTube: https://www.youtube.com/watch?v=Jq98OEXJSr8

- **Alive apps:** these work by recognizing images, logos, location, QR codes, and objects in real-time and are used to see exclusive content such as animations, videos, and photo shoots.   Alive apps examples from YouTube:

  - Jurassic World Alive AR app
    https://www.youtube.com/watch?v=JQnl1tHU2Kw

  - Augmented Reality Live Coloring app
    https://www.youtube.com/watch?v=QCceCt7bvFw

  - Bringing Newspaper Alive app
    https://www.youtube.com/watch?v=dDLGslEoS9c

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Unit 5
How to use Augmented Reality in the tourism sector

The tourism industry has always adopted new technologies quickly. The potential customers often would like to know what they are getting into before booking a tour. Once they arrive, they want their questions answered quickly and in detail.

AR can help in both; therefore, it is worth it for businesses to consider adopting this new technology when planning their marketing and services.

The most important sectors of the tourism industry are: accommodation, transport, catering, and attractions. Augmented reality can assist and improve each one of these sectors.
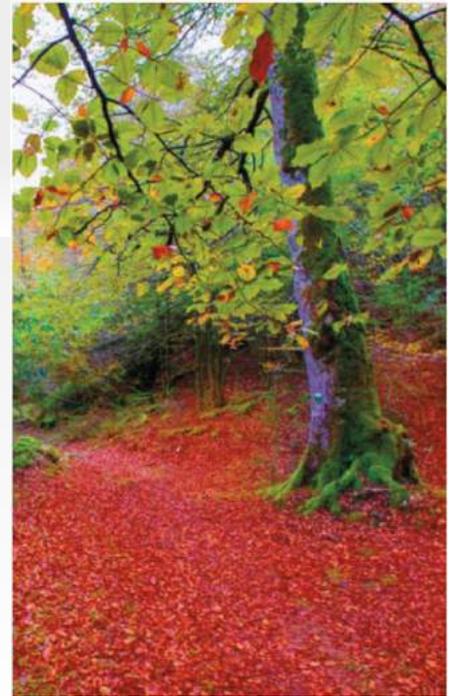
Content

5.1. ACCOMMODATION

- **AR can be used in advertising and for providing information:**

As an example, AR can be used to create all-around room tours with accommodation details, prices, etc. It is a good way to advertise the accommodation and to engage guests to try out different services.

For example: Guests just have to get a smartphone or a tablet, open the app, point to a certain marker and see the information about extra services and etc. Or if the accommodation has an interactive wall map in every room, that guests can point their phone to it and check out the local tourist attractions nearby.

- **New ways to observe:**

In the near future, electronic technologies and print products will not disappear. They will adapt to the needs of AR, creating a new storytelling medium.

For example: Today's tourists don't pay a lot of attention to simple pamphlets. AR makes it possible to discover information on a new level – getting 3D animations from printed flyers and brochures.

- **Interactive accommodations – one way to raise the interest of young generations:**

Pokemon Go has inspired many other businesses to take advantage of AR, also the ones from the tourism industry. Such gamification can make people, especially the younger ones, choose a particular accommodation.

For example, PAI Hotels in Thailand offer an app that displays every site of their hotel with additional AR objects, and by collecting 7 of them guests can win awards.

- **Language barrier disappears when traveling:**

When people travel abroad, there are foreign languages and signs around which are difficult to understand. AR apps or features (e.g. Google Translate) can give a helping hand by instantly translating information into the native language of the visitor. This feature can support everyone and make them feel more comfortable and confident while travelling.

For example: Currently Google translate AR mode allows users to see any text of 40 foreign languages as the native one.

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5.2. TRANSPORT

There is always getting from one location to another involved when travelling. It is often the case that when you exit the airport or step out of the bus/train/car in an unfamiliar place, you are not sure where exactly you have to go.

With the help of AR, a road map can be turned into an interactive guide with signs and names of the places in different languages.

For instance, when pointing at transportation objects you can get directions, routes, next stops, and places of interest. For foreign travellers especially, this could be quite helpful during their trips.

For example, the Tunnel Vision application (app) turns a metro map into an interactive guide in multiple languages in New York subway: https://www.youtube.com/watch?v=S5PiQLhxXeA

5.3. RESTAURANTS/CATERING

Catering establishments such as restaurants, bars, etc. can use AR solutions for their benefit in different ways:

- Restaurant menus with an interactive 360-degree view of each dish, portion sizes, and ingredients. Instead of waiting for the dish and imagining what the dish on the menu would look like in reality, you could scan the item on the menu and get the actual image of the dish.

- AR games/quests, as many restaurants are even using Pokémon Go to lure clients in.

- Navigation help with special AR mobile apps to provide information about restaurants, cafes and bars nearby.

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5.4. ATTRACTIONS

Exploring tourist destinations and attractions with AR can make classic city tours more exciting. We can travel back in time, see the development of landmarks in the course of time, explore 3D models of places, and enjoy fun tour guides.

The main advantages of using AR for attractions are:

- **Navigation:** Usually, attractions lie on a large territory and there is a map stand and directional signs. As a more attractive alternative, AR would enable interactive navigation and, for example, cartoon/animal characters to play with.

- **Gamification:** For instance, treasure hunts and games or quest apps to find hidden 3D characters.

- **Education:** Rich, useful, and visual information about any animal (e.g. if we talk about a zoo), even those now extinct.

- **Time-killer quiz:** To entertain visitors while they are waiting in lines, they could make pictures with AR objects.

5.5. MUSEUMS

During the last decade, unfortunately, museums all over the world have witnessed a decrease in visitors. AR can help reverse this trend. To fascinate people and to educate them in a memorable way, museums can create visual tour guides and exhibitions to bring non-existent objects to life.

You can point the camera on your device on a particular painting or artifact and a 3D view along with all of the history of the item appears on your screen.

For example the Smithsonian National Museum of Natural History in Washington has launched the "Skin and Bones" app, which allows people to see a full live representation of extinct animals based on their skeletons in the museum: https://www.youtube.com/watch?v=7agVb4IG16M

In conclusion, AR offers tourism businesses the possibility to simplify their business processes; for travellers, it offers the information they need, thus enriching their travel experience.

The benefit to your tourism business is that using AR:

- creates buzz around the business.
- increases sharing on social media and, as a result, brings new customers.
- gives you a chance to create unique content for marketing your business and to express its uniqueness.
- helps to outsmart the competitors and highlight your business from the rest.
- helps to deliver a truly unique customer experience.
- and much, much more!

Unit 6
Business potential and Augmented Reality investments – Factors influencing the development costs

There are different kinds of AR mobile apps available on the market. They function on a number of platforms which includes the Apple iOS for both the iPad and the iPhone, Android, the Web/PC, and even the Windows Phone. The cost for the development of an AR app, among other things, depends on the platform it's based on.

Apart from the platform, the cost of the AR mobile app development depends on the business model for a commercial app.
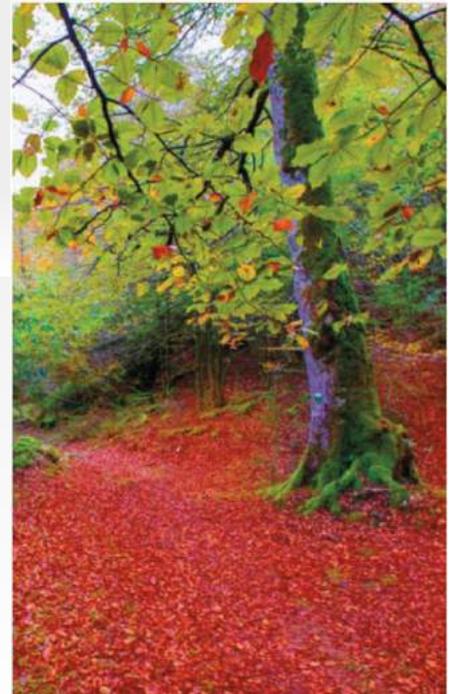
Will the app be downloaded for free, or will it be sold on the market for a fixed selling price? Is it enough to have barely the minimum in-app purchase options or does the AR app require full eCommerce functionality for it to be profitable? All of this influences the overall cost of the AR app.

The complexity of the AR app is another critical factor influencing the price of app development. The user interface of an application is extremely important for an AR app. While PC or Web apps require a simpler interface, smartphones and tablets need a more complex interface, thus, a more expensive one.

The smartphone apps developed on the iOS system might be considerably cheaper than Android apps because of the complexity of the Google's mobile app development platform. Android apps are harder to build and take almost double the time, so they cost more.

The application features, design, and functionality all influence the costs of an AR app. The technical specifications of the app - whether the app is list based or database based, is it with or without a server or API component - all affect the cost.

The creativity in an AR app's display and user interface design also matter. The more elements included in the app to make it more pleasing for the consumers, the more expensive it is. At the same time - the better the app, the more time the user will spend on it and, the more monetary gain there is for the business.

Perhaps one of the biggest influencing factors affecting the costs of an AR mobile application is the choice of the app development company:

- For small AR projects to be used in micro- or SMEs, freelancers can elaborate a complete APP (including the content management part via PC / internet browser) for less than 10.000 EUR. These AR projects will be based on one of the platforms that are mentioned above, such as WikiTude that was used for the Aurea4Rural toolkit.

- Medium-sized AR projects that involve a higher amount of programming, will be in the range of 20-50000 EUR

- Specialized bigger companies working on AR will start projects only from 2-300.000 EUR onwards

For example, the cost of developing and testing the Amazon AR view app was around 160.000 EUR. Toolkits for generating easy and simple AR applications are not yet available on the market.

The present Aurea4Rural set of tools intends to fill this gap by allowing small service providers (not only) in rural areas to create their own applications without cost. In the future, it is likely that similar solutions will be made available by professional AR platforms as what happened with website design platforms, based on the "Freemium" concept: basic individual use with limited functions is for free, while extended or more professional functionalities require a license.

Unit 7
Security and privacy issues when using Augmented Reality

As more and more developers across the world are building innovative applications for the technology, more and more security risks are arising. Like every other digital technology, there are security issues related also with AR.

As AR combines the digital world with the real world, cyber security risks could move over to the physical world. Some examples:

If someone manipulates a navigation system, then it shows the driver a wrong road route or inaccurate speed.

With the help of malicious applications, it can give a person's geo-location to criminals.

Variety of cyber threats like spoofing and data manipulation can make the content unreliable even if the source is authentic.

Possible disadvantages of AR:

- It is expensive to develop AR technology-based projects and to maintain them. Also, production of AR-based devices is costly.

- Lack of privacy is a concern in AR-based applications.

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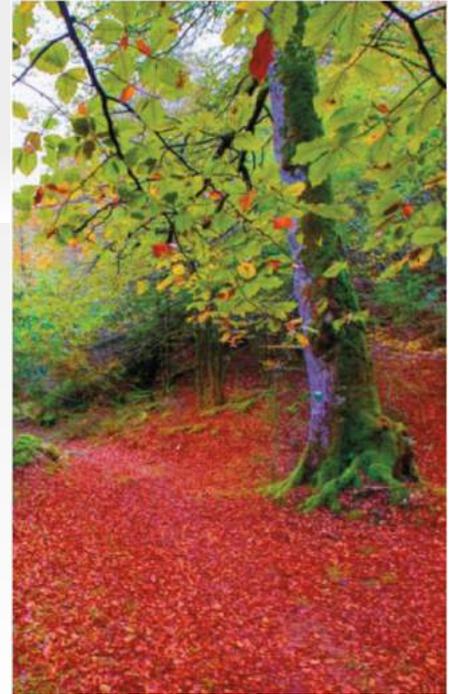
Unit 8
## The future and challenges of Augmented Reality
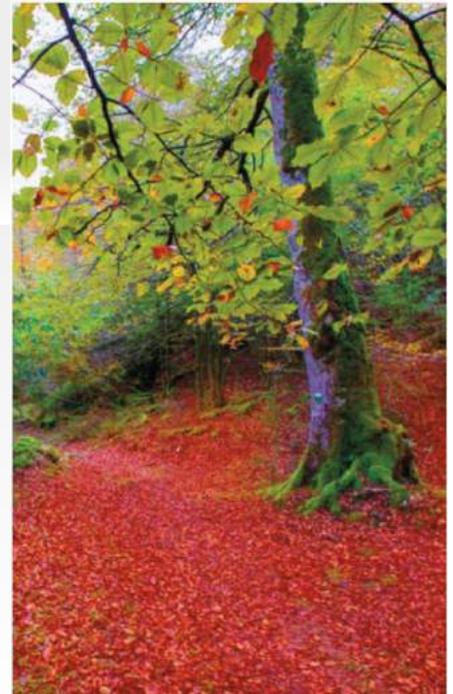
The previous parts of the module have covered different advantages of using AR. As the image above indicates, revenues of AR devices and services are expected to rise at a high speed. Yet, there are also several challenges related to the technology.

AR industry challenges (according to TheAppSolutions) include:

- Lack of proven business models
- Lack of AR app design & development standards
- Security & privacy issues with AR
- The possibility of physical harm
- Poor quality of content & use cases
- Social issues of AR: public acceptance & retention
- AR technology problems & limitations
- Ethical and legal Issues with AR

The list of the AR-related challenges may seem long, but the solution of these challenges is more of a question of time. It is for sure that AR technology will continue to develop and little by little will establish itself as an integral part of everyday life and online solutions.

Forecast of the augmented reality (AR) device and services revenue
worldwide from 2018 to 2020 (in billion U.S. dollars)
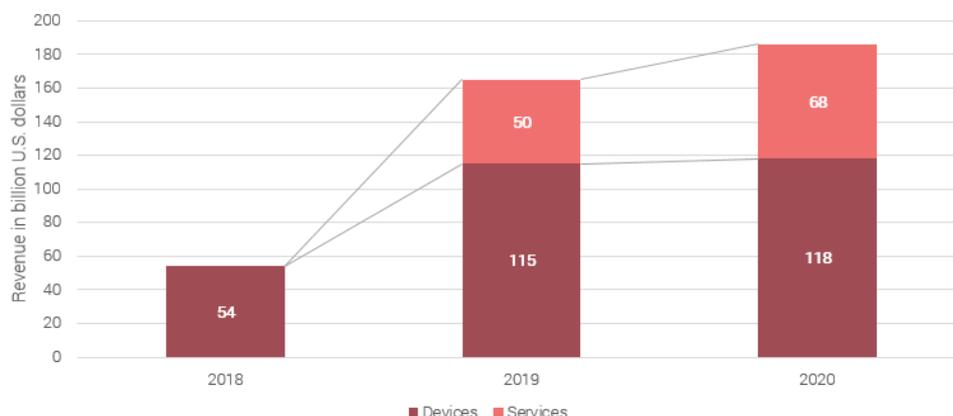
Source: www.statis

Read more:

www.networkworld.com/article/3174804/the-3-biggest-challenges-facing-augmented-reality.html

https://blog.globalwebindex.com/chart-of-the-week/augmented-virtual-reality/

https://medium.com/the-mission/the-6-biggest-challenges-facing-augmented-reality-8d48c470286d

https://theappsolutions.com/blog/development/augmented-reality-challenges/

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Module 2
Minimum technical resources and knowledge that are required for AR

AUREA
4RURAL
augmented reality
for rural tourism

AUREA4RURAL

augmented reality for rural tourism

MODULE 2:
MINIMUM TECHNICAL RESOURCES AND KNOWLEDGE THAT ARE REQUIRED FOR AR

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Unit 1
Basic introduction to how AR works

We looked at the functioning of augmented reality in the previous module, where there is more of a comparison between augmented reality, virtual reality, and different combinations of these realities. In this module, we will look more at the technical side - how augmented reality works, which hardware is used for augmented reality, and how that hardware works.

In general, augmented reality works thanks to a device capable of providing the user with additional information that the user cannot access in a normal environment. Access to this information may also be complicated or limited. The way the information is presented depends on the augmented reality application, its purpose, and the device that is being used. For examples of different augmented reality usage, see the next part of the module.

The user can be involved in augmented reality in different ways. Some solutions expect the user to be actively involved. Examples would be games where you have to move to certain points and do something there, or a 180 degree view of an area in different weather conditions.

The second option is augmented reality applications that passively pass on information. Examples of passing on passive information would be the time and the speed limits displayed on the car's windshield, as well as the graphics of football fields.

In addition, there are various levels of hybrid solutions that combine both options, including both active and passive elements; for example, information about sights displayed on the smartphone screen together with an animation, and how the object appeared 300 years ago, which is visible until the object is in the smartphone's field of view.

Let's also break one myth right from the start- the form of augmented reality is not always a so-called "phone game" - very often we use augmented reality without noticing or being aware of it.

Content

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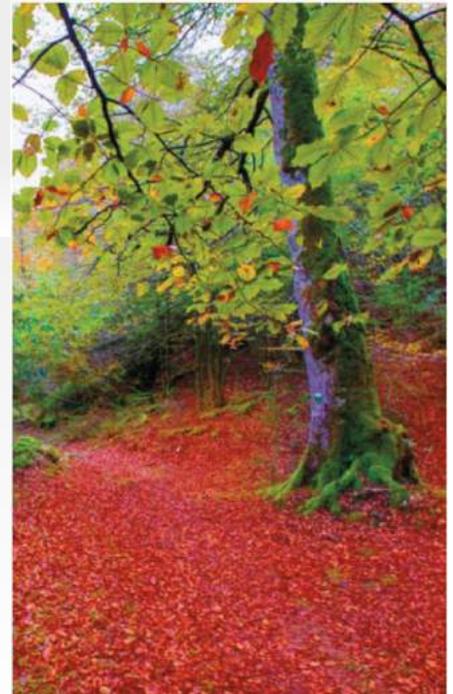
For instance, seeing a message that appears on a car's screen that a heavy rainstorm is approaching, reading the QR code to get more information about the object we are looking at, or measuring the volume of an object using our phone - all of this is augmented reality as well.

In a nutshell, augmented reality is not meant to replace the reality, or otherwise remove reality, but to complement it. There are many uses for augmented reality, but the point of all of them remains the same - the user gets more information about reality quickly and comfortably, and it does not replace his reality but complements it.

How is AR used?

There are several uses for augmented reality. In order to better understand them, we give some examples. We will look more closely in the following parts of the module about how the solutions shown in the examples work. In order to better understand the examples, we divide them according to the same categories we looked at in the previous module: marker-based and markerless AR.
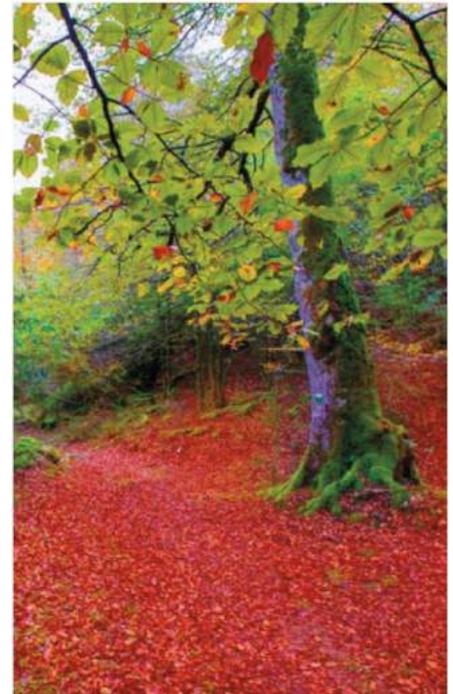
1.1. HOW IS AR USED?

There are several uses for augmented reality. In order to better understand them, we give some examples. We will look more closely in the following parts of the module about how the solutions shown in the examples work. In order to better understand the examples, we divide them according to the same categories we looked at in the previous module: marker-based and markerless AR.

Using marker-based AR

By pointing to the marker, we will be given an option to get more information. There are different kinds of markers, but all the markers are present in the system of the device used for augmented reality - that is, the device is unable to detect objects that do not have a marker.

To recognize the marker, the most popular function is that of the camera, which is used to identify the exact position of the marker in relation to the camera and the content of the marker. If the location and/or content is known, the device will do exactly what is associated with that marker; for example, pasting a virtual animal on the marker, providing information about the marker, or opening a webpage. The marker can also be audio (e.g.), radio waves (e.g. Wi-Fi, Bluetooth), or location-based (e.g. GPS). You can read more about this in Module 4.

The user directs his augmented reality device (such as a phone, camera, glasses, etc.) to a marker, and the device displays the function of the marker. The device does not necessarily have to have a camera; it is also possible to activate the device with, for example, sound (a bird noise or the lyrics of a piece of music) or based on a location. Also, you do not need to use the screen to display the marker - you can also play a sound or make objects move.

Examples of use:

QR-code – QR-code was used as early as 1994 in Japanese automobile factories. The purpose was simply to get information about the parts of the car; for example, when they were produced, in which factory, how many, etc. The user directs the camera/reader of his device (e.g. a phone, scanner, etc.) towards the QR code. The device opens the page or displays information related to the given code from the database.

Scan me

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Read more:
https://www.qrcode.com/en/history/

Yu-Gi-oh! AR – the device (such as a smartphone) recognizes the objects in its field of view - a game mat and playing cards. When a user places a card on the game mat, the characters on the playing cards are displayed in the air (with an image displayed on 3D projectors). Placing the cards in the right places on the mat (playing the game), the image displayed will change - for example, the dragon will attack the swordsman of the opponent.

Read more:
https://kotaku.com/yu-gi-oh-card-battles-look-explosive-with-ar-1828155314

Location detection

The AR device provides feedback (e.g. vibrates, makes a sound) about the possibility to get more information about the area or to get to know more about the objects in the area. This is an easy way to let the user know that there is something in the area that might interest the user. Or it can send information about the user's location to devices in the area. The user can choose whether he wants to explore the area or not. Usually it is based on GPS coordinates, but other location detection methods such as radio waves, wifi, cameras, etc. can also be used.

Examples of use:

Pokémon Go – a mobile game. The phone sends a signal to a nearby device when the user gets close enough to the GPS point. There is a game character "hidden" at the point, who can be caught using the application on the phone.

Read more:
https://www.pokemongo.com

Google Maps - a map and navigation app. If traffic in the area is heavy, the device displays information about it. It is possible for the user to read information, see the expected increase in travel time, and choose between different routes. As the user moves, the map lets him know (visually and with a sound) both about the current location and future events (for example, left turn).

Using markerless AR

The device attempts to identify objects and/or locations based on information received from its inputs. Unlike marker-based augmented reality, the device attempts to identify objects compared to a general description. For example, the device is able to identify which part of a person is the "face" and suggest the age and gender of a person. Another example is by pointing the camera of an augmented reality device on the couch, the device tries to find a level and put some animal, such as a tiger, to "sit" there.

The biggest difference with the application that uses markers is the need for a physical (additional) marker, whereas markerless augmented reality does not require additional markers. Instead of markers, markerless augmented reality attempts to determine itself by comparing objects and different parameters, which information to display, and how to do it.

Examples of use:

Google AR - Learning Application for children. When searching for a tiger's image with the phone and pressing "display in 3D", the application displays a camera view on the screen of the phone and places the tiger on the screen. By moving around the tiger with the camera of the phone, you can see the tiger from all sides and measure the size of the tiger and compare it with the size of the sofa, for example.

Read more:
https://www.theverge.com/2019/6/2/18649312/google-ar-search-results-animals-3d-model-augmented-reality-lions-tigers-bears-oh-my

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Facelytics – by directing the camera of a phone to the human face, the application tries to understand the gender, age, emotion and other similar information of the user. When a person's emotion changes (e.g. from happy to sad), this information is also displayed by the application.

Read more:
https://www.facelytics.io/en/

Leafsnap – making a photo of a tree leaf, the application analyzes the appearance of the tree leaf and displays what tree species it is.

Read more:
http://leafsnap.com/

Aurea4Rural application:

The Aurea4Rural app uses markers to create augmented reality. There are two different types of markers: GPS coordinate markers and QR-code markers. The GPS markers will be activated when the user reaches close enough to the specified area on the Aurea4Rural application map application. QR codes will be activated when the user directs the QR code reader in the direction of the QR code. Having received information from the marker, the application displays the requested information, such as a description, a web page, or a video.

Unit 2
Augmented Reality Hardware and Technology

Now that we have looked at different examples of augmented reality, let's look at what kinds of hardware and technology are used by augmented reality applications. This is a general overview of hardware and related technologies. For more information on how the communication between hardware and software works, see the following module.

Content

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2.1. CAMERA

Camera (and other light-capturing sensors) - light-capturing devices are generally used to capture objects. For the sake of simplicity of this material, we use the word "camera" in this section, but in this context the camera may also be a light sensor, a barcode reader, a colour detector, and so on.

Augmented reality devices using a camera compare the information from the camera with the information in their databases. For example, in the case of marker-based augmented reality, a recognizable object that is previously existing in the database is searched for in the image; for example, a QR-code or a playing card.
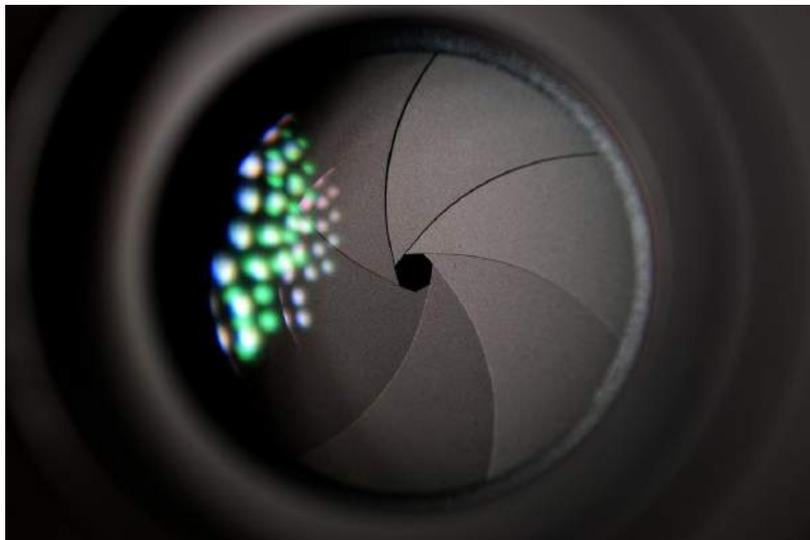
Markerless augmented reality apps attempt to find similar objects and then detect details of the object to display the information provided in the application. For example, when photographing a tree leaf, the application analyzes the colour, size, shape, and relief of the tree leaf. To identify the face of a person, the app compares the face with various parameters (for example, the shape and colour of the face, placement of the eyes, presence of hair and/or beard, position of the mouth, etc.).

The more sophisticated, smaller, and less illuminated the subject, the harder it is for the camera to capture it properly. Also, typical cameras do not capture very fast moving or vibrating objects very well. So, the bigger and clearer the object, the easier and faster it will be to use the application. For a faster and more effective augmented reality experience, different, clearly distinguishable markers (such as a QR-code) or SLAM methodology (the application itself selects a suitable environment from the environment) are often used.

Using the camera image and fast processing of the images requires relatively high computing power. Therefore, the fewer objects a device has to look for on the image and compare, the faster and less resource-consuming the functioning of the device is. This is also one of the reasons why marker-based augmented reality applications are often used - the quicker and smoother the object's detection, the easier it is to provide information about the object to the user.

The most common light sensor used in augmented reality applications is the camera of a smart device. The quality of the camera is generally good enough for the application to be able to distinguish the object(s) of search from the camera image. Also, the power of smartphones is sufficient to cover the computing power needed to analyze this image. Again, the easier the identifiable object is (such as a QR code), the less computing power is required.

2.2. MICROPHONE

The microphone is used to record sound. The recorded sound is compared and measured according to the purpose of the application. For example, the record of a bird song is compared to the record information contained in the application itself – having found a similarity, information about that bird is displayed to the user.

And when recording the warning whistle of a train, the recording is compared to parameter of whistles in the database, and the train model corresponding to the sound criteria will be suggested.

Once the sound is recorded, it must be analyzed and the similarities with the provided criteria assessed (for example, the record of the bird song with the data of the bird song in the database). High-quality recording equipment is needed to record the highest quality sound.

Since most portable devices are not professional devices (such as microphones on mobile phones), the quality of recorded sound is usually quite low. In addition, regular microphones also catch the surrounding sound, making it even more difficult to distinguish the sound you want from the surrounding sound environment.
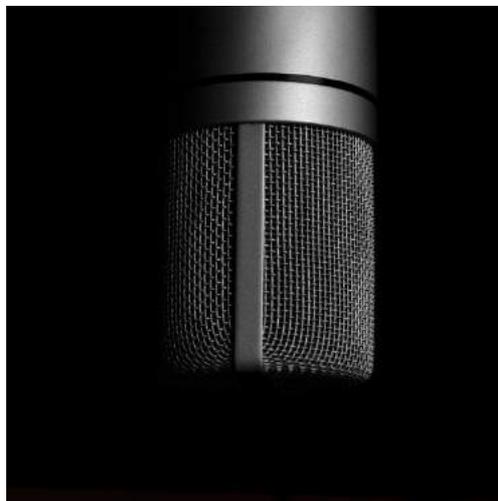
In order to use audio detection for augmented reality, the sound must be clearly distinguishable from the surrounding environment. This means eliminating the so-called "noise" in the background, or the recorded sound must be very different from the general sounds of the given environment. For example, a person says in a clear voice the phrase "Hello Google" / "Hi Siri" or there is a clearly heard piano sound in a quiet hall.

The most common microphone used in augmented reality applications is the built-in microphone of smart devices. Since these microphones are not professional devices, it is worth remembering that, for augmented reality to function, the sound to be recorded must be distinguishable from the environment as easily as possible. This means - clearly distinguishable and loud, and with the least amount of ambient noise.

2.3. GPS

GPS is used for determining location, often it is also referred to as GPS positioning. GPS systems use satellites and ground stations to assess the user's current location. The satellites send information about their location and their own (high-precision) time to the GPS device and the device calculates the time difference between arriving and sending the signal. If enough GPS satellites are available, it is possible to determine the location of the user quite accurately.

The GPS signal is not an almighty signal, and many factors are capable of preventing or delaying it; for example, the GPS does not work well in underground buildings, inside buildings, around magnetic fields or field suppressors, and in many other places.

Also, GPS devices for domestic use are not very accurate – the allowed fluctuation is + - 5 m, but can vary greatly. For example, in a densely populated area or in an area below the surrounding area, the fluctuation may be tens if not hundreds of meters.

Augmented Reality applications generally use a GPS signal to evaluate the arrival of a user in a particular area. For example, when a user approaches an object, the user's location and the location of the object are displayed on the screen. When the user is close enough to the object (within the radius of the object), information about the object is displayed to the user.

Since the quality of the GPS signal is volatile, it is recommended to use the coordinate radius of a location rather than the specific location coordinates in the augmented reality applications; this helps to eliminate GPS system's location detection errors.

The most widely used GPS device is a smart device. Although the GPS system of a smartphone is not the most accurate one, it is often used - because it is present in smartphones and for larger objects, the + -5 meter location error does not affect detecting the location to a very big extent. It is not recommended to use the GPS on smart devices in very specific areas or in densely populated areas. It should also be remembered that the GPS system does not work well inside buildings and in the midst of adding signals.

Read more:
https://www.gps.gov/systems/gps/

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2.4. RADIO AND OTHER SIGNALS

Radio- and other signals (Wi-Fi, Bluetooth, RF-ID, etc.) are electronic signals that can be "caught" if they exist. Signals are sent by different stations - for example, radio stations send radio signals and Wi-Fi routers send Wi-Fi signals. The best-known signals are Wi-Fi, radio stations, Bluetooth and near-field signals. In the presence of a signal, it is possible to assess the strength of the signal and either just "catch" the signal or transmit a signal itself.

For example, when you reach the area of radio station's signal, you can catch the radio signal and listen to the music. In the case of an augmented reality application, a message appears on the screen indicating that a new radio station has been detected, a brief overview of the radio station is displayed and you are asked whether you want to listen to the radio station.

Radio stations are rarely used in augmented reality, as the capture of radio signals often requires additional equipment (many smartphones require headphones that serve as an additional antenna). However, the existence of Wi-Fi and Bluetooth signals and the measurement of their strength are more commonly used. Unlike GPS signals, Wi-Fi and Bluetooth signals can be produced by yourself.

Therefore, these signals are often used to evaluate the moving direction, trajectory and location of the user indoors. If the signal is strong enough, the user is close. If the user's signal weakens at this Wi-Fi station but strengthens at another station, then the user moves towards the other station, etc.

In Augmented Reality, Wi-Fi and Bluetooth areas are generally used to determine the user's location. When the user reaches an area of a sufficiently strong signal, the Augmented Reality application activates and displays additional information.

The range of Wi-Fi and Bluetooth signals is considered to be about 20 m, the range of near-field signals 10 cm and radio coverage approximately 50 km. As with all wireless signals, the coverage area may be several times higher or lower than promised. For more information, see additional readings.

Near-field signals, unlike radio, Wi-Fi, and Bluetooth signals, are spread near the signal generator (e.g., about 10 cm in case of RFID). Therefore, the augmented reality application can only be activated if the device is very close to the object. As with GPS signals, there are many possible suppressors of radio wave signals - dense inhabitation, surfaces reflecting signal, larger objects located between transmitter and receiver, and the like.

The most widely used radio and other signal receiver is, once again, a smart device. Since many smart devices do not catch radio signals (without headphones, the headphone cord acts as an antenna), it is not advisable to use the radio signal for smart device's augmented reality application. Unlike catching radio signals, Wi-Fi and Bluetooth are built into most smartphones. It is therefore desirable to prefer these two technologies.

The most widespread use of near-field signals is with different contactless cards - by placing the card near the reader, it is possible for the user to get information about the museum exhibition in his/her language, or to activate the functions when the user passes a reader. Both the reader and the cards can be hidden, for example, in the user's clothes or in door openings.

In order to use radio- and other signals, it is necessary, first of all, to assess how strong the signal has to be to activate the augmented reality application. Consideration must also be given to the above risks (populated area, objects, signal reflection, noise, etc.).

Read more:
https://en.wikipedia.org/wiki/Wi-Fi

https://www.wi-fi.org/discover-wi-fi/specifications

https://en.wikipedia.org/wiki/Radio

https://www.makeuseof.com/tag/technology-explained-how-do-rfid-tags-work/

Unit 3
Ways of communicating information to the user

Different devices are used in augmented reality to communicate information to the user. The most common are different screens and other display methods. But sound, physical equipment, and various others are also used.

Content

3.1. SCREEN

Information from the augmented reality application is displayed on the screen (how the process works can be read in the following module). The sizes of screens range from very small (3-bit LED sensors, a few mm in size) to very large ones (large screens at large events, 120 inches and larger). It depends very much on the size and characteristics of the screen, and what the screen can be used for.

The simplest example of using augmented reality is viewing sporting events. Watching a static football match as a viewer would be the normal reality. When information is added to the big screen (the score, results, people's locations on the field, etc.), the normal reality becomes augmented reality.

As was described in the first module, the basic idea of augmented reality is not to bring the user into a new world but to add to and supplement our present world. We can classify screens and their types in very different ways, but in this example, we classify screens by their size and portability into three different categories.

The first category is static augmented reality screens. Static augmented reality screens do not require user feedback, but their information changes according to changes in the environment. For example, this category includes TVs, projectors with a screen, notice boards and other information boards. The difference from static information screens (for example, a promotional billboard on the street) is to monitor the changes in the environment, respond to changes, and add something to a conventional transmission mechanism that is not usually there.

For example, on a football field, it is not always possible to see the positions of team members and, at the same time, the score of the game- the focus is on showing a certain area, not on showing the entire field. In addition to the usual

image in focus, the score and team members' locations can be seen on an augmented reality screen.

The user could also get this information separately, keeping a close eye on each part, but it is possible to augment the reality with virtual information. Without the need to turn your head, you can see where your favourite player is located even when the ball is on the other side of the field.

The second category is mobile or transportable screens. This category includes smart devices, augmented reality devices with screens, portable projectors, etc. The biggest difference from static screens is the ability to move them. In general, the smaller the device, the easier it is to carry around and display the appropriate information on the screen. The user normally has to carry mobile devices, generally in hand/with him, which makes it harder to focus on reality, but adds a lot of opportunities to use augmented reality.

In addition, there is also a third category of screens - ultra-mobile screens. These include smart glasses and smart watches - devices that a person carries with him without much effort and that add to a person's reality without the person having to pick up the device.

Features of screens:

1) **Screen size:** the larger the screen, the further the screen needs to be viewed from to see the whole picture. It is also harder to move a larger screen.
2) **Contrast and brightness of screen colours:** the less contrast and brightness, the more the readability of the screen depends on the surrounding conditions.
3) **Power consumption of the screen:** when the screen is mobile, the convenience of using augmented reality largely depends on the amount of time the device can be used (how long the battery lasts).
4) **Ease of use:** the idea of augmented reality is to "add" virtual information to our reality. If the user cannot use the screen comfortably or when the screen takes full attention, it is more of a virtual reality- the real environment is replaced (for a short time) by the virtual environment rather than the functions of the existing environment being complemented.

3.2. AUDIO/SOUND

Augmented Reality applications can also use sound to let the user know about changes in the environment (temperature, speed of movement, dangers, information). The use of sound can vary from a simple beep to music, but also to loud signals. Neither sounds that are found in a normal environment, nor sounds that are static, can be considered augmented reality. This means that when the important factors change (such as location), the sound does not change; for example, with recordings.

However, listening to the history of a location when walking through the city can be considered augmented reality; as soon as a new location is reached, the history of that particular location will start playing. In short, augmented reality through sound is not an audio book (static, playing sequentially), but rather an audio guide (plays according to the location or other conditions).

1) **Volume of the sound:** how loud is the sound that is generated. Augmented Reality is designed to complement the experience of its users, not to disturb third parties and other people.
2) **Clarity / Quality / Purity:** Sound clarity is an important aspect, especially for the listener. It is difficult to hear sound in crowded places. Poor quality sound is difficult to understand, etc.
3) **User comfort:** The sound must be audible to those for whom it is meant, and at the same time the sound must not become disturbing to those for whom it is not meant.
4) **Power consumption of the audio device:** a wall-mounted audio device does not require a battery, but it cannot be carried around. The ease of use of a portable device depends largely on the amount of time the device can be used (how long the battery lasts).

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3.3. VIBRATION

Vibration is the vibrating of the device, in other words, "shaking" of the phone. Vibration can be used to transmit information, but vibration is generally used to draw attention- not as the main information conveyor in augmented reality applications. For example, the phone may vibrate to indicate that the point of GPS coordinates has been reached.

For example, Pokémon Go! gives a vibration signal when a user reaches the Pokémon located at the GPS coordinates. The user can choose whether he wants to catch the Pokémon in augmented reality or not.

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3.4. OTHER

You can also use senses such as smelling or feeling out to convey information, but their use of transmitting augmented reality information is not very common.

Unit 4
Examples of hardware used in Augmented Reality

Very often, different hardware is used in combination; for example, when a GPS point is reached, a record of the history of the house will sound in the headphones.

The users' smart glasses will display points on the buildings being viewed, and focusing on the points with the camera of the phone, the phone will show pictures of the houses in the past.

Upon entering a house, the house greets the user by his/her name, and when the user is moving around in the house, the history of the room through which he is currently walking is played in the headphones. In this example, a camera, GPS, and Wi-Fi have been used, but also near-field cards, sound, or other sensors may be used.

Below we will discuss the use of specific hardware in more detail.

Content

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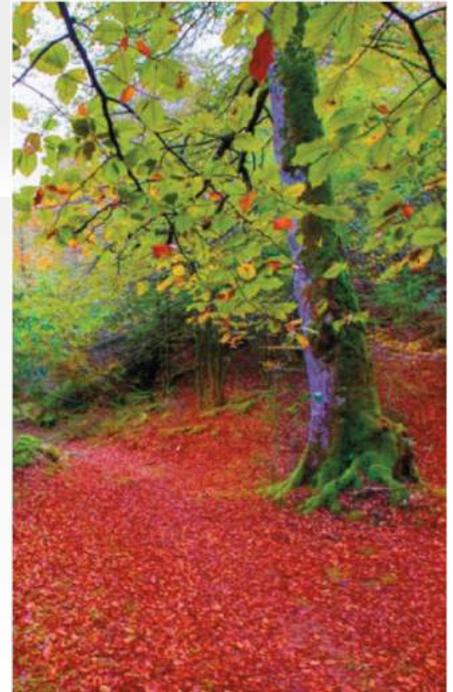
4.1. CAMERA

Many augmented reality applications use a camera to get information from or to add information to the surrounding environment. For example, many different markers are used. The camera is actively taking pictures of the environment and the device analyses the images. Finding the marker, information related to the marker is displayed to the user.

Displayed information can be divided into two types:

- **Active -** Active information is, for example, a dinosaur, which is pasted on the screen "virtually" on a playing card. In the normal view, it is still a card- but there is a dinosaur on the screen in addition to the card. It is possible to listen to a story about the dinosaur on this app and when you touch the dinosaur with your finger, the dinosaur makes a sound.

- **Passive -** When a marker is found, a web page is opened for the user, or information is pasted on what the camera is transmitting, where the user can read more about the object.

In order to detect objects, the camera of the device must be of sufficient quality and the object well lit; for example, it is very difficult for the camera to identify the code to be scanned in poor lighting conditions. However, the codes to be scanned are easy to install. It is also easy for the user to use such codes. Therefore, various markers that are detectable by a camera are popular. Also, using different codes does not require much computing power from a user's device, therefore making the user experience smoother.

Also, the camera is used in markerless augmented reality applications - in which case the device used must use much more computing power and compare the objects it sees with the objects in the database. This method is also used to paste objects (SLAM technology) anywhere on the user's screen; for example, to create a tiger on the floor.

The drawback is the demand for computing power (and thus the slowness) and the trembling of the object (especially when moving faster). As the computer is trying to figure out where the point that was previously taken as the center of the tiger is located now, it continuously calculates at which angle and where the tiger is located at a given time.

Much less computing power is required to place the tiger on a white sheet of paper in the middle of the room than on a table with wooden texture. To avoid flickering, some applications display information when detecting an object similar to the object being searched and open a separate information menu that is not related to the location of the object.

Using a camera can be related to only receiving an input, but the output may be different from the output of the camera. An example is a psychology museum– there is a screen on the wall, loudspeakers, and a camera looking towards the person. The camera detects the person's emotion. When recognizing a joyful emotion (a smile), it makes the music in the room more dynamic, and the screen displays information about joy. Identifying a sad emotion (downward corners of the mouth), the melody becomes sad and information on depression appears on the screen.

In order to consider this example augmented reality, the application must receive an input from the external environment (the emotion) and then supplement the reality with a virtual environment (change of music and text appearing on the screen, depending on the input received).

4.2. GPS

When the user is close enough to the object (for example, within a 20 m radius), information about the object (for example, a video about the object in the past vs. present) is displayed on the screen. Often used together with the camera, when the user gets close enough to the object, the device will signal this with a sound, for example. The user can then point the camera of his device to the object and get more information about the object.

It cannot be considered augmented reality when the device plays a sound effect when the user reaches a GPS point and thereafter ends work. If, however, when you reach this point, the GPS device knows that you are there and offers you the possibility to see pictures of what the place looks like in different seasons, it is augmented reality.

4.3. WI-FI

When the user reaches a certain Wi-Fi area, the device offers information about that area. For example, by opening the camera, the user can obtain more detailed information about the objects. Or when switching on the microphone, it is possible for the user to find out on the screen which piece of music is playing in the room.

Just having a Wi-Fi hotspot and discovering it is not augmented reality. However, if the device also shows other sights on the map, it is augmented reality- the information on the Internet was automatically brought into the user's field of view.

Unit 5
AR Content generation

Content can be created using a wide variety of tools. Augmented reality brings virtual content to our reality; so, if it is virtually existing, it can be displayed in augmented reality. There are different ways to display it- visual, audio, tactile, smell, taste, etc. The first two are the most commonly used - because many users own devices that are suitable for both visual and sound generation (smart devices).

It is also important to consider when creating content that the user should have the possibility to use real life without additions, or, without augmented reality. For example, the QR marker provides audio-visual information about the use of a smoke sauna, but there should also be a leaflet or the possibility to get information in another way.

When creating content, we must remember that augmented reality is meant to complement reality- not to replace reality, otherwise it would be virtual reality.

Content

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5.1. VISUAL CONTENT

Visual display is the most common because it is the easiest way to pass on a lot of information. The user can choose what he / she reads, what and how much he / she looks at. There is also a saying- "a picture is worth a thousand words". Visual display can be used for both image and text as well as video and animation. The display options depend greatly on the screen size and capability. A small screen does not fit much; the screen of smart glasses can fit only the number and floor of your hotel room.

There can be much more on the screen of a phone; for example, the location of the room, general information about the room and a link from where you can find more information. And on the TV in the reception area, you can display a video about the luxury features of a hotel room, an overview of its features, and a visual overview of the room.

It is important to note that the amount of information does not replace the user's experience - otherwise it is a virtual reality, not augmented reality. Thus, it is important to select a suitable amount of information for each augmented reality device used.

Image source

5.2. TEXT

Text content is the easiest one to create - by writing down which additional information the user could get. It is important to make sure that there is not too much text and that it is clearly readable from the used augmented reality device - for example, to display a direction arrow on the smart watch instead of a written description of where to go. It is useful to create a brief overview of the text first and initially share only this with the user. The user should have the freedom to choose whether and how much of his / her reality will be augmented.

At the end of the short overview, you can offer the user the opportunity to get additional and more detailed material. The size of the text should be sufficient for the user not to focus solely on reading the text (for example, when reading what's on the screen of the phone you have to place it practically against the eyes). It is also worth remembering that a picture is worth a thousand words.

5.3. IMAGES, VIDEOS, ANIMATIONS ETC.

It is often more informative for the user to see an animation, 360-degree view or a video than to read. For example, direct the camera of the tablet to the castle ruins and look from the screen of how the castle could have looked like in the past.

Again, it is worth remembering that augmented reality is reality which has been improved. If the user is shown an hour documentary about the history of the castle, it is not augmented reality - the user's experience is not improved, but replaced. However, if a short clip (e.g. 30 seconds in length) of the documentary is shown, and the possibility to watch the full-length documentary film later is added, it is augmented reality; the user receives additional information that he did not have before, in addition to actually seeing the castle. Whether the user wants to see additional information now or later is up to the user to decide.

For all visual content, the capability of the screen of the device you are using must be taken into account - for example, it is impossible to read the text on the screens of some smartphones in direct sunlight. The solution would be, for example, to move a marker (such as a QR-code) to a shaded place, or to use audio content instead of displaying written material.

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5.4. AUDIO CONTENT

It is worth recording audio content with proper recording technology. The surrounding background must also be considered. For example, a sea breeze may make it difficult to hear a sound. Audio content should not last longer than the time it takes to visit this point - for example, a two-hour sermon is not suitable when the user uses augmented reality for 20 minutes while visiting a church. However, a three-minute summary of the history of the church, together with giving a link to listen to the sermon, would be suitable.

5.5. CONTENT TRANSLATION

Content should be translated into a language suitable for the user. In the case of more simple content, automatic translation is sometimes used, but automatic translation is not error-free - rather, the reverse. If possible, the content should be translated by someone who is a native speaker of the language. It is also possible to use universally understandable content (images, animations, etc.).

For more information on content, its translation, and other related topics, see Module 3 and Module 5 respectively.

5.6. AUTOMATIC CONTENT GENERATION

It is also possible to automatically create augmented reality content. There are different ways to do this:

Artistic

There is an empty table, and the user is "handbuilding" a clay vase – the vase the user is handbuilding appears on the screen on the wall. The user can change the content, control the content generation by moving his/her hands, and so on. When the user thinks that the vase is ready, he/she can order it from the clay printer. Pay attention! In this example, it is important that in the case of augmented reality, the vase is displayed on the screen and the user sees a genuine empty table in front of him/her and a real environment around. In virtual reality, the user is separated from the environment and everything the user sees is virtual.

Using existing databases

There are thousands of databases existing virtually. Content can also be generated from them automatically - for example, take a database of sights with names and coordinates of attractions. When the user reaches the sight, the screen of his smart device will display the website of the landmark, which is found from another database based on the name of the attraction. Combining different data and databases, you can create very complex content with very little effort. The disadvantage of this content creation is incorrect or obsolete information that can be found in databases - for example, a painting exhibition may have moved to another city, but the database has not been updated and the application displays misleading information to the user.

5.7. RANDOM CONTENT GENERATION

One of the possibilities for content creation is random generation, which allows the computer to select any content for the application.

For example, in the case of augmented reality games, it is possible to let the computer generate any GPS coordinates that people have to visit to play the game. The more points a team visits, the higher the score. The locations of all points on the map, the score of your team, and the score of the opponent's team are displayed on the screen.

Another example is the running application Zombies, Run! It gives the user the opportunity to run to any point in the real world and back (January 2019). The user can choose the trajectory to be passed and the application provides feedback (using sound) on running statistics and reports when the point was reached.

Random content generation with rules

Random content generation can be limited by using different rules - for example, it is possible to set a certain radius (for example, 2km) where the computer generates the point, or to add a rule that the point where to run must be located on a public road, etc.

The biggest disadvantage of random content generation is that it is random - if there is no rule that the generated point must be located in a public area, on a green area, or on a sidewalk within a certain radius, the generator places the points randomly- for example, in the middle of the sea or in a private house.

5.8. SEMI-AUTOMATIC CONTENT GENERATION

By setting certain rules, it is also possible to generate content semi-automatically. For example, by directing the camera of the Augmented Reality app device to a drawing, the device will display what the house in the drawing might look like in the 3D view. In this example, the application recognizes the markers in the drawing and displays a 3D view of the drawing.

By directing the camera to a person, the screen on a display window of a shop shows what a person might look like wearing new clothes. In this example, the application must recognize the person and dress him/her in virtual clothes. It is necessary to insert the clothes into the application, but the computer "dresses" the person automatically. The person can find out which clothes he/she would like and can pick which ones to try on next.

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Unit 6
Updating content

There are several different ways to add and / or update content – manual, automatic, or live view from the web.
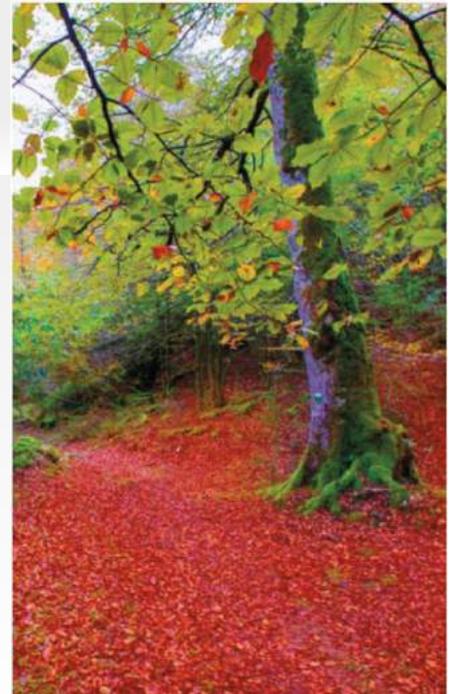
Content

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6.1. MANUAL UPDATE

The user has the ability to download content from the Internet, or use the already existing content when the connection is poor or missing totally.

Pros:

+ The latest downloaded content is always available
+ Content loading is independent of Internet or connection speed
+ User can choose when content will be downloaded

Cons:

- Content may not have been updated or may be completely missing when content was changed between download and use
- Content cannot contain large-scale references (e.g. videos, animations, lots of pictures, etc.)
- Content cannot show real-time changes
- You can download only a restricted area (for large-scale content) or low-volume content (no images, videos)

6.2. AUTOMATIC UPDATE

As soon as the user launches the application, the application will try to get the latest information from the databases.

Pros:

+ Latest information
+ If the application is open for the entire duration of use, the content does not need to be downloaded again

Cons:

- Sudden downloading of content can generate extra cost (volume of Internet used)
- Dependent on good internet connection
- Sudden automatic downloading requires a lot of system computing power
- Cannot be used for large files (such as videos).
- You cannot download a restricted area (for large-scale content) or low-volume content (no images, videos)

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6.3. LIVE VIEW OF CONTENT FROM THE WEB

Content is only opened from the web when the user wants this content. When the application is closed, the user has to re-select the content he/she wants, but will always get the latest content.

Pros:

+ Latest content
+ Less unwanted content - only the content related to this augmented reality task is downloaded.
+ High quality videos, animations and photos can also be transmitted

Cons:

- Depends on internet connection
- Use may be limited in areas with poor internet coverage.

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Unit 7
Markers and generating your own markers

In order to understand how reading and creating different visual markers works, we'll give you an example based on the QR code. See Module 4 for detailed information.

To read the QR code, a smart device with a camera and a QR code reading application are required. Many phones come with a pre-installed QR code reader - such as the QR-Scanner, QR-Reader, Scanner, or Reader. If the application is not already included, one can get it for free from an app store. To read a QR code, you need to open the QR reader application, which then displays the image transmitted by the camera on the screen.

It is then necessary to move the marker (in this case the QR code) to the center of the screen by directing the camera, the app then recognizes the QR code and does whatever the marker tells it to do. For example, opens a web page. Everyone can create a QR code for free. There are many free websites that enable to do it for free. The search for "QR code generator" in the Google search engine results in, for example, about 67,200,000 results. Choose one of the matches, enter the address or text you want, and press "generate" to create a completely free QR code. Codes can be created in two ways - static and dynamic.

Static

Static content, that is, non-changing content is content that does not change and cannot be changed later. From their status, all QR codes are static, i.e. do not change over time. If a QR code creates a link to a web page, the QR code is always the same. This also guarantees that the user always gets the same result when scanning the code. If you want to change the content of the QR code, you need to replace the QR code with a new QR code entirely.
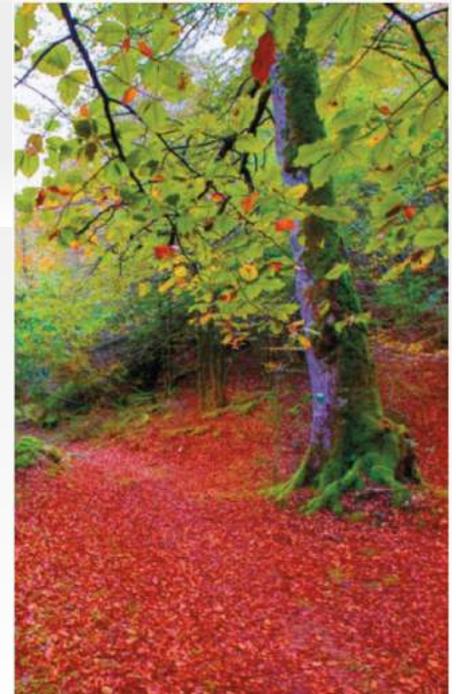
Dynamic

Getting the same result may not always be the desired goal; for example, if in summertime you want to show different information from what is displayed in the wintertime, or you want to display different information to various tourist groups. If Static QR codes are used, the entire QR needs to be replaced each time. Dynamic QR codes have been created to address this concern.

The use of dynamic codes is usually fee-based (there are exceptions, such as the Aurea4Rural application - see the last module to understand its functioning). The dynamic code stores the content you have entered into the code provider's database. The generated QR code refers to the server database and the user can change the information on the server. This means that the code remains the same physically, even if the content of the QR code is completely replaced.

Module 3

Augmented reality content: How to generate and manage it

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augmented reality
for rural tourism

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AUREA4RURAL

augmented reality for rural tourism

MODULE 3:
AUGMENTED REALITY CONTENT: HOW TO GENERATE AND MANAGE IT

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AUTHORS:

Module Introduction

With augmented reality, it is possible to provide a great deal of information in addition to ordinary seeing and hearing. Let's say you are driving a car along the road and you have added your destination to your car's GPS system. When passing the traffic signs along the road, the car displays on the windshield the limits that are currently in force - for example, the speed limit. If you want to outdrive the car in front of you, when you get close enough to it, a dot appears on the windshield of your car, showing the direction, location, speed and distance of the car coming from the opposite direction. This augmented information will enable you to safely drive past the car driving in front of you.

In this example, there are several different kinds of information that the on-board computer of the car registered and showed to the user as needed. This is an example of a good use of augmented reality - the user's reality was improved, as virtual information was added to it. The real world was never replaced with the virtual one. In the case of the car coming from the opposite direction, there was no virtual road drawn on the windshield of the user. When passing the traffic sign, no video was shown about proper traffic behaviour, but rather the virtual information was brought to complement the real world, not to replace it. This is also the concept on which augmented reality rests - virtual knowledge is brought to the real world. By following this principle, it is easy to create and manage augmented reality content.

In previous modules, we looked at how different hardware can be used to deliver content. But how does one choose the right content? Most augmented reality applications combine multiple media. In order to better understand combinations, we first need to understand how to create relevant content. The content that can be displayed with augmented reality can be divided into several content types, such as text, images, audio, video etc. The different types will be covered in detail below.

Unit 1
Text

Text is one of the most common methods for passing on information. The display of the text depends largely on the capability of the augmented reality device. Several hardware parameters should be considered (see module 2) and a combination of the appropriate hardware device and text should be selected.

In order to display text on the augmented reality device, you must first find out what kind of devices are being used. The purpose of the text should not be to remove the user's focus from the surroundings.
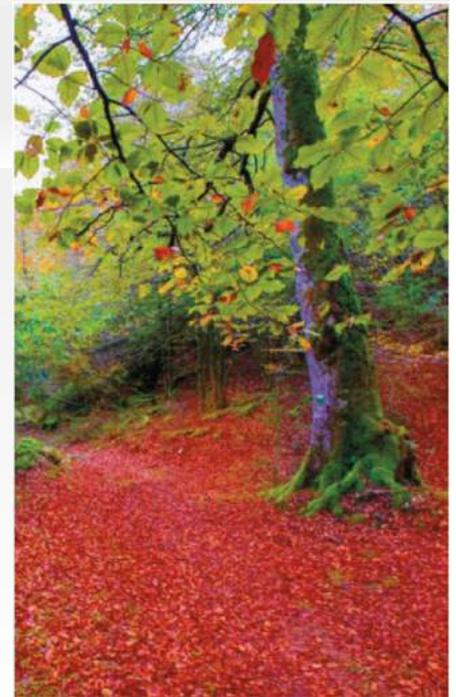
Rather, the text should be informative, short and understandable. Reading text in augmented reality should not become the main focus; otherwise, augmented reality becomes virtual reality. However, a choice can be given to a person if he / she would like to read more thorough information.

Be sure to take the visual side into account when creating the text - a large number of users will visit one website for 10-20 seconds, and will decide in just a second whether the text is worth reading or not. Thus, the visual appearance and length of the text is also important when creating the text. Certainly, augmented reality should not be just text - the best user experience is received when using different media.

Universal symbols

Many symbols are unambiguous and universal today - a smiley face means joy; a red X means a ban and a green check mark is a permit. The text can be designed and supplemented with different symbols or even smileys. For example, it is easier for a user to understand on the phone screen that a red X in front of the action means a prohibited activity, but a green check mark is a recommended action. You shouldn't be afraid of using universal symbols - their use makes it easier to understand the text. However, it must be ensured that the use of the symbols is not too extensive. Too many symbols make the text a diverse field of smileys, where understanding the idea can take longer than just reading the text would take.

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Using text in AR devices

AR devices need a screen to display text. The screen may be large or small and text must be created according to the screen.

The text can be displayed in very different ways:

- Hovering "in the air" on the screen in the camera view, rather than depending on a specific object - information boards, newsletters, etc. This method allows the user to move further from the location and to read the text at a convenient time

- Hovering "in the air" on the screen "attached" to an object – e.g. the names of hotels in camera view. This method is used to show the location of objects.

- Replacing the information on the screen with text – to invite the user to first read the text. This method is used when the user's attention is sought to better understand or use the object.

Text-related errors to avoid

There are certainly situations where displaying text is not reasonable:

- Too small screen – Smart watch
- Too annoying - long text on the windshield of a car
- Excessive attention - text on the glass of smart glasses
- Too small and concise text - multiple pages of information in fine print on the screen of the smartphone

Read more:
https://www.digitalinformationworld.com/2018/09/the-human-attention-span-infographic.html

https://en.wikipedia.org/wiki/Emoticon#Origin_of_the_term

Unit 2
Image

"A picture is worth a thousand words."

Displaying images to the user's field of view is an easy way to convey information. Screens are generally used to display images in AR. More advanced and complex technologies include hologram projectors and others but they are out of scope for most AR projects.

Images can be used in very different ways.

Miniature images

Miniature images are like universal symbols, the biggest difference between images and symbols being their complexity.

When symbols use little colour (except smileys) and are simple, then images can be more complicated. Images can be displayed in the same way as text and universal symbols.

- The image may be informative - for example, to give information about speed limit (an image of a traffic sign), or that coffee will be brought to the table in 5 minutes.
- The image may be a warning - the user has reached an area of active air traffic.

Common images

Common images are often used for illustration - it is much easier to show what a house looked like 30 years ago through a picture than using text. When selecting images, the capability of the augmented reality device must be taken into account (see module 2).

It is not recommended to display a very large picture for the user on a smartphone screen, although the image may be larger in size on the screen of a tablet, for example. In the case of pictures, the same rule applies as for text - the picture must be easy to understand.

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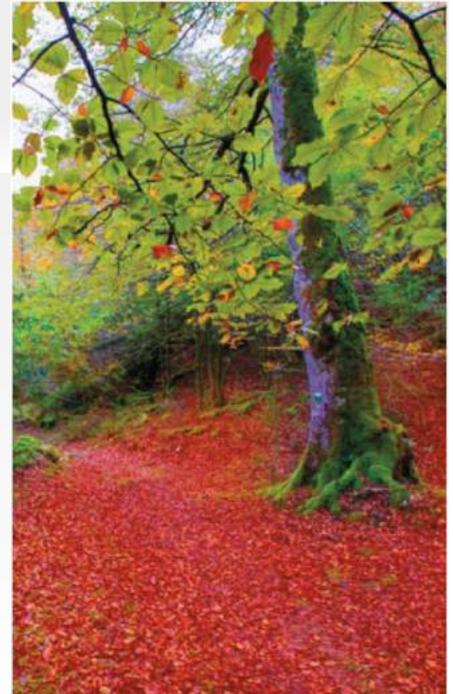
The so-called "variegated" images that are too dense in content require a lot of focus from the user and ruin the AR experience. Once again, it is wise to give the user a choice - to show the user the most important images and to provide a link to a gallery with additional and more detailed images.

Animated images

Animated pictures are pictures that move generally and repeatedly. An animated image can be, for example, a quick slide show about the construction of a building or about how the bread is made. Animated images have the advantage of having low need of computing power - playing a video file requires more device resources than displaying an animated image. Animated images are also smaller in size.

When using animated images, the ability of the user to view the animation from the beginning to the end must be taken into account in addition to the capability of the device. This means that the user's attention is taken for a much longer period of time than a few words to read or one image to display.

In addition to animated images with no sound, there are also animated images with sound. The difference between normal video files and animations are the same as in the case of an animated picture. When playing the sound, one has to take into account that the user may have different problems with the sound.

We will take a closer look at them below.

Unit 3
Audio

Sound is one of the most common ways of transmitting information. The biggest disadvantage of using audio is that, unlike text, sound is much more difficult to "scroll". The text can be scrolled and sentences that are not relevant for the user can be skipped, but scrolling the sound is much more difficult - unless there are timestamps that allow the user to jump to the topics of interest to him. Sound can also be used as a warning or for information and entertainment. For example, the use of a warning signal when the user is about to step in front of a moving car when crossing the road or a piece of music that was played in the room when a famous musician was living there.
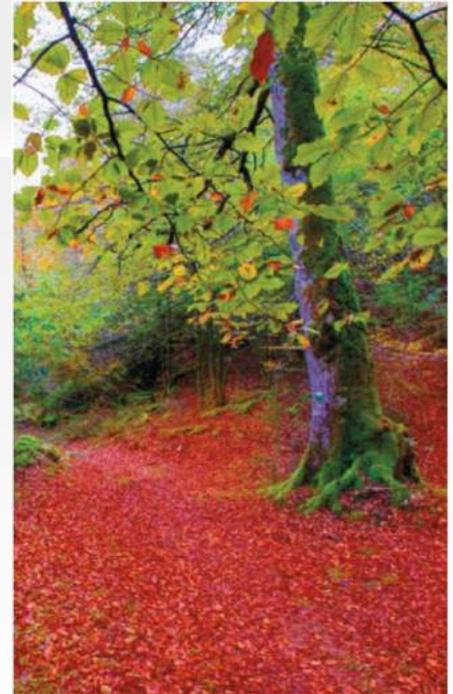
When using the sound, it is crucial to make yourself aware of the purpose of using the sound. Is the sound intended to complement some other experience (faster music when the user runs faster), is the audio an experience by itself (listening to famous pieces of music created in the historic house), or is it used to give information to the user quickly? The sound can be used, for example, as an audio guide, for creating a mood or atmosphere, or for informing the user.

When creating and using audio, it is important to consider:

1. Sudden sounds can frighten the user.
2. Sound can be turned off on smart devices, so the user may not hear that there is a sound playing altogether. Without a notification in another format that the sound is playing, the user may miss the sound.
3. Hearing the sound requires the sound to reach the user's ears – from hanging headsets or when there are machines rumbling around, one may not be able to hear the sound.
4. Sounds that have the same loudness begin to interfere with each other - especially if the sound is not synchronized.
5. The user may want to selectively listen to the sound, or "jump forward" in listening to the sound - for these timestamps are useful.
6. The user may not want to listen to a sound at the moment.

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When creating an audio for augmented reality, one should take into account that the audio should not be too long (it should be limited to a few minutes); for example, it is too long when the audio guide tells the history of the region and the clips are long enough for the user to walk from one historical place to the next.

Unit 4
Video

In a video all the three ways of transmitting information that were mentioned above - text, image, and sound - can be combined. Video is an effective method to convey maximum information in a minimal amount of time.

The same recommendations as for the above-mentioned media also apply to videos - the information must be suitable for displaying on an augmented reality device.

For example, it is not wise to display a video on the screen of smart glasses as it draws too much attention. As with text and images, it is possible to attach the video to a part of the screen; for example, the next movement of the process of folding a box to the screen of the smart glasses or to "attach" an introductory video to a marker.
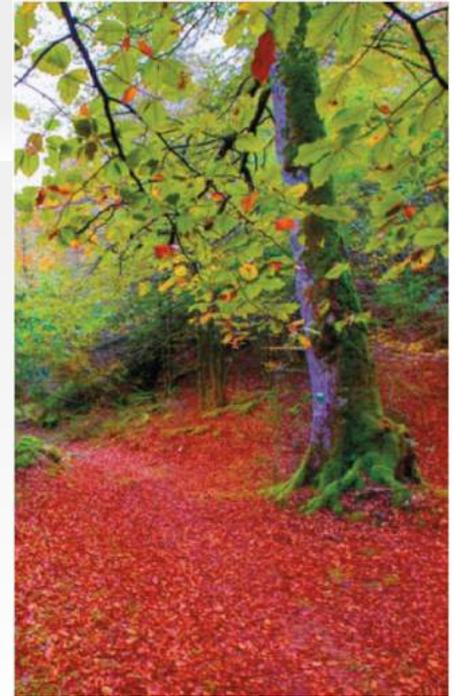
When creating a video, the following is to be considered:

- Video draws the attention of the user.
- The video must fit the device that is being used.
- Video transmission is (generally) significantly larger than that of an image.
- Playing a video requires more resources (eg high CPU Speed, RAM, powerful graphic card, etc) than other activities do.

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Unit 5
Animations, visualizations, etc.

In addition to video, it is possible to use various augmented reality solutions by combining the virtual world with the real world. By pointing the smartphone camera to the castle ruins, you can let the computer draw a 3D image of the castle ruins and display the castle in its times of glory instead of the ruins.

You can create a 3D image of how a food looks when brought on the table by scanning the QR code of the food on the menu. The difference between simply pasting pictures or a video is that the visualizations are designed to fit the environment.
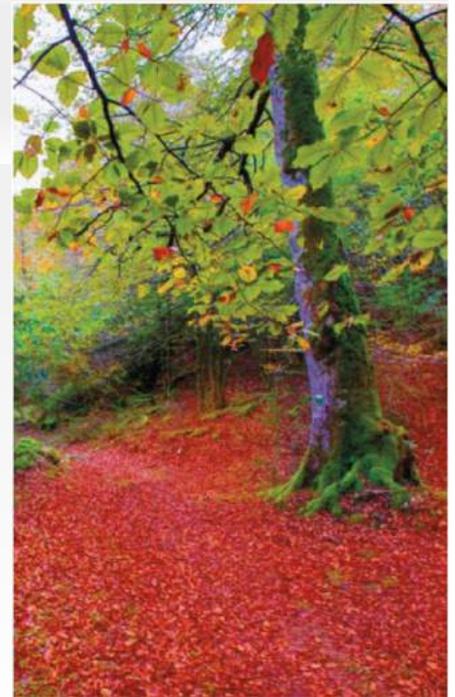
For example, a tiger sitting on the floor, when using the Google AR for Kids app with a smartphone. The camera transmits the image and the computer pastes the tiger on the picture. By moving "around" the tiger with the phone, you can explore the tiger from different angles.

The biggest problem with 3D visualizations is their instability - the device must be able to analyse both the camera image as well as the location and movement of the phone. Since it requires quite a lot of computing volume, it is not wise to use animations and visualizations in moving conditions - the more moving the situation, the more the pasted image will shake and bounce.

A good example of using visualization is to direct the smartphone camera to a package of Christmas candy on the table, and a dwarf appears on the screen who "lands" on the QR code and starts to dance.

When creating animations and visualizations, the following should be considered:

- Using animations and visualizations usually require a separate environment.
- Using and / or attaching more complex animations is resource-intensive.
- Creating and displaying animations and visualizations require specific software.

Holograms and other visualizations without a screen

Holograms are yet outside of scope for basic AR applications, but we mention them here to provide a complete overview of the upcoming options in the near future. They are often mentioned in science fiction literature, and already used in big events.

Projections and holograms are largely categorized as mixed reality. In addition, the projection technology is still in its infancy when writing this material. It requires very specific circumstances, is difficult to use and expensive.

A good example of a hologram is, when standing in the middle of a room, the user chooses on the screen a piece of furniture that he likes and it is created in front of him (using hologram projectors). The user can manipulate the hologram and move it to see if he likes it or not.

Other real use is in concerts or public meetings, where the speech of a politician is given to the audience through a hologram on stage while the "real" person is hundreds of kilometers away.

Image source

Unit 6
Links outside the AR environment

The idea of augmented reality is to bring to the user virtual information to which he had not previous access or had difficulty accessing. Several augmented reality applications give the user general information and the opportunity to extend (augment) this information.

For example, you are pointing the smart device's camera to the leaf of a tree, and the screen of the device then shows which tree it is and there is an opportunity to get more information about the subject.

This example can be seen as augmented reality - the user got the information about the type of tree and the opportunity to explore the topic in more detail.

If all the information on a given tree species were immediately displayed on the screen, the user would have had to concentrate on the text to find important information (the sort of the tree).

This case could be considered a mixed reality (if the user quickly finds information) or a virtual reality (when the user is separated from the current reality and placed in an environment of virtual information).
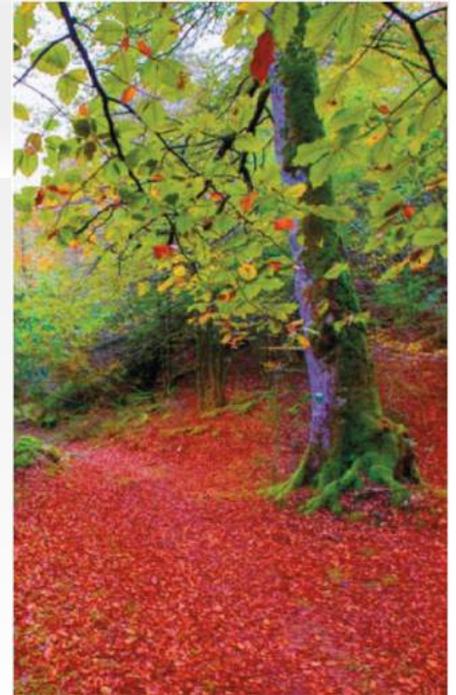
Unit 7
Different combinations

Most augmented reality applications use combinations of different elements; for example, video and text are displayed at once, images are displayed, and at the same time, there is a recording playing about the historical meaning of each image. Or a dinosaur is made to dance on the screen and when you touch the dinosaur a roaring sound is played.

Most common applications also use combinations of several of the above methods. Both Google Maps and Apple Maps use a combination of visual text, sound and image to provide as much information as possible to the user as easily as possible.
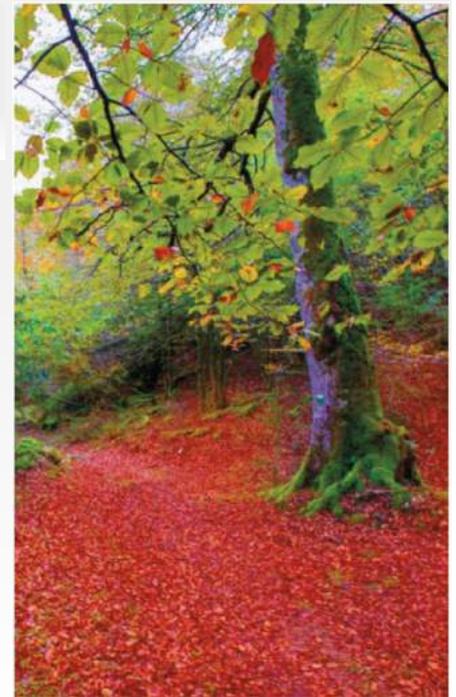
Other solutions

There are still many different methods to deliver information, such as smell, taste, tactile, vibration, manipulation of the nervous system, and so on. Since these methods require more specific devices than a regular user would normally have, we do not focus on these methods in the current material.

Content translation

When creating content, we need to think about both comprehensibility and translatability. Phrases and sentences with multiple meanings, a translation that is significantly longer or shorter than the original text, and translation errors can completely change the content translated.

The result is either inaccurate or incomplete translation, thoughts lost in translation or completely unrelated information.

You can read more about the different translation solutions in Module 5.

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Unit 8
Summary of content generation

Virtual reality tears the user out of the "real" environment to provide information. The idea of augmented reality is perceiving both the real and the virtual environment at once.

The advantage of AR is to provide the additional information just at the point and moment when it is needed: it is more sensible to put a QR marker to each of the points of interest in the castle, rather than putting one marker with a QR code at the entrance to the castle and opening the castle's home page. Important information for a specific location should be provided at that location.

Then the user can hear how the medieval music sounded in the largest hall of the castle, and watch the video of how the rock-throwing machine worked in the castle's armoury. By combining real life and augmented reality, the user gets more information in addition to real experience. When creating content, you must consider the capabilities of the equipment and the hardware used for augmented reality and the various factors of the environment. Content must be created for the devices that are likely to be used.

Examples:

- A too slow device will not be able to read the camera image quickly enough to add things on it later on.
- It is not appropriate to fit several pages of fine text on the smartphone screen.

Regarding the environment, the changing factors have to be taken into account (we will talk more about the changing factors below), as well as the fact that information has to be up-to-date. It is also necessary to consider the ease of use of the systems, including, for example, the speed and availability of the Internet.

The best results can be obtained by using different media; for example, by combining a picture and sound that can be selected by the user. When creating content, you should definitely not forget the possibility that a person may not want to use augmented reality, for whatever reason. It is worth remembering that augmented reality is not meant to "replace reality" but to complement it.

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Unit 9
How does the Augmented Reality System know when to display information?

So far, we've talked about various augmented reality launch options (see Module 1), hardware requirements, and how hardware works (see Module 2) and about the different possibilities of formats to present information (this module). But we haven't yet taken a look at how the Augmented Reality system knows when to display the information.

To simplify this chapter, we use the smartphone and its sensors as an example.
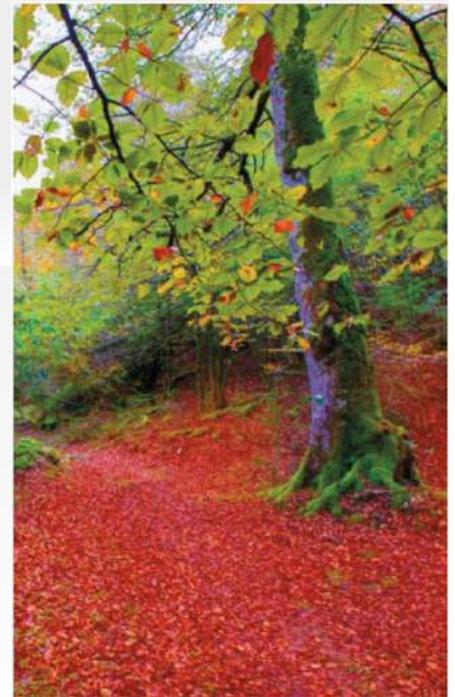
However, we must not forget that there are a number of other devices that can be used to create augmented reality in addition to the smartphone - starting with smartwatches and smart glasses, to light spectrometers and devices installed into the nervous system. Because they are not just as common or are used in very specific areas (such as medicine, car repair, etc.), we focus on commonly used smart devices.

Here we explain you how they work in the context of AR projects. The different options of how to pass information to them ("Markers") is presented in more detail in the next module.

Camera

Unlike a human being, the computer does not have the innate ability to generalize. When a person sees a house in the picture, the computer "sees" a data path. In order for a computer to distinguish between images, the computer starts to compare the image with the data in the database and to look for similarities. Having found enough similarities, the computer offers the match with most similarities.

Unlike a person who can instantly tell if it's a building or a car, the computer can't do it. The computer must compare each pixel (the smallest part of the image) of the image separately and look for similarities with the data in the database. The more data in the database, the longer the time it takes to compare, but the more accurate the answer.

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Markerless augmented reality apps that add information to the environment try to locate their own markers for them from the environment (such as Google AR for Kids) or ignore them completely (Heads-Up Display – smart glasses, which receive information from the surrounding devices and display the information of the device).

In order to create a marker itself, the processor searches for a certain number of points in the image, and the information displayed is "attached" to those points. Moving the camera changes the position of the points in relation to the camera, and the computer then moves the text back to the point again.

GPS system

The operating principles of the GPS system were covered in Module 2. AR systems use GPS to determine location. In general, some GPS markers are also used with GPS coordinates. Since the GPS system is not accurate and depends on very different parameters, the radius is usually used instead of a particular point. You will find more information in Module 4.

When the user's GPS device reaches the designated GPS marker area, the system sends a notification of this to the augmented reality application. The Augmented Reality application displays the information in the respective marker - for example, plays audio, displays information on the screen, or vibrates and invites the user to read information. The user learns that he has arrived and, if he so wishes, will complete his reality with virtual information.

Wi-Fi, Bluetooth and other wireless signals

The smartphone continuously transmits a number of signals. Also, the device is capable of evaluating signal strength. In general, the stronger the signal, the closer the device transmitting the signal. For example, it may be written in an AR application that if a signal strength of at least 30% has been achieved with such a wireless signal, then information is to be sent to the augmented reality application. Upon receiving the information, the application looks at which information is connected to the respective signal strength and displays it in a suitable medium.

For example, when walking around a museum, the lights will turn off and the sound goes silent. When you reach another room, the attractions begin to work and from the headphones one can listen to the background information on the exhibits. There are no cameras in the museum. Also, motion sensors cannot be used to identify the user.

Each museum room has a wireless signal transmitting and measuring station placed in the centre of the room. As soon as the user gets sufficiently close to the signal transmitting station, he moves further away from some other station. As a result, the system knows where the user is located, when to display information to the user, activate the attractions, and which audio recording to play to the user from the headphones.

The Aurea4Rural application offers two types of markers - GPS and QR-code. As soon as the user activates the marker with his smart device, he is directed to the Aurea4Rural environment where the content creator has added an overview (both audio, video and text can be used). The content creator may, after the overview, provide a link for more information.

Unit 10
Constantly changing content and its management

Reality and virtual data are combined to use augmented reality. When reality and virtual data are different, there is no benefit from augmented reality. If the view at the top of the hill is described as a view of snowy meadows, but at the time of viewing the meadows are green, it is probably obsolete information that would need to be updated.

Depending on the application and hardware used, it is possible to define the content according to different parameters. Different applications allow different solutions.

For example, if a 360-degree view of the area is offered and it is winter, the user will first be shown a 360-degree view of spring, summer and autumn - because the user already has a winter view. If a tourist walks in an area where an event is scheduled to take place at 12 o'clock, from 12 o'clock the user will be shown specific information about the event, but before this time general information about the event is shown, etc.

In order to assess what kind of information to give to the user, it is first necessary to assess if information is up-to-date - whether the information is valid at any moment or is it valid only at certain moments. When creating content, the very same aspect of keeping it up-to-date has to be considered. Different applications use different methods to evaluate content delivery. For example, checking the content by the administrator is required after a specific time period.

Here are some examples of the methods used to make sure that content always matches the reality:

- Regular content check requirement over time period X.

- Setting timers, calendar days, etc. - the content is shown only for a certain period of time until the timer expires or there is a certain calendar date.

- Automatic information about the environment - when it rains, no information about the possibility of sitting on a terrace without a roof is displayed, etc.
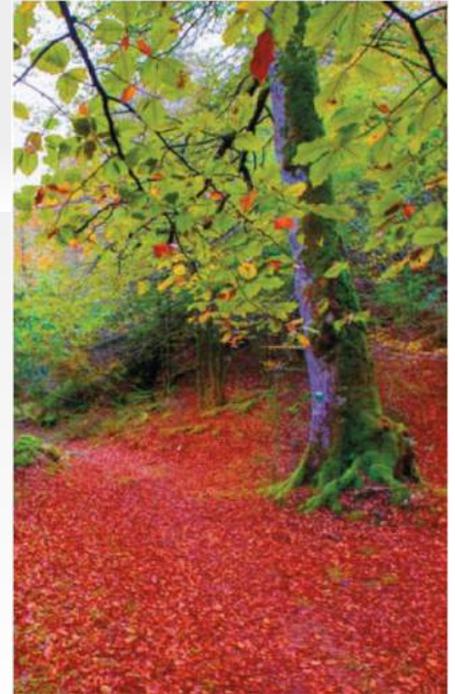
- Semi-automatic update - different information is entered for each case, but a person needs to inform about the need to update the information (for example, choosing Japanese instead of an English information display).

- Manual update of information - someone is responsible for keeping the information up to date.

- Other solutions.

Many methods can also be applied if no special functions have been built into the augmented reality application - you can use external alerts, such as a calendar, to manually update the information.

Used images and sources:

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Module 4
Markers and their Location

AUREA
4RURAL
augmented reality
for rural tourism

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4RURAL
augmented reality
for rural tourism

European Commission

Co-funded by the
Erasmus+ Programme
of the European Union

AUREA4RURAL

augmented reality for rural tourism

MODULE 4:
MARKERS AND THEIR LOCATION

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AUTHORS:

Module Introduction

People talking about augmented reality often refer to the words "tracking" and "markers". What exactly are augmented reality markers? We want to give you a short explanation and a few examples of real markers.

In short: Augmented reality markers (AR-markers) are visual cues which trigger the display of the virtual information. Markers can be normal images or small objects, as well as GPS coordinates. They are designed to be recognized by the device camera or GPS. After a marker is recognized, its position or content triggers the associated virtual information.

In this module, we explain in more detail the different types of markers, and give you a few examples of the most common cases. We will also present the most frequent uses, as well as understand the devices used to detect them and how they do this. Finally, we will describe different factors that must be taken into account from the point of view of AR end users.

Unit 1
Markers

Markers are elements that trigger an AR action. They can be visual objects (QR code, designs, images), or a GPS location. By reading these markers through a device, the action associated with the marker is activated.

Visual markers are "artificial" elements in an environment where they are placed. Their recognition is based on the use of a camera to catch sight of the marker; then a software on this device (mobile, tablet, computer) triggers the related information to appear (image, text, video, additional product information, etc.) on its screen.

To ensure this, markers of any AR project ideally are clearly visible, and, more importantly, not hidden by other objects. They must be easy to identify- this can be done by using a common format or design, combined with a high contrast of the elements that compose them compared with the context they are placed in.

Computers are quite effective in comparing data when there is less data they have to compare in the picture. This means that recognizing a person's face from a picture is much easier for a computer than determining the object in the picture – there are much less faces and lineaments than there are all the possible buildings, animals, birds etc. together. This is also the main reason why many "markers" are used in augmented reality.

For example, QR-codes, cards, rectangles, etc. These markers are easy to find from the picture because they are different from the regular environment and the computer has a much smaller database that it has to look for in the picture.

Additionally, the camera can also be used in markerless augmented reality applications that look for similarities.

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For example, a picture taken of a tree leaf is compared to the data about tree leaves in its database, and if there are enough similarities, the information about the species of the tree is conveyed to the user.

Artificial elements are still invasive and require a production and maintenance process. In the future, the largest field of work in augmented reality related to visual markers will focus on recognition without them. This recognition is based on image recognition techniques. They avoid the need to generate specific artificial markers, but require a high processing capacity on the part of the device and/or a good online connection for using cloud services.

GPS markers work in a different way. They compare the actual location of the reading device with the spots that are stored in the AR application. If the user reaches a location with the associated AR information, it is shown automatically on the device.

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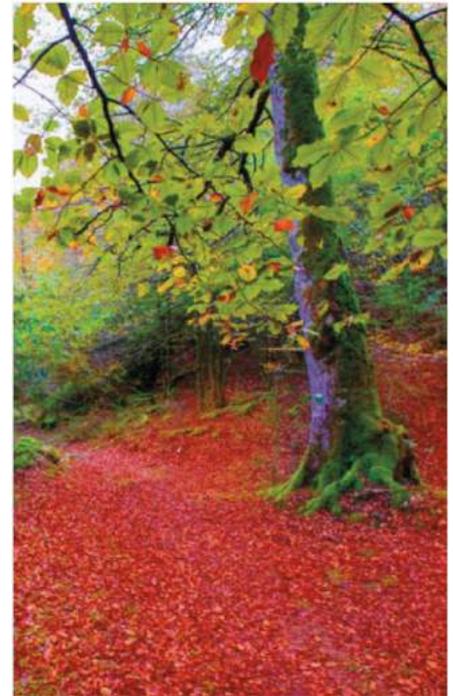
1.1. WHERE TO USE MARKERS - EXAMPLES

Markers are the ideal solution to visualize AR content for untrained users. Here is a list of possible situations or cases where markers are recommended:

- **Gaming and entertainment:** The best-known use of location-based AR is in games like Pokemon GO and Ingress. Entertainment apps that make use of the player's immediate surroundings and environment appeal to large audiences. For instance, Juego Studios has created a social AR Game for players to meet and interact within their locality. For more info, see: Augmented Reality Game & Social Platform.

- **Marketing and promotion:** AR apps can be used to display promotional information such as news about offers and sales whenever users are in close proximity to stores, restaurants, etc. In these cases, GPS-based markers will be used- one example is GPS Treasure Hunt, a location-based AR hunt of promotions and special offers in the surrounding area.

- **Education:** Need to increase student engagement in the classroom? Lessons don't have to be boring – the keyword is "gamification". Markers can be printed in school books, or even directly in the homework or other classroom tasks. Give students something to play with, and they will enjoy learning.

- **Culture and services:** Walk into an art museum and look near the painting- there is a marker linking to an AR experience about Van Gogh and his cut off ear. We put markers close to an exhibit or object and leave them there. Visitors can use them by themselves at their leisure. It is cheap for the museum and the visitor can enjoy the exhibition quietly.

  Other similar uses are in the history of objects and buildings, trails and itineraries, and even restaurant menus. For instance, the marker triggers the recipe or a video that shows the preparation of the dish

- **City Information:** We can use markers at a bus stop or subway: it provides the bus schedule in AR and indicates when the next bus will arrive. The information is dynamic. The audience is captive - people wait for their bus, they aren't going anywhere, and this situation can be linked to other suggestions about what goes on in the place they are located.

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Image source

Image source

Image source

Image source

Read more:

[‘5 ways augmented reality can improve mobile user experience’.](#)

Author: Camila Kohles
Date: December 20, 2018
Source: www.wikitude.com
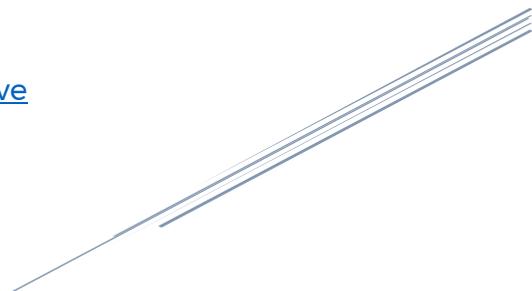
1.2. TYPES OF MARKERS

- **FRAME MARKER**

Definition: Frame markers are distinctive shapes with any visual content, which can be created using elementary image processing operations.

Features: Frame markers are geometrically shaped in black and white - their content is framed in a square. Sometimes they also include acronyms or simple images.

Real-time recognition of pictures in framed rectangles has been enhanced over the years, and is now the most reliable method, even if they are rotated or skewed. Usually it is a 2D-image, printed on a piece of paper or another smooth surface. These markers are square and have a significant black border.

During the tracking phase, the system searches for a black rectangle. If it finds one, it examines the interior of the border to determine the real marker. Depending on the shape of the border, the system can extract the position and rotation of the marker in relation to the camera.

Image source

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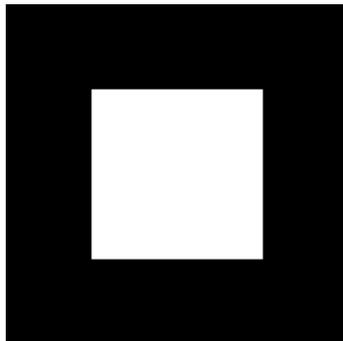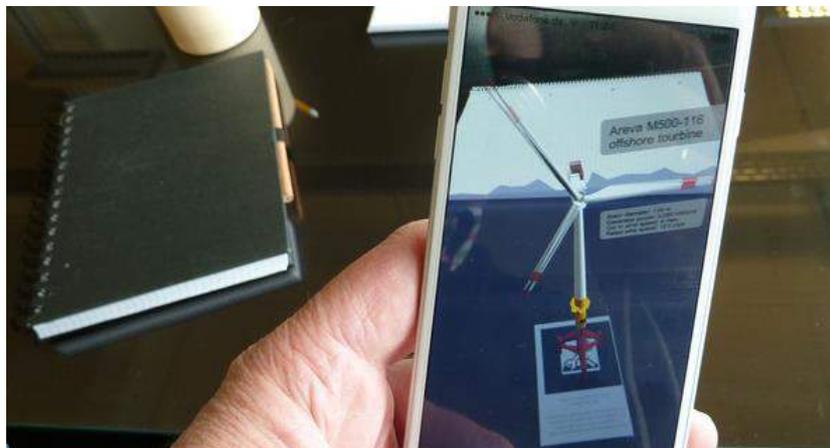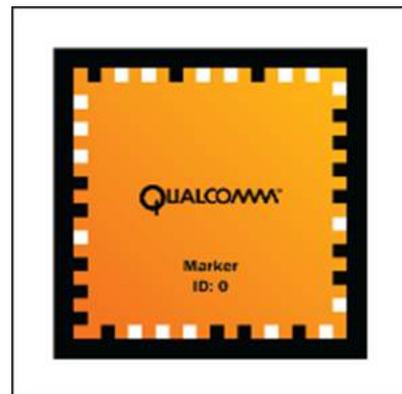
- **QR CODES**

Definition: The acronym QR stands for Quick Response. It allows us to store information in a dot matrix.

Features: In a QR code we can encrypt a diversity of alphanumeric information such as a URL, a small text, SMS, an email, a telephone number or a business card. We can access this information quickly from a smartphone, tablet or PC. It is necessary to install a QR code reader on our devices to read these codes. All modern mobile phones have this by default and alternative free options are widely available on PlayStore.

Types of QR codes:

- Static QRs - once generated, its content cannot be modified. They always show the same information (URL, telephone, …) that is hardcoded into the QR. This information can be read without the need of an internet connection (e.g. content of business cards or other texts). However, if it refers to an external resource, an internet connection is necessary.

- Dynamic QRs - physically it is the same as a static QR, as their aspect does not change, but in this case the content is retrieved from the cloud. In reality the QR does not store any content but creates an online query to content that you can change in a simple way, and as many times as you need. The drawback- this type of QR requires internet connection, and the cloud service is free of charge.

For basic AR applications where QR codes are exclusively used to trigger related information that is controlled and can be edited by the owner of the project, Static QR as implemented in the Aurea4Rural toolkit are sufficient.

Images Sources:

- https://www.pinterest.es/desafiointerior/c%C3%B3digos-qr-creativos/

- http://qrdresscode.over-blog.com/article-bordeaux-ville-numerique-en-qr-code-68524482.html

- https://wiki.creativecommons.org/images/thumb/1/15/Cc-bc-sa-icons-qr-code.png/200px-Cc-bc-sa-icons-qr-code.png

- https://omicrono.elespanol.com/2018/03/codigo-qr-resurge-asia-peligroso/

- http://www.theleftfielder.com/blog/how-to-qr-code/

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SANDY BEACH
DEEP BAY

MAPS

bowentrails.ca/sandy-beach

HERITAGE

bowentrails.ca/sandy-beach-heritage

NATURE

bowentrails.ca/sandy-beach-nature

bowentrails.ca/how

Use any QR CODE SCANNING app (free)

BOWEN IS.
TRAILS   TP 10

QR Code Anatomy

Dead Space - keeps the data seperate from surrounding details

Positioning Markers - identify the code's boundaries

Version Information - tells the code reader what kind of code it's reading

Alignment Markers - lets the reader access codes viewed on an angle

Format Information - helps the reader correct for fuzzy or missing data

Timing Code - shows the reader how big the code is

Information - the data

theleftfielder.com

- **GPS MARKER**

Definition: Marker based on positioning parameters.

Features: The information is captured through the camera of the mobile device and, in turn, will process the information through the positioning software installed on it.

GPS Marker elements are:

- GPS: Indicates the location of the device through the coordinates.

- Compass: Refers to the orientation of the device in the direction that focuses the integrated camera.

- Accelerometer: Identifies the orientation and angle of the device to use.

Geo-location based AR refers to augmented reality features that are anchored to a real-time location. Location is usually determined via GPS or beacons, along with the embedded digital compass and accelerometers in mobile devices. This location triggers the content with a wide variety of options:

- Static content similar to that triggered by a visual marker.

- Digital content is virtually placed over the image of the actual physical surroundings, such as buildings, streets, etc. allowing users to access it using AR ready devices, such as smartphones. The digital overlays or "augmentations" are virtually placed over the points of interest. These can include sound effects, animations, music, videos, images, etc. Users can then activate and interact with the digital overlays based on their physical location. For example, such content could substitute today´s view of a building on the mobile screen with a vision of how it looked 300 years ago, or it can guide you to the entrance of a site by projecting arrows and indications on the real-time camera view of the street.

Image source

- **MULTIMARKERS**

Multimarkers are a group of several single markers which have a predefined relation to each other. It was the first attempt to widen the field of view of a user. Only one marker out of the group is needed to be completely visible to project the virtual information.

Image source
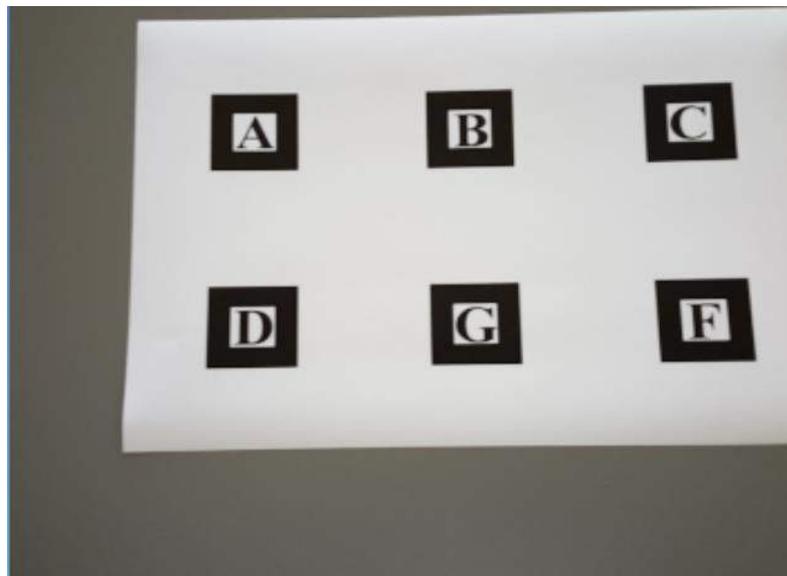
Image source

- **OTHER TYPES OF MARKERS**

Previously, we explained the visual and GPS markers that are presently the vast majority of cases. These two types of markers are also the ones available in the Aurea4Rural toolkit, and most users will be perfectly happy with them.

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However, there are various other possibilities. Here are four other non-visual markers that are likely to become more common in the future.

● Activation marker- When opening the camera app on your mobile phone, you often see additional information on the upper and lower side of the screen. In most cases, they refer to the current settings for your camera. Since this is virtual information which is projected into your live camera feed and allows you for taking action, it is augmented reality by definition. Your marker is replaced by "activation" of your camera-app.

- RFID Tags- Used for short distance wireless communication. You might know them from contact-free payment methods such as NFC, contactless credit cards, or travel passes for local transport. You have various tags (i.e. the chip on your card) and an antenna (i.e. the payment terminal at the supermarket). When the tag comes close enough to an antenna, there is some form of communication between them. The same method can be used to trigger local based virtual information to be shown in certain spots.

- Speech commands- This method is more suited for AR-glasses, but mobile devices also use it increasingly: think about Cortana in Windows 10, or Alexa of Amazon. You can just order your device to display or provide certain information – for example, your current position.

- Infrared (IR) Markers- Their interesting characteristic: they are invisible to the human eye, but can be detected by devices. An IR marker system can either use a self-illuminated marker, retro-reflective material or IR spotlight. In addition, it can use an IR projector to create markers.

Invisible marker systems have been very developed in terms of general barcodes. Researchers have also studied IR marker systems for augmented reality. In addition, invisible markers have been used for watermarking in augmented reality. A common limitation of the IR markers is that they only work indoors, where no uncontrolled IR light source is present. Outdoors the sun emits IR light and disturbs the IR detection system.

Self-illuminating marker emits IR light. The marker itself may consist of IR LEDs, which the system detects using an IR camera. Or the marker can be a binary marker, where white cells are transparent and black cells are opaque and the system has IR LEDs under it. The former approach is more common.

A good example of IR markers are those used for self-guided visits to museums, as already mentioned on page 9 of module 3.

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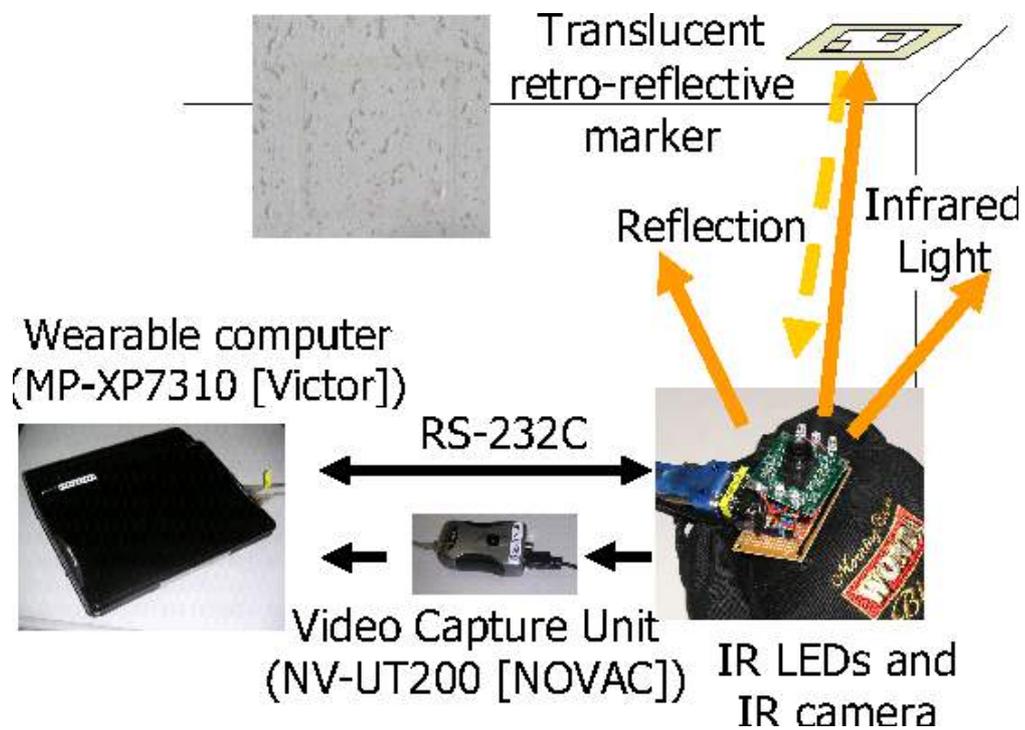
Image source

Image source

3M IR Reflective III Gen. film + YKK velcro

High Visibility IFF Patches
3x3cm   1. 1/4"
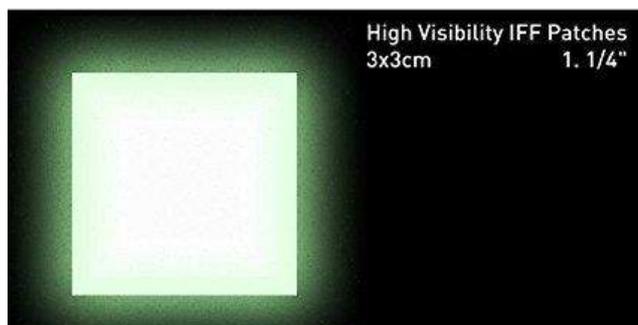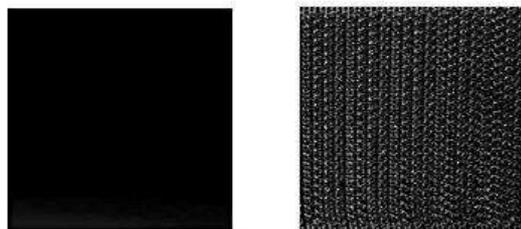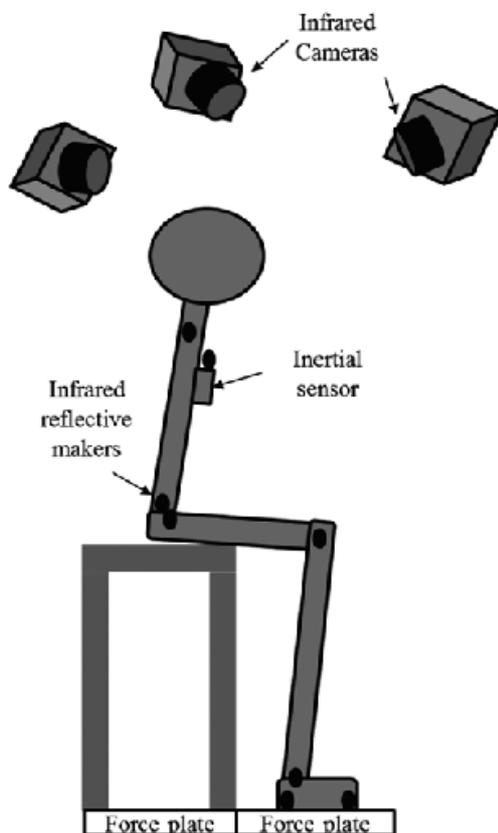
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Comparative Table of different Types of Markers

Types of Markers	Definition	Features	Best used in AR for....
FRAME MARKER	Distinctive shapes with any visual content,	Geometrically shaped in black and white - their content is framed in a square	AR toolkit Marker for Video Games
QR CODE	Quick Response, allows to store information in a dot matrix	Encrypts a diversity of alphanumeric information such as a URL, a small text, etc.	Transport tickets. Pictures QR descriptions (Museums).
GPS MARKER	Based on positioning parameters	Digital content is virtually placed over the image of the actual physical surroundings	Poi. (Car Navigation Systems). Google Maps points
ACTIVATION MARKER	Virtual information projected into your live camera feed for taking action	Additional info (upper and lower side of the screen). Marker replaced by your cam-app.	Camera App buttons mobile devices.
RFID TAGS	Markers for short distance wireless communication	Communication starts when the tag comes close enough to a wireless antenna,	Contactless Credit Cards
SPEECH COMMAND	Voice recognition commands that triggers instructions	You can just order your device to display or provide certain information	Windows Cortana. Apple Siri
INFRARED MARKERS	They are invisible to the human eye, but can be detected by devices	They only work indoors, where no uncontrolled IR light source is present	Flight cockpit sensors

Read more:

'Using QR Code share your visiting card'
https://newtechworld.net/using-qr-code-share-your-visiting-card/
Date January 3, 2013. Source:
https://newtechworld.net

How to use QR trail markers
http://bowentrails.ca/how/
 Date: May 2015. Source:
http://bowentrails.ca
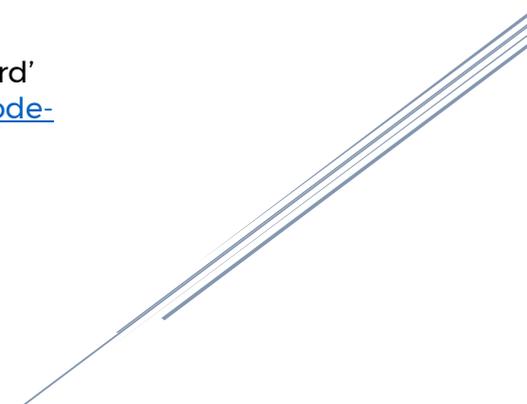
Unit 2
Devices

Up to now, we have seen how the AR content can be triggered through markers. However, we also need to understand the equipment that the final user needs to use these markers. Devices capable of accessing AR are known as AR Form Factors.

Aside from the usual camera on mobile phones or tablets, other options include: glasses, headsets, projectors and heads-up displays (HUDs) that are better known for Virtual Reality. However, manufacturers are not providing them for mass-consumption devices yet.
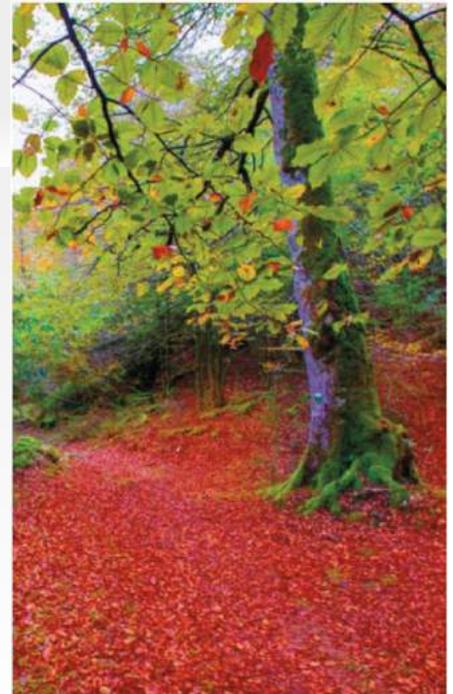
Content

2.1. MOBILE DEVICES

Augmented reality is slowly coming to cell phones, with mobile manufacturers already including special hardware (AR chips) into their new medium and high level devices. The future of AR in mobiles has just begun, and the applications available at the moment have a long way to go.

Mobile devices like smartphones and tablets are the most available and are the best fit for AR mobile apps, ranging from pure gaming and entertainment to business analytics, sports, and social networking. Some Android phones, such as Lenovo Phab 2 Pro and Asus ZenFone AR, already incorporate Google augmented reality technology and have special hardware to make this possible. Apart from specially designed chips that hardwire the AR capacities into the phones without the need of extra software, this hardware includes several cameras and sensors that detect depth, distance and scale between the elements of an image.

AR at a basic level – as mostly used nowadays for daily use – is already possible with the standard equipment of smartphones: a decent camera, compass, and GPS. These AR applications are driven by software that comes embedded in the device's operating system. For example, two platforms for developers to work on new apps of augmented reality are Apple's ARKit and Google's ARCore:

- with Apple's mobile operating system, iOS 11, it's now also possible to download and run AR apps to phones from iPhone 6S onwards, although only the iPhone 8, iPhone 8 Plus, and iPhone X cameras are specially calibrated for AR.

- Google Pixel 2 and Pixel 2XL also boast AR in their cameras.

The Aurea4Rural APP for small companies or public institutions in rural tourism is designed to be used with common mobile devices of their clients and visitors. This app, while comparatively basic, allows these small entities to create their own AR service for their customers.

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2.2. AR HEADSETS (HUD), HEAD-UP DISPLAYS, AND AR GLASSES

An augmented reality headset is a specialized, head-mounted display device that provides a simulated visual environment through physical display optic lenses, allowing the user to see both a digital display and the world through the glasses- sending data to a transparent display directly into user's view. They provide virtual images, videos, animations or informational content to users who wear them, allowing them to add virtual elements to the real world they can see through the glasses. This is an emerging technology that aims to transform the world as users see it, depending on what they're looking at.

Smart Glasses are wearable computer glasses that add information alongside what the wearer already sees. They are similar to the previous headsets, but in smaller size – ideally, not much bigger than normal eyeglasses. They are sometimes defined as wearable computer glasses that are able to change their optical properties at runtime. Smart sunglasses, which are programmed to change tint by electronic means, are an example of the latter type of smart glasses.

Both work similarly, and in fact the limits between them are not clear- in the example links below, you will find the same models in both categories. They typically provide the same reality-based environment as it is seen with the naked eye, but add visual simulation or content to provide an enhanced view to the user. They are designed to be similar to eye glasses except that the lenses are made of transparent LCD or other display mechanisms. The headsets also include a built-in microprocessor and storage. Originally introduced to train military fighter pilots, now these devices have applications in aviation, the automotive industry, manufacturing, sports, etc.

How do they work? Superimposing information onto a field of view is achieved through embedded wireless glasses with augmented reality (AR) overlay that has the capability of reflecting projected digital images as well as allowing the user to see through it, or see better with it.

Early models can perform basic tasks, such as serve as a front end display for a remote system, as in the case of smart glasses utilizing cellular technology or Wi-Fi.

Modern devices are effectively wearable computers which can run self-contained mobile apps. Some are hands-free and can communicate with the Internet via natural language voice commands, while others use touch buttons.

Like other computers, AR headsets and smart glasses can collect information from internal or external sensors. They may control or retrieve data from other instruments or computers, and support wireless technologies like Bluetooth, Wi-Fi, and GPS. A smaller number of models run a mobile operating system and function as portable media players to send audio and video files to the user via a Bluetooth or WiFi headset. Various models also have all the features of a smartphone, including full lifelogging and activity tracker capability features (also known as a "fitness tracker") as seen in some GPS watches.

- Available headsets already in the market (Meta 2, Mira Prism, Magic Leap One): https://www.redbull.com/us-en/best-augmented-reality-headsets-2018

- Available glasses already in the market: https://www.tomsguide.com/us/best-ar-glasses,review-2804.html

Image source

Image source

Image source

Images sources:

- https://www.extremetech.com/gaming/223762-microsoft-hololens-up-for-pre-order-today-if-you-can-afford-it

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'Your smartphone is ready to take augmented reality mainstream'. Author: Leander Kahney
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Unit 3
Marker installation and maintenance

Both markers and content need to be presented in the most adequate media format to be easily detected by mobile devices.

Where to place markers:

1. <u>Physical Marks on Objects.</u> The most frequent and simple solution for AR in a wide-open space is placing the visual marks on or close to the objects that have AR content associated. QR codes or any other design of markers can be printed on adhesive stickers, paper sheets, or textile. It is important to remember that they must be clear, easy to read, and placed on a flat surface.

2. <u>Leaflets and promotion material.</u> You can enhance information in your brochures (printed or digital), posters, adverts, etc. by including markers that take the reader to AR content. QR codes come as a graphic file that can directly be included in the design of any such material.

3. <u>Physical Objects.</u> Those that have a very characteristic and clear-cut form with high contrast to the background can directly be used as markers: take a photo of them and use it as a marker. It will work!

4. <u>Locations.</u> Frequently at open or public locations there is no possibility to place physical markers that are big enough to be found by a camera from a distance. For triggering AR content in these cases, use GPS markers.

5. <u>Websites.</u> Similar to the use of leaflets referred above, you can include markers on websites. A good example is access to the PC version of WhatsApp through a QR code that is scanned by a mobile phone. However, on websites it will be more effective to use hyperlinks for access to more detailed or augmented information.
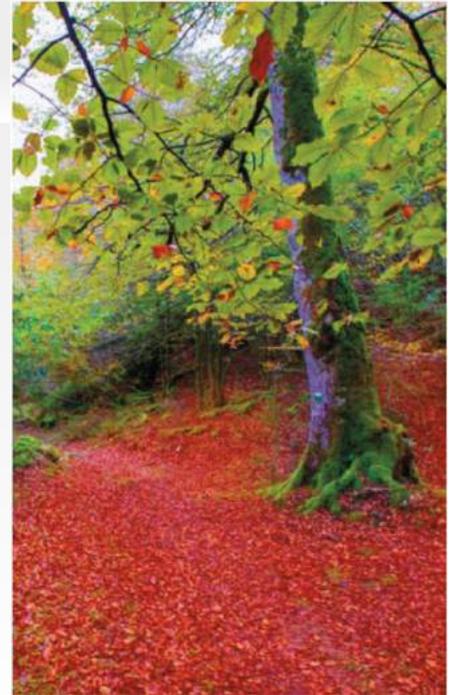
Depending on the type and placement of markers, they can deteriorate or become invalid over time, for instance:

- Physical markers fixed on objects can fall off, be hidden by objects placed in front of them, or lose contrast due to sunlight or other environmental influences.

- AR projects can be abandoned, cancelled, or modified over time while their respective markers still appear on objects or promotional material

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- Locations that trigger action through visual or GPS markers can become inaccessible (roadwork, construction, closure of previously accessible areas, etc.)

Periodic inspection and testing of their operability is therefore mandatory. For this purpose, the documentation of each AR project must include a list of markers and where they were placed. At intervals to be defined, all markers must be tested by the owner of the project. If any problem is detected, corrective action needs to be taken, such as:

- Relocate markers, remove objects that hide them, or replace them with new marks

- If AR projects are abandoned, related markers must be removed. If possible, at least for the "entrance" marker, new content should be created. This content either advises that this AR project is not operative any more, or it redirects to the new project that substitutes it.

- In the case of modification, obsolete markers shall be removed. The same marker may, however, be placed at a new position and with new content.

- Where places are no longer accessible but the content remains valid, new GPS coordinates can be assigned to it. Otherwise, the marker and its content can simply be eliminated from the project.

From previous modules you already know which real-life situation will be "augmented", the types of content and how to manage it (Module 3), and how the user will access it through markers. Now we can establish the different kinds of experiences that users could have in the context of Rural Tourism. Apart from plain text and pictures, here some additional content that can be used:

1. Videos. Sound and movement help creating a more immersive experience. You can link to your webcam that shows real-time views from you service; videos placed on YouTube and similar sites, or link to any other video content available online.

2. Re-construction of sites (used already in ruins to show how it used to look like in the past) – through single pictures, a picture series as a slide show, or a video. More complex options such as projecting these views directly over the camera view, are yet out of scope for small businesses.

3. Scenarios live on-site (show processes, creations, etc.) or recreations / simulation of live activities in the past. As an example, show how a painting was made by an artist.

Unit 4
User experience

A seamless and intuitive user experience is critical for any AR implementation. Markers must be easy to locate and use; content needs to be simple, visual, fast to load, easy to understand, etc.

What is user experience?

User experience is the feeling and perception of a person during and after using a service or device, especially regarding how easy or intuitive it is, and to what extent it meets his needs and expectations. Given this concept (perhaps a little ethereal for many), we try to give examples and aspects to keep in mind when creating and placing markers in the context of AR projects.

Content

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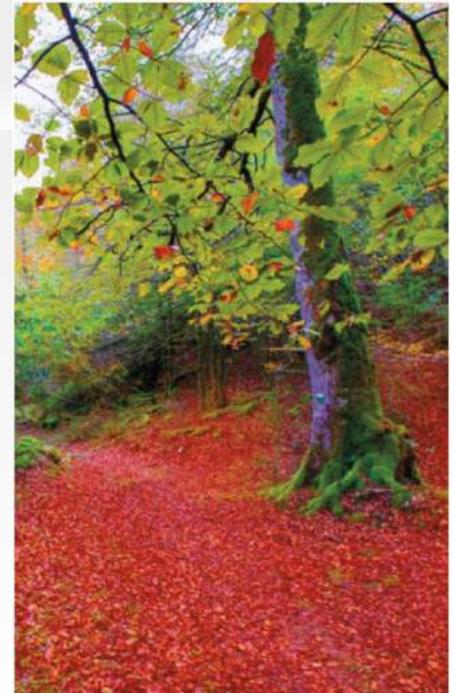
4.1. TYPES OF INTERACTIONS

In augmented and virtual reality, we face a series of actions beyond the first click that allows the user to interact and understand these realities. The user performs these actions on a day-to-day basis while navigating apps. He is used to certain patterns and actions, and the results they trigger; any deviation from this pattern will have a negative impact. Lack of knowledge of these patterns is perhaps the most common error. That is why we will explain each one of them briefly:

- Tap: Touch the screen with your finger to trigger a reaction.

- Swipe: Swipe with your finger to move around and learn more about the environment.

- Pinch: Pinch or join two fingers to interact- usually to zoom in or out.

- Rotate: Use your finger to visualize to turn the object.

- Air Tap: Touch in air.

- Voice: Voice commands to trigger action of the device or app.

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4.2. RECOMMENDATIONS FOR OPTIMIZING THE QR MARKER DESIGN AND PRODUCTION

We suggest a series of best practices in the use of QR codes to help provide a better user experience when using them as markers:

Plan and define objectives.

In any product development or marketing campaign, it is essential to define in advance the objectives that are pursued in order to be able to measure their effectiveness. The markers cannot be a last-minute addition; they must be a part of the planning from the start. Criteria to keep in mind: where they will be placed, what physical supports they will use, what is the necessary size to be found, and which common design will be used. For each of these criteria, find details below:

Marker design.

It is necessary to take into account:

- The size: it must be big enough to make it visible and easy to detect, and read from a reasonable distance between the user and marker

- The color: ideally, only in black and white; or in any case, with the highest-possible contrast. Recently it has become fashionable to use markers with different colors. They can be more attractive but we must be aware that the contrast is going to be worse and, therefore, increasingly difficult to read.

Be careful with embedded images.

Markers can theoretically be high-contrast images, or a QR code can embed logos. This can reinforce a company's branding, but it also makes it more difficult to read the marker because the relevant information cannot be detected and, as a consequence, it will cause scanning problems.

Marker placement.

Special care must be taken when placing the markers. There are several elements to consider:

- It should have enough space around and undisturbed visibility to make it easier to detect and read.

- Good contrast of the marker against its background

- For outdoor use, it should be at eye level, or at least easily scanned by extending the user's arm with a mobile phone

- A façade is not the best place to place a marker. If you do, however, keep in mind that mobiles will have to read it from a long distance and it must be large enough. In such cases, it is highly recommended to use a GPS marker!

- If the marker is used on TV, websites, or advertising screens with ads in video format, it is important to remain visible long enough. 10 or 15 seconds is the minimum time if the user already expects a marker to appear and has his mobile scanning device prepared for it. Otherwise, it should remain for a much longer period to allow time for the user to decide if it is worth scanning, and then open the QR app on the mobile phone.

- Mobile coverage is important. If the marker leads to online content and we place it in a garage without coverage, it will be completely useless. The same applies for markers in rural areas with poor mobile coverage. If this applies to you but you have landline internet, make sure that your Wi-Fi covers the place where the marker is placed.

- Finally, it is important to consider the environmental conditions in which the marker will be found. For example, will it be in a site with bad illumination? Or, on the other extreme, outside with too much light?

4.3. RECOMMENDATIONS FOR OPTIMIZING THE GPS MARKERS

GPS markers are comparatively less complicated. However, a couple of points need to be taken into consideration:

- if the location is selected, for example, from Google Maps, be aware that locations such as company names, monuments, etc. are frequently not exact. Make sure that the indicator is exactly where the object is.

- establish a reasonable distance from the point when AR content is triggered. This depends on the type and size of the object.

- to decide this distance, put yourself in the situation of the end-user: form where he will approach, how clearly the element can be identified, how close can a user get to it, etc. Three examples:

  - a small statue like the Männecken Piss in Brussels is only visible at a short distance: 10-20 mts are sufficient, while at even 40-50 mts the user will still be in some street without being able to see the object.

  - bigger objects such as a cathedral can be approached from different sides, as the GPS will be situated in its center but the content needs to be triggered already at 50-100 mts.

  - a landscape scenery where the object (castle, mountain) is not accessible and only can be seen from far - here a distance of 1-2 kms is necessary. As this is probably too much, a workaround is to define the best viewpoint to see these objects, and trigger content from this point- rather than from where the objects are in reality.

Ideally, take the location manually at the original spot, or at least know the spot very well. This assures that:

- the position is correct
- you know the surroundings and possibilities to approach the point
- trigger distance can be set to a value that is practically useful

In most cases, GPS markers will not vary over time, nor do they deteriorate over time. Once well defined, maintenance is minimum.

4.4. ALWAYS KEEP IN MIND THE USER EXPERIENCE

Inform the user about your AR solution: avoid markers without previously informing the user what they are related to. If you use QR codes as markers and your visitor knows what they are, they will try them. Some content may show up without any specific app, but in order to make full use of your AR solution, users first need to download and install the adequate app. Many are reluctant to do this unless they understand the associated benefits, so tell them about it- there are still few AR implementations and many clients will be curious!

Keep in mind that there are still many people that have never scanned a QR code, or something similar, in their life- depending on your target audience, this segment may be precisely the most interesting one. Using your AR system can be a totally new experience for them, so "take them by the hand" and guide them.

In the case of projects created with the Aurea4Rural AR toolkit, users need the Aurea4Rural APP to access content. For the visitors that need to download and install this APP for the first time, it is a good idea to create a specific QR code that directly leads to this download, and publish it on the visitor information, entrance, etc.

Include a call to action: people are curious about AR, they have heard a lot about it but very likely, never truly got to experience it. Playing around with your AR solution can be the starting point of opening a new world for them. But in order to achieve this positive experience, your AR solution must offer added value, provide useful information and invite them to take action to obtain something better.

Use a shortened address: if your marker leads to a URL, use a bit.ly, a type of a shortened address. This will decrease the coded information, and makes codes smaller and/or easier to read.

Prove that the marker reads perfectly on different devices and readers. Try with all possible devices you can get a hold of: older mobile phones with a basic camera, tablets with bad illumination, etc. Prove that the URL and information still open correctly. Make a thorough pre-test with friends and clients – and inviting them for a glass of wine or other goodies will motivate them even more!

The destination of the marker must be optimized for mobile. Do you know how frustrating it can be to be taken to content that they can't see from their mobile device? Whatever it is- video, an App or a mobile website- it must always be visible from the mobile device. Do not test this from your PC with high-speed internet when you create the AR project: go on your mobile, disconnect the WiFi, and check out how it works.

Last but not least, it is essential to measure the results and get feedback from users. Your AR solution is not (just) for fun – it is meant to add value to your visitor. Control and measure at least three parameters: the percentage of your visitors that access your AR, the total number of markers scanned per session, and which markers generate most interest. This provides important

information to improve your AR solution, making it more useful and, thus, attractive for your client.

4.5. COMMON APP DESIGN ERRORS

Most of the above applies not only to markers, but by extension to the general app design. Frequent errors that do not take into account the user experience as a central axis are:

- Content and reality do not match – mostly because the content is not updated

- Wrong scale and/or inadequate proportions of objects shown – the intended message or information is not delivered, or is distorted

- Focus only on the initial elements – what about the rest of consecutive pages and spaces?

- An inadequate position between the user and the elements – show what is really relevant at this moment and at this location. If the location is a city square, don't explain a small statue in a corner

- Unclear or out-of-standard use of the controls for navigation

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4.6. FINAL IDEAS

- The User Experience is not on a whim, nor should it be seen only as nice graphics or clean interface. User experience goes much further, placing the user at the center of all app content, development, and navigation from start to end.

- If we put the user at the center of all our work, the risk that our project will fail will be lower.

- Think of the environment: it is the pivotal point for augmented and virtual reality projects. The context of any marker and associated content to the location is the most important attraction and benefit- NEVER leave it aside.

- Comfortable for the user: minimum effort for the user is the key for success.

- The interface must be intuitive- wasting time trying to understand the interaction with the app is very frustrating. Let's not frustrate the user, but instead facilitate the use for fulfilling their needs.

Image source

US Augmented Reality Users, 2016-2019
millions and % change

- Augmented reality users
- % change

Note: individuals of any age who experience augmented reality (AR) content at least once per month via any device
Source: eMarketer, May 2017

226961   www.eMarketer.com
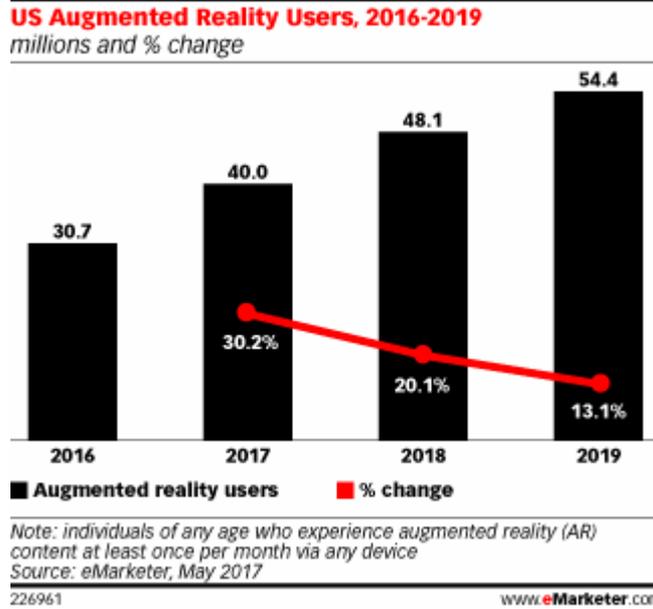
Figure 1. The evolution of interaction

SHORTENED CHAINS OF COMMAND

Augmented and virtual reality help accelerate the coalescence of users with their device-powered experience of the world, improving the fidelity of intention, increasing efficiency, and driving innovation.

HARDWARE

INTERFACE

INTERFACE

MESSENGERS

Intermediate devices interact with interfaces; virtually all input occurs through a mouse or keyboard.

POINT   CLICK   TYPE

SMART SCREENS

Screens manipulated based on environment facilitate direct physical or spoken interaction with displays.

TOUCH   SWIPE   TALK

INTUITIVE INTERACTION

Devices respond to ambient cues and intentional movements to create empathetic, personalized experiences.

GESTURE   MOOD   GAZE

Graphic: Deloitte University Press | DUPress.com

Image source

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Step ① — ① Users will download an app

Step ② — ② Launch the app, and point your camera on the Menu

Step ③ — ③ Your Customers can start interacing with the menu

Step ④ — ④ Restaurants will receive full report on usage with all data
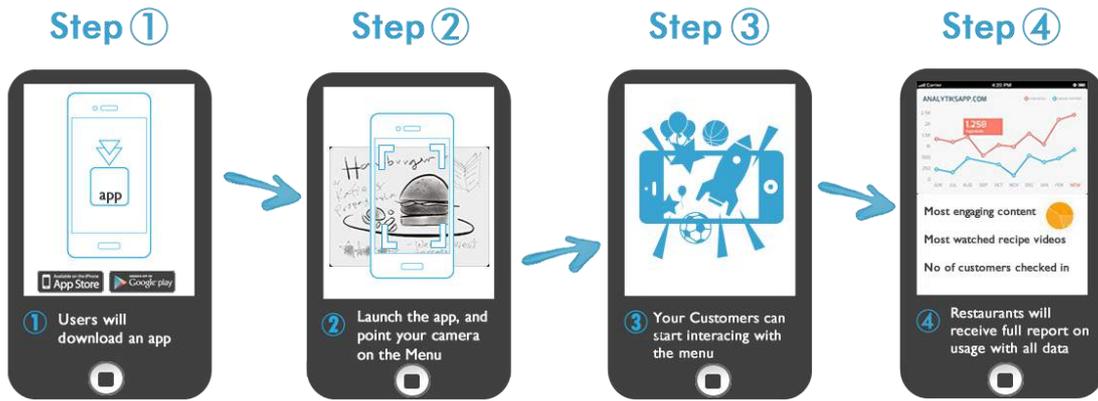
Read more:

Practical Design Considerations for Augmented Reality Apps on Mobile Phones. Author: Neil Mathew
https://medium.com/placenote/practical-design-considerations-for-augmented-reality-apps-on-mobile-phones-517469f4a09c
Date: November 29, 2017. Source:
https://medium.com/

Vision
http://bowentrails.ca/virtual-trails-vision/
Date: may 2015. Source:
http://bowentrails.ca

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TOOLS

Necessary equipment for generating a basic AR project with the Aurea4Rural toolkit:

- Personal Computer or laptop – should not be older than 4 years, capable to run the operative system WIN10 or equivalent

- Printer for markers

- Mobile phone capable of catching GPS location coordinates

- High-speed internet connection (minimum 20 Mbps download / 3 Mbps upload)

- In case of bad mobile coverage: WiFi that can be used by visitors and that covers the area where AR is implemented

- $$$

Read more:

Your smartphone is ready to take augmented reality mainstream. Author: Leander Kahney
https://www.wired.co.uk/article/augmented-reality-breakthrough-2018
Date: January 4, 2018. Source:
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Date: July, 15 2017 Source:
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https://econsultancy.com/five-new-and-innovative-examples-of-augmented-reality-in-retail-apps/
Date: September, 27, 2017. Source:
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Date: January 8, 2019 source:
www.wikitude.com

Practical Design Considerations for Augmented Reality Apps on Mobile Phones. Author: Neil Mathew
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Date: November 29, 2017. Source:
https://medium.com/

Vision
http://bowentrails.ca/virtual-trails-vision/
Date: May 2015. Source:
http://bowentrails.ca

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Module 5
Multilingual and Translation Tools

AUREA
4RURAL
augmented reality
for rural tourism

AUREA
4RURAL
augmented reality
for rural tourism

AUREA4RURAL

augmented reality for rural tourism

MODULE 5:
MULTILINGUAL AND TRANSLATION TOOLS

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This project has been funded with support from the European Commission (Project 2017-1-EE01-KA202-034896)

AUTHORS:

Module Introduction

You prepared a beautiful and almost perfect AR project in your local language for your service.The content is nice, the markers work, and your domestic customers love it. But what about visitors from countries that do not speak your language?

International visitors are of high interest because they stay longer and spend more money. If you do not speak their language, AR is an excellent tool to present and explain all the details of your service or installations to them. Or you can prepare a self-guided tour in their surroundings in their language.

This is where multi-lingual design and content of AR apps comes into play. In this module, we first explain to you how language selection on electronic devices works.

Then we introduce you to a few online tools for translation that are available for free: Google Translator has the advantage of more than 100 languages, but the results are frequently not up to the standard of a good translation. If you only need the main European languages, a better choice is Deepl. It only operates with nine languages, but it has surprisingly good results even in technical or legal texts.

For fine-tuning your translation results, we present online dictionaries such as WordReference, Linguee and Reverso.

Finally, we give a couple of suggestions about how to structure a simple multilingual AR project.

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Unit 1
Multilingual AR content

Multi-lingual interfaces and content are one of the biggest advantages of AR: with just a few clicks, content in your native language is understandable to your visitors from other countries. Translation to English is usually the most common, but many other languages are now available through different translation tools.

When preparing the content in several languages, you need to understand:

- how the user will access content in a specific language
- how to create content in different languages

In this module, we present you an overview about how multi-lingual content is managed in Augmented Reality, and the tools that you can use for creating it.

The Aurea4Rural AR toolset already incorporates some basic multilingual capacities in English, German, Italian, Estonian, and Spanish:

- webtool interface comes up un English, but the interface can be selected in any other language
- content of the same project can be generated in all other languages
- APP in device language (if none of the above, English comes up)
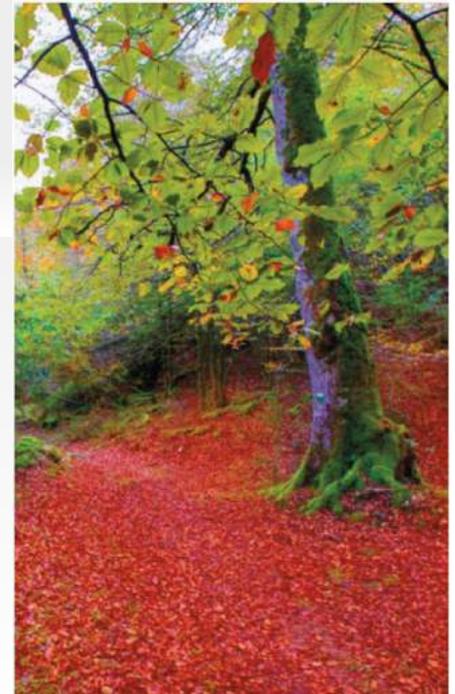
Content

1.1. SELECTION OF LANGUAGE

When using applications on your mobile device or on the internet, you may wonder why a website or content appears automatically in your native language. This very comfortable solution is now standard for medium and high-level applications, and recent developments include it by default. If the detected system language is not available, a default language (usually English) is shown. So how does this work?

Mobile devices and computers are configured for one specific language. This usually happens the first time you install or use such equipment; your decision at that moment is stored and then automatically repeated in future connections. This decision not only tells tell the device in which language it should interact with you, but it is also sent when connecting to remote servers or applications in the cloud for the same purpose.

On complex devices such as PCs or laptops, this language selection can be modified on the go for a specific application such as an internet browser. Browsers that allow you to change your language preferences will generally allow you to specify from a list of languages. That way, if your first choice is not available, you can say what alternative languages to try, and in what order. Language versions for a specific region, such as Canadian French, are not always available at the side of the server you connect to, and this server may default to a different, more common, language like English. This ensures that another language tag for the "vanilla" language (i.e. generic French in this case) is also selected.

On mobile devices, the language preferences are likely to be determined once by the operating system settings, or in some cases by the language of the system when you installed the app. If this language is not available remotely, visualization will default to English or to the language where the website or app is located.

If you are in doubt, use the Internationalization Checker to discover the language(s) currently being requested by your browser. In many cases, the initial browser setting will meet your needs. For example, if you have a Japanese version of a browser, the browser typically assumes that you prefer pages in Japanese, and sends this information to the server.

Sometimes a remote server may determine which content and language to send to you without taking into account the language selection that you made on your device. For example, Google tends to use IP information to determine your location, and then decides the search results that best match this location and its language.

However, the implementation of this automatic selection requires a lot of technology and knowledge. This is normally not available in SMEs that just want to create their own small AR app. In these cases, the solution is a manual selection of the desired language at the start-up of the application.

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1.2. TRANSLATION TOOLS

The good part of the content in any AR project is text: either plain text, or embedded in pictures and videos. The original text is what we call "source language text". This source text needs to be passed into a different language, and the result is called "destination language text".

If you know the language in which to translate, you can do smaller texts manually. But for larger content, using translation tools is much faster. Here you need to distinguish between two types:

- Online translation tools – they are presented in this module unit and allow for quick translation of large quantities of continuous text. Some of these tools provide surprisingly good results, but they typically still need revision and improvement in details. This is when you will need and use online dictionaries.

- Online dictionaries – you will find them explained in detail in the following module unit. These dictionaries do not translate phrases or longer texts: they are limited to single words or short expressions. Their advantage- they give you alternative translation options for a source language word, frequently also providing context examples. This makes them very useful for fine-tuning the results from the previous online translations.

GOOGLE TRANSLATE

Google Translate (https://translate.google.com/) offers online translation from and into more than 100 languages. It is a free translation tool that uses computer programs to translate different languages. This means that not all translations are perfect and the accuracy may vary between different languages.

Working with Google Translate is easy: open the link, select the language you translate from (left) and the language you want as a result (right). Then paste the source text in the left part – the translation will appear almost immediately on the right.

This is the most popular translator on the Internet since, in addition to translating texts, phrases and web pages, it incorporates other very useful functions. We will explain them shortly:

What the Google Translator is and what it's used for:

Google Translator or Google Translate is Google's official translation application that allows you to translate words, texts and web pages between dozens of different languages. It is a free Google service that is offered through a web interface (the web page), and as extension in various browsers and mobile applications for iOS and Android.

Google Translator supports over 100 languages, including Latin and Yiddish. Google Translator automatically scans text entered by the user or linked from a website in a foreign language and, by default, provides a translation in the user's native language. You can change the translation settings for language input and output in order to obtain a translation of the text in any of the supported languages.

How to use the Google Translator correctly:

What elements you can translate with Google Translate:

Google Translate is a powerful free online translator. In addition to being fully accessible from any browser or mobile device, it has multiple functions to share, save, improve and validate translations. In addition, it offers the possibility of translating anything, whether in the form of a text, document, web page and much more. In addition, an optional Translator Toolkit is available which adds more functions. Here are the possible sources explained one by one:

- Written words: You can translate words or phrases with the Google Translator application or use the Google Translator from any browser.

- Documents and web pages: On some devices, you can translate special types of content such as text messages, websites, or documents. Simply enter the web address in the box on the left or upload the document by clicking "translate a document".

- Text in other applications: With the Google Translator application, you can translate text in other applications. In Android, when "Touch to Translate" is enabled, you can copy text from any application installed on your Android device and translate it to another language. In iOS, when "3D Touch" is enabled on your iPhone, copy text from any application and translate it to another language from the home screen.

- Images: With the Android app and Google Translator's iOS, you can use your phone's camera to translate text from everything around you, such as posters or handwritten notes, directing your phone's camera lens to the text you are interested in. Translations of small, poorly lit, or special formatted text may be less accurate.

How to use the Google Translator correctly:

Learning how to use the Google translator correctly is key to getting the most out of it. Although it is not the most accurate online translator, it is the most used and, therefore, the one that receives the most corrections of translations that increases reliability. Here are the steps you have to take to translate words, phrases or texts in Google Translate:

1. Go to the Google Translator page: https://translate.google.com/
   Using Google's online instant translation tool is really easy. Although you don't need to create a Gmail account to use it, in order to have access to dozens of other interesting Google tools and the Translator Toolkit you are required to have one.

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2. Type or paste the word, phrase or text you want to translate. Google Translate also has a voice input option- by activating the microphone on your device, you can speak to the translator and it will write everything you say. This voice recognition does not always work as expected, and manual correction of words will frequently be necessary. Whatever you choose, the important thing is to have text inside the left box.

3. Define the source languages of translation. Google Translate will remember the last source language that was used, and apply it by default in the next session. If your source text is in a different language than the previous, you can either select the language directly from a list, or check the option "Detect language" on the left side of the translation header. This is very useful if you do not know the language of your source.

4. Define the destination languages of translation. As with the source language, Google remembers the last destination languages that were used. However, if you want the translation to be done in another language, you only have to select it from the list of options.

5. Read, review and listen to the full translation. Dictate or type in the content you want to translate, and Google takes care of everything instantly. Now it's time to check the quality of the translation (although this quality is already being measured by Google with a grey check next to the translated text). Read or listen to the translated text and use it wherever you want. To re-translate another text, delete the existing one on the left side, or keep typing below.

   You can also save your translations in the vocabulary. Click on the star icon next to your translation to add it to your vocabulary. The vocabulary is synchronized with your Google account, so you can access your saved translations quickly and easily, regardless of whether you access the Google translator from a browser or through the Android or iOS Google Translator application.

   Note: If you are translating into a language with non-Latin letters, a button with the "Ä" symbol will appear next to the translation. Clicking this button will spell the translation in the Latin alphabet.

6. Check the dictionary with the parts of the speech and possible alternative translations. When translating a common word or phrase, a dictionary may appear beneath the translation indicating parts of the speech and possible alternative translations. Next to each entry in the dictionary, you will see the corresponding set of inverse translations in the original language. The bar next to each entry indicates how often that particular translation is used on the web, which gives you indications about the "best" translation in case of doubt.

7. Help to improve the Google Translator. Google Translate is built on contributions from of all of us. One of its maxims is that the users themselves help make it better every day. You can improve translations and even add new languages as part of the Google Translator

Community. Once you've joined the Community, you may see the option to translate or validate words, phrases or sentences in your language when you access the page. Here is what you can do:

- Translate new words or phrases: When you click "Translate", Google Translator will display words or phrases to translate into your language. Translate words or phrases in the same way you would say them aloud or write them, correct any grammatical and spelling mistakes you find, and be consistent with capitalization, tone (formal or informal), idiomatic expressions and jargon. If you don't have all the information you need, such as the gender or context, translate the text as you think it should be.

- Validate translations: click "Validate", and the Google Translator will display several translations of a word or phrase in your language. Check which ones are correct and which ones are not.

Read more:

Video tutorial on GoogleTranslate:
https://www.wikihow.com/Use-Google-Translatebasic

THE ALTERNATIVE TO GOOGLE TRANSLATE: DEEPL

DeepL is an online machine translation service. The service allows the translation from and into nine of the most frequent European languages, thus giving 72 language combinations. Results are very reliable, even in technical language or for texts with specific content. It offers data confidentiality- after the translation is generated, all your texts will be deleted. It also allows translations of fully editable documents.

Real-time online translation with DeepL:

Similar to Google, DeepL translates your texts in real time with just a few clicks: select the source language, select the destination language, paste the source text in the left window, and results appear immediately on the right. DeepL has a very complete dictionary. Within the translated text, it allows you to click on any word to find out about meanings, alternatives, or descriptions and uses in phrases. Click on one of the alternatives, and it automatically substitutes the previous text in the translation result. If you feel that results do not reflect your source text, try changing some terms in this source and they immediately change the results.

Translate complete WORD and PowerPoint files with DeepL:

You can also translate complete files in Microsoft Word (.docx) and Microsoft PowerPoint (.pptx) format. All elements of the document, such as the main text, titles, captions and even footnotes, will be translated into the language of your

choice while maintaining the original formatting. This document translator is extremely intuitive and easy to use. Simply drag and drop the original document into the text box on the left. Once you have uploaded the file, select the language into which you would like to translate the document.

The translation will immediately be generated, as you can see in this image:
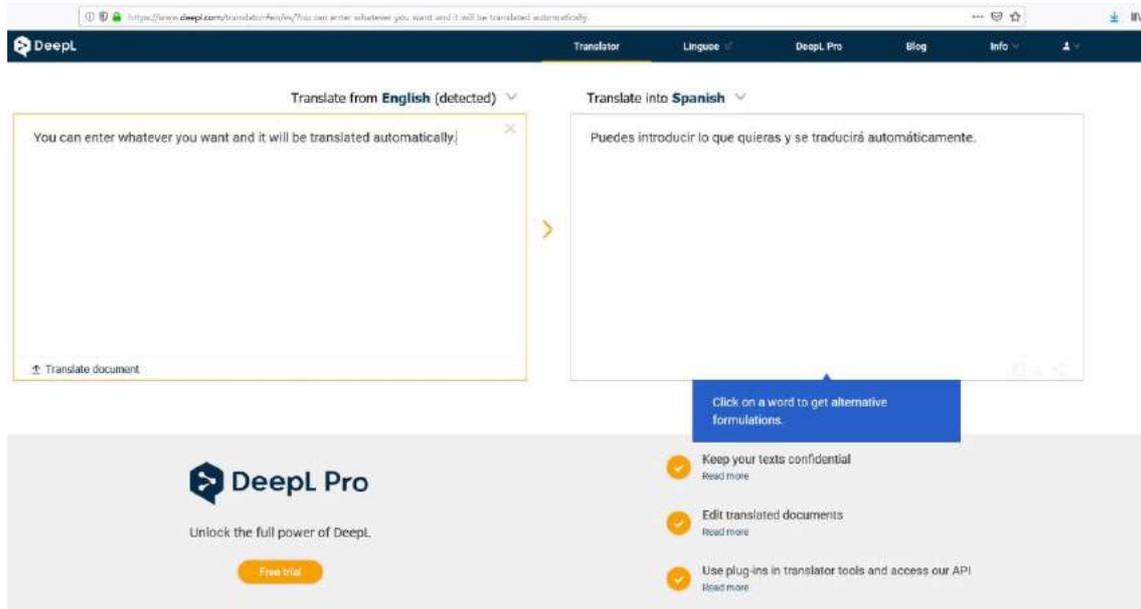
You can also place the cursor over the "Translate document" button, located in the lower left corner of the input text window, and then select the language in which you want to translate the document, as shown in the following image:

Image source: https://www.deepl.com/pro.html
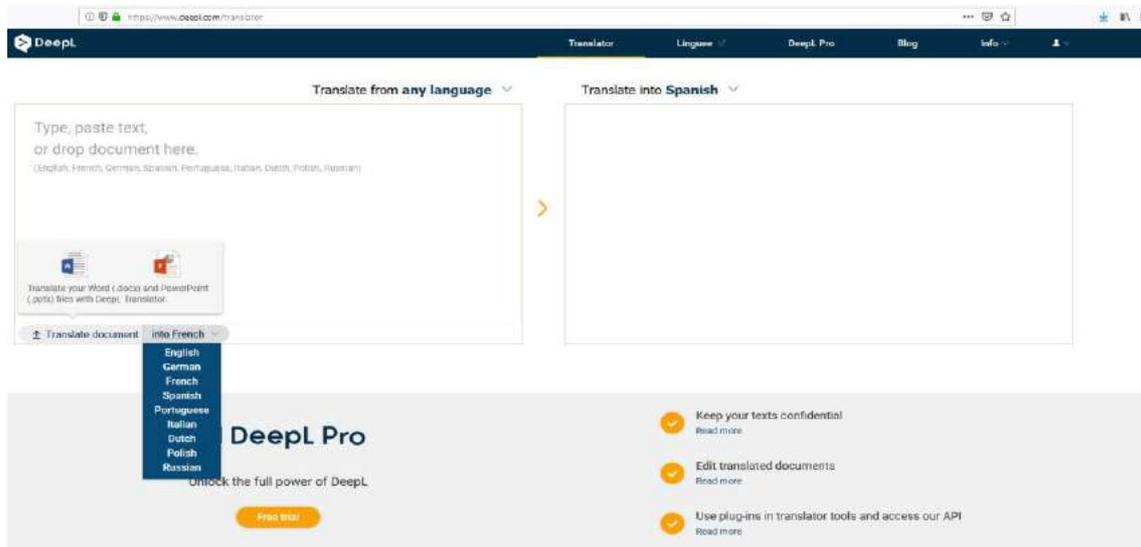
Then select the document you want to translate, and DeepL will take care of the rest. When finished, the document with the translation will be downloaded automatically.

The negative side of complete file translation: all of the options in the real-time translation for fine-tuning results on the run before storing a translation (as explained in the second paragraph above) are, of course, not available.

You receive a closed file, and corrections must be done manually offline. Therefore, this complete file translation only makes sense if the source text is relatively simple (i.e. the translation is likely to require few corrections), or if you dominate the destination language very well. If you need a high-quality translation of not too much source text – as will be the case in most AR projects – the real-time online translation with DeepL is the better choice.

Even more options and functionalities: DeepL Pro:

As a new feature, DeepL now has its professional version, DeepL Pro that allows DeepL's translation technology to be used in third-party applications.

The most interesting reason to use DeepL Pro is real-time translation. DeepL's response is very fast and its dedicated supercomputer processes one million words per second. Imagine combining that with headphones to translate what you're being told, or a poster that you focus on with your smartphone's camera. The only requirement is a very fast internet connection, especially when you want voice translation.

The availability of the DeepL API allows this intelligent translator to be integrated into any software code: web applications, mobile apps, desktop programs, and even the operating system itself. This can lead, for example, to video conference apps or chats with simultaneous translation. In addition, it can be used for public or private use within companies, since DeepL and its professional version DeepL Pro guarantee anonymity and non-intrusion in the texts that are sent.

WHICH ONE TO CHOOSE?

For translations from and into the main European languages that are covered by DeepL, results are excellent and clearly better than Google Translate. In most cases of basic AR applications, if you have a good source text in English, German, French, Spanish, or Russian that needs translation in another one of these languages, then DeepL is your choice.

If your source language is not covered by DeepL, initially you may depend on Google Translate. Even in this case, we recommend creating first one perfect translation into English – possibly even with the help of a professional translator. Then, use Deepl for translating the English text into the other main European languages.

If the destination language is not covered by DeepL, your only option is Google Translate. Results will be understandable in general, but can be somewhat

inaccurate at times especially when special vocabulary is required. If the final user of this text requires a good or perfect translation, you have no choice but to contact the services of a professional translator. You may also decide to use a professional online translation service such as Translate.com. This site provides professional translations for texts that require perfect grammar, superior accuracy and deep understanding of the language. Aside from similar functionalities as Google Translate and DeepL, it has over 17,000 translators on demand, available 24 hours a day, 7 days a week. It also has more than 30 integrations and extra applications. But this comes at an extra cost, of course.

Image source: https://www.deepl.com/pro.html

Image source: https://translate.google.com/

Image source: https://translate.google.com/
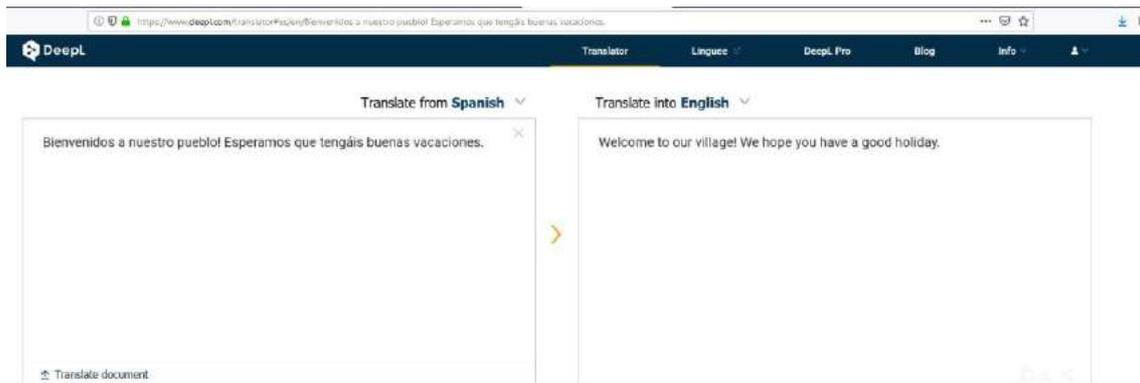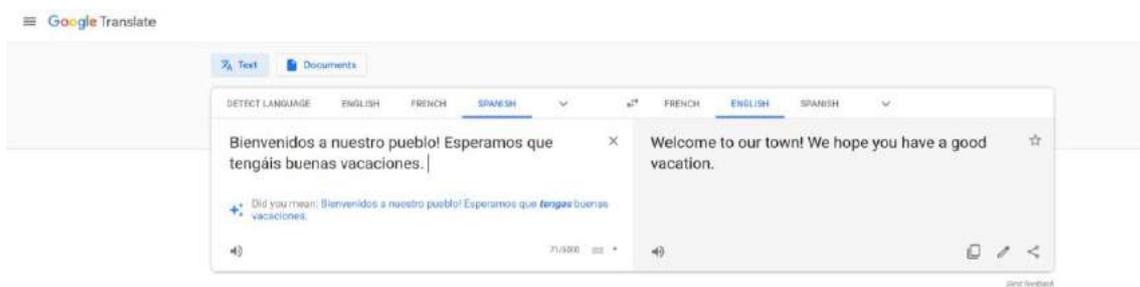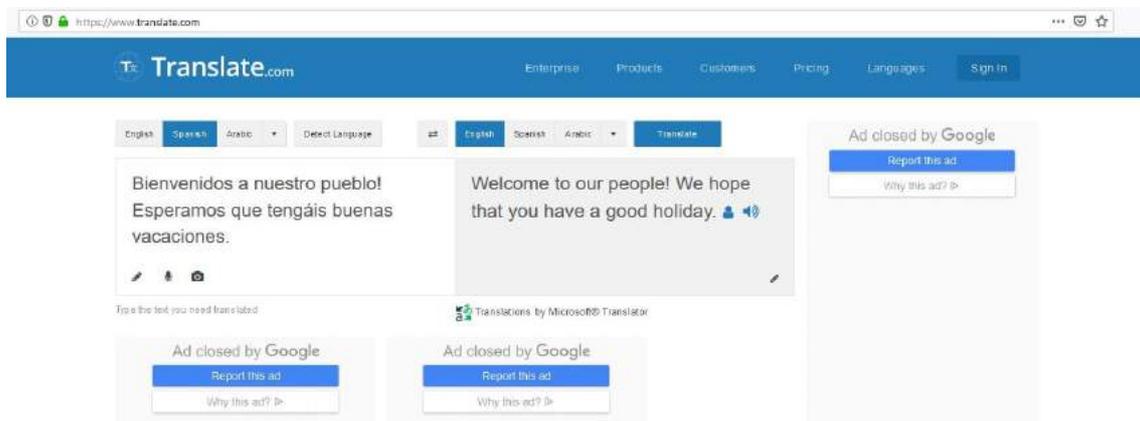
Read more:

Step-by-Step guide to translate a website /
app content in SPANISH.

https://internetpasoapaso.com/traducir-
pagina-web/

ONLINE DICTIONARIES

The automatic translation looks good, but you are not sure about certain terms. Or you have a good knowledge of the destination language, can do a translation yourself, but have the same doubts while translating.   In both cases, you need a good online dictionary.

WordReference is a free online translation dictionary that most closely resembles a traditional dictionary in print format. It covers: English-Spanish, English-French, English-Italian, English-German, English-Russian, English-Portuguese, English-Polish, English-Romanian, English-Czech, English-Greek, English-Turkish, English-Chinese, English-Japanese, English-Korean and English-Arabic, as well as French-Spanish and Portuguese-Spanish.

The advantage of WordReference compared with other alternatives is the wide choice of translation options that are offered for one source term, covering different contexts and providing examples for them.   Decent or good knowledge of the destination language is, of course, required to decide about the most adequate term to choose.

Very interesting in the case of set phrases or idioms: WordReference maintains a wide array of language forums where translators post questions about how to translate terms and expressions best into another language. For example, you want to find out how to translate "one (drink) for the road" into Spanish? – the English-Spanish Forum of WordReference will give a long list of options and suggestions by native speakers.

Other online dictionaries like Linguee or Reverso take a different approach: they focus on the context of a term and offer alternative translation examples in longer texts. This can be useful if the solution offered by WordReference is not convincing, or if you still have doubts about the best contextual translation of your source text.

Linguee is an online dictionary with automatic translation. Its most interesting feature is that while translating a word, it offers a complete list of external sources (sentences or texts in the original language and in the translated one) where the word or expression appears in a specific context or meaning. These examples are provided by users, which greatly help to choose the most coherent and appropriate translation. Linguee is also the dictionary engine that

feeds the Deepl translator. This explains, to a greater extent, why DeepL generates such excellent results.

Reverso: has similar functionalities to Linguee, although its approach is more technical and professional.   Its main characteristics are:

- Improves translation quality by automatically correcting errors in your source text.

- Makes progress in oral communication and improves accent by listening to the pronunciation of your texts by a native speaker.

- Translates many idiomatic expressions and suggests other translations that can be improved by the translator.

- Consults the results of the dictionaries on the same page and discovers different meanings of the words, indications of use and expressions related to them.

- It also offers specific technical translation in subjects such as: Computer Dictionary, Business Dictionary, Website Translator, Database Translator, etc.

Useful links:

- Google Translator: https://translate.google.com/

- DeepL: https://www.deepl.com/translator

- Translate.com: https://www.translate.com/

- WordReference: https://www.wordreference.com/

- Linguee: https://www.linguee.com/

- Reverso: www.reverso.net/text_translation.aspx

1.3. MULTILINGUAL IN AUGMENTED REALITY

When the content is static and bound to a fixed location (as is likely to be the case in AR projects), the automatic language selection functionality is usually not implemented. These AR projects create a full language version of the content, and the language is manually selected when starting the related application. For small projects with little change of content, this is technically a lot easier and does not affect the user experience.

On the other hand, bigger projects where content is dynamic use one single interface template that is common for all languages. Language is decided automatically as explained in the first unit, and then the headers, texts and content are incorporated in real time from a database. This facilitates the language adaptation and maintenance of larger projects, but is also more complicated. For the AR projects that a SME will be able to generate and maintain, such complexity is out of scope.

As indicated, AR projects for micro-enterprises will normally use static translations, combined with one AR project version for each language. At the start of the session, the user (visitor) defines the language and from this point on, the application runs in its own closed version for that language.

The only exception can be external resources to which the app links (videos, pictures, etc.) – they can be shared between different language versions of the AR project. However, in most basic app technologies, like the one used in the Aurea4Rural Toolkit, each language version is completely stand-alone and therefore requires the upload of related files – even if identical - one by one.
The generation of multi-lingual projects in AR at this technology level is therefore straightforward:

- Gather all texts, images, videos, sound, or other content to be shown in the source language.

- Translate texts with one of the above explained translation tools. For all other content, find the respective language version if available.

- Create each language version by combining the translated text with other content, like you did in your original source language version.

For future updates of your language content, we recommend to gather all translations in one WORD file, with reference text in the first column plus additional columns for each different language. This should be done in such a way that headers, sub-headers, and shorter text blocks can easily be identified.

Find an example screenshot of such design below:

TRANSLATIONS MENUS, COUNTRIES, etc.

English	French	German	Spanish
Top menu			
ABOUT	CE SITE	ÜBER UNS	
COUNTRIES	PAYS	LÄNDER	PAÍSES
Text at landing page (final, and *add-on provisional during translation process)*			
Member Countries 31 professional organisations from 28 countries give you the choice of an authentic rural holiday experience.	**Pays membres** 31 organisations professionnelles de 28 pays vous offrent le choix d'un séjour rural authentique.	**Mitgliedsländer** 31 Anbietervereine aus 28 Ländern bieten Ihnen hier eine breite Auswahl an Urlaubsmöglichkeiten auf dem Land.	**Países miembros** 31 asociaciones de 28 países te ofrecen aquí una amplia oferta para tus vacaciones en el medio rural.
NOTE: we are still translating menus and headers to French, German, and Spanish. During this period, some menus or pages are only available in English. We apologize for inconvenience.	*NOTE : nous sommes toujours en train de traduire les menus et les en-têtes vers le français, l'allemand et l'espagnol. Pendant cette période, certaines menus ou pages ne sont disponibles qu'en anglais. Nous nous excusons pour le dérangement.*	*WICHTIG: wir sind derzeit noch dabei, die Menüs und Titel dieser Webseite auf Französisch, Deutsch, und Spanisch zu übersetzen. In dieser Zeit sind manche Menüs oder Seiten nur auf Englisch sichtbar - wir bitten um Verständnis und Entschuldigung.*	*NOTA: en este momento estamos aún traduciendo los menus y otros títulos al francés, alemán, y español. Durante este tiempo, algunas menus o páginas solo se pueden visualizar en inglés. Rogamos disculpes las molestias.*

Read more:

Quick summary of the most important reasons to have a multilingual website or app:
https://wpml.org/es/2018/07/multilingual-business-website/

This article gives an overview of several advanced tools for creating multi-lingual websites and content:
https://steelkiwi.com/blog/how-to-make-a-multilingual-website/

Module 6

A step-by-step guide: how to implement AR in a small and micro business

AUREA
4RURAL
augmented reality
for rural tourism

AUREA
4RURAL
augmented reality
for rural tourism

European Commission

Co-funded by the
Erasmus+ Programme
of the European Union

AUREA4RURAL

augmented reality for rural tourism

MODULE 6:
A STEP-BY-STEP GUIDE: HOW TO IMPLEMENT AR IN A SMALL AND MICRO BUSINESS

Erasmus+

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ceTEM

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Karlsruhe Institute of Technology

E·E·S·T·I MAATURISM
ESTONIAN RURAL TOURISM

EUROGITES

Olustvere Teenindus- ja Maamajanduskool
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EUROPEAN DIGITAL LEARNING NETWORK

Module Introduction

In the previous modules, we looked at what augmented reality is, which means are used to create AR, what must be considered when creating content for AR, and how to choose the appropriate tools for AR. In this module, we will take a look at how AR can be used in small and micro businesses.

You can start right away here to create your project. On the first three pages, a summary about Augmented Reality explains the most important practical aspects to take into account.

However, it is recommended to first familiarize yourself at least with the Module 1 that provides a deeper understanding of AR. For more specific questions and terms on devices, types of content, markers, and translation you find the details in the respective modules 2, 3, 4, and 5.

For a specific example of a free tool that can be used in micro and small businesses, please take a look at the Module 7.

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Unit 1
Why do something in a different way?

It may seem that for dozens, if not hundreds, of years accommodation has provided the same service - a place to sleep. The user arrives, books a room, sleeps and leaves. Easy. Why should you consider changing or adding something?

But when you take a look at history, successful businesses have always been innovative while unsuccessful businesses have deteriorated until they completely disappeared from the picture. We have to go along with the technological developments, whether we like it or not.
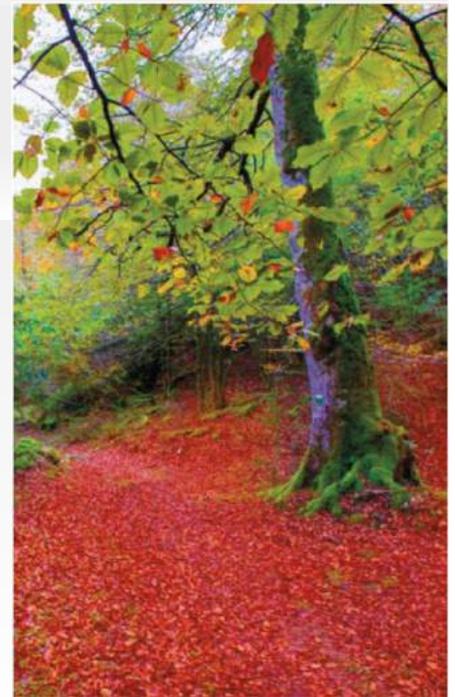
When aviation opened up the global world to a regular person, hundreds of hotels, motels and other similar accommodation establishments were opened. In order to win the visitors over, hotels added extra features to the hotel itself - for example, a health spa, organizing seminars or just an entertainment offer. They also started to offer experiences - for example, rural and adventure tourism packages, travel packages, etc. With the emergence of the phone, the first travel agencies appeared on the market that arranged accommodation, booked rooms, etc. for customers. As the use of the Internet spread, booking rooms moved to the Internet.

Discussing such developments with the 19th-century accommodation manager, he would have laughed and said it was impossible and would not bring any benefit. He would no longer be laughing at this moment. For every new development, some of the customers went along with it; but certainly not all, as some admirers of old ways certainly stayed.

But every new development increased the number of users for those businesses who went along with the development in the way that suited them best. Presently, it can be said that if you are not on the Internet, you do not exist. If the property does not have wireless internet access, its rating will be extremely low.

If food, in addition to having a great taste, does not look beautiful, it gets rated three stars out of five. When it is possible to book a hotel room only by making a phone call, the user often gives up the hotel and goes to a competitor.

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Unit 2
A crucial aspect - the user of the service

There can be many examples similar to the one above and they do not have to be limited to the accommodation sector, but apply to all walks of life. In the past, it took 5 men and 3 weeks to cut the forest; today the same area is cut in 5 hours.

In the past, the person sitting next to the driver had to read the map to give directions; now, we are instructed by a smartphone application, which - compared to the so-called "map reader" - always knows our exact location.
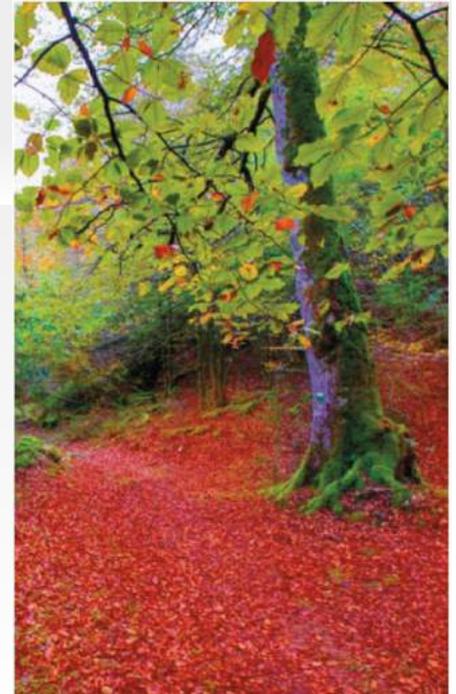
In addition to technological developments and their deployment, these examples include another critical factor. This is the user - the person to whom the service is provided. How is technological development and the user interrelated? The user is looking for the best experience and rates their experience. Your hotel may have the best computers and the fastest servers, but if customers do not benefit from them, it does not matter to them.

However, if the computer system allows the customer to get his room key quickly and enables him/her to enjoy fast internet access in his / her hotel room, this will benefit the customer. If you are a simple accommodation provider who gives the key when a customer arrives and takes the key back when the customer leaves and offers nothing more, then there is no benefit to you from augmented reality. All in all - if new technology brings benefits to your customers, then it is worth considering introducing the technology.

Read more:
https://www.customer-alliance.com/en/articles/hotel-industry/

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Unit 3
Why Augmented Reality?

The purpose of this training material is not to convince small businesses that they definitely need to use Augmented Reality to go along with the advancement of technology. Nor is Augmented Reality something magical that would bring thousands of customers to a place where no customer ever went to before.

No business should go along with a momentary "fashion rush" that at one point is there and at the next point is gone.

Every business owner should think about the benefits of a technology for their specific business and its clientele.

Content

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3.1. WHAT ARE THE BENEFITS OF AUGMENTED REALITY FOR A SMALL ACCOMMODATION ENTERPRISE OR A COMPANY OFFERING SERVICES RELATED TO EXPERIENCES?

Augmented reality allows you to bring digitally existing information to users. In order to provide this information to the user, it must be created or gathered first.

Take, for example, rural tourism - if there are many attractions in the area, the easiest solution is to collect these attractions and mark them as points on a map. This is a good and easy way to inform the user. When a user reaches a point, he would like to have more information about the particular point. To enable this, we are placing an information board.

There are different historical images about this location and there even is an audio clip featuring the location. All this information does not fit on the information board at the best of will. This is why we place an internet address on the information board, where the customer can receive more information.

And finally, the customer has so much information that he/she will give up the information either completely or partially. And, he/she might fail to get the really important information. In addition, the ability to read a map varies from person to person, but most people can manage reading a map on a smart device.

3.2. COULD THIS PROBLEM BE SOLVED IN A DIFFERENT WAY?

1. Minimum information can be placed on the information board and the customer can type the Internet address into his smart device to get more information.

2. The second option is to make a guided tour for the client - where the guide speaks important information in addition to what is included on the information board and also shows the photos of the location.

3. The third option is Augmented Reality. The user can himself choose a route on his map application. When reaching the location, he will automatically get information about the point of interest and if he wants, he can get more background information about the location on the Internet. All of this occurs without reading an information board or typing in an Internet address. In addition, it is possible to choose listening instead of reading, watching a video, or even a hybrid view where the user sees the location developing over time, and so on.

Each of the above options has its advantages and disadvantages. The most flexible one of them is augmented reality - allowing the most information to be transmitted in a flexible way without a large extra cost. Easy updates at low or zero cost are another advantage.

Thus, one of the greatest pros of augmented reality is the ability to provide the AR user with information that already virtually exists. This is done by providing different kinds of information according to the client's wishes – e.g. a customer who simply wants to navigate to a location can do so with the help of a map application that he is accustomed to use.

Generally, from the information board, the customer receives basic information- but from his smart device he can view images and listen to the background history at the same time. Whoever wants can also take a closer look at the materials available on the internet.

Augmented reality does not depend on the time or date - it always works and is not late for work. If content displayed with AR depends on external factors, it can also be managed (see Module 3, continuously changing content) with a few clicks.

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Also, it is not necessary to change the physical information board when the material is changed or new things added - the material is changed on the internet and it is up-to-date for the augmented reality user.

Using a mobile-, animated-, audio-, or in other words multimedia content also gives the user a better experience and allows more information to be provided in a shorter time. All this means that the customer's experience of this environment improves - the customer gets more information and a more entertaining environment.

Read more:
https://en.wikipedia.org/wiki/Multimedia

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Unit 4
How to start using Augmented Reality?

Is the use of Augmented Reality a "must" for everybody? No. There is no such technology that you absolutely must use. The first step in the introduction of any new technology is to evaluate the situation and then decide if this technology would help to solve the problem.

Problems come first: implementing a technology first and then looking for the problems that could be solved by it is likely to be a waste of time and effort.
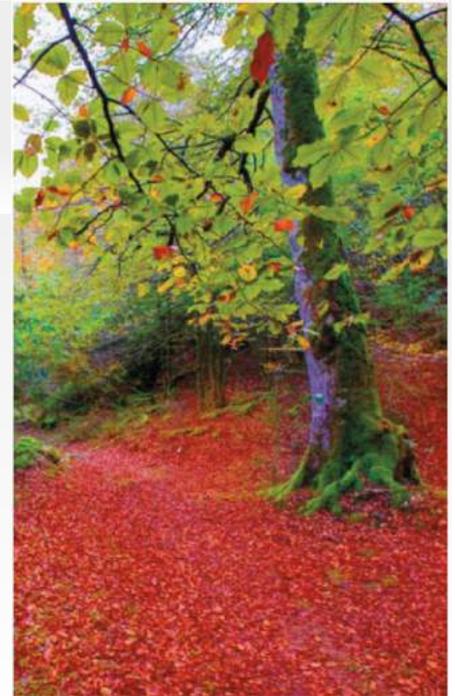
The first steps, in brief, are:

1. Analyse the current situation - can the customer experience be improved or complemented? Do customers want to improve their experience or is the current experience sufficient? Is there any problem, no matter how small, which ruins the customer experience?
2. Choose the experiences that can be improved or that are problematic.
3. Select the appropriate solutions.
4. Solve the problem.
5. Analyse the results and repeat the process.

How does this model look like in case of augmented reality?

1. Set the goals for your augmented reality project.
2. Select the appropriate software and hardware combination.
3. Select the appropriate technology (physical markers like QR, GPS, other).
4. Select, edit, or create relevant content.
5. Evaluate the suitability of the content for the software, hardware, and the overall environment (i.e. test it).
6. If necessary, supplement or modify the content or its form.
7. Analyse the results and, if necessary, make corrections.
8. Set up rules when content is updated or checked.

Unit 5
Integrating AR in your business

This section will describe each one of the eight points above in more detail.

Content

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5.1. SET THE GOALS FOR YOUR AUGMENTED REALITY PROJECT

The first step is to evaluate the problems that are solved with augmented reality. The problems can be different:

- The clients do not bother or are unable to read the information boards.
- It is not possible to place information boards or it is not practical.
- The information you would like to show to the customer cannot be communicated using an information board (audio-visual or other multimedia information).
- Customer experience can be improved
- And many more.

The success of the project depends largely on the correct wording of the goal, so it is important to think about what the goal of the project is. When the goal is set – e.g. to provide location-specific information in a more convenient way (for example, when you reach the location of ancient rites you can listen to stories about the rites that were held there) or to combine entertainment, information, and real-life experience (for example, while waiting for the bread to be brought to the table, the customer can watch a video of how the bread was made). Also be aware that not all customers may wish to receive additional information.

Already at this moment, you should consider the technical solution that you will implement (see point 3 below) and its limitations. For example, a solution such as the Aurea4Rural toolkit allows only two types of markers (QR and GPS), and they cannot be mixed in the same project. For a guide about local points

of interest, you will use GPS technology. For explaining different places and objects within your accommodation, QR technology is adequate.

But in the same project, you can NOT guide the user first to places in your area by GPS, and then once there use QR for detailed elements on that site.

5.2. SELECT THE APPROPRIATE SOFTWARE AND HARDWARE COMBINATION

In order to provide information to the customer, you need to choose the appropriate hardware and software. There are various hardware solutions for displaying information (smart clocks, glasses, phones, screens, etc.).

When choosing hardware, be sure to think about the convenience of the user - for example, in direct sunlight, the screen of some smartphones is very difficult to see. Also, the information displayed depends very much on the capability of hardware and software; therefore, pasting a character onto a screen may not be a smooth user experience. In an area with poor internet connection, it's not wise to show the user a large video, etc. Read more about hardware selection in Module 2.

There are a variety of software choices, and one of which we are currently focusing on in this training material is Aurea4Rural.
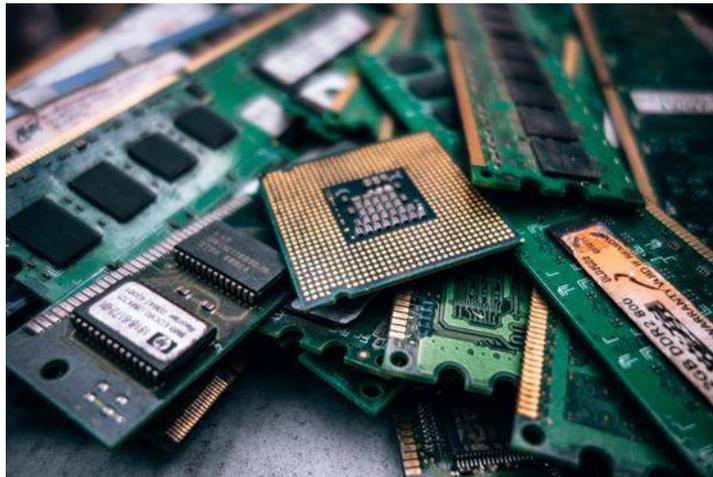
In the case of Aurea4Rural, the access to the Augmented Reality (additional information on an object) can be provided to the customer through a QR Code or by GPS location. Reading the QR code is universal, it works with all smartphones with camera, a QR code reader and an internet connection. However the format of content is not mobile-friendly without the A4R App. Alternatively, it is possible to use GPS coordinates – this requires the Aurea4Rural app to be installed on the user's device.

When the code is read or a location reached, the application will open the "landing page". The landing page is related to specific GPS coordinates or a QR code marker. It is possible to show a picture, a short video or formatted text

with a video or audio playing function as the landing page. The application can also be used to direct the user to the desired internet address or to navigate between different points of interest.

For example, by scanning the QR code next to the "home-baked bread" on the menu, the user can be shown a video on how the bread was made and baked. When the video ends, fresh bread is brought to the table together with salty butter. Real experience has been augmented with information that the user would not have liked to acquire in another form (such as in writing).

5.3. SELECT THE APPROPRIATE TECHNOLOGY (PHYSICAL MARKERS, GPS, OTHER)

Once you have chosen the suitable hardware, you need to choose the marker technology you want to use. This decision is critical for two reasons:

- It defines which specific software shall be used or is most adequate. For AR, there are different applications available for smartphones that use a variety of technologies with different possibilities. For example, we want to use QR codes and GPS markers: to do this, we choose the Aurea4Rural application.

- Depending on the application that you select, the projects that you generate will have additional criteria to observe. For example, the Aurea4Rural app allows to generate projects either based on QR markers OR on GPS markers, but not both at the same time.

How do different technologies work and when to prefer GPS markers to QR markers can be studied in more detail in Modules 2 and 4. In a nutshell, the QR marker is activated when the camera on the user's phone detects a QR code on the image, while the GPS marker is activated when the user gets close enough to the GPS point.

5.4.   SELECT EDIT, OR CREATE RELEVANT CONTENT

More information about content creation is provided in Modules 3 and 5. A brief summary of these modules: first show the basic content quickly in a more general way, and then offer the user a possibility to obtain more information.

When creating content, consider the capability of the hardware (whether the hardware is powerful enough), the technology (what type of markers is used, and how are they defined), and the surrounding environment (what kind of virtual information is suitable for the environment; for instance, when listening to music in a music hall, it is not reasonable for an audio-guide to be talking at the same time).

Also consider the needs for multilingual content - a video with just background music is understandable to everyone, while an audio recording is understandable only to the person speaking the language.

Aurea4Rural, for example, offers several different solutions for bringing virtual content to the real environment. You can only transmit a short clip, a single image, or provide more information - for example, a YouTube clip or an audio recording. It is also possible to design a text and combine it with images, videos, etc. and finally give the user an opportunity to get a deeper insight from a website, for example.

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5.5. EVALUATE THE SUITABILITY OF THE CONTENT FOR THE SOFTWARE, HARDWARE, AND THE OVERALL ENVIRONMENT (I.E., TEST IT)

Once you have produced the content, it is wise to always test it first - whether it works and whether the user experience can be further improved. For example, a QR code that displays the image of a location in the old days: is the picture visible on the smart device? Should the edges of the picture be cropped? Is the size of the image small enough so that it will actually open completely without need of scrolling? Is the GPS coordinate point activated in time or does it happen too early or too late due to a GPS error?

Aurea4Rural enables the generated QR codes and their operation to be instantly checked so that improvements and changes could be made, if necessary: open the App on your mobile, select the project you are working on, and after each modification in the content webtool, scan the QR code again. The new content comes up almost immediately on your mobile device.

For GPS content, it works similarly: temporarily place the GPS point in the content webtool at your own location, and you will see how the device displays information at that point.

It is absolutely critical to check out the operation of all the points in real conditions - there may be a factor in the given environment that prevents a user from accessing the information for this point. The influencing factors can be, for example, bright sunlight (not seeing the screen of the phone - the solution would be to move the point to a more shaded place), or the audio recording currently playing might not be heard on the beach because of the wind.

5.6. IF NECESSARY, SUPPLEMENT, MODIFY THE CONTENT OR ITS FORM

If you have found a mistake in the previous aspect, fix it. Sometimes it is necessary to change the used solution - for example, change the distance where GPS content is triggered, or to add a duplication for customers coming from another direction.

5.7. ANALYSE THE RESULTS AND, IF NECESSARY, MAKE CORRECTIONS

If you are sure that it works, let your customers test it - feel free to say you are trying out a new solution to complement customer experience. Curious customers will test the points you have set and will be happy to give you feedback. And, in addition, your customers will get extra action and experience.

Be sure to take customer feedback into account and make any necessary changes.

5.8. SET UP RULES WHEN CONTENT IS UPDATED OR CHECKED

It is important for the content to be up-to-date. Depending on what the content is, it needs to be updated or modified from time to time.

For example, if you no longer offer home-made bread at the accommodation, it would be wise to remove any references to fresh bread.

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Unit 6
Integrating AR in your business using the Aurea4Rural application
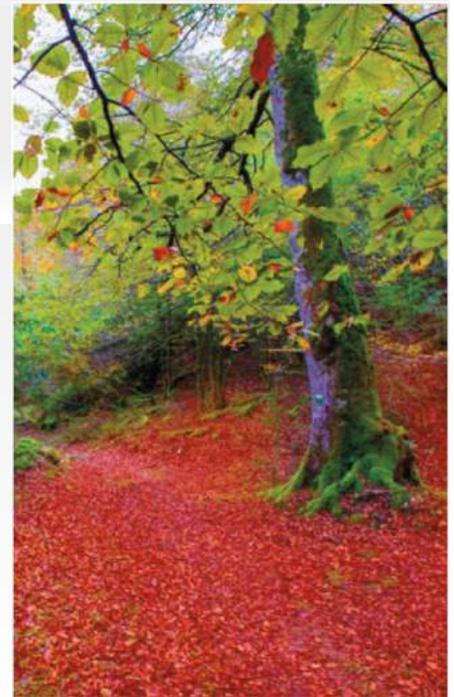
The 8-point process described above, using the Aurea4Rural application, would look like this:

1. Define a project you want to show in the Aurea4Rural environment - for example, surrounding attractions.

2. Think through the hardware needs. Do your customers use smartphones? Maybe they would like to borrow a smartphone from you to use? If they don't want to or can't use a smartphone - can they get the information in some other way? How?

3. Select the appropriate technology - use QR or GPS markers. The QR markers must be scanned using the phone, GPS markers are activated when entering the area. Keep in mind that for each project, both options are alternative: you can use either QR or GPS markers, but no both of them combined in the same project.

4. Select, edit, or create relevant content. If you already have the content, you can give the user the initial information through the markers, but you can always direct the user to visit your website or to order the products sold.

   The purpose of Aurea4Rural is not simply to provide a link to your website to make a sale, but to give the user primary information about the object and the possibility to get more information.

   When a QR only redirects to your website, the Aurea4Rural application is not necessary - QR codes opening directly a webpage can be created without the Aurea4Rural stopover page.

   However, this means that the information on your website must work correctly on all mobile phones, and the website must have at least two different designs - for the computer user and for the smartphone user.

   Be sure to also consider different languages when creating content. Content should be easy to translate into different languages or unambiguous (e.g. emoticons, image, video, music without words, etc.).

5. Evaluate the suitability of the content for the software, hardware, and the overall environment (i.e. test it). Once the content is created and ready, visit all the points yourself - check if everything works. See what could be done better.

6. If necessary, supplement, modify the content, or its form. When you find problems, you have to solve them. Sometimes you have to go back to the very beginning and think about what you want to offer to the user. This is why we commented in the very beginning to think thoroughly which technology (QR or GPS) you will use: once a project is created for QR markers, it cannot be changed to GPS (and vice versa).

   If you really find out that GPS is better than QR (or vice versa), the whole project needs to be created again from scratch. Of course, prepared content can be re-used, but each marker must be created again and content loaded into it one by one.

7. Analyse the results and, if necessary, make corrections. Use the system, see what the customer's feedback is, monitor what is being used and which points are not visited. If necessary, modify the system or introduce corrections.

8. Set up rules when content is updated or checked. In order for the content not to age or expire and that it would always be up-to-date, decide when and who will update and check it.

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Unit 7
Frequently asked questions and statements

- **Many augmented reality applications are for a fee or have hidden charges. Are there any applications that are free?**

Yes there are. The Aurea4Rural application used as the example in the training material is free and does not include any hidden charges.

- **Augmented Reality forces me to duplicate information and will not increase the sales of my product.**

The idea of augmented reality is to give the user a brief and quick additional information that he previously did not have. So yes, some of the information is duplicated and there is no way around it. But the user can always be left with the option to access your website or to use AR to raise interest and desire in the person to order the product from your website.

- **The use of augmented reality chains a person to a smartphone for a longer period of time, and the user does not experience any real experiences at that time.**

In this case, it is a virtual reality, not an augmented reality. In a nutshell - AR brings virtual information to the user to complement the real experience, while virtual reality replaces the current reality entirely with virtual information.

Augmented reality complements the experience - for example, guidance on how to pass an obstacle course (what to do and how) is transmitted in the format of a short video. If the user is forced to watch the video longer than is necessary for reading and understanding the instructions, it is rather virtual reality - the user is removed from the real environment. But, for example, a short video of what a castle in ruins could have looked like during its days of glory adds virtual information to the reality of the user. Thanks to the information received, the user can pay attention to things that otherwise seemed to be of little importance (for example, the location of the castle walls).

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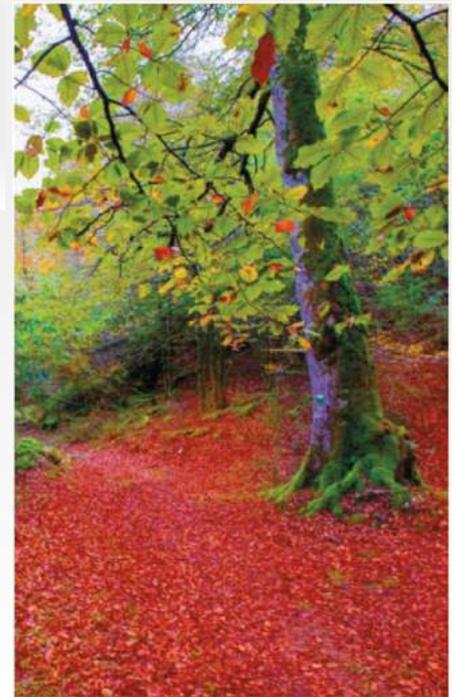
- **What are markers, GPS coordinates, and how to choose the best technology?**

See the previous modules (Module 2 - hardware; Module 3 - software; Module 4 - use of markers).

- **Can I combine QR and GPS in the same project with the Aurea4Rural toolset?**

No, this is not possible. Projects prepared with the Aurea4Rural tool must use either QR- or GPS markers.

- **What is the initial investment for introducing augmented reality?**

If the information you want to communicate to the customer already exists, the initial investment is only the time required to set up the markers and the cost of informing the customers. If information is not yet available or has not been collected, then the cost of producing content is added to that of the initial investment.

- **I do not see that augmented reality would benefit my clients, why should I start to use it?**

If a technology does not benefit your customers, it is not reasonable to use this technology. First, there should be a problem that needs to be solved, and then a solution, not vice versa (there is a solution and now let's start looking for a problem to be solved with the help of the technology).

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Module 7

A step-by-step guide: how to use the Web Platform and the App for smartphones

AUREA
4RURAL
augmented reality
for rural tourism

AUREA4RURAL
augmented reality for rural tourism

MODULE 7:
HOW TO USE THE WEB PLATFORM AND THE APP FOR SMARTPHONES

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AUTHORS:

Module Introduction

The main objective of this module is to teach the future user how to work with the tool we are developing, the intention is to make detailed content or "Guideline" along with video tutorials.

This part will be divided into three main points, in the first we will talk about the CMS WEB, in the second of the APP and in the third about some limitations of the current version of the A4R App.

1. CMS WEB (Content Management System).
   - Guided explanation with screenshots on how to register on the web.
   - Manual on how to create a project with QR markers.
   - Manual on how to create a project with GPS.
2. AUGMENTED REALITY TOOL.
   - Manual on the use and functionalities of the augmented reality application. Interface, menus, how to search for the project.
3. LIMITATIONS OF THE CURRENT VERSION OF THE AUREA4RURAL APP.

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Unit 1
CMS WEB (Content Management System).
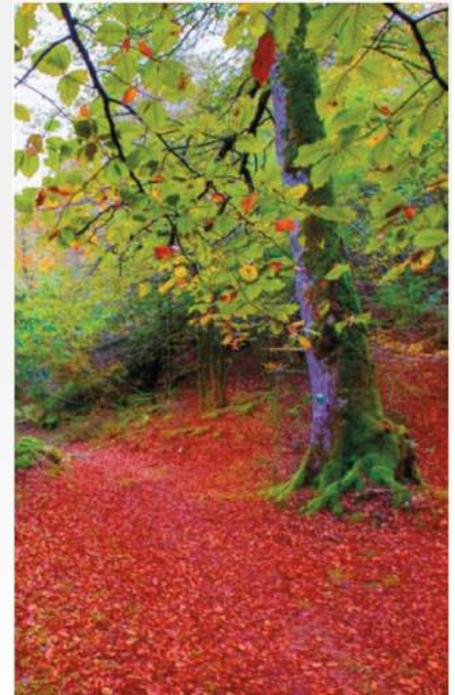
Contents

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1.1. ACCESS, REGISTRATION AND AUTHENTICATION.

Users can access to Aurea4Rural platform via website (https://aurea4rural.building-lifecycle-management.de/aurea4rural/login.php?lang=en).

Requirements for successful access and training course performance:
- Computer;
- Internet connection;
- Web browser (for example Google Chrome or Firefox)
- Email account.

1.1.1. ACCESS.

The user has the possibility to use the website in different languages: English, German, Spanish, Italian and Estonian. The user finds this tool at the bottom of the access page. The website will change language by clicking on the name of the desired language. These changes will be applied to both UI (User Interface) and the contents.
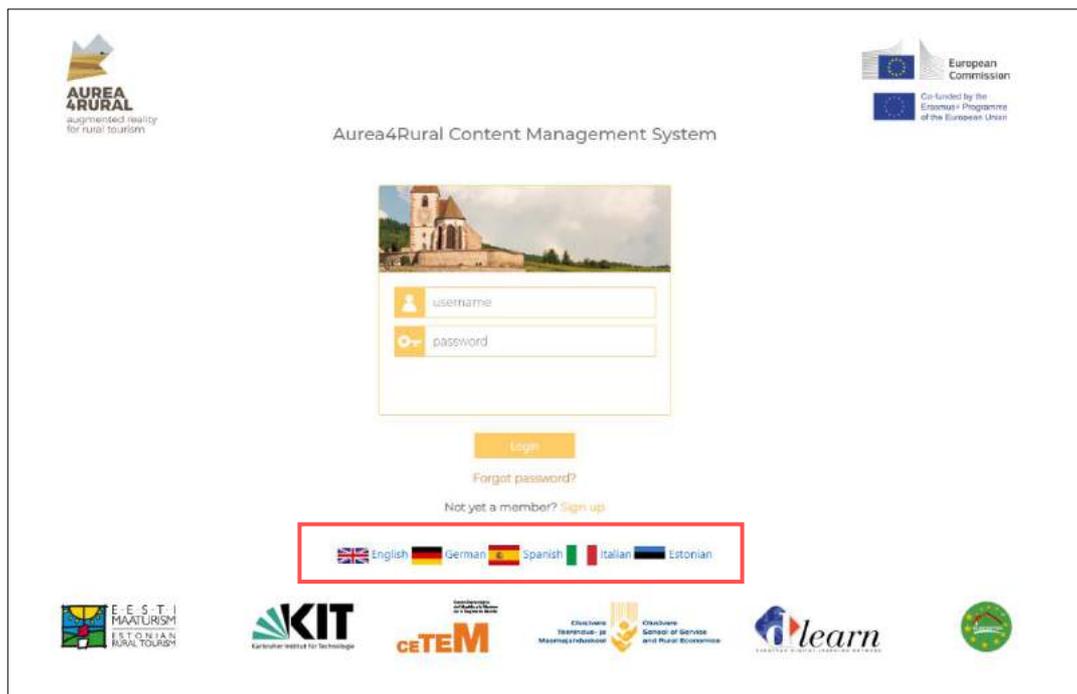
1.1.2 REGISTRATION.

Users should register in the platform when they access to it, by clicking on the "Sign up" button, in the main page. This takes you to a new web page.
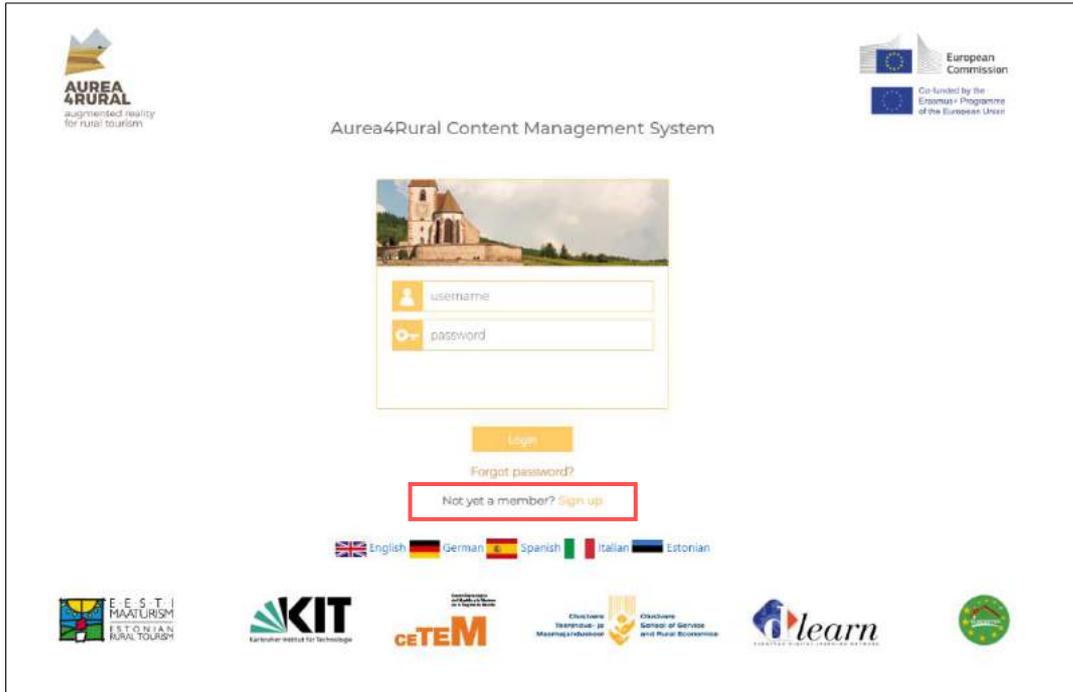
To register on the platform, the following information is required:
- Username;
- E-mail;
- Password;
- Confirm Password;

The user can also add business Information and other information. They are optional. As the example below.

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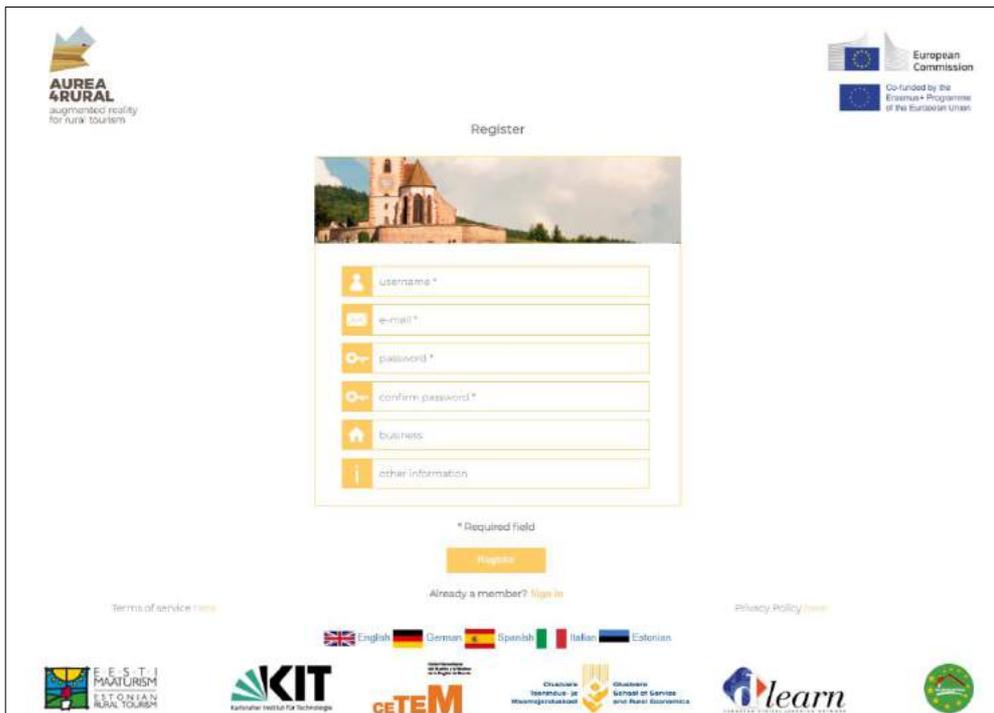
After the registration is done, the user will receive an e-mail to confirm the login. By confirming the link, which is sent via e-mail to the user, a user can access the platform and then account is activated.

1.1.2.1   REGISTRATION.

When the user forgot which password uses for the login, it is possible to reset the password by clicking on the button "Forgot password?".
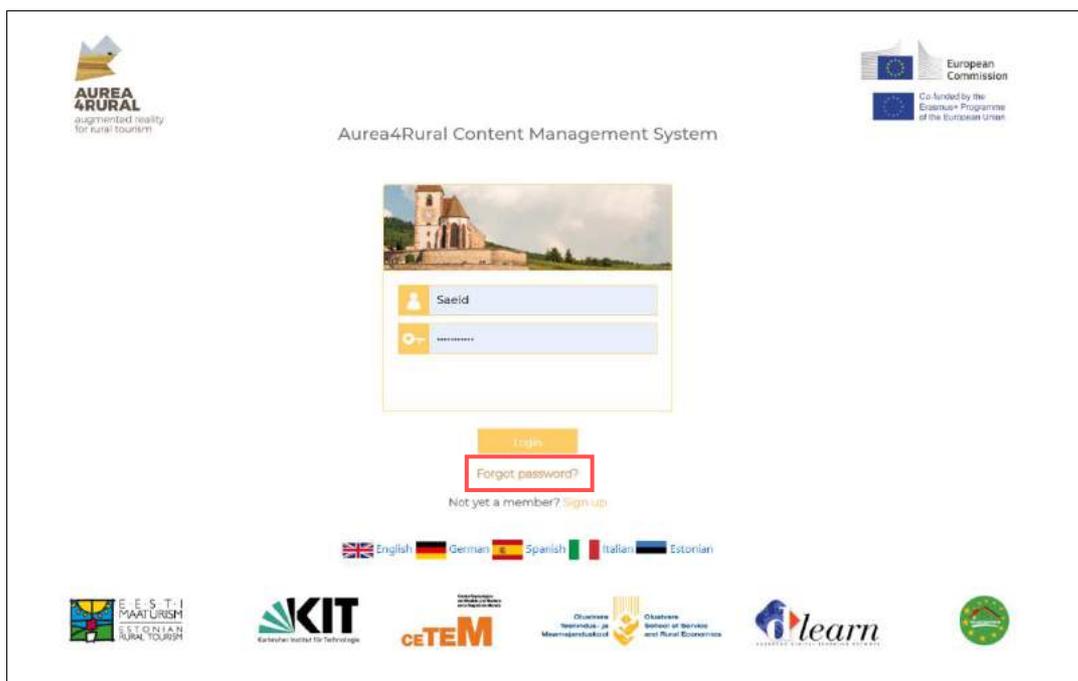
A new page will appear, where the user should enter the username's (e-mail) to receive an e-mail with a link to create a new password and after confirming the reset password link and giving the new password, the user can access again to the platform with the new password.
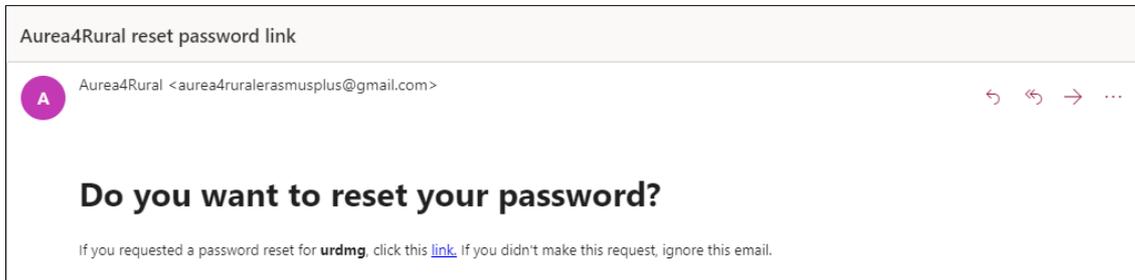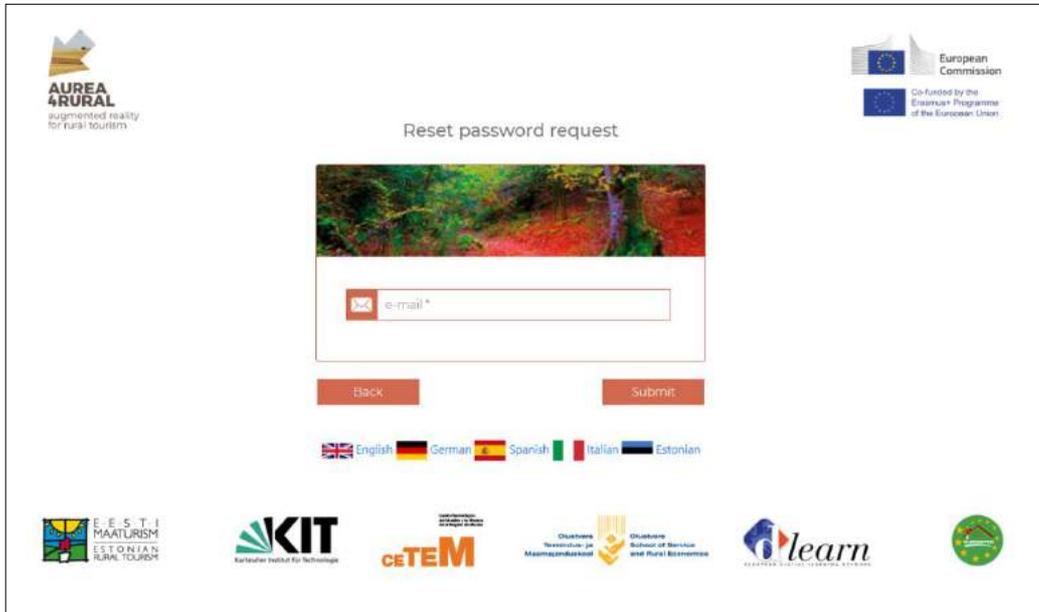
1.2.   ORGANIZATION OF THE PLATFORM AND NEW PROJECTS.

Once the registration is done, the user will be able to access the online platform and start to use the platform.

When the user enters in the platform, a set of options are available to manage the projects. The layout is easy, intuitive and user friendly.

The options are all under table of the project list. The user can choose between "Add", "Delete", "User Properties" and "Logout".
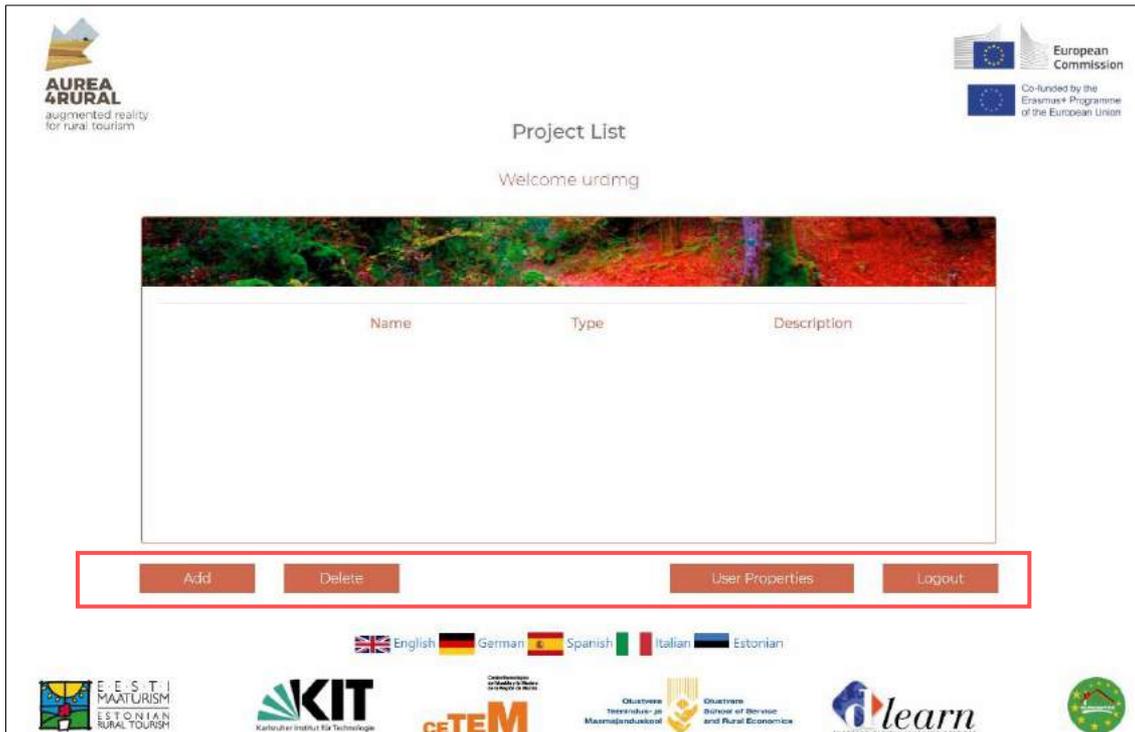
1.2.1. ADD NEW PROJECTS.

To add a new project the user should click on the button "add", then a message will appear, informing the language in which the project will be created, which is the language that is in use in the page.
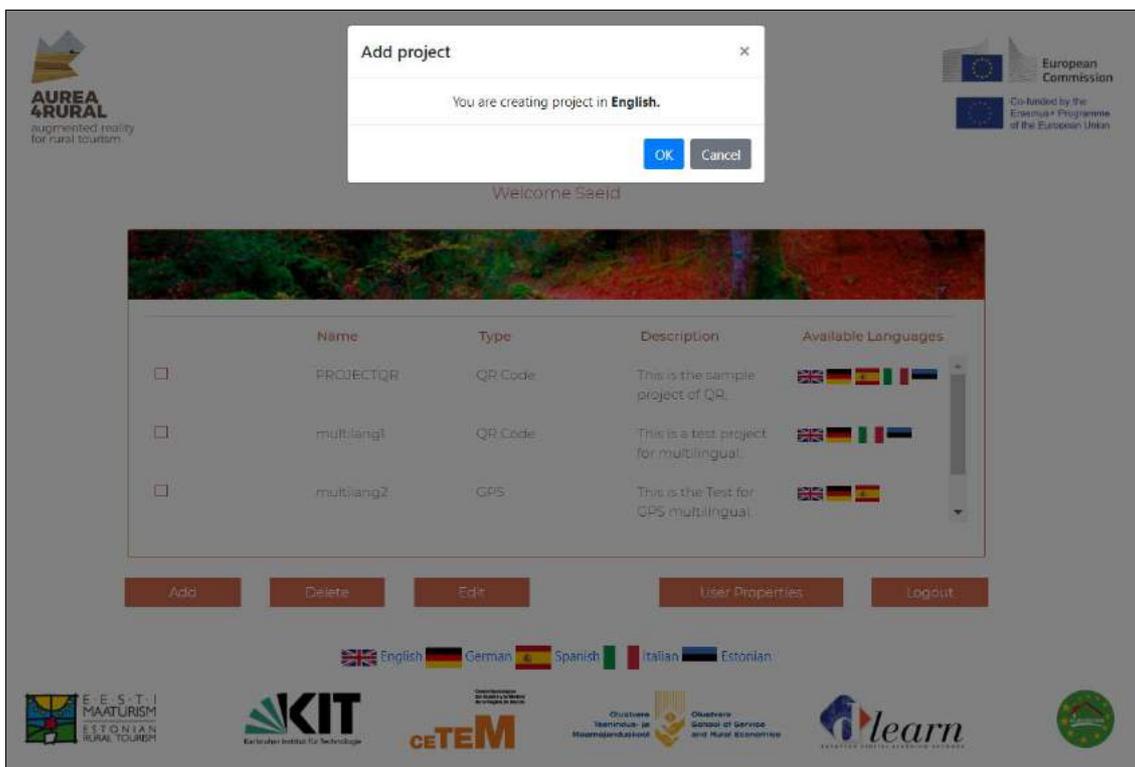
In case the user wants to use another language, First the "cancel" button should be clicked, then the language of the platform by clicking on the name of the available desired language at the bottom of the page can be changed.

By Clicking on OK, a new page will be opened. At this page the user finds the form to add a new project. To create it the user should:

1. Choose a name (the name cannot contain blank spaces between the words);

If the name is available will appear on the right "is available" and user can use this name to create a project and if it shows "is already in use" then the name should be changed.

2. Next step is to choose which project's type the user wants to add between QR Code marker and GPS marker;

If it is a GPS Project, then click on GPS box.

3. Then the user can upload an image (*.png/*.jpg format) with maximum file size of 2 Mb which will be the logo of the project by clicking on the button "choose file";

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4. The last step is to write a description about the project on the last board with maximal 150 characters and Save the project.

In this page project name and project type is required information and they must be filled out.

After saving the project it opens automatically a new page to edit the content of the project. At first, as the Project has no content (QR Code/GPS), the board will be empty.

As the main page, the control buttons are below the board. The user uses then to add or delete content or to edit or print an already existing one.

The user should click on "add" to open a new page, where the information about a new content can be filled.
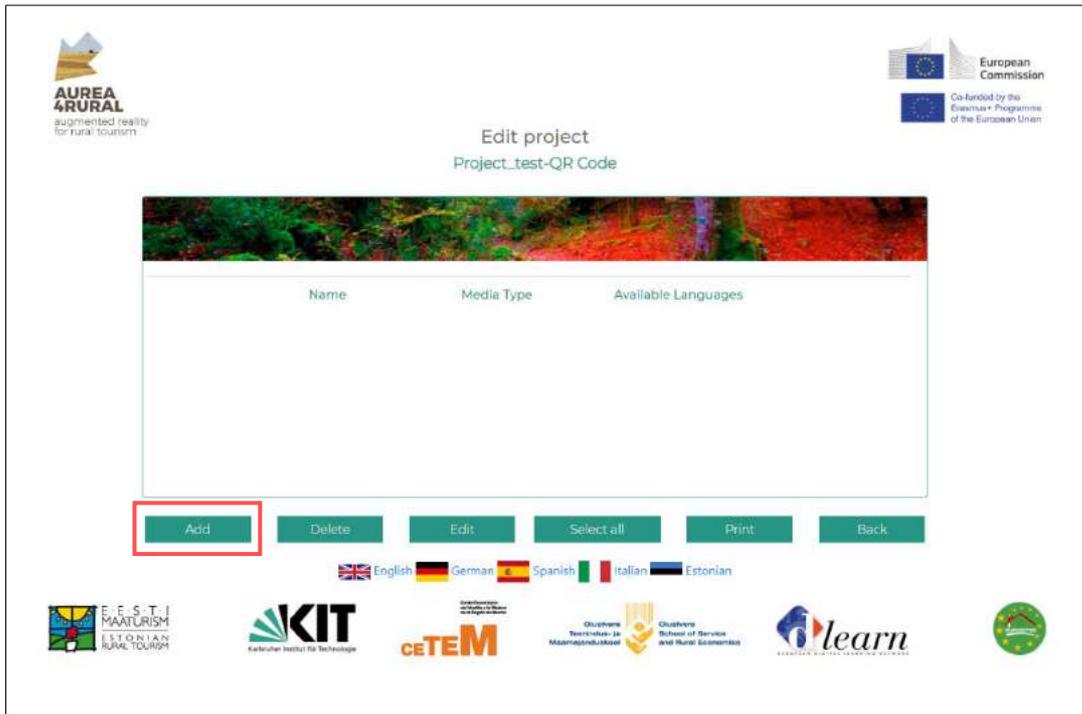
As with the creation of a project – in this case QR Code Project – when the user clicks on ADD to add a new QR Code, a message appears informing the language that the marker is being created. If the user wants another language, the "Cancel" button should be clicked and the language at the bottom of the page should be chosen.
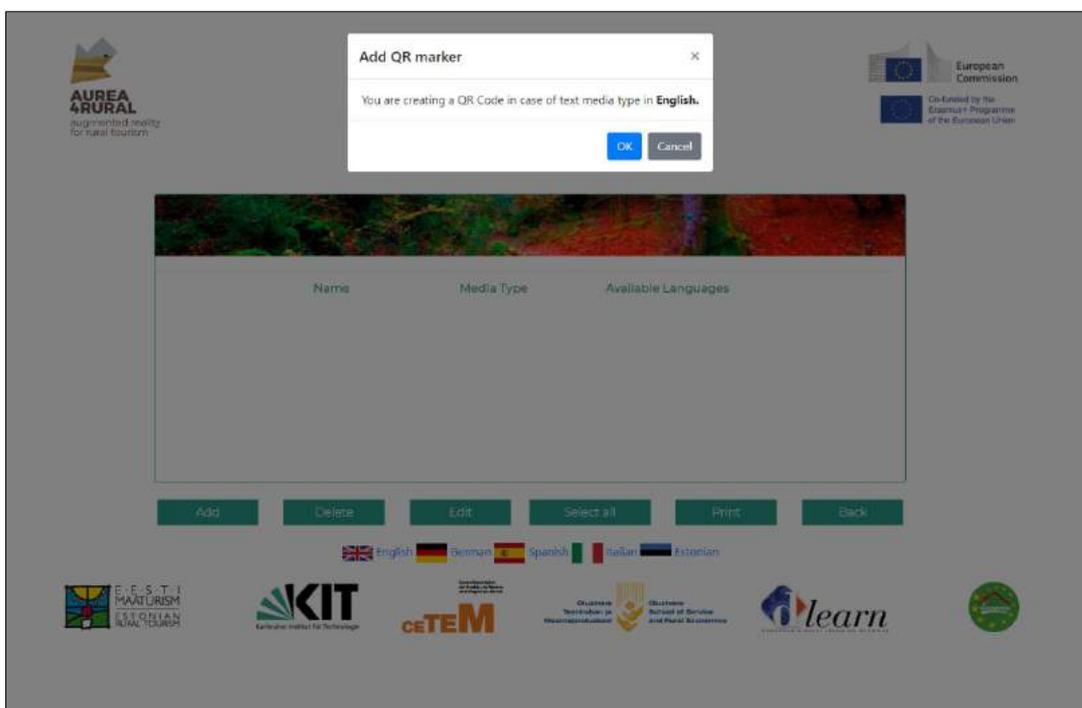
1.2.1.1   ADD A QR MARKER.

To add a new QR marker the user should enter inside a QR Code Project.

The color of the fields for QR Code marker are in light green. The process to fill the fields are almost the same to the process to create a new project.

To add a new QR Code the user should:

1. Enter the name. If the name is already in use, it will appear a message "is already in use" which means the name is not available and another name has to be chosen.

Add QR marker

2. After inputting an available name, the size of the code must be selected. It can be small, medium or large. The preview of QR Code will appear on the right side.
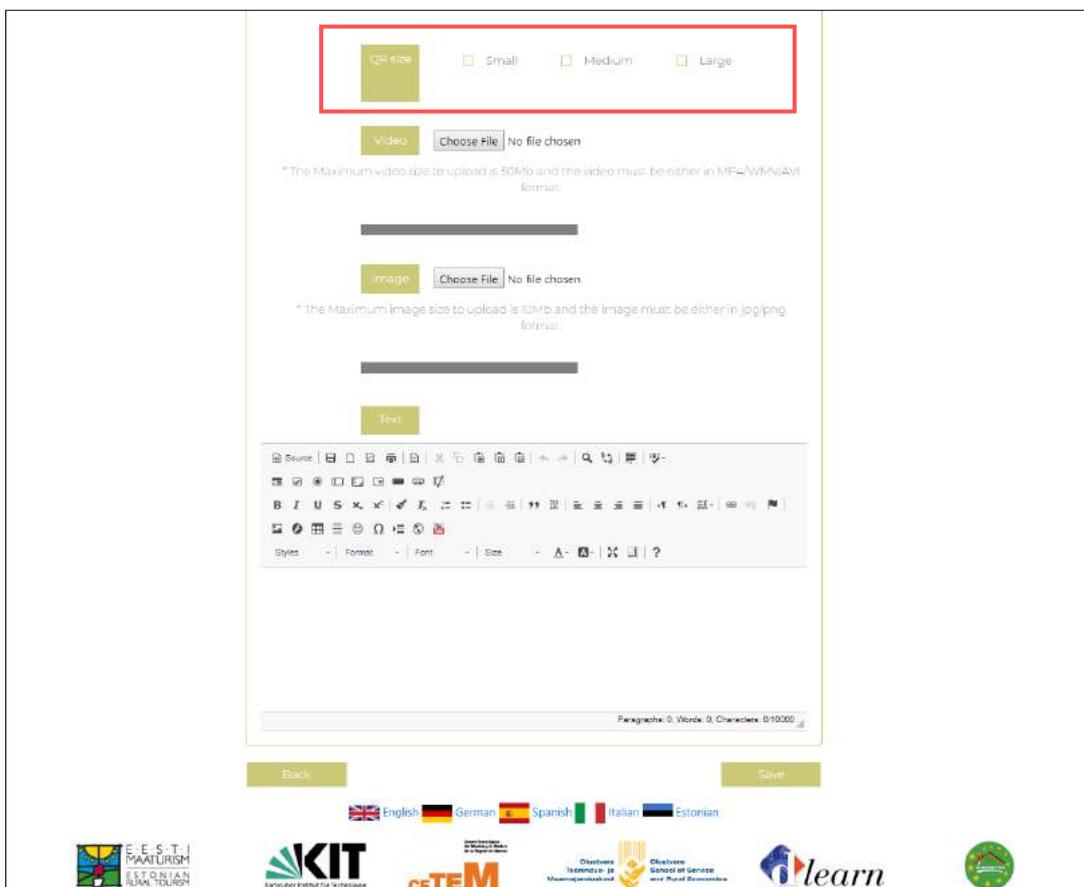
Here is an example of QR Code with Medium size:

3. Then the content of the QR Code should be chosen. There are 3 possibilities: the QR code can have an image or a video or a text. When the User chooses one of the options, it will not be possible to choose another one. If the user makes a mistake and chooses the wrong option until the video or image is not uploaded, user can go back and select other media type by closing the file dialog otherwise the process should be began again by pressing back and navigating to the previous page and clicking again on "add" button to open the page to add a QR Code, or refresh the page, so the fields will be empty again and ready to be filled.
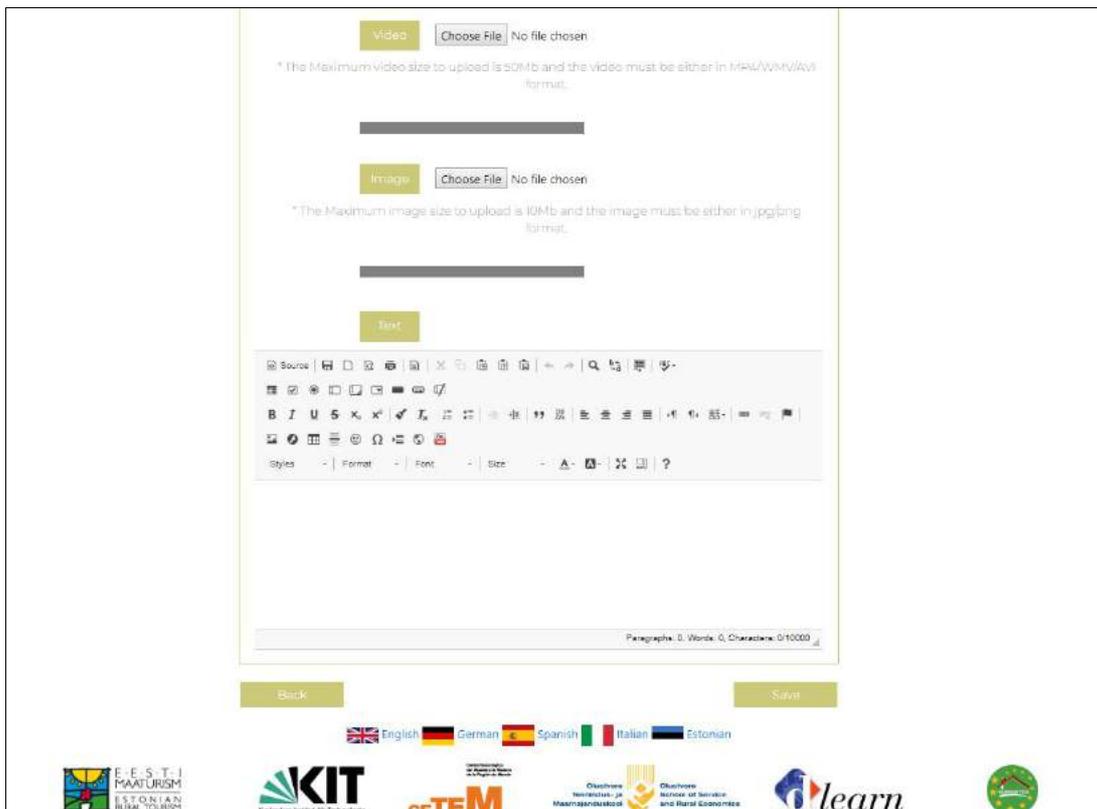
3.1. In this example a medium size of QR Code is chosen and the content type is an image which is successfully uploaded. Please note, that after choosing one of the kinds of content and upload it or start typing, the

others turn automatically gray and blocked, showing which isn't possible to change the kind of content.

*If the option "Text" is chosen, it is recommended to use format "Heading 1" with Font Size of 48 and for standard text size to be able to read in the app, it is recommended to use Font size of 36 and for small text size 28 can be a good choice.
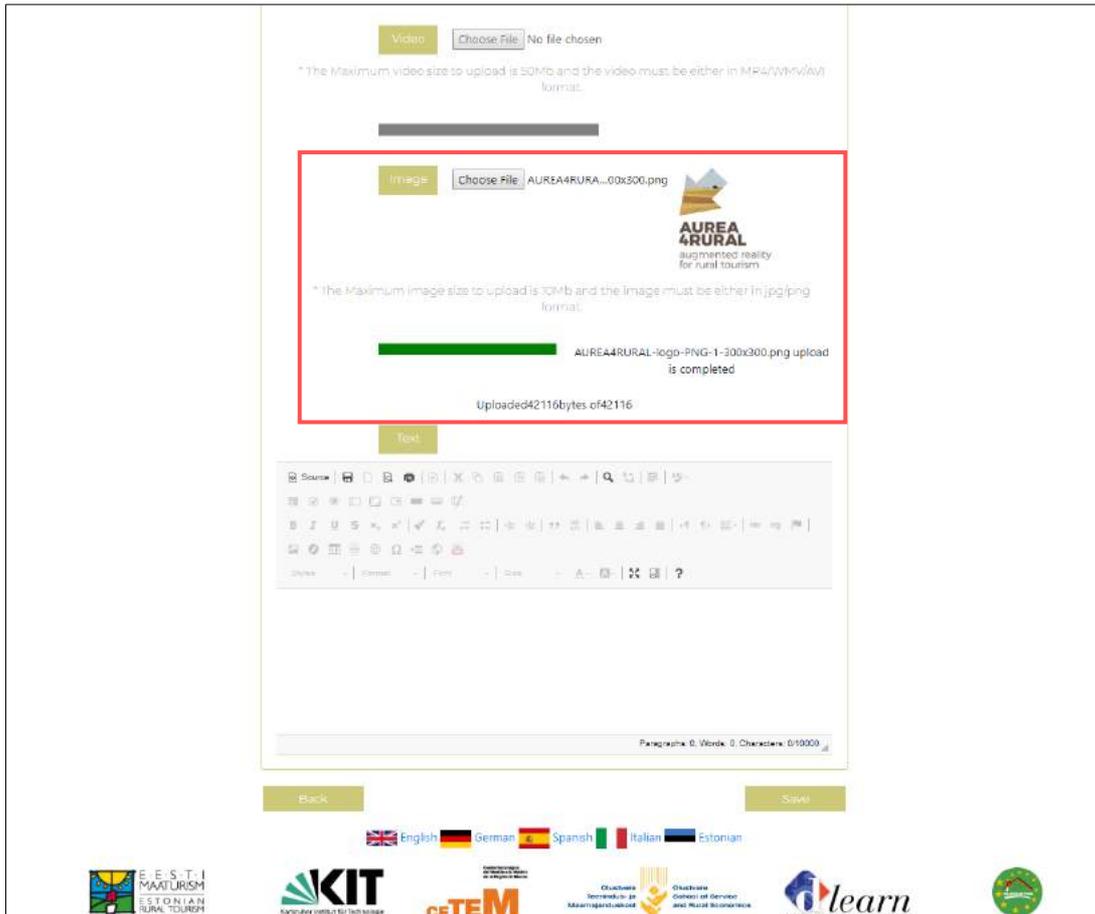
1.2.1.2   ADD A GPS MARKER.

To add a new GPS marker the user should enter inside a GPS Project.

The procedure of adding a Project of GPS marker is the same as written before, to add a QR Code project:

1. Choose a name;
2. Select the type, that in this case is GPS instead of QR Code;
3. Choose an image as a logo for the project;
4. Write a description about the project;
5. Click on the button "Save".

A new page opens automatically to insert new content to the GPS project. To add new GPS marker, the user should click on "add". Once again, a message will pop up stating the language the marker is being created.

The pages for GPS marker have the fields in blue color.

To properly add a new GPS marker the user must enter a name for the marker and check if the name is available. Next step is to choose a location. By default, the location is setted to the user's location. If the user wants to create a GPS marker in other location, there are two possibilities as following:

a) Drag and dropping a marker on a different location on the map;
b) writing the latitude and longitude on the field under the map.
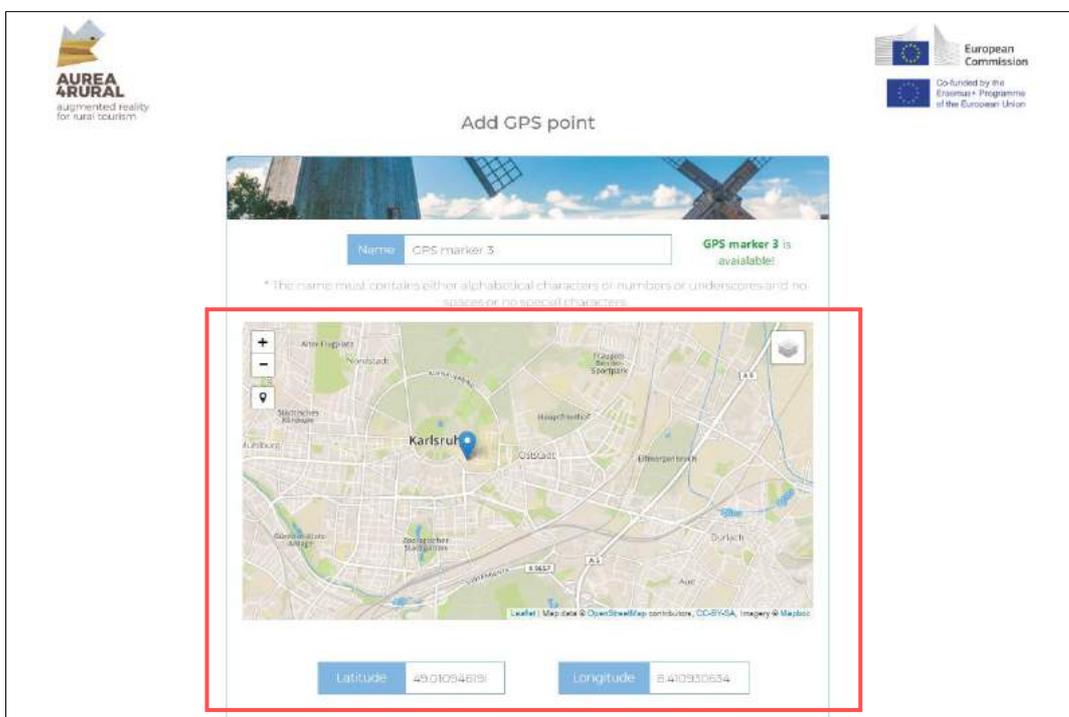
The user can also see the map with satellite view, a tool placed on upper right corner, which changes the view of the map between the real image (satellite view) and the street view. Another tool placed on upper left corner are the buttons "zoom in", "zoom out" and "set my location", used respectively to change the zoom of the map and to point the place on the map. This tool can show the real place of the user – if Location is allowed on the device -or a chosen location, when the user click on the place marker.
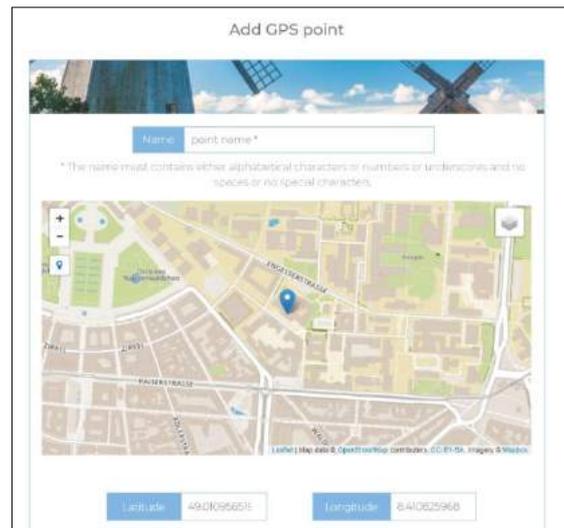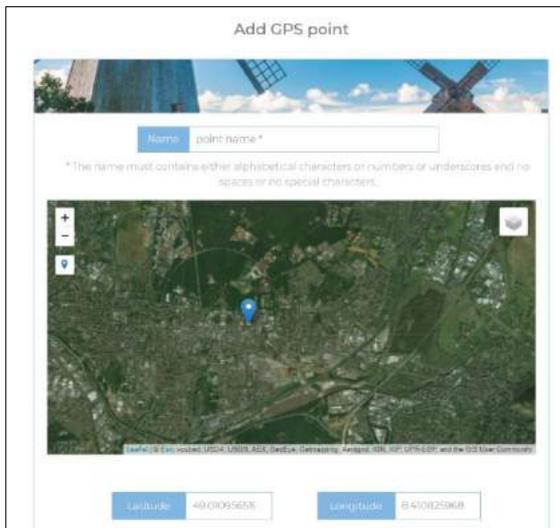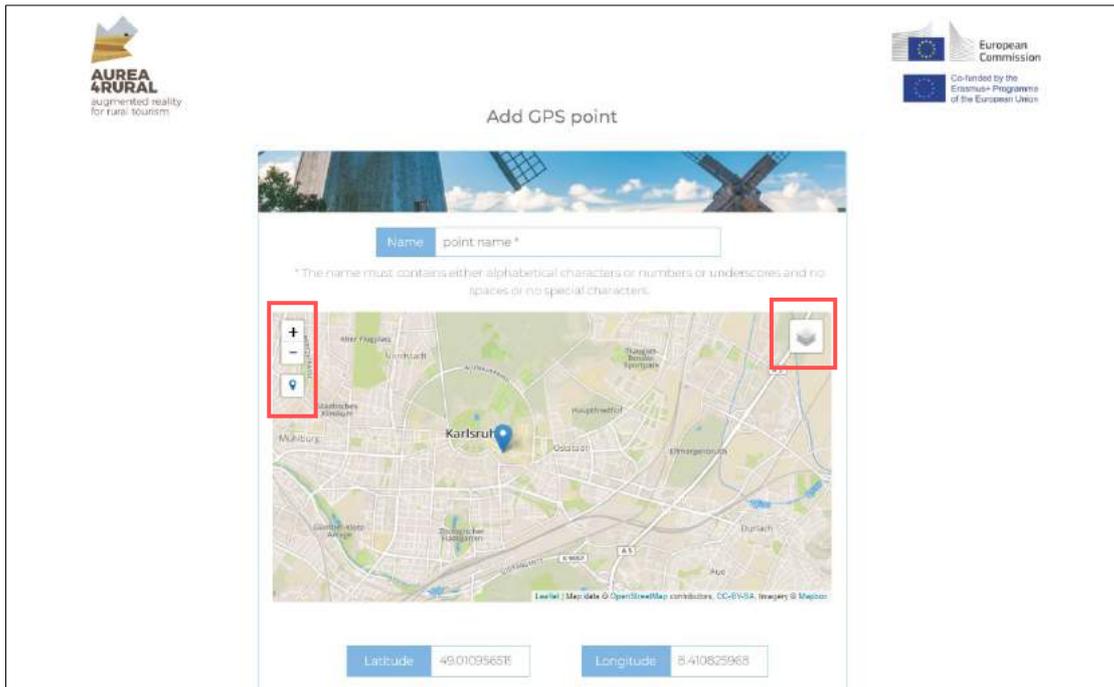
The next step is to choose the content of the marker. First, the user should specify the distance where the content of a marker will be able to show in the app tool the minimum distance is 10 meters and the maximum is 500 and by default it is 10 meters , then the content type between video, image or text, as explained by QR Code marker should be selected. Finally, by clicking on the button "Save" a GPS marker will be created.

*If the option "Text" is chosen, it is recommended to use format "Heading 1" with Font Size of 48 and for standard text size to be able to read in the app, it is recommended to use Font size of 36 and for small text size 28 .

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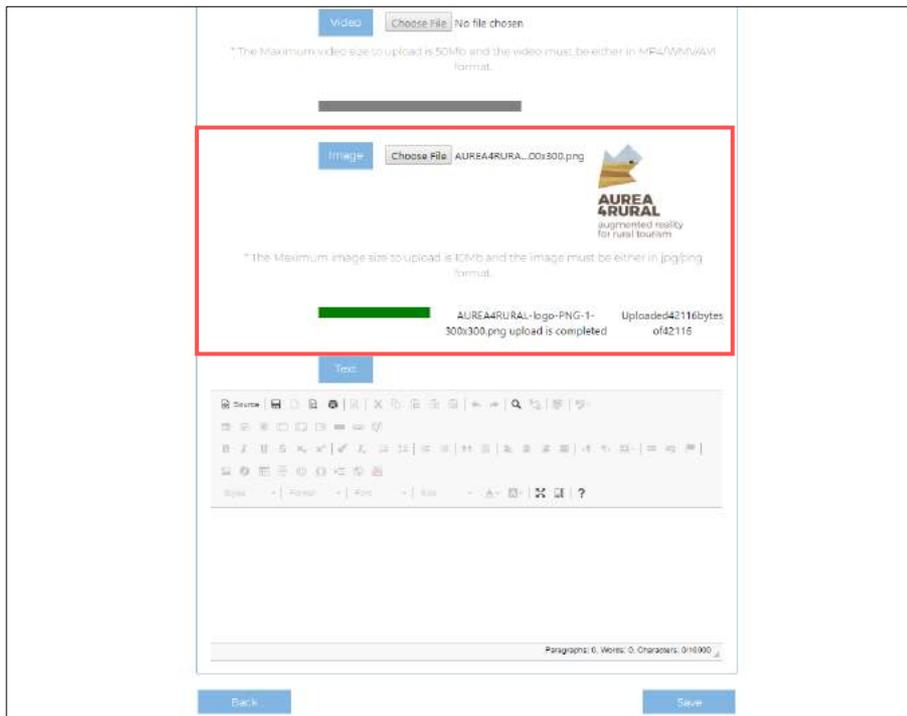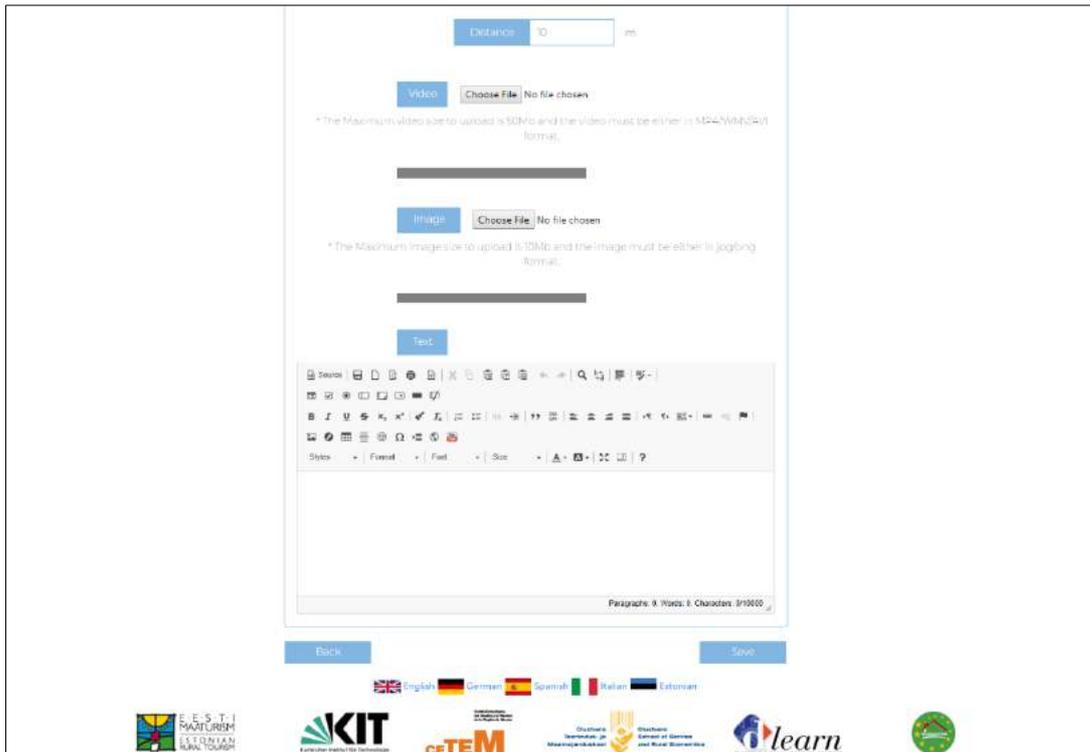
In the same way as in the QR Code project example, after choosing one of the kinds of content (in this example Image is used), the others turn automatically gray, showing that isn't possible to change the kind of content. User should be noticed that there is a limitation in the format and size of the image and video content for uploading. The maximum image size to upload must be 10 Mb and the format must be either in jpg/png format. The maximum video size to

upload must be 50Mb and format of the video file must be either in MP4/WMV/AVI type.

1.3. LIST OF PROJECTS AND QR CODE/GPS MARKER INSIDE A PROJECT.

1.3.1. ADD NEW PROJECTS.

After the creation of the projects and the addition of the markers, the projects will be displayed on the project list with their information (name, type, description and the available languages) on the main page.
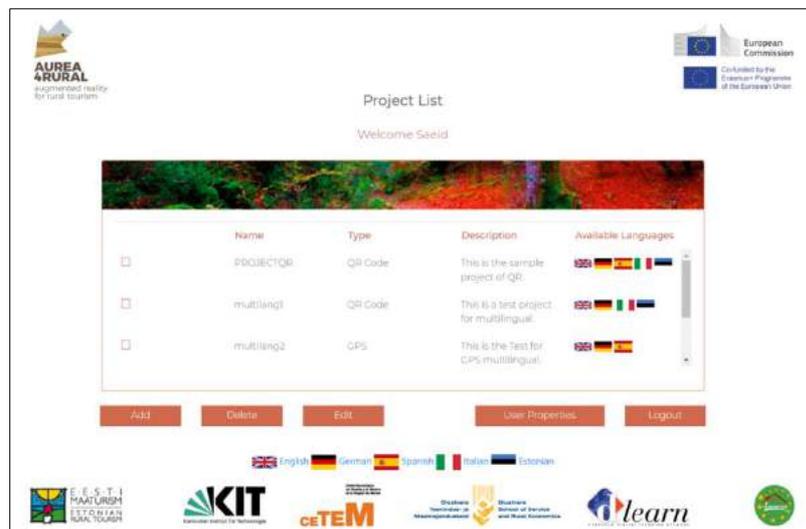
1.3.1.1. Edit a Project

In order to see the contents of a project the user should click either on the information – name or type or description – of the project, so a new page will open with the content. However, for editing a project the user should select the target project by clicking the checkbox on the left side and pressing the "Edit" button. The user can not edit multiple projects simultaneously.

After pressing "Edit" button, a new page with a message will appear, to ask what the user wants to do between edit the project or add/edit the languages.
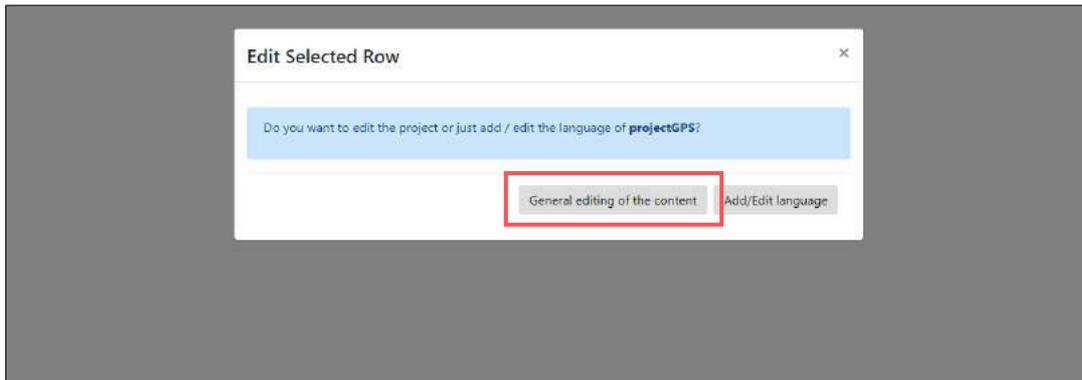
When the user clicks on the button of "General editing of the content", then the name and image/logo of selected project can be edited.
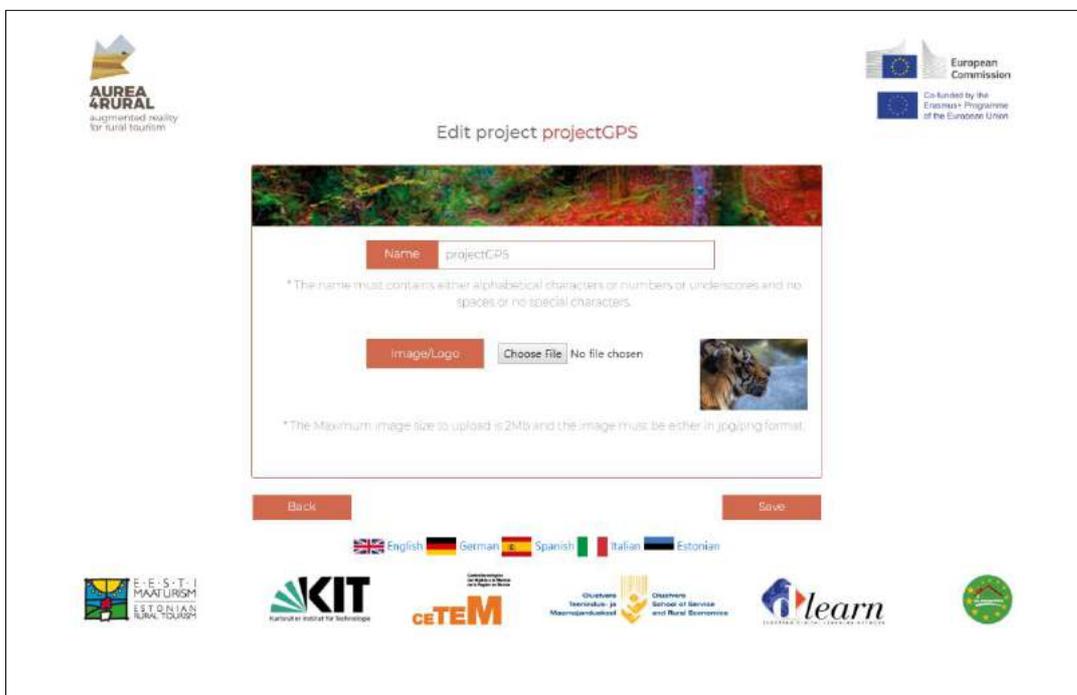
1.3.1.2. AVAILABLE LANGUAGES.

Each project can be available in up to 5 languages including English, German, Spanish, Italian and Estonian. The first available language is the language in which it was originally selected by the user to use the platform, but other languages can be added if the user selects the project and edit it.

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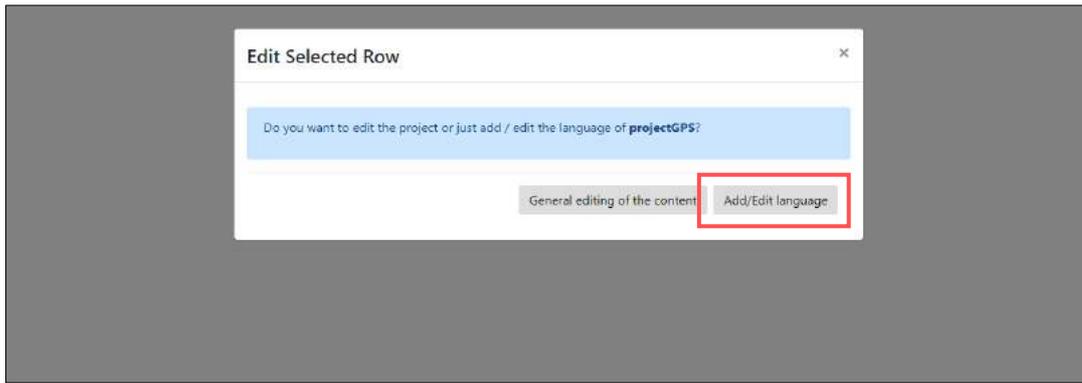
If the user wants to edit/add a language, the screen below will appear.
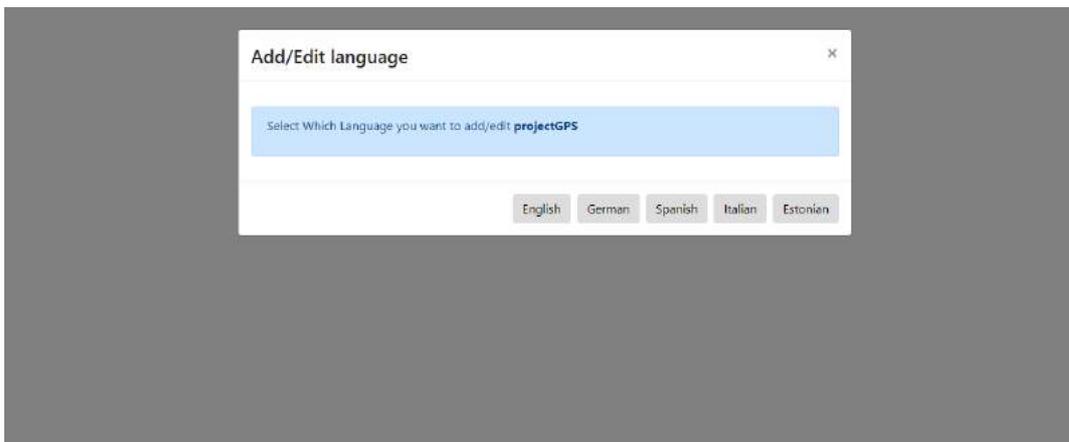
After choosing the language a new page will be opened, where the user can add the description of the project on the selected language and by pressing the "Save" button a selected language for editing or adding will be inserted to the "Available Languages" column of projects list. *German is used in the example below.

1.3.1.3.   DELETING A PROJECT.

To delete a project, the user should click on the checkbox on the left side of the name and then the button "Delete" under the board with all the projects. A message will appear to confirm if the user wants to delete the project.
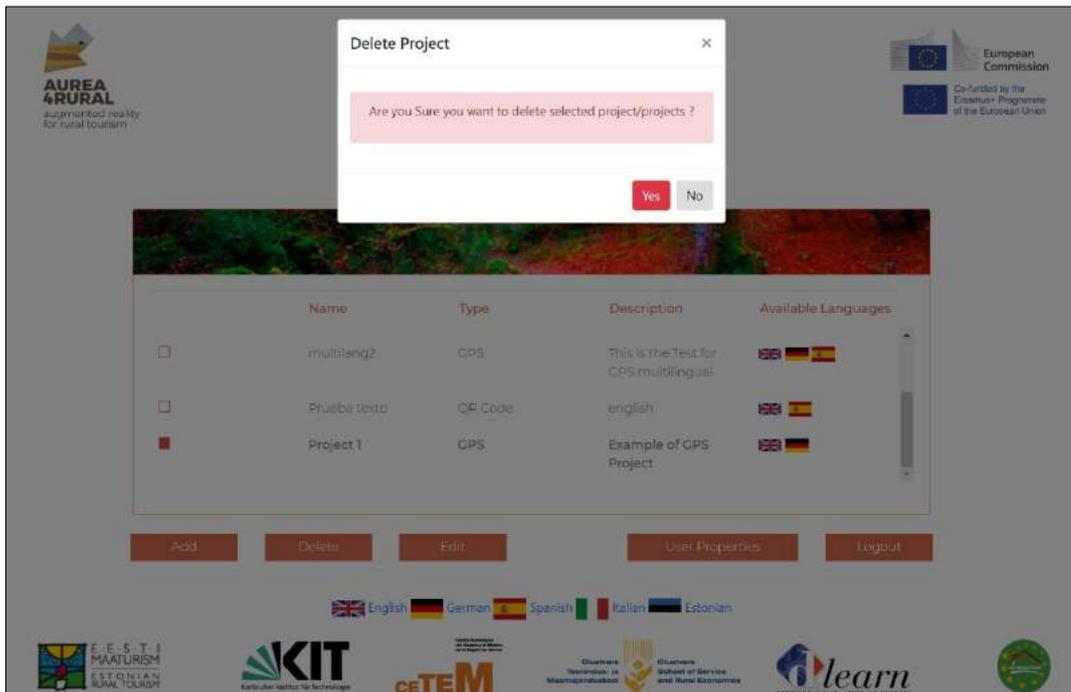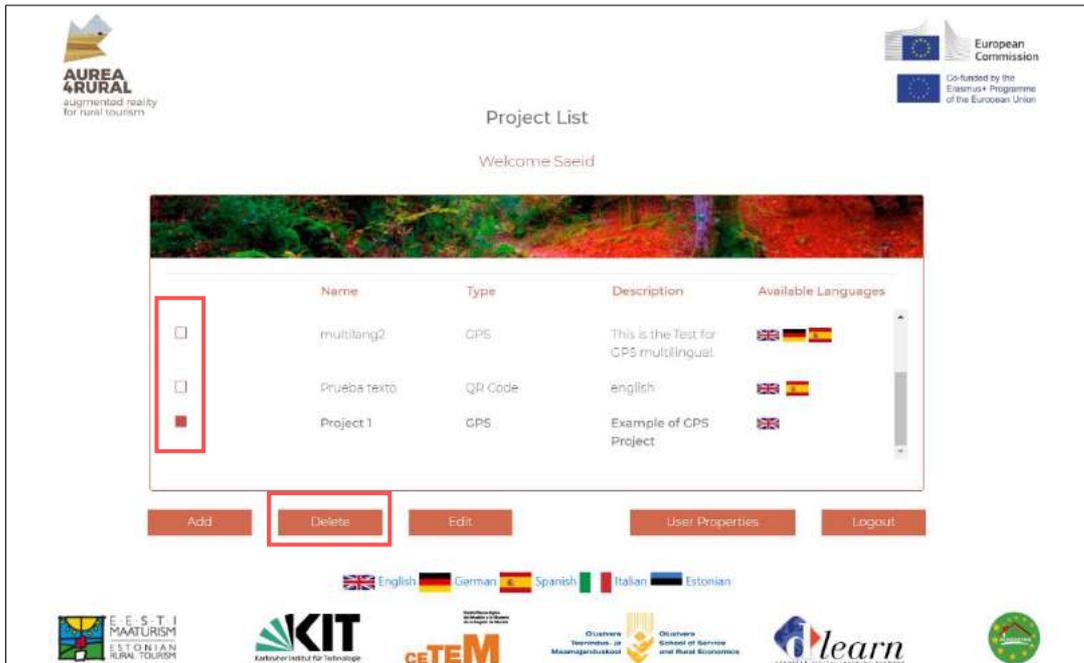
1.3.2. LIST OF CONTENT INSIDE A PROJECT.

As it is already explained, to open the list of content inside a project, the user should click either on the name or type or description of the project, then a new page will appear with the list of the markers containing type of content which belong to the project. To select a marker the user can click on checkbox next to the name. They can also be selected at the same time by clicking on "select all", instead of clicking on each marker to print them in a pdf format.

Each project/marker can be printed or deleted by individual selection or more selection at the same time, using the tool "Select All". Editing can be done only for one marker each time; therefore, the user should select only one item to edit.
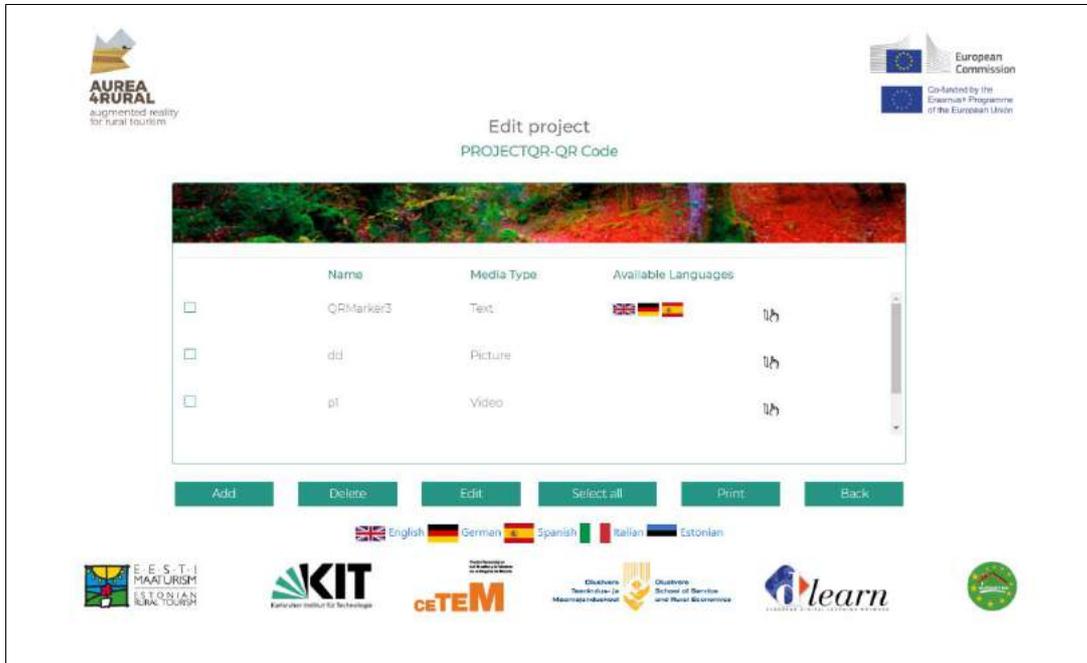
The user can also change the order of the markers on the list by clicking on a row and dragging an element to a new spot within the list.

1.3.2.1.   EDITING CONTENT OF A MARKER – QR CODE OR GPS.

It is also possible to edit a content of QR Code or GPS marker. On the list of content inside a project, the user should click on the checkbox on the left side of the name and then the "Edit" button should be pressed. In the edit part every information of the marker can be changed similar to adding a new marker.

1.3.2.2. EDITNG TEXT CONTENT OF A MARKER.

It is also possible to edit a text content of a QR code or GPS marker. When the user clicks to edit a marker with text type, a new page will be loaded, and a message will appear, asking if the user wants to edit the content of selected marker or add/edit a language.
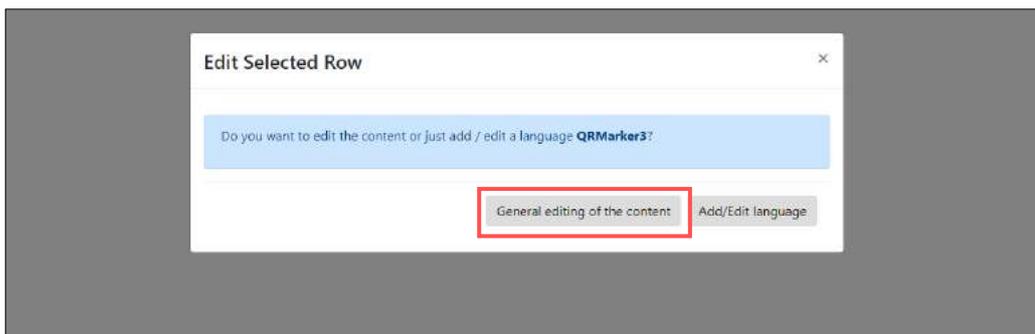
Clicking on the button "General editing of the content" will open the screen, where the user can change all the information about the marker/GPS, such as Name, QR Size or Location, Video, Image or Text.

1.3.2.3. ADDING A LANGUAGE TO A MARKER WITH TEXT CONTENT.

Only the markers with text content type has on the right side the available languages. This column shows how many languages are available for a marker. For instance, if a text has three languages (English, German, Spanish), then in the augmented reality tool the content of the text can be shown in three different languages based on the selected language in the app.
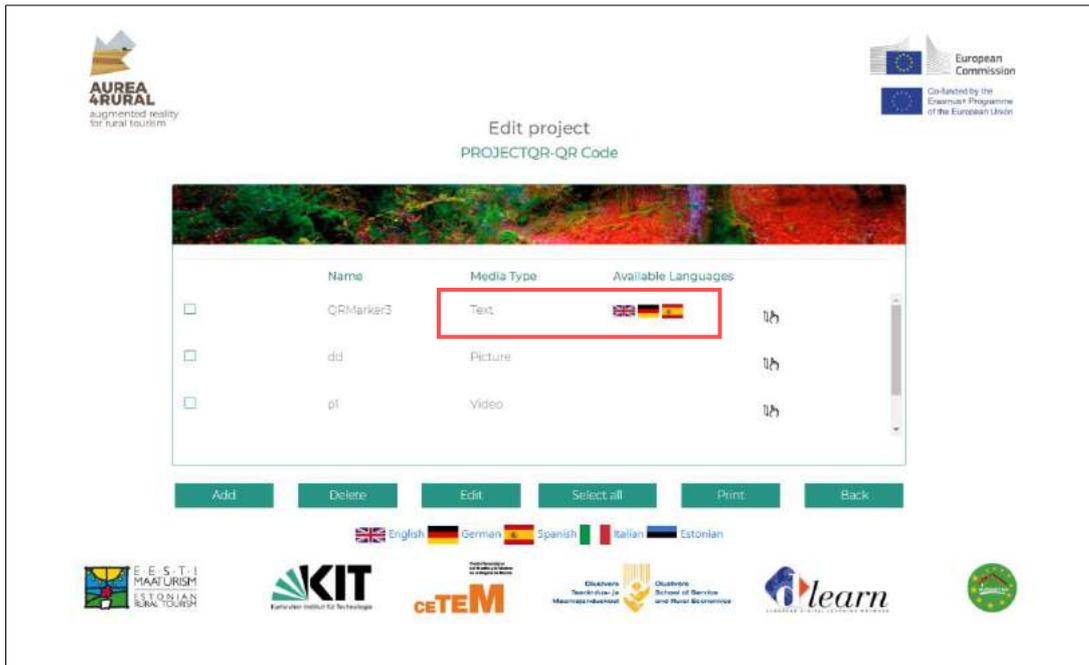
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When the user clicks to edit a marker with text type, a new page will be loaded, and a message will appear, asking if the user wants to edit the content of selected marker or add/edit a language.
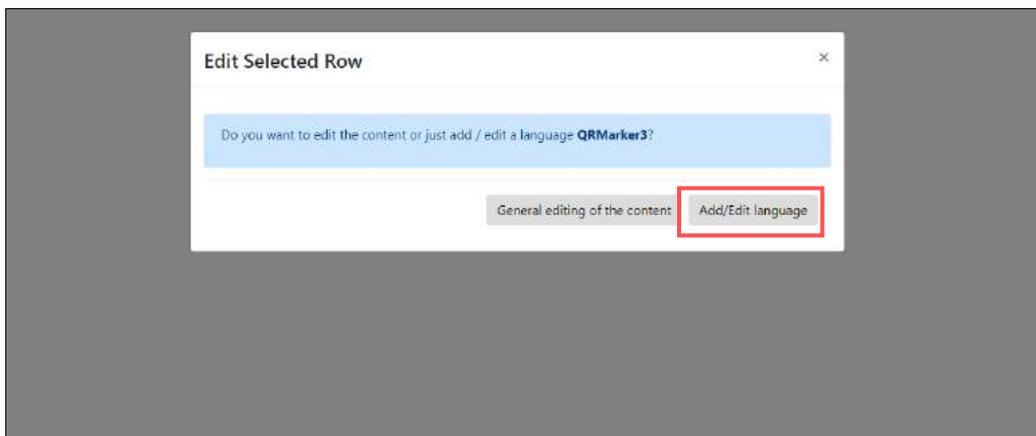
A new screen will appear with the options of language. After clicking the on the button of the "Add / Edit" language will appear a screen, and user can choose a language which is going to be added or edited to the selected marker and after selecting the language a page will open where the user can add or edit the selected language to a marker.

Adding/Editing Language to QRMarker3

So, the user can write the text in the language that was chosen and finish clicking on the Save button. A new language flag will appear in the list of markers along with the others already available for this marker / GPS.

1.4.   PRINTING A QR CODE/GPS MARKER.

To print a marker the user should click on a project, then the list of the markers will be showed. On the list the user can select one by one, clicking on each

checkbox on the left of each marker or click on the button "select all" to print all the existing markers within a project.

A new tab will open with the selected markers to print:

1. If it is a QR Marker, it will be showed with the name and the QR Code;
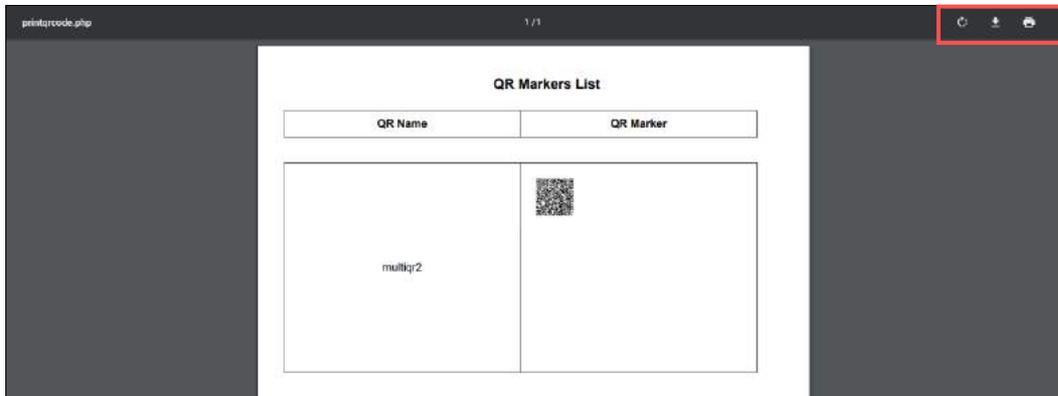
2. If it is a GPS marker, it will be showed with the name of the point, latitude and longitude. The user can either download the document or print it.
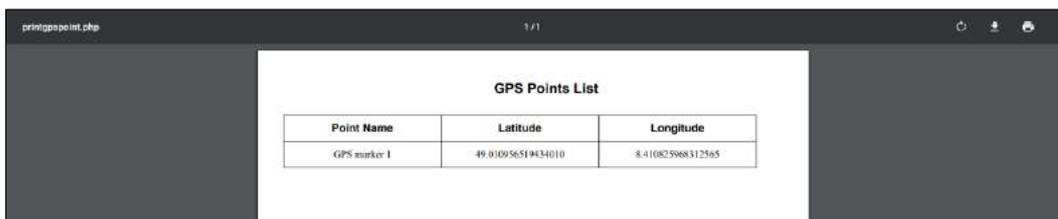
1.5. USER PROPERTIES AND LOGOUT.

Back to the main page (welcome page with the list of the projects) the user finds a button called "user properties". The user information can be changed by pressing this button and opening a page showing the information which user entered during registration process and there is another button "Logout" and by pressing this button the user exits from the system and goes back to the login page.

If the user in the "Change User information" page wants to change the password, then the "Change Password" button should be clicked and it leads to a new page where the password can be changed by inputting the old and new password and confirming the new password and finally by clicking on "Save" a message will be appeared stating the password changed successfully.

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Change user password

old password *

new password *

repeat new password *

Back   Save

Terms of service here   Privacy Policy here

English   German   Spanish   Italian   Estonian

Password successfully changed! Go Back

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Unit 2
AUGMENTED REALITY TOOL

33

Contents

Module 7, Unit 2

2.1. DOWNLOADING AND INSTALLING THE APPLICATION ON YOUR MOBILE DEVICE (Smartphone or Tablet) AND INITIAL SCREEN.

2.1.1. DOWNLOADING AND INSTALLING.

Please Note: This application ONLY WORKS ON ANDROID.

To get access to the application, the following steps are necessary:

- Download the app from the link
- Now, the app is not certified by Play Store. Your device may ask for permission to install the App from an unknown source - you should click on "accept".

2.1.2. INITIAL SCREEN.

After installing the app when the user opens the app, the initial screen will be opened at the mobile screen.

2.2. CONTENT AND TOOLS.

2.2.1. MENU.

On the left side of the screen the user finds a three-lines symbol, which by clicking on the symbol the menu on the left side will appear:
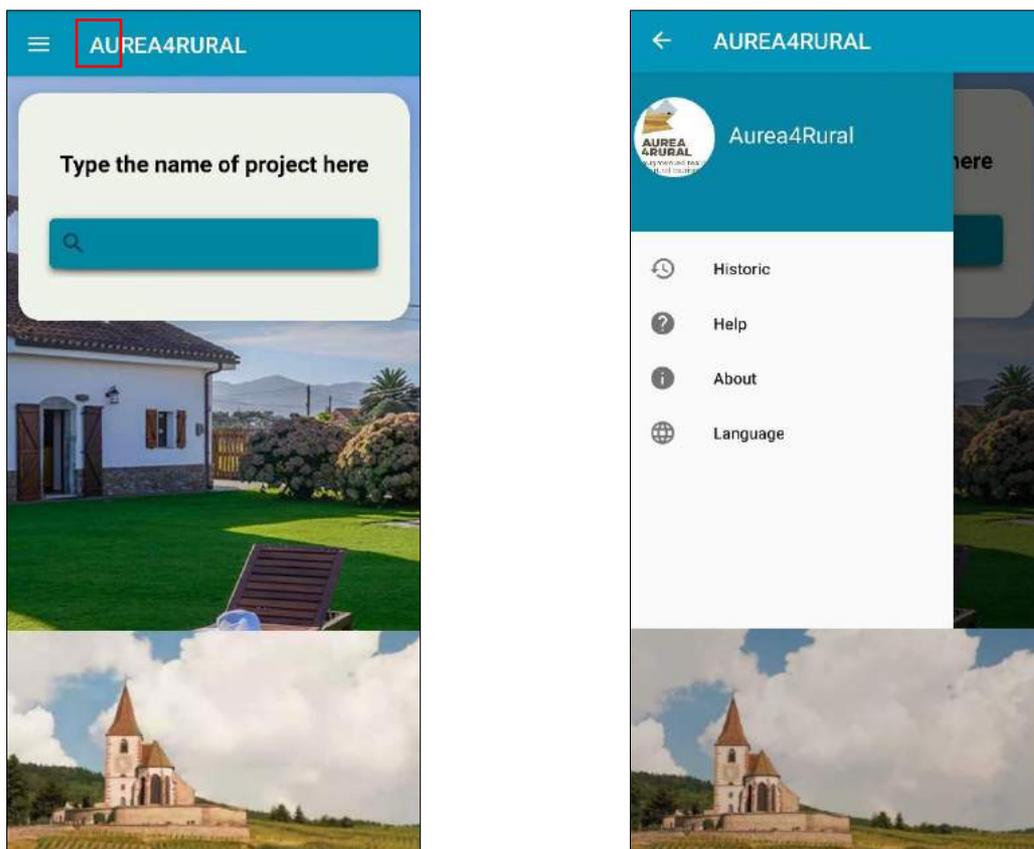
In the menu there are four submenus and each of them has its own functionality and they are explained as following:

- Historic: All the projects which the user has already visited will appear on a list.
- Help: This item is placed to tell the user about how to use the app with the description of each icons.
- About: Information about the project, main objective and partners, a link to the website of each partner and institution, which is in the part of the project.
- Language: To use the app the user should choose a language. Here the user finds all the 5 languages including English, German, Spanish, Italian and Estonian. By default the language which app is running on is in English.
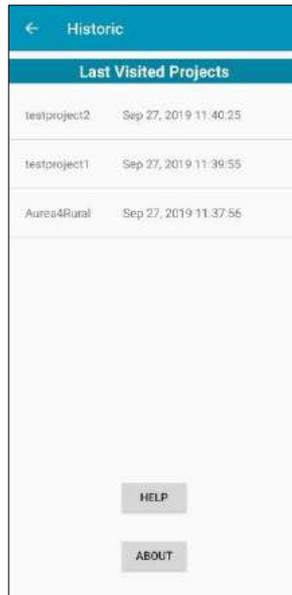
2.2.2. MAIN SCREEN AND SEARCHING FOR PROJECTS.

When the user opens the application, the name of the project should be entered in the search bar. All projects of Aurea4Rural can be searched. The result list will appear once the first letters are typed. Then it starts automatically to filter the list when user types more letters – this means that the full name of

the project is not needed to be typed to find it. After finding the target project, the user can click on it and it will start the project.

2.3. ACESSING THE PROJETCS.

2.3.1. QR MARKER PROJECTS.

Once the user has selected the project, a page will be opened which shows the brief information about the selected project such as the name of the project, the logo and the description of the project. Then for starting the project the user should press the "START" button. This will open a page which the camera of smartphone or tablet is on and it gives to the user impression of being in augmented scene. Once the user has a printed QR MARKER of the project in view, then the "SCAN" button can be pressed. After pressing "SCAN" the phone will scan the QR Marker.

Once the Scanning is finished, the content (image, video or texts) associated with that QR MARKER will appear on the screen of the device.
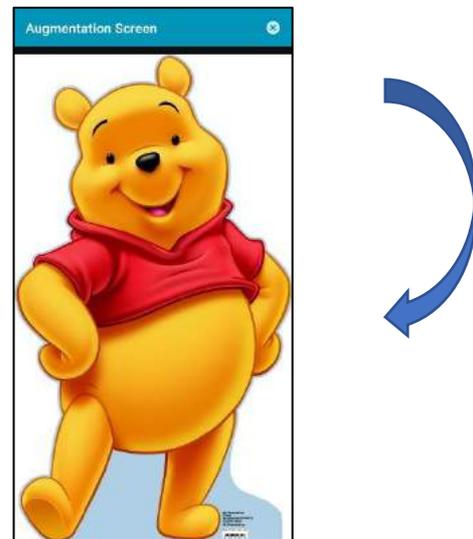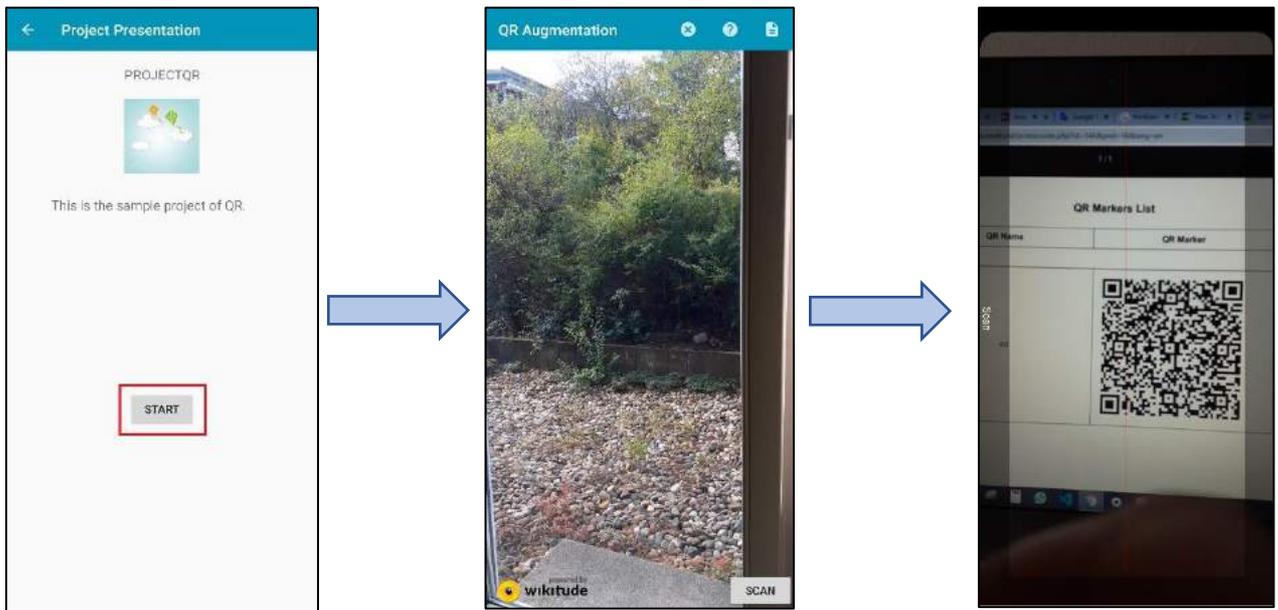
2.3.2. GPS MARKER PROJECTS.

After searching and finding the target GPS project and starting the project (similar to a QR Marker project) then a page will be opened which considers the on/off GPS status of the device. If the GPS of the device is not already turned on an alert dialog will appear showing "GPS is not enabled. Do you want to go to the settings menu?". If the user ignores this message and starts to continue, then the device will not use GPS of device for getting high accuracy position and it will only use the Internet (Mobile network or wireless) to locate. This might be not a good choice if the user is in rural area (outdoor) which can get the position from the satellites. Therefore, it is recommended to use both GPS

and Internet technologies for locating. After turning on the location by clicking on the "SETTINGS" in alert dialog, the button which is called "GO TO MAP" can be clicked. By clicking this button, a page will be opened displaying a map which is centered based on current location of the user. The map consists of tools on top left side of the map including Zoom in or Zoom out with "+ or – "buttons, and location icon and by pressing this icon it will locate and show your position on the map. The user can also scroll and zoom in and zoom out within the map by using two fingers. There is also an icon which is located on the top right side of the map and by pressing this button the view of map can be changed. Two options for the view are available, Streets view and Satellite Imagery view.

Once the device detects the user's location, the closest GPS markers to the location of the user will be shown on the map. By clicking on each of these GPS markers, a summary of the contents (image, video or text) associated with selected GPS MARKER will appear on the screen of the device.

This summary includes:

- Name of the marker or object
- Media: if the user is more a range of specified distance in web tool, a text indicates that the user is "Too far away" to see the content. If the user is within a range of specified distance in web tool, a text indicates that the user is "Ready" to see the content.
- Distance: the distance between the user's current location and a GPS marker.
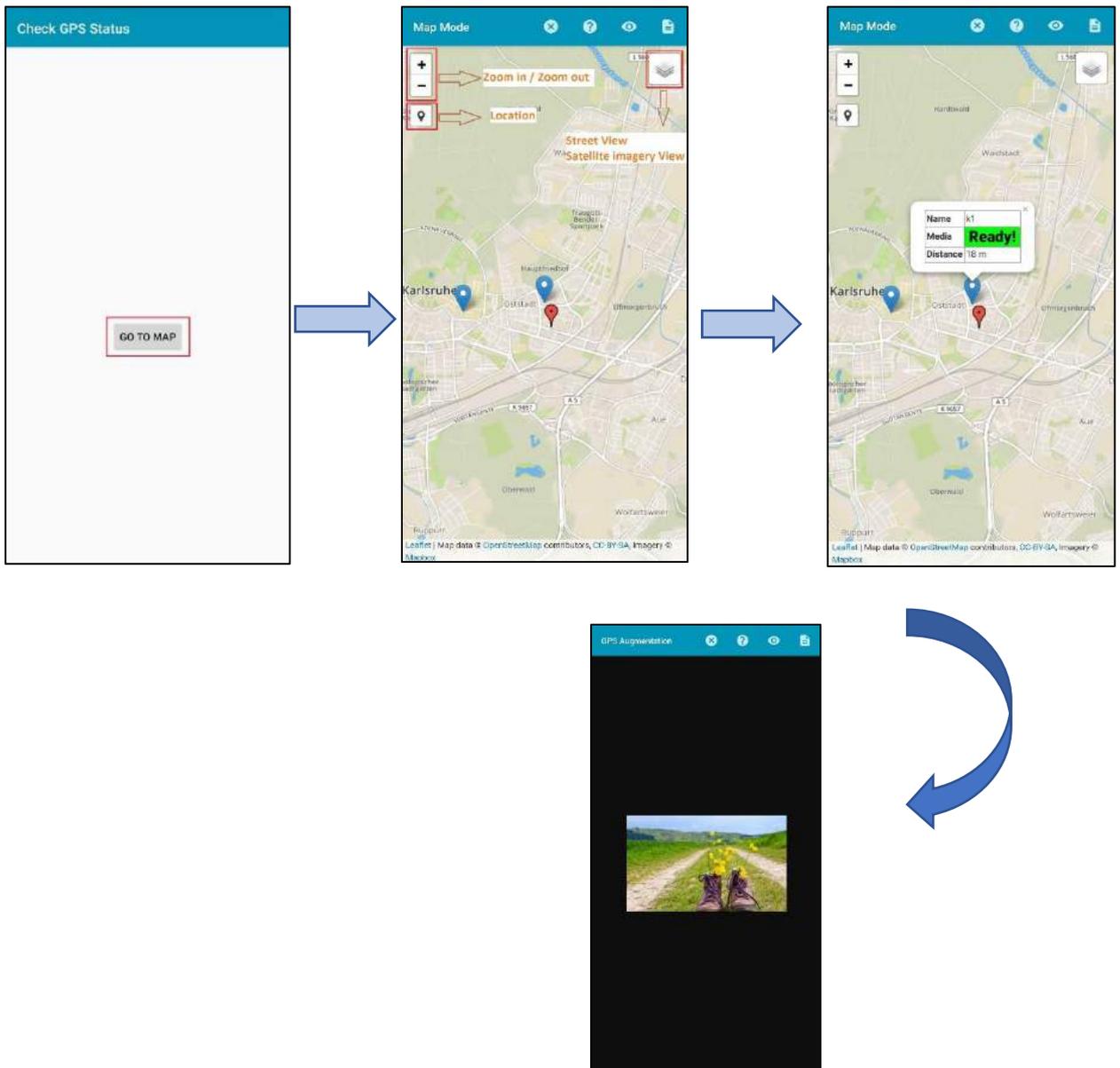
The content is only accessible if the user is physically within the range of a GPS marker location. At this moment, in the pop-up box next to "Media" the green button "Ready!" will appear. By pressing "Ready" button a page will be loaded which is the augmented page and finally the user will see the contents of the selected GPS marker which can be either image or video or text. If this button is with red color and text is "Too far away" then the user can not see the contents unless the user is within the range and by pressing this red button it will also show a message which indicates how far should be user within the point to see the media.
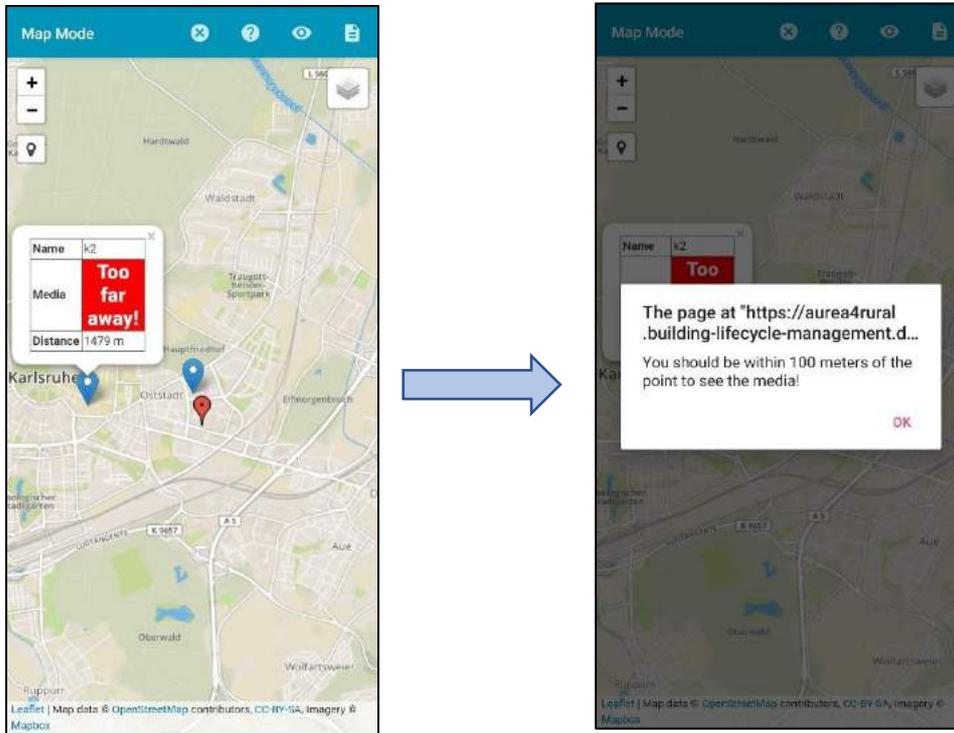
There is another possibility to see the content of a point. User can see the points in Augmented scene by clicking 👁 on the View Icon.

By pressing this icon, a new page will be opened which demonstrates the points in augmented environment. Points are in blue markers and there is a "Radar" on the top left corner which shows the points based on the geographical arrows to navigate the user to find a point easily. The user can get the information about the points by clicking on each of them in the scene. By clicking each point, a panel will be opened showing details about the selected point such as the name, distance from user's current location and a button which enables the user to click on it and see the content of the related point. Similar to the map mode the user can see the content of a point which is physically within the range of a GPS marker location. In this case the color of the button is green with the text "Ready". If the user is not within the range of a GPS marker location the content of a point can not be accessible to show.
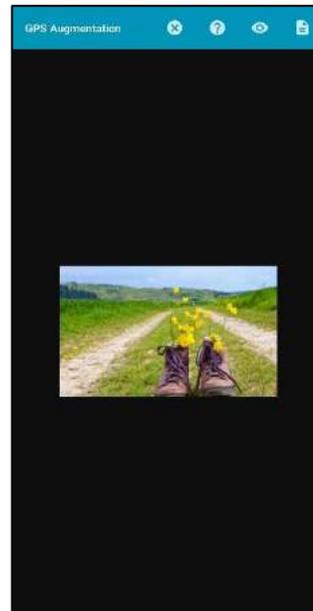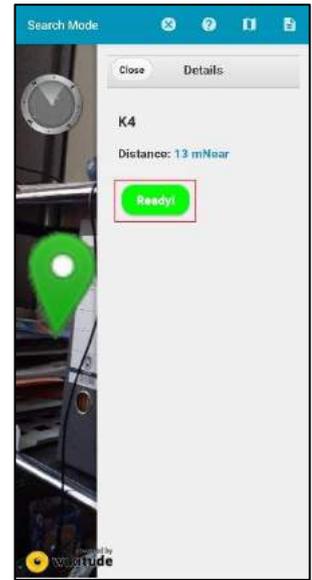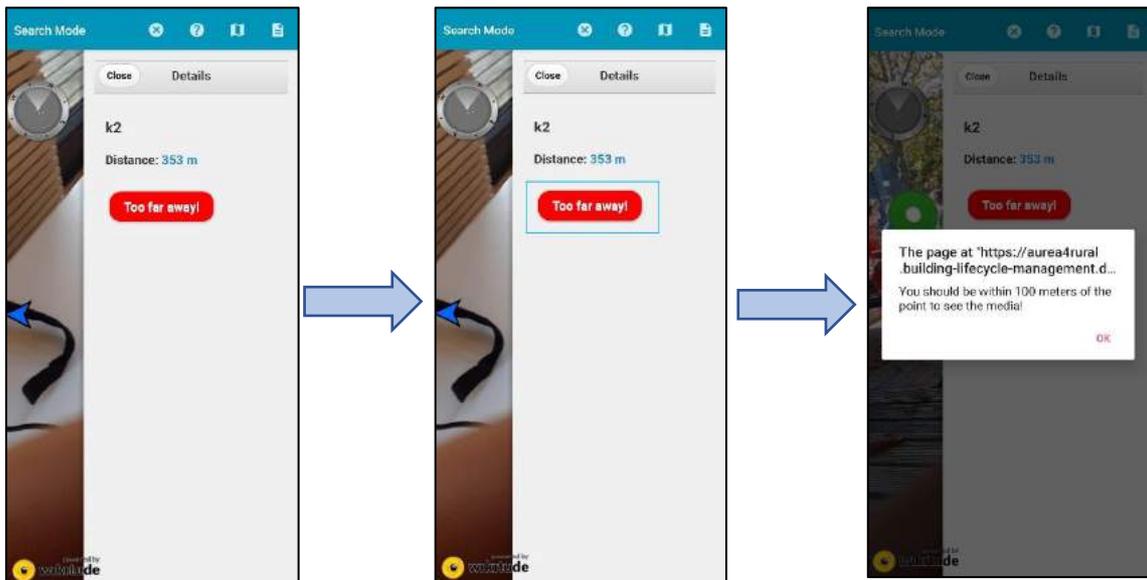
There are some icons which are common in some pages. They are described as following:

Help: By pressing this button the user will get the help about the usage of application or QR Code help or Map mode help or Search mode (augmented scene) which explains the functionality of each icon in the current page.

Exit: By clicking on this icon the user will return to the main page of the app with the search field.

Info: This icon leads the user to the project presentation page where user can see the short information about the current selected project such as name of project, the logo and the description.

Map mode: This functionality is used to take the user back to the map mode where the points of a GPS project are located and displayed on the map.
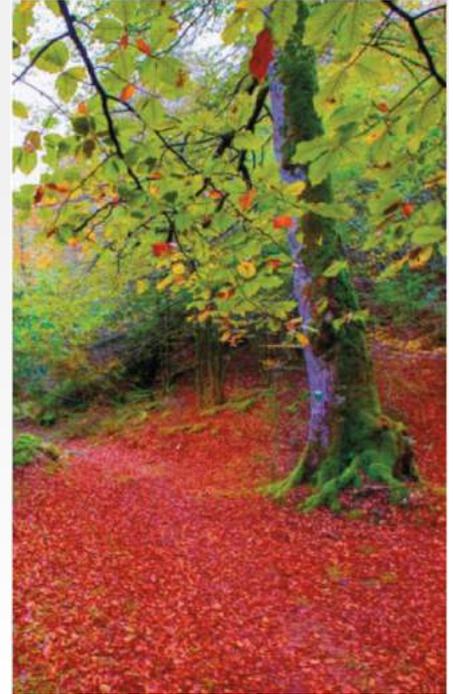
2.4.   EXITING THE APP.

When the user clicks the back button on the device, a pop-up message will be shown. By confirming it, the app will close.

Unit 3

LIMITATIONS OF THE CURRENT VERSION OF THE AUREA4RURAL APP.

Contents

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3.1 LIMITATIONS OF THE CURRENT VERSION OF THE AUREA4RURAL APP.

The limitations of the current version of the Aurea4Rural application are the following:

• It allows only one type of multimedia content at the same point of augmented experience.
• In a project, only one type of sensor system can be used to activate the augmented experience.
• All types of possible multimedia content are not implemented in the application, for example, the types "audio" and "3D objects" are not incorporated.

All the limitations indicated above, can be remedied with the technologies currently available. Specifically, they could be implemented with an update of the code, contemplating such objectives. This code update is possible without the need to implement any other system or language to the current development, since the technologies used have an architecture capable of supporting them.

For many countries, tourism is one of the most important industries within their national economies, and being able to offer the visitor an incredible and memorable experience becomes essential to determine the success of a tourist destination.

With the rise of new technologies, the democratization of tourism and the increase of young millennials within the traveling community, the tourism sector must keep pace with technological advances to be able to transform them into a competitive advantage that allows its customers to interact immersivity with the different elements that are part of your trip.
And is that augmented reality systems can exert a tremendous power of persuasion, giving the sector a unique and lucrative opportunity to market their services and offer a travel experience that differentiates them from the rest, it is only necessary to have a smartphone or a tablet
The tourism sector has begun to see the potential offered by this technology and there are increasingly more applications based on augmented reality that strive to improve the traveler's experience. However, the novelty of this technology, together with the high costs of platforms and tools, makes it currently only feasible for large cities and companies, such as hotel chains and restaurants.

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The possibility of marketing the product is very high given that the applicability of this application to the sector is very high, also in the current situation, offering a service of this type transcends the use by the end user and acts as a marketing tool.

Currently there are many companies that offer services for the development and implementation of augmented reality solutions. Below are some companies classified by country or region.

Spain Visuartech - http://www.visuartech.com/ Realmore - https://www.realmore.net/es/ Innovae - http://www.innovae.eu	**France** Total Immersion - http://www.t-immersion.com/ Immersion - http://www.immersion.fr Artefacto - https://www.artefacto-ar.com
Germany Weldplus - https://weldplus.de Zühlke - www.zuehlke.com Re-flekt - www.re-flekt.com	**Estonia** Subatomic - https://www.subatomic-tech.com/ Operose - https://www.operose.io/ Criffin - https://criffin.com/
Italy Anothereality - www.anothereality.io Illogic - http://illogic.xyz Faenzagroup - http://www.faenzagroup.com	