

Location Based Services and Augmented Reality in Environmental Management

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2. Proveďte analýzu dosavadních nástrojů pro rozšířenou realitu.
3. Diskutujte využití kontextově dostupných služeb v environmentálním managementu.
4. Navrhněte vhodné využití rozšířené reality a kontextově dostupných služeb v environmentálním managementu.



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[2]CHIANG, Tosti a Stephen YANG. An Augmented Reality-based Mobile Learning System. 2014, , 15.

[3]Location-Based Services: Learning. Geoawesomeness [online]. 2012 [cit. 2016-01-23]. Dostupné z: <http://geoawesomeness.com/knowledge-base/location-based-services/location-based-services-introduction/>

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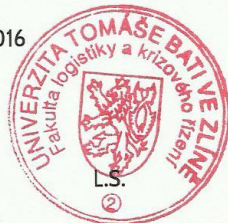
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V Uherském Hradišti


.....
podpis studenta

ABSTRAKT

Tato bakalářská práce se zabývá kontextově dostupnými službami a rozšířenou realitou v environmentálním managementu. V teoretické části jsou definovány kontextově dostupné služby, rozšířená realita, virtuální realita, rozšířená virtualita a smíšená realita a jejich nástroje. Na závěr teoretické části si vysvětlíme pojem environmentální management, jeho vývoj v historii a nynější použití ve společnostech. V praktické části se zabývám tvorbou aplikace, která využívá rozšířené reality a měla by sloužit jako osvěta pro dnešní mládež o se týče správného třídění odpadu a důležitosti této problematiky.

Klíčová slova: realita, virtuální, rozšířená, smíšená, environmentální, management, aplikace, kontextové, služby

ABSTRACT

This bachelor's thesis deals with Location Based Services and Augmented Reality in Environmental management. In the theoretical part are defined location based services, augmented reality, virtual reality, augmented virtuality and mixed reality and their tools. At the end of the part we will explain environmental management and its evolution in history and usage in societies nowadays. In the analytical part I deal with the creation of an application, which uses tools of augmented reality and should work as information for current youth about correct waste management and its importance.

Keywords: reality, virtual, augmented, mixed, environmental, management, application, location, services

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CONTENTS

CONTENTS	7
INTRODUCTION	10
I. THEORY	11
1 LOCATION BASED SERVICES	12
1.1 HISTORY OF LOCATION BASED SERVICES	12
1.2 MODERN HISTORY OF LOCATION BASED SERVICES	12
1.3 USAGE AREAS OF LBS	13
1.4 LBS APPLICATIONS	13
1.4.1 <i>Emergency Applications</i>	14
1.4.2 <i>Information services applications</i>	14
1.4.3 <i>Navigation applications</i>	15
1.4.4 <i>LBS social media applications</i>	15
1.4.5 <i>Sports applications</i>	16
1.4.6 <i>Geotagging applications</i>	17
1.5 GPS BASED LOCATION BASED SERVICES.....	17
2 AUGMENTED REALITY	19
2.1 HISTORY OF AUGMENTED REALITY	19
2.2 COMPONENTS OF AUGMENTED REALITY	20
3 VIRTUAL REALITY	21
4 AUGMENTED VIRTUALITY	22
5 MIXED REALITY	23
6 VIRTUAL AND MIXED REALITY TOOLS	24
6.1 MICROSOFT HOLOLENS	24
6.2 OCULUS RIFT	24
6.3 HTC VIVE	24
6.4 ADVANTAGES AND DISADVANTAGES	25
6.5 OCULUS RIFT VS. HTC VIVE	26
7 ENVIRONMENTAL MANAGEMENT	28

7.1	EVOLUTION OF ENVIRONMENTAL MANAGEMENT.....	28
7.2	ENVIRONMENTAL MANAGEMENT IN CORPORATES	28
II.	ANALYSIS	31
8	APPLICATION – TRASH UH.....	32
9	QUESTIONNAIRE	33
9.1	RESPONDENTS.....	33
9.2	QUESTIONS	33
9.2.1	<i>Questions for Children and Adolescents</i>	<i>33</i>
9.2.2	<i>Questions for Adults.....</i>	<i>33</i>
9.3	EVALUATION	34
9.3.1	<i>Evaluation of Children and Adolescents Category.....</i>	<i>34</i>
9.3.2	<i>Evaluation of Adults Category.....</i>	<i>35</i>
9.4	CONCLUSION OF QUESTIONNAIRE.....	36
10	CONNECTION BETWEEN USER AND SERVER.....	37
10.1	REQUIREMENTS FOR USER.....	37
11	SERVER	38
11.1	DATA ON SERVER.....	38
11.1.1	<i>Waste containers types and positions</i>	<i>38</i>
11.1.2	<i>Information about waste containers</i>	<i>39</i>
11.1.3	<i>Collection Schedule</i>	<i>41</i>
11.1.4	<i>Appropriate and inappropriate types of waste thrown in waste containers</i>	<i>41</i>
11.1.5	<i>Final products of plastic waste</i>	<i>44</i>
11.1.6	<i>Final products of paper waste</i>	<i>44</i>
11.1.7	<i>Final products of glass waste</i>	<i>44</i>
11.1.8	<i>Achievements and rewards</i>	<i>44</i>
12	DESIGN AND DESCRIPTION OF APPLICATION.....	46
12.1	HOME SCREEN	46
12.2	PREVIEW	46
12.3	ACHIEVEMENTS	47
12.4	PLASTIC	48
12.5	PAPER	48

12.6	GLASS.....	49
12.7	BIOTRASH	50
12.8	MAP.....	51
12.9	ABOUT.....	52
13	FINANCIAL BUDGET FOR APPLICATION	53
14	WASTE MANAGEMENT IN UHERSKÉ HRADIŠTĚ.....	54
	CONCLUSION	55
	BIBLIOGRAPHY	57
	LIST OF ABBREVIATIONS	59
	LIST OF FIGURES	60
	LIST OF TABLES	61
	LIST OF CHARTS	62
	APPENDICES.....	63

INTRODUCTION

This bachelor thesis deals with location based services (LBS) and augmented reality in environmental management. First, we define the location based services and look to its origin in the past century and how it looks nowadays. Then we divide the usage areas of location based services and we describe several examples of applications and how they work on the principle of LBS. Next part will be focused on augmented reality and its history. We find out what components we need to use it well. Also we look at the other features such as virtual reality, augmented virtuality, which together form a mixed reality and we describe all of them. After that we explore the virtual and mixed reality tools and evaluate its advantages and disadvantages. In the last section of theoretical part, we define environmental management and its evolution and how it serves in society.

In practical part I will develop an application which will be using LBS and augmented reality. It will be a unique application that allows a user to view information about trash cans in city for example amount of plastic taken from exact can. This application will primarily serve for pupils in elementary schools. It will help them to realize, how important it is to sort waste. We must create and gather data for this application, which contains number of trash cans, their position, visualize it on a map etc., and create design of it. Create and gather data will be crucial for this project. I need to collect every data about waste containers. For example its number, location, tons of taken from them and more.

Develop an application can be very expensive and problematic so I will try to calculate price and the most important things for project like this.

In last part of this thesis I focus on waste management in Uherské Hradiště, its norms and laws, system and companies which cooperate with city.

I. THEORY

1 LOCATION BASED SERVICES

Location based services can be well-defined as services that connect a mobile device's location or position with other information so as to provide added value to a user. [1]

1.1 History of Location Based Services

Location Based Services are not domain of 21st century. It all began in 1970s, when the U.S. Department of Defense has been operating the global positioning system, known as GPS, a satellite infrastructure serving the positioning of people and objects of various kinds. Big and important step for the mankind was in the 1980s, when U.S. government decided to make the system's positioning data freely available to other industries which was great opportunity for them. For instance, the automotive industry integrated navigation systems into their cars. [1]

1.2 Modern history of Location Based Services

Most of people using nowadays location based services (LBS) without realizing it. Popularity of personal navigation devices as well as mapping services like Google Maps is now part of society. LBS have not long ago uncovered its potential to transform mobile communications. LBS applications are limited only by the technology and creativity of developers. [2]

Tab. 1. Chronology [2]

1999	The first Digital Location Based Patent was filed in the US
2000	Launch of Dodgeball – The first LBS social network
2009	Twitter added location feature
2009	Dodgeball turn into Google Latitude
2011	Facebook check-ins
2012	Apple Maps, Google Glass Project

1.3 Usage areas of LBS



Pic. 1. Usage areas of LBS. [1]

As you can see in the picture, there are three main areas of LBS usage. It is military and government industries, emergency services and the commercial sector. [1]

As an example for emergency services we can use application Rescue Navigator developed by Point.X. Nowadays is Rescue Navigator application used by Fire Departments (HZS) and Voluntarily Firemen (JSDH) units. It allows a user to see location of another vehicle from HZS, reported fires and burning, closures and other information.

1.4 LBS Applications

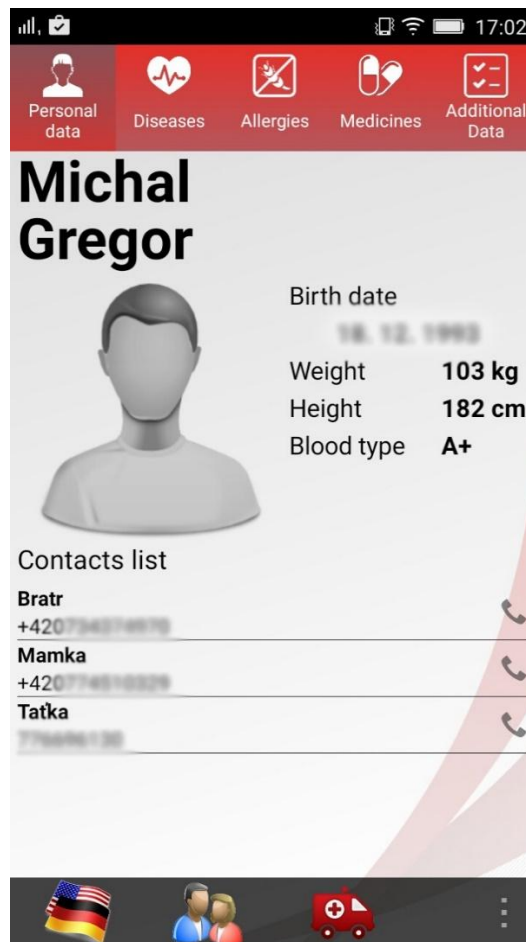
There is large amount of LBS applications and it is almost impossible to catalogue all of applications. In order to provide more useful, attractive and engaging social networks, apps and services location components have been added to new innovative projects. The LBS applications are catalogued in the following way: [3]

- Marketing
- Emergency
- Information Services
- Navigation
- Location Based Social Media
- Mobile Location Based Gaming
- Sports
- Billing
- Geotagging
- Tracking

- Augmented Reality

1.4.1 Emergency Applications

One thing most of us carry at all time is our mobile phone. And not many people realize, that it can save our lives. Mobile phones nowadays can do much more than check email, social media or taking a pictures. They can be very useful in an emergency situation.



Pic. 2. ICEcard application

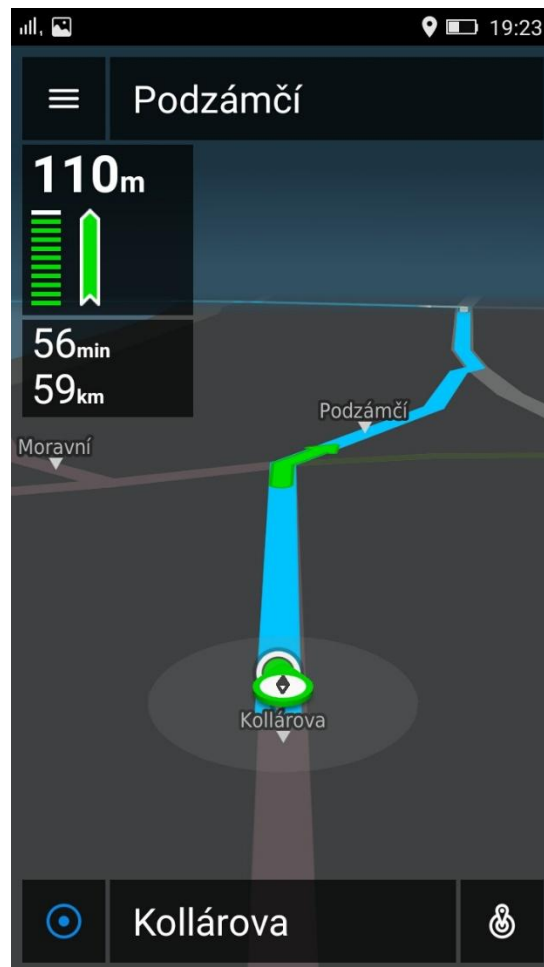
– own creation

1.4.2 Information services applications

Location-based information services refer mostly to the digital distribution of information based on device location, time specification and user behavior. This is one of the most widespread and earliest implemented types of LBS utilizing both pull and push services. [3]

1.4.3 Navigation applications

Navigation services allow locating the exact geographical position of a mobile device using one of available positioning systems and get direction and navigate user to required location including vehicles, crafts and pedestrians. However, according to LBS definition only those navigation products that are receiving the information from wireless networks and be considered a part of LBS.



Pic. 3. Navigation application "CESTY"

– own creation

1.4.4 LBS social media applications

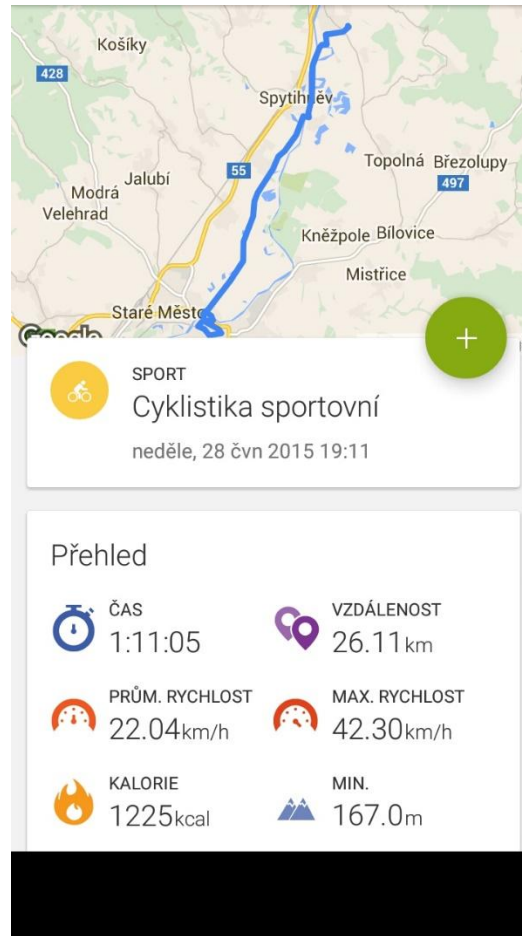
Social media have been widespread on the Internet and have become a research topic. Networks like Facebook and Twitter changed the way how people communicate and how to get information. The development gave social media possibility to integrate location with content created by users. There are many ways how to do it; most common on social networks is "check in" (sharing your location through positioning system). [3]



*Pic. 4. Twitter application
- own creation*

1.4.5 Sports applications

The potential of LBS and modern mobile devices can be used as well to monitor sports activities (running, cycling, jogging etc.). LBS applications like Nike +, Endomondo and Run Keeper has millions of users. Functionality of those applications allows users to automatically collect data, such as location, distance, speed, duration or burned calories and store them on the server. Endomondo allows to visualized real-time route of outdoor sport activity through user smartphone using Google Maps and sharing that data with a social networking. [3]



*Pic. 5. Endomondo application
- own creation*

1.4.6 Geotagging applications

Geotagging is defined as adding geospatial metadata to digital media such as photographs, videos, messages, blogs, web pages and GeoRSS. Significant amount of the social media content is created by users through location-aware mobile devices. Geotagging allows browsing the content of the Internet with geographic filtering. It is as well possible to visualize some of the content. Especially photo-sharing sites enabling geotagging are popular among users of LBS. [3]

1.5 GPS based Location Based Services

LBS can be used as a service that utilize the ability to make use of geographical position of the mobile device. Location Based Services use a single base station with a radius of inaccuracy to determine a phone's location. Several categories of methods can be used to find

the location of the user. It is GPS based LBS, GSM localization, Bluetooth, WLAN, Infrared or RFID technologies. [9]

The simple and standard solution from these methods is GPS based LBS. It is used to maintain the knowledge of the exact location. The GPS is made up of three parts:

1. Satellites orbiting the Earth
2. Control and monitoring stations on the Earth
3. The GPS receivers owned by users

It uses a constellation of between 24 and 32 Medium Earth Orbit Satellites that broadcast signals from space that are picked up and identified GPS receivers. These satellites also transmit piecewise microwave signals, which allows GPS receivers to determine their current location, the time and their velocity. [9]

2 AUGMENTED REALITY

Augmented reality is the integration of digital information for example with video or environment in real time. Augmented reality takes an existing picture and combine it with new information into it. Most important thing in augmented reality is the software. Programs are mostly written in 3D software like Total Immersion AR Engine¹, Unifeye Platform² or FLARToolKit³. [4] It is a new technological system that allows inserting virtual contents (virtual reality) in the real world in order to run in the same representation and, in real time, enhancing the users' sensory perception of reality. In an AR system, users see an image made up of a real image and virtual elements that are superimposed over it. [5]

2.1 History of Augmented Reality

Tab. 2. History of Augmented Reality. [7]

1962 – Morton Heilig	Designs a motorcycle simulator called Sensorama. It had visuals, sound, vibration, and smell.
1968 – Ivan Sutherland	Creates the first Augmented Reality system called The Sword of Damocles.
1975 – Myron Krueger	Creates AR system which allowed users to interact with virtual objects.
1992 – Tom Caudell and David Mizell	Boeing Computer Services Adaptive Neural Systems Research and Development project.
2004 – Mathias Möhring	The first system for tracking 3D markers on mobile phones.

¹ Total Immersion AR Engine has been the world's most widely-used commercial augmented reality technology.

² Unifeye is world's most comprehensive and powerful augmented reality software suite.

³ The world's first Flash based augmented reality library

2006 – NOKIA	Mobile Augmented Reality Applications (MARA) project
2008 – MOBILIZY	Wikitude World Browser with Augmented Reality.
2009 – SPRXmobile	Layar AR browser

2.2 Components of Augmented Reality

Augmented reality is consisted from pieces that make AR work. There are many necessary components to make the whole process work as well as the different types of platforms that can be used for AR. [7]

Hardware:

- Computer, mobile device
- Monitor
- Camera
- Tracking system (GPS)
- Network infrastructure

Software:

- Application or program
- Web service
- Content server

3 VIRTUAL REALITY

Virtual reality is reality generated by computer which supports interaction with user. Long time was computer only a screen and were looked into it. Now the user is fully connected with the computer and its possible to change elements of computer and change the world.

Virtual reality is an artificial environment that is created with software and presented to the user in such a way that the user suspends belief and accepts it as a real environment. On a computer, virtual reality is primarily experienced through two of the five senses: sight and sound. [13]

The simplest form of virtual reality is a 3D image that can be explored interactively at a personal computer, usually by manipulating keys or the mouse so that the content of the image moves in some direction or zooms in or out. More sophisticated efforts involve such approaches as wrap-around display screens, actual rooms augmented with wearable computers (more in 3.3), and haptics devices that let you feel the display images. [13]

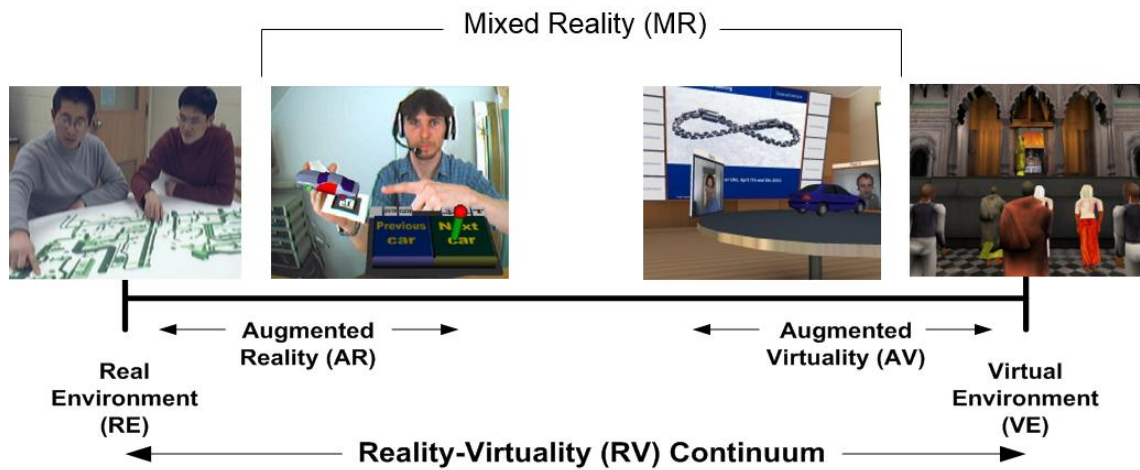
4 AUGMENTED VIRTUALITY

Augmented Virtuality (AV) describes all the cases where the real object is inserted into a computer-generated environment. A system in which real multi-sensory input is provided, which supplements the visually presented virtual environment. [14]

With Augmented Virtuality you can create an augmented virtual world that contains real world images as object textures. This allows a user to explore a virtual representation of a real space. The textures are taken from objects that exist in the real world and which have dual (mirror) objects in the virtual world. This has the advantage of making a virtual world appear as the real world, but maintaining the flexibility of the virtual world. Objects look like their real counterparts but can be manipulated in virtual settings. The virtual world can be used as a control interface for manipulating objects in the real world. [15]

5 MIXED REALITY

Mixed Reality (MR) is a term that has been used to refer to the entire spectrum of situations that span the continuum between virtual reality and actual reality. It includes augmented reality, augmented virtuality, and other mixed configurations. [14]



Pic. 6. Mixed reality continuum. [14]

6 VIRTUAL AND MIXED REALITY TOOLS

6.1 Microsoft HoloLens

HoloLens embraces virtual reality and augmented reality to create a new reality – mixed reality. Virtual reality immerses you in a simulated world. Augmented reality overlays digital information on top of your real world. By understanding your environment, mixed reality enables holograms to look and sound like they're part of your world. [10]

You can interact freely with holograms, people and objects in your world because the holographic frame positions holograms where your eyes are most sensitive to detail, leaving your peripheral vision unobscured. Holograms are responsive to you and the world around you. Microsoft HoloLens enables you to interact with content and information in the most natural ways possible. You can interact with gaze (Built-in sensors let you use your gaze to move the cursor so you can select holograms. Turn your head and the cursor will follow.), gesture (use simple gestures to open apps, select and size items, and drag and drop holograms in your world) and voice (use voice commands to navigate, select, open, command, and control your apps. Speak directly to Cortana⁴, who can help you complete tasks.). [10]

6.2 Oculus Rift

Rift uses state of the art displays and optics designed specifically for Virtual Reality. Its high refresh rate and low-persistence display work together with its custom optics system to provide incredible visual fidelity and an immersive, wide field of view. [11]

Its advanced display technology combined with its precise, low-latency constellation tracking system enables the sensation of presence – the feeling as though you are actually there. The magic of presence changes everything. [11]

6.3 HTC Vive

Vive is the first-of-its kind virtual reality system developed in partnership by HTC and Valve. Designed from the ground up for room-scale VR, Vive combines state-of-the-art technologies into a complete system that includes video, audio and precise motion tracking. [12]

⁴ Cortana is an intelligent personal assistant created by Microsoft

Visual experiences are provided by a headset that features a 110° field of view and 32 sensors for precise tracking for total immersion. The 2160 x 1200 resolution and 90 Hz refresh rate deliver detailed graphics and lifelike motion for smooth gameplay and realistic movement. Fluid interaction is provided by two wireless controllers, each with HD haptic feedback, dual-stage triggers, and multi-function trackpads. [12]

6.4 Advantages and disadvantages

Tab. 3. Advantages and disadvantages of Microsoft HoloLens.

Microsoft HoloLens	
Advantages	Disadvantages
Augmented reality made useful and engaging	High prize (3,000 \$)
Windows 10 means it will be easy for developers to create HoloLens applications	You can have problem if you wearing glasses

Tab. 4. Advantages and disadvantages of Oculus Rift.

Oculus Rift	
Advantages	Disadvantages
Enhance the gameplay experience	Too low resolution
Very good immersion	Heavy weight
	Limited field of view

Tab. 5. Advantages and disadvantages of HTC Vive.

HTC Vive	
Advantages	Disadvantages
Inside-out sensing	Higher price than Oculus Rift
Big field of view	

6.5 Oculus Rift vs. HTC Vive

Tab. 6. Technical comparing. [16]

	Oculus Rift	HTC Vive
Display	OLED ⁵	OLED
Resolution	2160 x 1200	2160 x 1200
Refresh Rate	90Hz	90Hz
Platform	Oculus Home	SteamVR
Field of View	110 degrees	110 degrees
Tracking area	5 x 11 feet	15 x 15 feet
Built-in-audio	Yes	Yes
Built-in-mic	Yes	Yes
Controller	Oculus Touch, Xbox One controller	SteamVR controller, any PC compatible gamepad
Sensors	Accelerometer, gyroscope, magnetometer, 360-degree positional tracking	Accelerometer, gyroscope, laser position sensor, front-facing camera
Connections	HDMI, USB 2.0 and 3.0	HDMI, USB 2.0 and 3.0
Prize	600 \$	800 \$

The Rift and the vive both capitalize on two custom controllers, known as Oculus Touch and SteamVR, respectively. Both devices will also support gamepads. Rift will ship with an Xbox One controller. Vive has not made any such promise, but since the Xbox button layout has become the industry standard for PC gamepads, it will certainly support the Xbox One controller, too. [16]

⁵ An organic light-emitting diode (OLED) displays are brighter with higher contrast that have faster response times, wider viewing angles and consume less power than LED or LCD displays.

Virtual reality headsets are only as good as the display they utilize. That said, the Rift and Vive both come outfitted with vibrant OLED displays, each of which offers 1080 x 1200-pixel resolution for each eye. [16]

It is very hard to reveal a winner, especially when so many of the crucial components of said comparison remain a mystery.

7 ENVIRONMENTAL MANAGEMENT

Environmental management is a part of management. Classically management have main function in businesses and organizations. Management is primary used for organization of the activities of a business in order to achieve defined objectives.

7.1 Evolution of Environmental Management

In past decades starts a growing interest in the environment and about damage being done to the environment. The process of European integration and the growth of international trade has brought the transnational nature of the environmental problem to the forefront. The hole in the ozone layer is year by year bigger and bigger and global warming is the result of not one country's or one company's action but that of many. That was impulse for individual governments and for intergovernmental agencies to put in place policies which begin to rectify the situation. [8]

Nowadays there is a rapid growth in environmental legislation and other policies such as the introduction of eco-taxes and levies. Such policies are likely to be further strengthened in the future and this will affect the way in which every business is run and the way in which managers must recognize their responsibility, not only to a company, but also to the environment in which it operates. Perhaps more importantly, many of the more recent initiatives on the environment, emanating from the European Commission, have been market driven and are voluntary. Collectively their impact is to demand that businesses take more responsibility for the environmental damage which they create and to approach corporate environmental management in a more proactive way. [8]

7.2 Environmental Management in Corporates

Companies are beginning to realize that environmental issues need to be addressed for a number of reasons, including; consumer pressure, potential cost saving, legislation and ethics. There is therefore growing interest in the area of corporate environmental management. Corporate mainly need to recognize the strategic advantage which corporate environmental management can bring and to ensure that commitment to environmental improvement exists in the business. After the company has decided to embark on a concerted effort to improve its environmental performance, it must build a comprehensive environmental management system within the organization. [8]



Pic. 7. Strategic framework for environmental management. [8]

USED METHODS

In the analytical part I used method of questionnaire which is one of quantitative method for research of public opinion. Research done by questionnaire method can help us gauge sociological phenomenon and also can be analyzed by mathematical modules and statistical techniques. Questionnaires are send or communicated to selected group of people.

Collection of data was done in three days. Respondents were divided into two categories, each category had different questions and also were evaluated separately.

The purpose was to determine if it is appropriate to develop this application and estimate its usage for society.

Outcome is verbal summary, tables and charts are compiled in Microsoft Excel.

II. ANALYSIS

8 APPLICATION – TRASH UH

Trash UH is a unique application that works on the basis of the location based services and augmented reality. It allows a user to view information about trash cans in city Uherské Hradiště, for example tons of plastic taken from this exact can etc.

This application should serve primarily as an educational application for elementary school students to realize, how important it is to sort waste and make us an idea of how huge amount of waste can produce city such as Uherské Hradiště, which is globally small city. Maybe this can make us think about their waste management in future and how to treat with nature. And these experiences charged forward and not be ashamed to warn someone, who throw waste on the ground.



Pic. 8. Application logo – own creation

9 QUESTIONNAIRE

To be sure, that I am creating something useful. I decided to venture into streets of Uherské Hradiště and asked people questions, as their answers should provide me with information how and if I should continue with this work.

9.1 Respondents

Respondents are divided into two categories: Children and Adolescents (10 – 18) and Adults (19 – 40) and each category had its own set of questions. In the first category there was 89 respondents and in second I had 73 respondents. Questioning was done in three days.

9.2 Questions

Questions for both categories were created in a way so they can be evaluated for this project.

9.2.1 Questions for Children and Adolescents

- How old are you?
- What school do you study? (Primary school, Secondary (High) school)
- What is knowledge about waste management? (None/Basic/Average)
- What color does the container for paper, plastic and glass have?
- Do you think they give you enough information about waste management in school?
- Would you use an application, that would, in an interesting way gave you information about waste management?

9.2.2 Questions for Adults

- How old are you?
- Do you have children aged 10 to 18?
- Do you think that your children can sort waste?
- Do you sort?
- Which you accept application about sorting waste for your children?

9.3 Evaluation

9.3.1 Evaluation of Children and Adolescents Category

Tab. 7. Evaluation for Children and Adolescents.

Average age:	14 years
Primary school students:	63
High school students:	26
No knowledge:	29
Basic knowledge:	46
Average knowledge:	24
Right answer for colors:	41
Inadequate information in school:	63
Using of application:	61

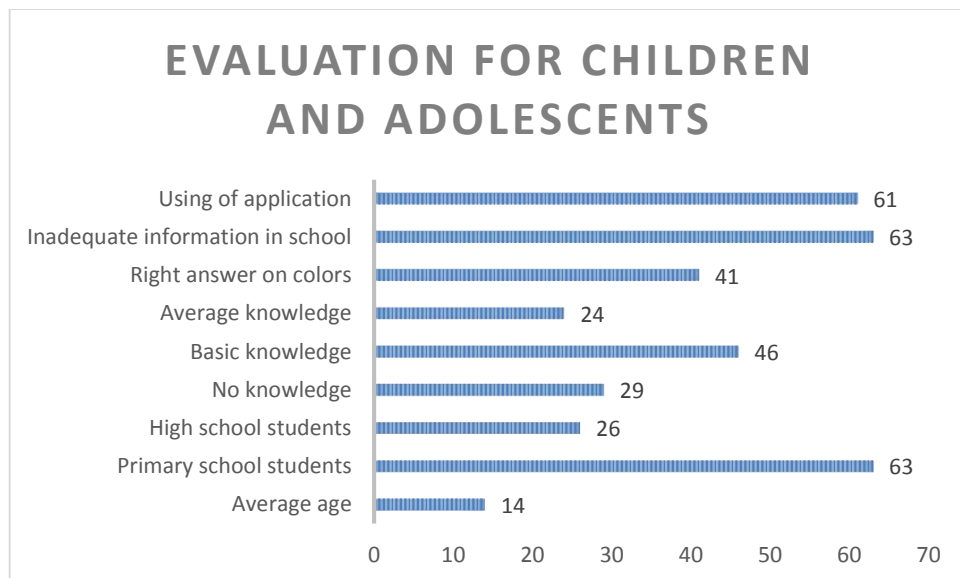


Chart 1. Evaluation for Children and Adolescents.

Average age of respondents in Children and Adolescents category is 14 years. From 89 respondents, 63 are students of primary school, 26 from Secondary school. 29 does not have any knowledge about waste sorting, 46 basic knowledge (they know how to sort), 24 have average knowledge (they know how to sort and where). 41 of them were able to answer

what color does the containers have and what we dispose in them. 63 think they do not get enough information about waste sorting in school and 61 of them would use the application if explain how to.

9.3.2 Evaluation of Adults Category

Tab. 8. Evaluation for Adults.

Average age:	39
Children in age 10 – 18:	41
Knowledge about waste sorting:	28
Waste sorting:	54
Application for children:	48

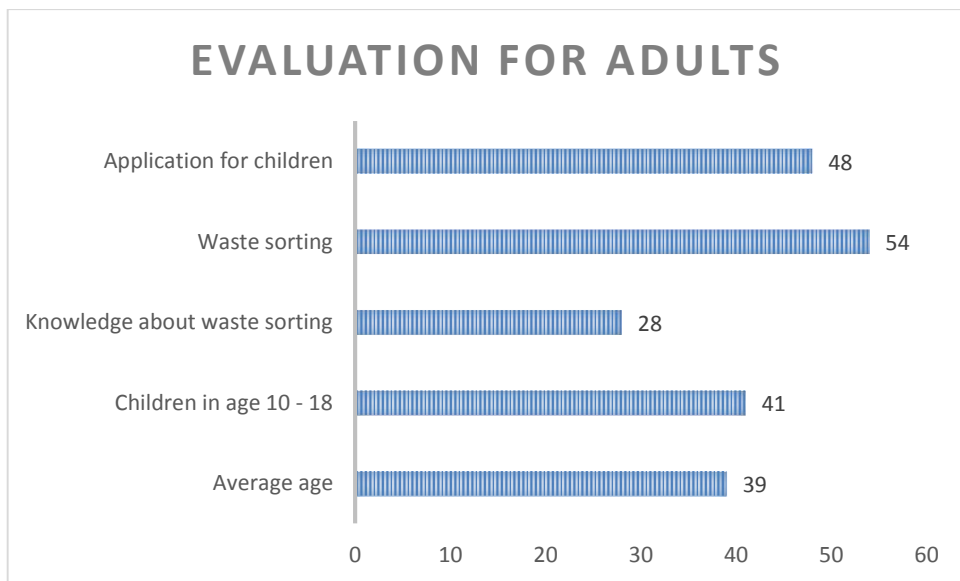


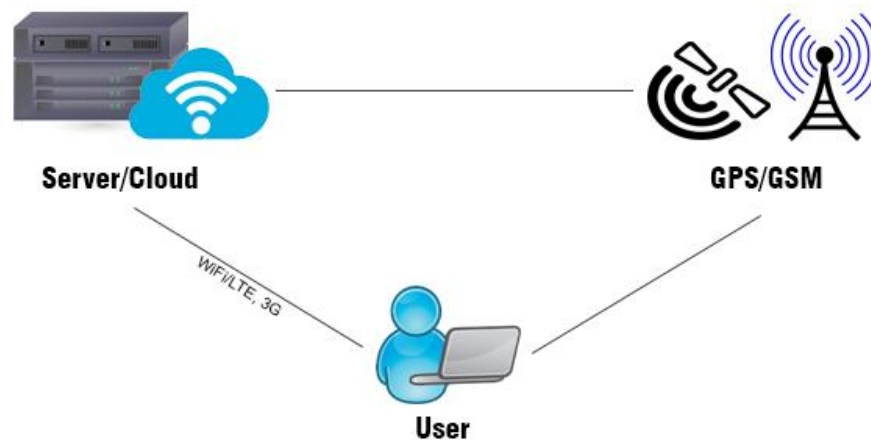
Chart 2. Evaluation for Adults.

Average age of respondents is 39 years. From 73 respondents at least 41 have one child aged 10 – 18. 28 respondents believe that their child can sort waste and 54 sort themselves. 48 thinks that this application would be an asset for children.

9.4 Conclusion of Questionnaire

When evaluating the answers from both categories I revealed that there are still gaps in information and knowledge about waste sorting in society. In both categories more than half respondents agreed, that they would use the application themselves or they think it would be good for their children.

10 CONNECTION BETWEEN USER AND SERVER



Pic. 9. Connection between user and server – own creation

[Inspired by Gary Cutlacks]

When user point his smartphone camera onto a waste container, through his GPS location or through GSM⁶ the server will send actual info about specific waste container into the application. If user is not in front of waste container supported by the app, it will show him nearest location and direct him to another waste container with assistance of GPS or GSM.

10.1 Requirements for user

- Internet connection (WiFi, LTE, 3G)
- GPS
- atleast Android 4.4+

⁶ GSM – Global System for Mobile Communications

11 SERVER

Server is a central, and usually the largest, and most powerful computer in a network that houses the server software, stores and manages common (network) data and supplies it to the individual workstations (clients), and provides shared services. Servers are named after the primary functions they perform, which is:

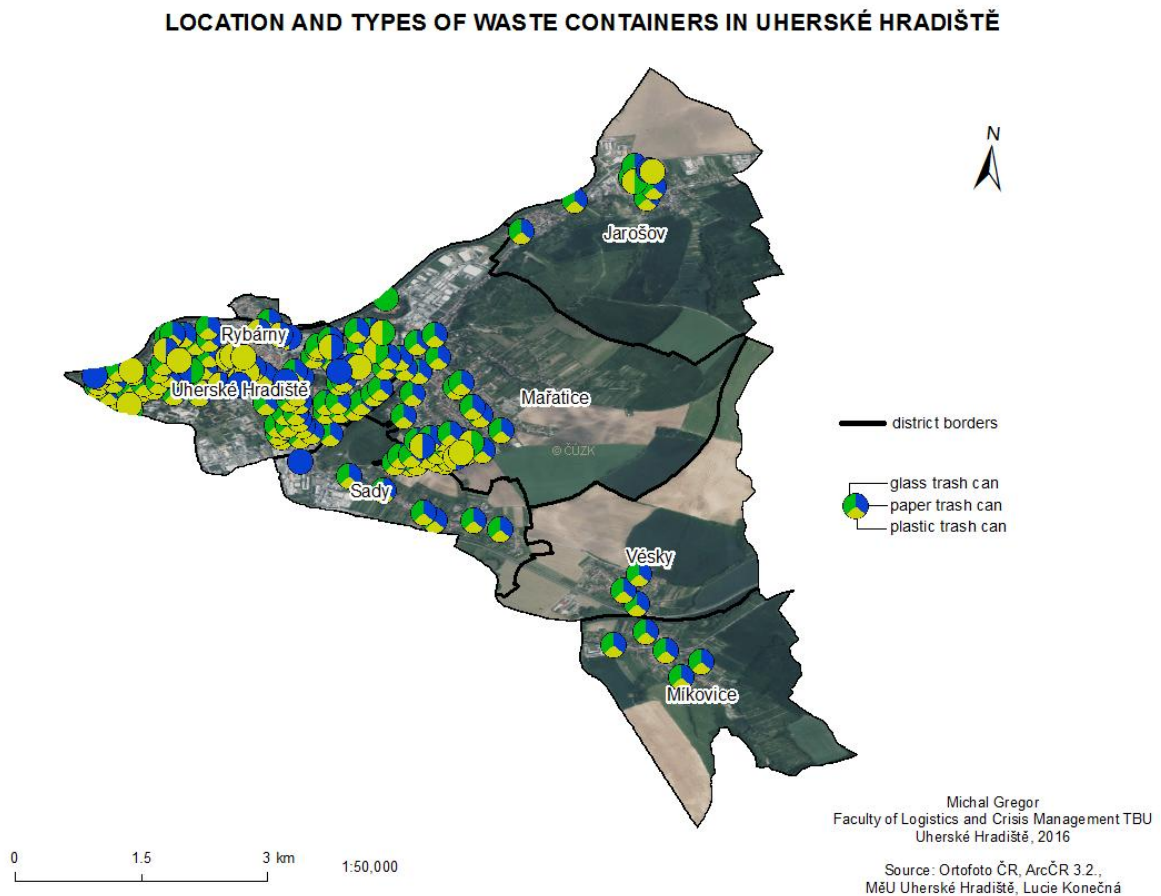
- File servers receive, store, and send files;
- web servers store webpages;
- mail servers receive, store, and forward emails, etc. [17]

11.1 Data on server

Every kind of data which is available for user must have its place on hardware server or a cloud. This data is provided to the user by his internet connection via smartphone (described in part 10).

11.1.1 Waste containers types and positions

Information about location of all waste containers was given to me by city government of Uherské Hradiště and Bc. Lucie Konečná. Enclosed you will find GPS coordinates of waste containers and maps for each city part.



Pic. 10. Location and types of waste containers in Uherské Hradiště – own creation

Most of the waste containers are located in Uherské Hradiště, mainly in Mojmir I and Mojmir II housing estate. Another big part of containers is located in city part Mařatice. Boundary city parts Mikovice, Věsky and Jarošov forms minority.

11.1.2 Information about waste containers

In Uherské Hradiště city are about five hundred waste containers. But their number is not constant, because each month waste containers can be removed or relocated or their number can change. Due to information from municipality, in last quarter 2015 there were 488 waste containers. As you can see bellow, most of them are for plastic. [19] Their exact location is illustrated on Pic. 10. Representation of waste containers in each city part separately you can find in appendices.

Numbers of waste containers in city:

- Paper: 155
- Glass: 164
- Plastic: 169

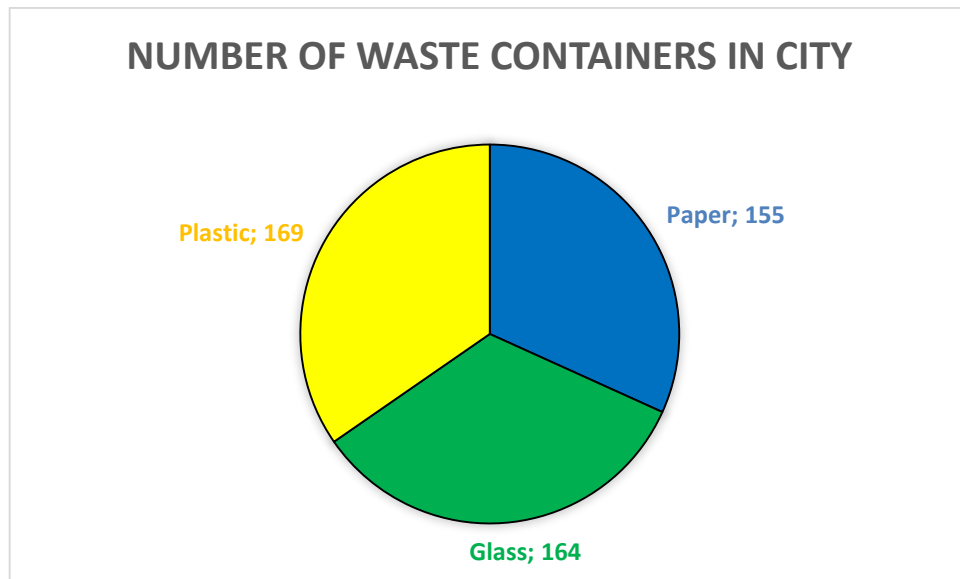


Chart 3. Numbers of trash cans in city.

In the year 2015 was picked about two thousand tons of waste. The biggest part is created by paper – 1 412,84 tons.

Tons of waste:

- Paper: 1412,84 t
- Glass: 284,98 t
- Plastic: 309,14 t

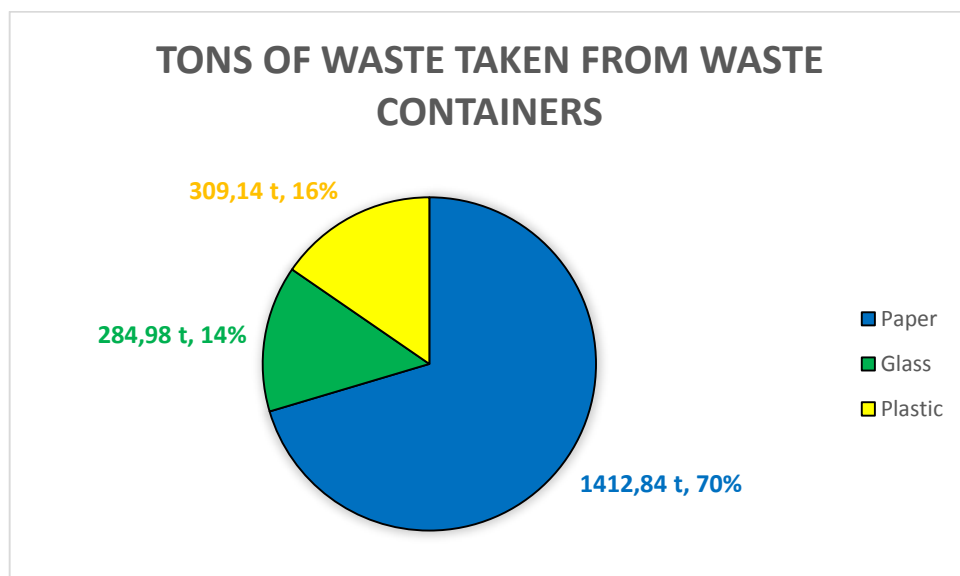


Chart 4. Tons of waste taken from waste containers.

11.1.3 Collection Schedule

Companies Sběrné suroviny UH, s.r.o. and Odpady-Třídění-Recyklace a.s. are taking care of this waste. Glass in odd weeks in Fridays, paper in even weeks on Monday, Tuesday and in odd weeks in Wednesday. Plastic in odd weeks on Monday and Tuesday and in even weeks in Wednesday. [19]

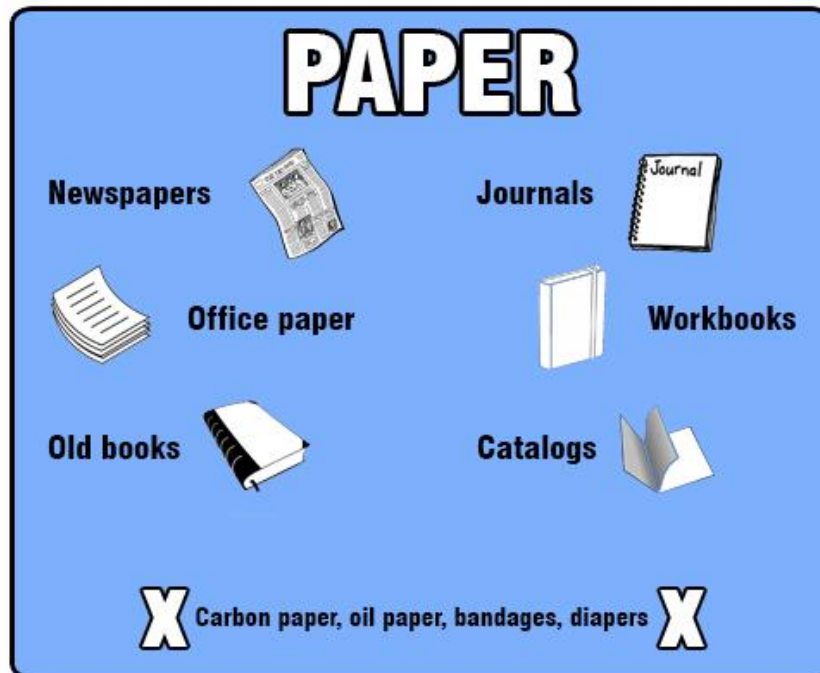
Tab. 9. Collection Schedule. [19]

WASTE	WEEK	DAY
Glass	Odd	Friday
Paper	Even	Monday
	Even	Friday
	Odd	Wednesday
Plastic	Odd	Monday
	Odd	Friday
	Even	Wednesday

11.1.4 Appropriate and inappropriate types of waste thrown in waste containers

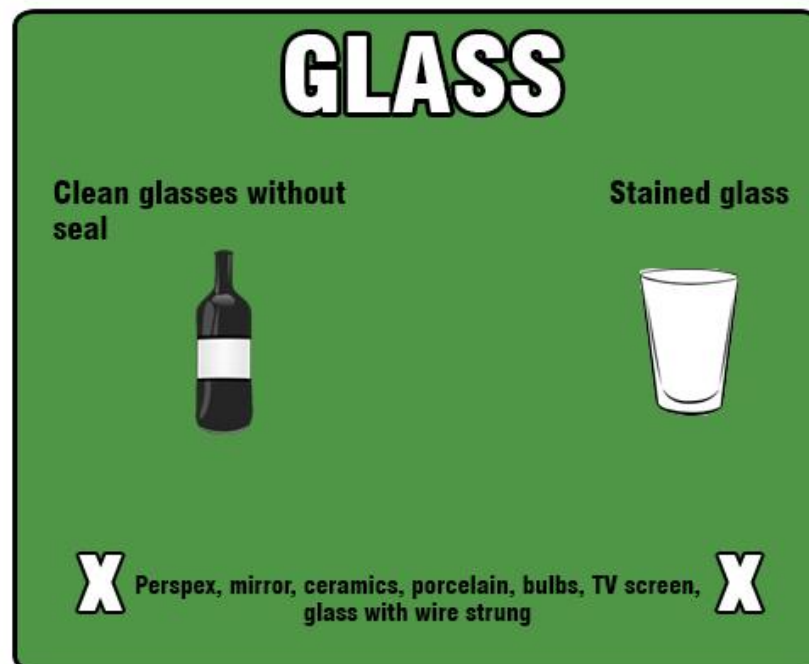
Trash containers should be labelled with stickers, which tells to a citizen, what kind of waste should be thrown into this container. But this sticker has limited lifetime and can be damaged or unreadable. That is another advantage of this application – if you are not sure what can you throw into a waste container, you can simply look into your application.

- Paper:



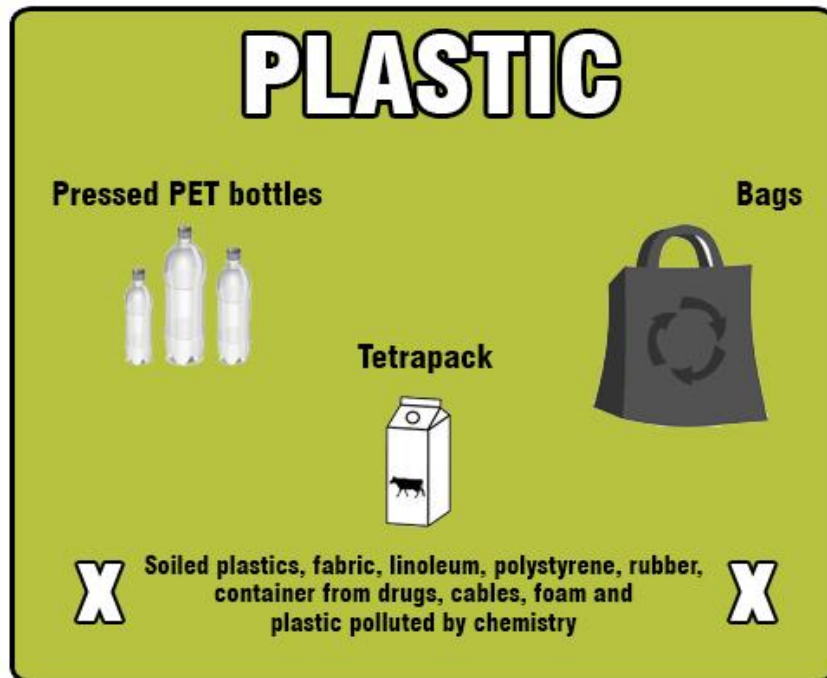
Pic. 11. Appropriate and inappropriate types of waste for paper containers – own creation

- Glass:



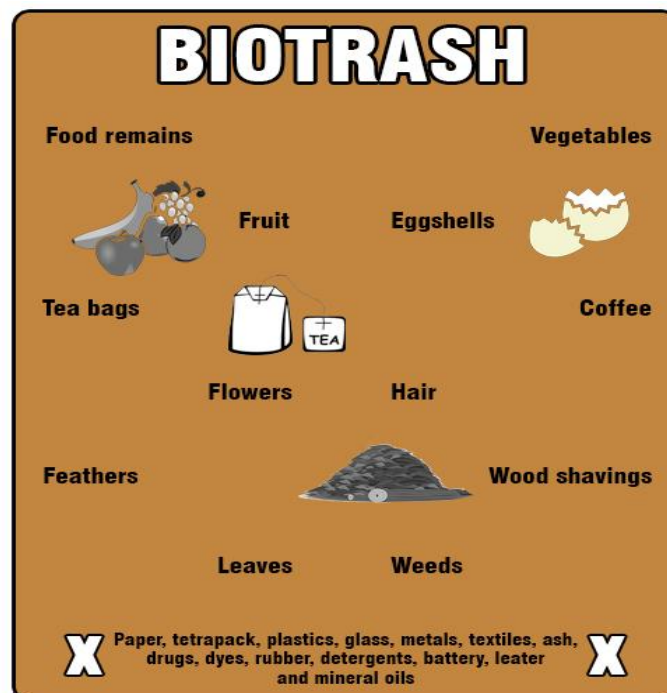
Pic. 12. Appropriate and inappropriate types of waste for glass containers – own creation

- Plastic:



Pic. 13. Appropriate and inappropriate types of waste for plastic container – own creation

- Biotrash:



Pic. 14. Appropriate and inappropriate types of waste for biotrash containers – own creation

11.1.5 Final products of plastic waste

Recyclated PET bottles are used in jacket and sleeping bag, manufacturing or they are added into a carpets. Recyclated plastic bags became plastic bags again. Tufted plastic is used in furniture, composter and noise barrier manufacturing. [18]

11.1.6 Final products of paper waste

Recyclated paper is by far the most known material as its sorting and recylation began in nineteen-century. The truth is that most of the paper is recyclated even if it's not written on it. Usually recyclated products of everyday use are toilet paper, newspapers, office paper, paper boxes etc.

11.1.7 Final products of glass waste

Reusing of glass waste allows glassworks to save tremendous amounts of energy and also substitutes primary material. Only sixty to eighty-five percent of waste glass can be used in production. The biggest advantage of recycling glass is, that it can be repeated indefinitely.

11.1.8 Achievements and rewards

Achievement is something that has been done or achieved through effort. In this application user can get the achievement for some tasks predetermined. For every one achievement he gets points.

Tab. 10. Achievements and Points.

Achievements	Points
Open map for the first time.	5 points
Scan your first waste container.	10 points
Share this application on Facebook.	10 points
Share this application on Twitter.	10 points
Become a fan on Facebook.	15 points
Scan 5 trash can positions.	15 points
Scan 10 trash can positions.	15 points
Scan 15 trash can positions.	15 points

Scan 20 trash can positions.	25 points
Accomplish five achievements.	30 points
Accomplish all achievements.	50 points

If user completes all achievements and gets 200 points he will win a special gift from municipality of Uherské Hradiště.

12 DESIGN AND DESCRIPTION OF APPLICATION

In this part we will focus on design of the application and its description. This should allow us to understand it more deeply.

12.1 Home Screen

Home screen is conceptualized by clear graphics. In the upper part we will find menu, which gives user a choice of different sections of application. On the upper right corner is faculty logo which references to web presentation of faculty. In the main part we can see logo of the application by clicking on it you will start your mobile camera and through his GPS location it will show him augmented reality of waste containers. If the user is not near any supported waste containers it will point him to nearest supported location.

This application will disable internal stabilization so it will always appear widescreen.



Pic. 15. Home screen – own creation

12.2 Preview

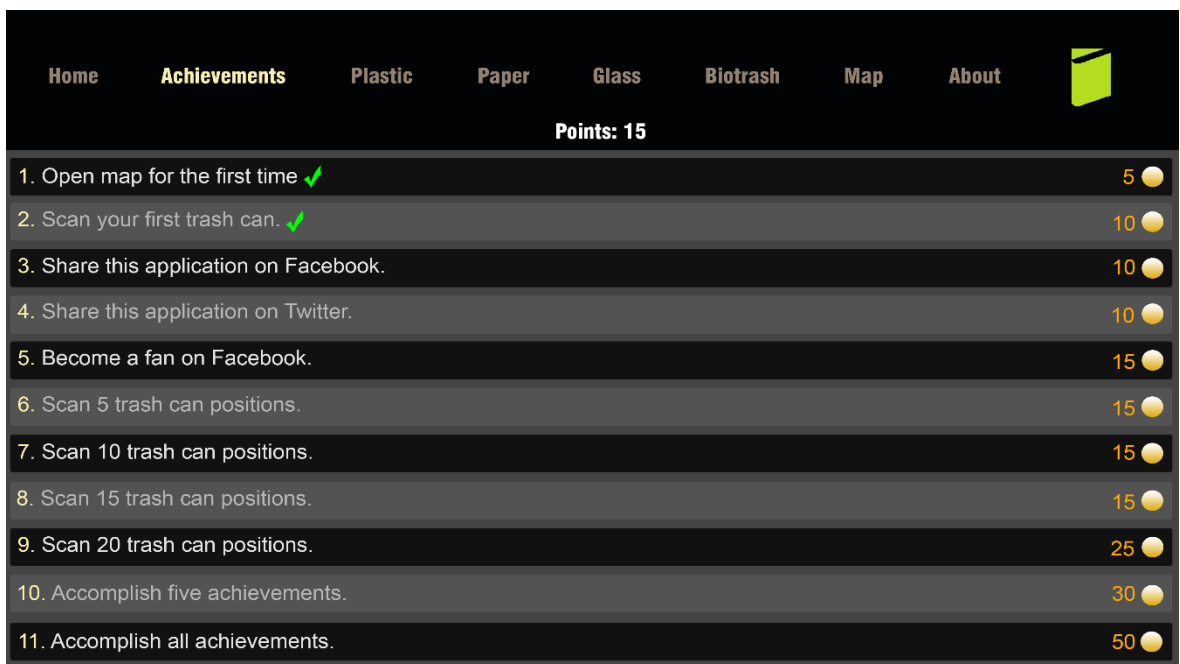
After clicking on logo (if user is on right place near containers) data about specific containers will show.



Pic. 16. Preview – own creation

12.3 Achievements

Achievements are described in part 11.1.8. On this screen we can see classic menu like in Home screen (12.1). In main part is list of achievements with coins. If user complete one of this achievement, he will get points and green “DONE” marker will show up. Information about actual number of points is in upper part under the menu.



Pic. 17. Achievements – own creation

12.4 Plastic

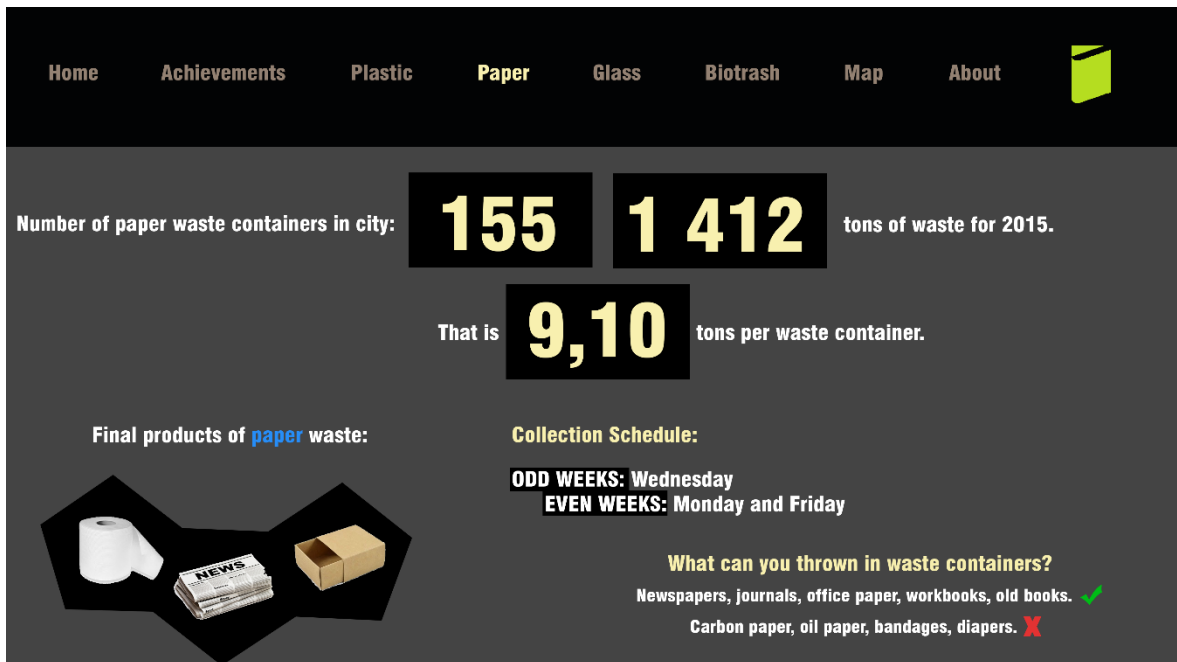
In this section are illustrated basic information about plastic waste. Number of plastic waste containers in city, tons of waste for 2015 and number of tons per one waste container. Further final products of plastic waste, collection schedule and appropriate and inappropriate waste. All information is taken from part 11.



Pic. 18. Plastic – own creation

12.5 Paper

In this section are illustrated basic information about paper waste. Number of paper waste containers in city, tons of waste for 2015 and number of tons per one waste container. Further final products of paper waste, collection schedule and appropriate and inappropriate waste. All information is taken from part 11.



Pic. 19. Paper – own creation

12.6 Glass

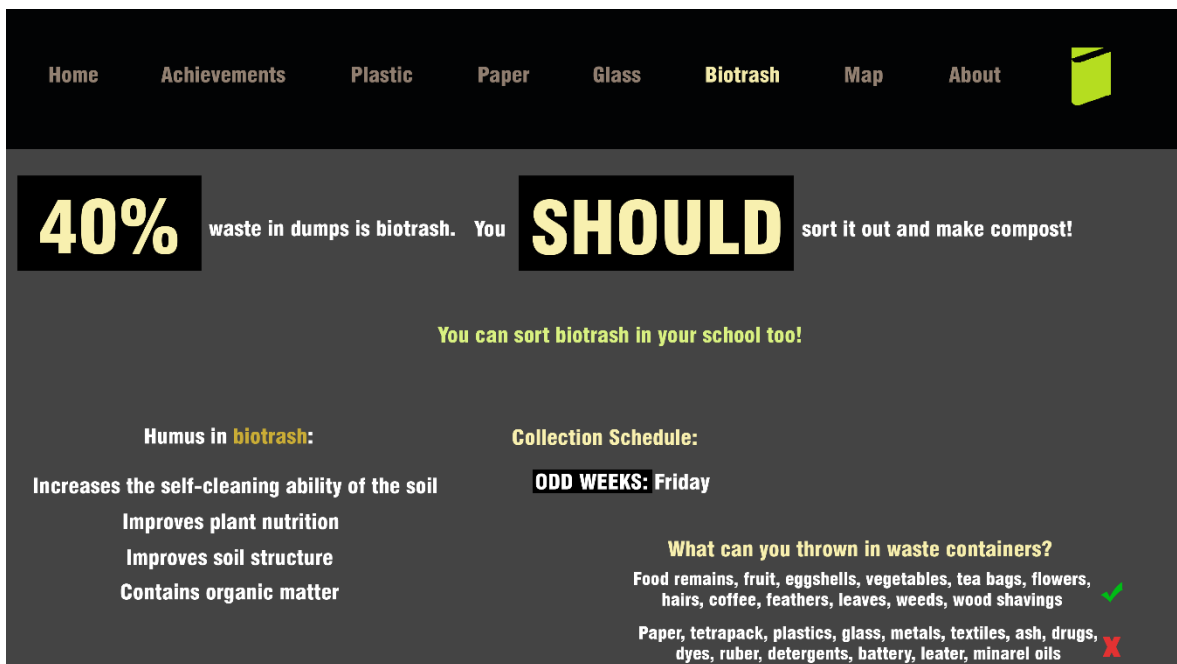
In this section are illustrated basic information about glass waste. Number of glass waste containers in city, tons of waste for 2015 and number of tons per one waste container. Further final products of glass waste, collection schedule and appropriate and inappropriate waste. All information is taken from part 11.



Pic. 20. Glass – own creation

12.7 Biotrash

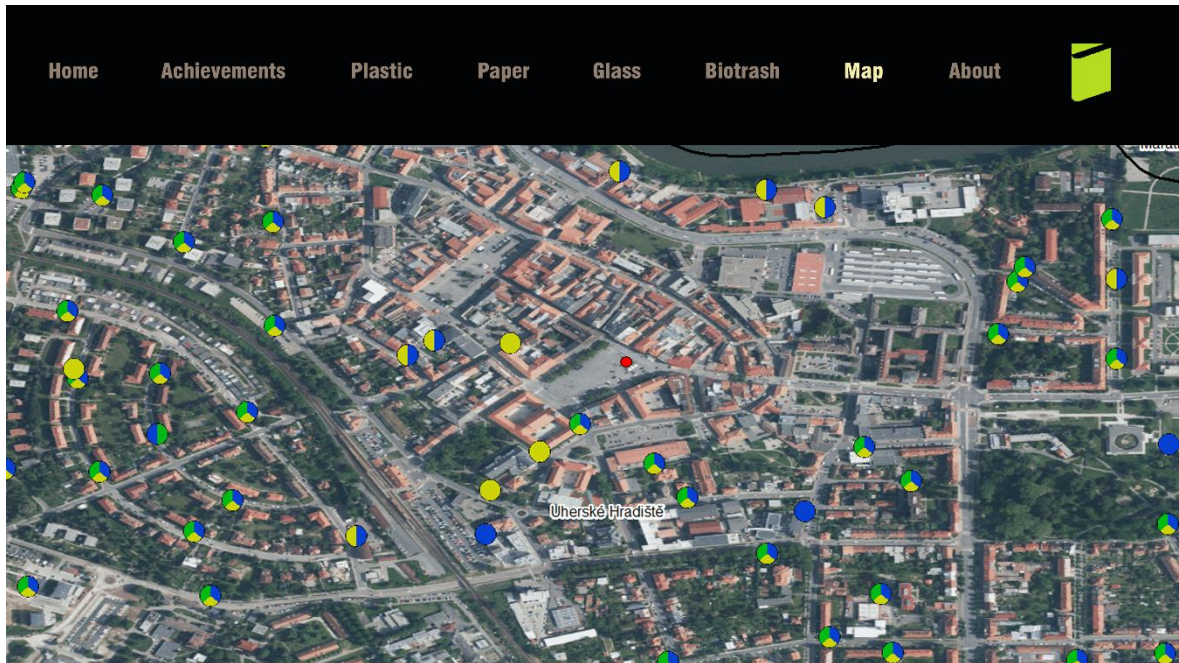
In this section are illustrated information about biotrash. 40% waste in dumps are created by biotrash. That is reason why anyone should sort it out and make compost. Humus from it increases the self-cleanin ability of the soil, improves plant nutrition etc. Also you can find here collection schedule and appropriate and inappropriate types of waste.



Pic. 21. Biotrash – own creation

12.8 Map

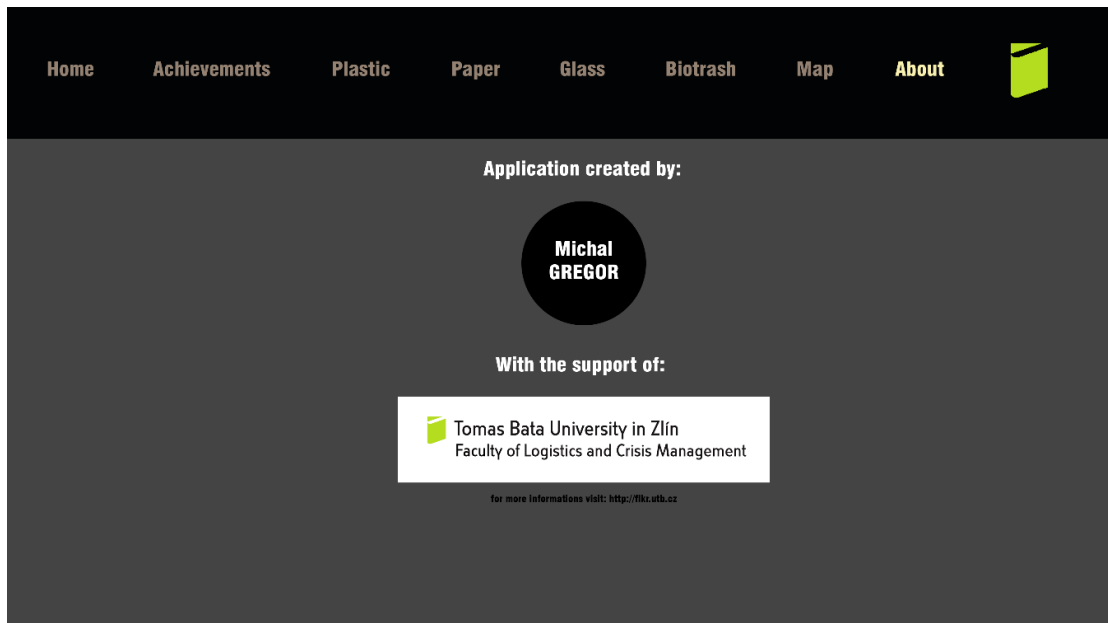
On map is shown users location and waste containers nearby him. You can click on any position and info about it will show.



Pic. 22. Map – own creation

12.9 About

On the page “About” you can find author of the application and logo and link to Tomas Bata University.



Pic. 23. About – own creation

13 FINANCIAL BUDGET FOR APPLICATION

Financial budget for this application was consulted with Mr. Ladislav Balon from ViP Trust Inc. This company deals with graphic design, copywriting, programming and marketing. Guesstimate is 300 000 Czech crowns.

What is important?

- Analysis
- Task
- Project system
- Graphic
- Development and Implementation
- Integration with other systems
- Optimization
- Operation
- Support

This guesstimate does not count with server (part 11) for data and communication with user. Development would probably last from three to six months. It would be great to entrust development to company with great experience in this field of specialization. Application must have perfect handling, must be fast and the code must be written clearly (for better development in future).

14 WASTE MANAGEMENT IN UHERSKÉ HRADIŠTĚ

City Uherské Hradiště has created a plan of waste management and its purpose is creation of conditions to prevent generation of waste and for its treatment in accordance with law about waste. This plan respects priorities in environment in all ČR. Purpose of this document is proposal of integrated system which would upgrade current system and also to put forward material and energetical use of waste before its removal. Waste management in the city is ruled by law norms which are valid for waste management and also by binding regulations of city Uherské Hradiště. Mainly its regulation no. 16/2006 system of collection, salvage, movement, categorizing, using and removal of communal waste and construction waste in the area of Uherské Hradiště and also regulation no. 4/2014 charge for service of system of collection, salvage, movement, categorizing, using and removal of waste. [19]

This system deals with communal waste while citizen is obligated to sort out specific parts (paper, glass, plastic, biowaste, dangerous waste, bulky waste and residual waste). The rest of the waste is moved to the municipal waste dump in this case MWD Otrokovice – Kvítkovice. This waste dump is operated by Marius Pedersen Jsc. Biowaste is moved to the composter in Buchlovice. City Uherské Hradiště does not use waste incinerator, the closest one is in Brno. [19]

CONCLUSION

In theoretical part I defined the location based services and looks to its origin in the past century when it all began in 1970s, when the U.S DoD starts the global positioning system (GPS). In modern history of LBS was the first digital location based patent filled in the USA in 1999, that was a key moment. I also divided the usage areas of location based services and described several applications for emergency, information services, navigation, sports and geotagging and how they work on the principles of LBS.

Next part is focused on augmented reality and its history. AR is the integration of digital information for example with video or environment in real time. It takes an existing picture and combine it with new information into it. History of augmented reality starts in 1962 when Morton Heilig creates simulator called Sensorama. There are many necessary components to make AR work, sort into hardware and software.

Another three parts are focused on virtual reality, augmented virtuality and mixed reality. VR is generated by computer which supports interaction with user. AV describes all the cases where the real object is inserted into a computer-generated environment. MR is a term that has been used to refer to the entire spectrum of situations that span the continuum between virtual and actual reality. It includes augmented reality, augmented virtuality, and other mixed configurations.

After that we explore the virtual and mixed reality tools and evaluate its advantages and disadvantages. In the last section of theoretical part I defined environmental management, its evolution and how it serves in society.

In analytical part I developed application Trash UH. This is a unique application that works on the basis of the location based services and augmented reality. It should serve primarily as an educational application for elementary school students to realize, how important it is to sort waste. To be sure, that I am creating something useful I decided to venture into streets of Uherské Hradiště and asked people questions. Conclusion of questionnaire was good. In both categories more than half respondents agreed, that they would use the application themselves or they think it would be good for their children.

In next part I described connection between user and server. Through GPS location or through GSM the server will send actual information. I also specified the requirements for user device.

Next part is about server, which is a central, and usually the largest, and most powerful computer in network. Every kind of data which is available for user must have its place on server. Data on server contains waste containers types and positions, information about waste containers, collection schedule, appropriate and inappropriate types of waste thrown in waste containers, final products of waste and achievements and rewards.

Another part is focused on design and description of application. This part is about to understand it more deeply. There is design of all pages in application and its description. It contains home screen, preview, achievements, plastic, paper, glass, biotrash, map and about. Very important is financial budget. After consult with Mr. Ladislav Balon from ViP Trust Inc. we agreed, that prize would be 300 000 Czech crowns.

In last part of analytical part is described waste management in Uherské Hradiště and plan of waste management.

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LIST OF ABBREVIATIONS

GPS	Global Positioning System
LBS	Location Based Services
HZS	Hasičský záchranný sbor
JSDH	Jednotka sboru dobrovolných hasičů
GeoRSS	Geographically Encoded Objects for RSS feeds
GSM	Global System for Mobile Communications
WLAN	Wireless Local Area Network
RFID	Radio-Frequency Identification
AR	Augmented Reality
VR	Virtual Reality
AV	Augmented Virtuality
MR	Mixed Reality
HD	High-Definition
OLED	Organic Light-Emitting Diode
LAN	Local Area Network
WiFi	Wireless LAN
LTE	Long-Term Evolution
3G	Third Generation of Mobile Telecommunications Technology
PET	Polyethylenterelftalát
MWD	Municipal waste dump

LIST OF FIGURES

<i>Pic. 1. Usage areas of LBS. [1]</i>	13
<i>Pic. 2. ICEcard application – own creation</i>	14
<i>Pic. 3. Navigation application “CESTY” – own creation</i>	15
<i>Pic. 4. Twitter application - own creation</i>	16
<i>Pic. 5. Endomondo application - own creation</i>	17
<i>Pic. 6. Mixed reality continuum. [14]</i>	23
<i>Pic. 7. Strategic framework for environmental management. [8]</i>	29
<i>Pic. 8. Application logo – own creation</i>	32
<i>Pic. 9. Connection between user and server – own creation [Inspired by Gary Cutlacks]</i>	37
<i>Pic. 10. Location and types of waste containers in Uherské Hradiště – own creation</i>	39
<i>Pic. 11. Appropriate and inappropriate types of waste for paper containers – own creation</i>	42
<i>Pic. 12. Appropriate and inappropriate types of waste glass containers – own creation</i>	42
<i>Pic. 13. Appropriate and inappropriate types of waste for plastic container – own creation</i>	43
<i>Pic. 14. Appropriate and inappropriate types of waste for biotrash containers – own creation</i>	43
<i>Pic. 15. Home screen – own creation</i>	46
<i>Pic. 16. Preview – own creation</i>	47
<i>Pic. 17. Achievements – own creation</i>	47
<i>Pic. 18. Plastic – own creation</i>	48
<i>Pic. 19. Paper – own creation</i>	49
<i>Pic. 20. Glass – own creation</i>	50
<i>Pic. 21. Biotrash – own creation</i>	50
<i>Pic. 22. Map – own creation</i>	51
<i>Pic. 23. About – own creation</i>	52

LIST OF TABLES

<i>Tab. 1. Chronology [2]</i>	12
<i>Tab. 2. History of Augmented Reality. [7]</i>	19
<i>Tab. 3. Advantages and disadvantages of Microsoft HoloLens.</i>	25
<i>Tab. 4. Advantages and disadvantages of Oculus Rift.</i>	25
<i>Tab. 5. Advantages and disadvantages of HTC Vive.....</i>	25
<i>Tab. 6. Technical comparing. [16]</i>	26
<i>Tab. 7. Evaluation for Children and Adolescents.....</i>	34
<i>Tab. 8. Evaluation for Adults.....</i>	35
<i>Tab. 9. Collection Schedule. [19]</i>	41
<i>Tab. 10. Achievements and Points.</i>	44

LIST OF CHARTS

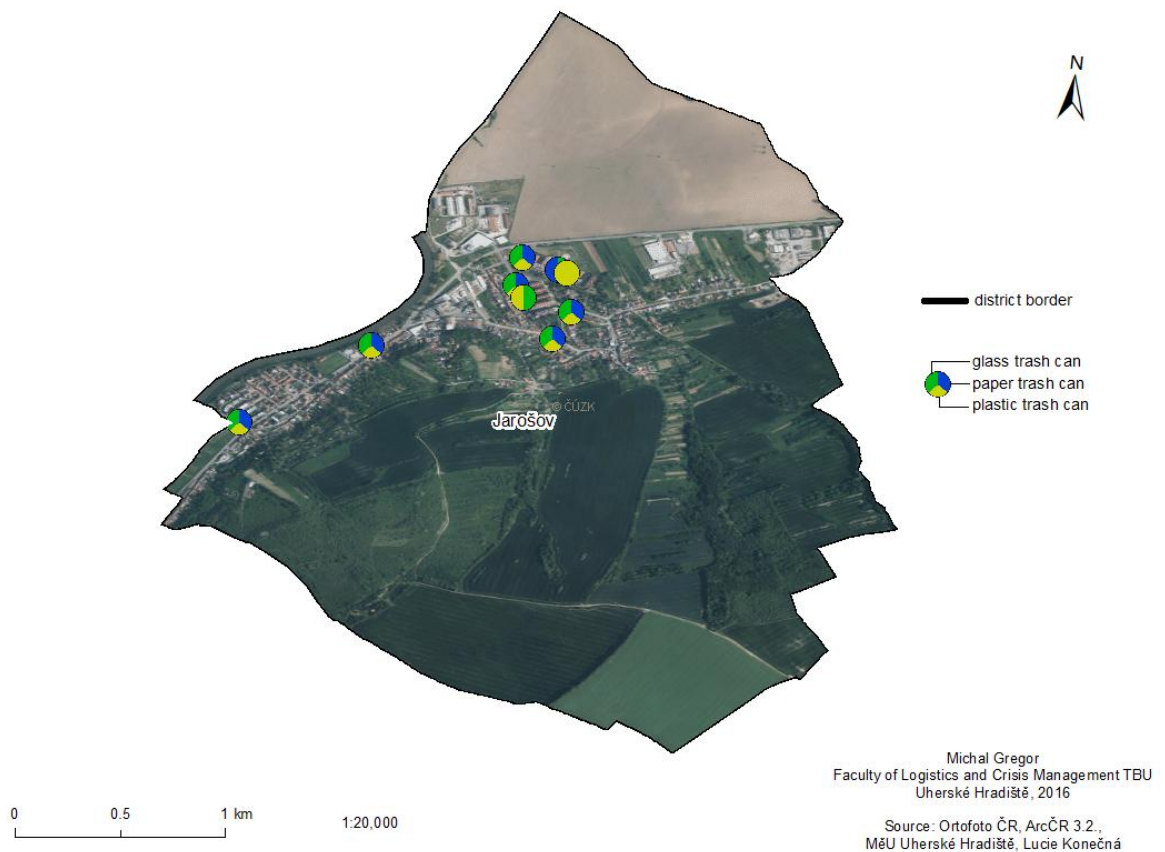
<i>Chart 1. Evaluation for Children and Adolescents.....</i>	<i>34</i>
<i>Chart 2. Evaluation for Adults.....</i>	<i>35</i>
<i>Chart 3. Numbers of trash cans in city.</i>	<i>40</i>
<i>Chart 4. Tons of waste taken from waste containers.</i>	<i>40</i>

APPENDICES

- Appendix P I** Location and Types of Waste Containers in Uherské Hradiště – Jarošov
- Appendix P II** Location and Types of Waste Containers in Uherské Hradiště – Mařatice
- Appendix P III** Location and Types of Waste Containers in Uherské Hradiště - Míkovice
- Appendix P IV** Location and Types of Waste Containers in Uherské Hradiště – Sady
- Appendix P V** Location and Types of Waste Containers in Uherské Hradiště – Vésky
- Appendix P VI** Location and Types of Waste Containers in Uherské Hradiště

APPENDIX P I: LOCATION AND TYPES OF WASTE CONTAINERS IN UHERSKÉ HRADIŠTĚ – JAROŠOV

LOCATION AND TYPES OF WASTE CONTAINERS IN UHERSKÉ HRADIŠTĚ - JAROŠOV



APPENDIX P II: LOCATION AND TYPES OF WASTE CONTAINUERS IN UHERSKÉ HRADIŠTĚ – MAŘATICE

LOCATION AND TYPES OF WASTE CONTAINERS IN UHERSKÉ HRADIŠTĚ - MAŘATICE



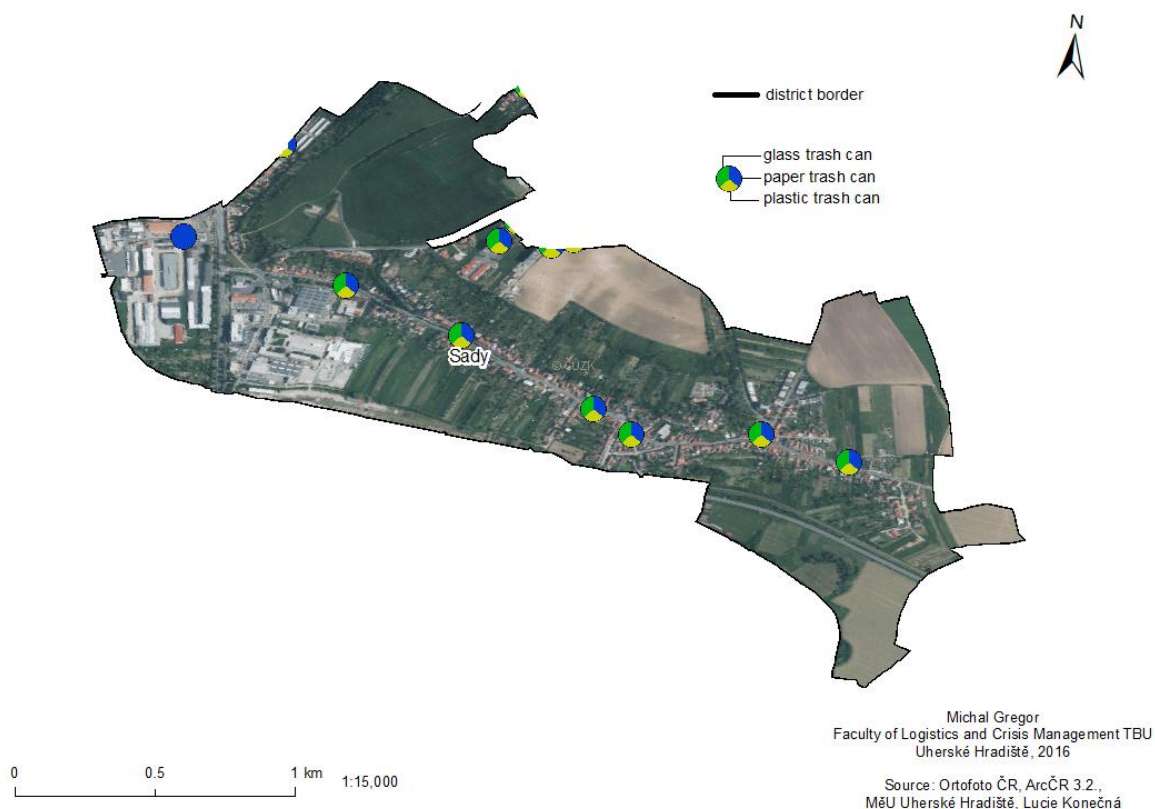
APPENDIX P III: LOCATION AND TYPES OF WASTE CONTAINERS IN UHERSKÉ HRADIŠTĚ – MÍKOVICE

LOCATION AND TYPES OF WASTE CONTAINERS IN UHERSKÉ HRADIŠTĚ - MÍKOVICE



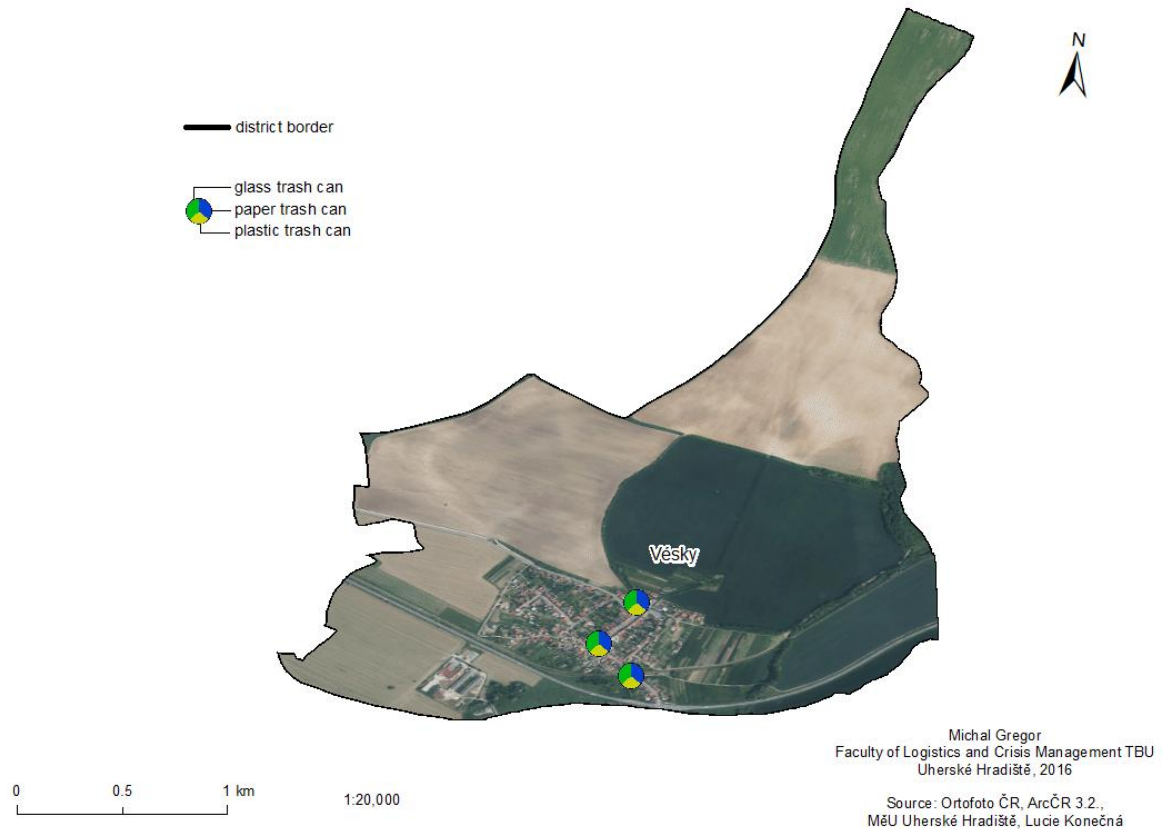
APPENDIX P IV: LOCATION AND TYPES OF WASTE CONTAINERS IN UHERSKÉ HRADIŠTĚ – SADY

LOCATION AND TYPES OF WASTE CONTAINERS IN UHERSKÉ HRADIŠTĚ - SADY



APPENDIX P V: LOCATION AND TYPES OF WASTE CONTAINERS IN UHERSKÉ HRADIŠTĚ – VĚSKY

LOCATION AND TYPES OF WASTE CONTAINERS IN UHERSKÉ HRADIŠTĚ - VĚSKY



APPENDIX P VI: LOCATION AND TYPES OF WASTE CONTAINERS IN UHERSKÉ HRADIŠTĚ

LOCATION AND TYPES OF WASTE CONTAINERS IN UHERSKÉ HRADIŠTĚ

