THE MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN

Kazakh National Research Technical University named after K. I. Satpayev

Institute of Information and Telecommunication Technologies

Department of Cybersecurity, Data Storage and Processing

Uzakov Mukhtar

Augmented reality and 3D modeling in Daily life and education system

DIPLOMA WORK

Specialty 5B070300 – «Information systems»

Almaty 2019

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ADMITTED TO DEFENSE
Head of Department Cybersecurity
Data Storage and Processing,
PhD, associate professor
_____ N.A.Seilova
« 13 » 05 2019.

DIPLOMA WORK

The theme of work: « Augmented reality and 3D modeling in Daily life
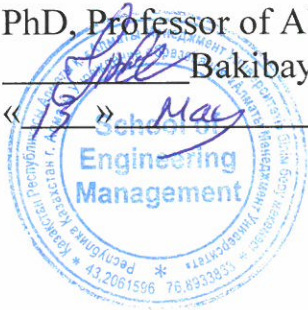
and education system»

Specialty 5B070300 – «Information systems»

Performed:

Uzakov M. A.

Reviewer,
PhD, Professor of AlmaU
_____ Bakibayev T. I.
« 13 » May 2019.

Scientific advisor,
Master of technical science, lecturer
_____ Duisenbayeva A.N.
« 13 » May 2019.

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5B070300 – Information system

AFFIRM
Head of Department Cybersecurity
Data Storage and Processing,
PhD, associate professor
_____Seilova N.A.
«_13_»_05_____2019.

TASK
to perform the Diploma work

Student: Uzakov Mukhtar
The theme of diploma work: <u>«Augmented reality and 3D modeling in Daily life and Education system»</u>
Approved by the order of the University №_1162_from «_16_»__10____2019.
Deadline for completion of work «_13_»__05____2019.
Source data to work: Analysis of Augmented Reality in human's daily life and education system, the development of mobile application with Augmented Reality technology.
The list of subject to the development of the thesis or a summary of its content:
<u>a) Development of mobile application</u>
<u>b) Integration of AR technology to mobile application</u>
The list of graphic material presented <u>15</u> slides of presentation work
Recommended main literature: 15
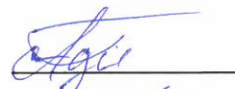
SCHEDULE
of preparation of the Diploma work

The name of the sections, a list of issues	Deadline for submission to supervisor and consultants	Notice
Overview and analysis of existing IS on the market	10.01.2019 - 08.03.2019.	
Writing the functional structure of IS	05.02.2019-10.03.2019.	
Writing program part	11.03.2019-28.04.2019.	

Signature
Consultants and norm control to complete a thesis indicating the related sections of the Diploma work
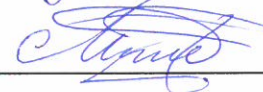
Section titles	Consultants, Full name (academic degree, rank)	Data for signing	Signature
Program software	M. B. Bauyrzhan, Master of technical science, lecturer	08.05.19	
Norm control	O.V. Kisseleva, Ph.D senior-lector	08.05.19	D.Kul

Scientific adviser _____ Duisenbayeva A. N.

Task was accepted for execution by the student_____Uzakov M.A.

Data «13» 05 2019

REVIEW

of **Diploma work**
(*name of the type work*)

Uzakov Mukhtar
(*student full name*)

Specialty 5B070300 – «Information systems»

Theme: **Augmented Reality and 3D modeling in Daily life and education**

Performed:
a) software part on ___*25-36*___ pages
b) the volume of work ___*47*___ pages

The thesis is focused on augmented reality technology. This topic of the thesis is very relevant due to the fact that the rapid development of information technology contributed to new types of requirements in daily life.

The content of the thesis consists of an introduction, three chapters, conclusion, and a list of references.

In the first chapter, the author gives a theoretical description of augmented technology and possibilities to enhance daily life. Exploring this question, the author introduces us to the essence of augmented reality.

In the second section author analyzes in detail the effect of augmented reality on human brain and problems in education system.

The third section is dedicated to development of mobile application with AR technology.

The author of the final qualifying work showed an excellent ability to formulate his own point of view on the problem under consideration. The conclusions formulated in the paper are sufficiently substantiated and can be used in practical activities. Significant deficiencies in the thesis are not revealed.

Performance evaluation

Diploma work is executed on "excellent" (90%), and its author deserves the academic degree "bachelor" on specialty 5B070300 – «Information systems».

Reviewer

PhD, professor of AlmaU
_____ T.I. Bakibayev
« ___ » ___ *May* ___ 2019.

REVIEW

of **Diploma work**
(*name of the type work*)

Uzakov Mukhtar
(*student full name*)

Specialty 5B070300 – «Information systems»

Theme: **Augmented Reality and 3D modeling in Daily life and education**

Performed:
a) software part on ___25-36___ pages
b) the volume of work ___47___ pages

The final qualifying work was carried out on a topic that is currently relevant since each person leads his or her daily life. The author has conducted examples of improving the methods of presenting information in training, which certainly deserves special attention.

Author processed enough amount of needed material, at a high theoretical and methodological level; a study of the problems of augmented reality was conducted. The material in the final qualifying work is logically structured, written by the proper style of presentation.

The submitted diploma work consists of introduction, main parts, and conclusion. The main parts are focused on general principles of augmented technology.

The conclusions formulated in the paper are sufficiently substantiated and can be used in practical activities. Significant deficiencies in the thesis are not revealed.
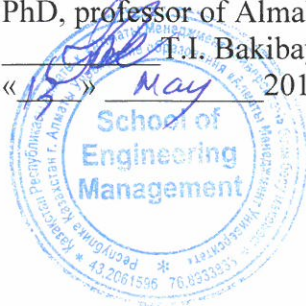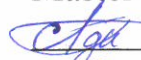
Reviewer
Master of technical science, lecturer
_____Duisenbayeva A.N
« 13 » __May__ 2019.

Протокол анализа Отчета подобия

заведующего кафедрой / начальника структурного подразделения

Заведующий кафедрой / начальник структурного подразделения заявляет, что ознакомился(-ась) с Полным отчетом подобия, который был сгенерирован Системой выявления и предотвращения плагиата в отношении работы:

Автор: Uzakov M.A

Название: Augmented Reality and 3D modeling in daily life

Координатор: Асемгуль Дуйсенбаева

Коэффициент подобия 1:0,7

Коэффициент подобия 2:0

Тревога:0

После анализа отчета подобия заведующий кафедрой / начальник структурного подразделения констатирует следующее:

☑ обнаруженные в работе заимствования являются добросовестными и не обладают признаками плагиата. В связи с чем, работа признается самостоятельной и допускается к защите;
☐ обнаруженные в работе заимствования не обладают признаками плагиата, но их чрезмерное количество вызывает сомнения в отношении ценности работы по существу и отсутствием самостоятельности ее автора. В связи с чем, работа должна быть вновь отредактирована с целью ограничения заимствований;
☐ обнаруженные в работе заимствования являются недобросовестными и обладают признаками плагиата, или в ней содержатся преднамеренные искажения текста, указывающие на попытки сокрытия недобросовестных заимствований. В связи с чем, работа не допускается к защите.

Обоснование:

Заимствований не обнаружено

Дата 13.05.19г.

Подпись заведующего кафедрой /

начальника структурного подразделения

Окончательное решение в отношении допуска к защите, включая обоснование:

....

.... *Допускается к защите* ....

....

....

....

Дата *13.05.19г*

Подпись заведующего кафедрой /

начальника структурного подразделения

Протокол анализа Отчета подобия Научным руководителем

Заявляю, что я ознакомился(-ась) с Полным отчетом подобия, который был сгенерирован Системой выявления и предотвращения плагиата в отношении работы:

Автор: Uzakov M.A

Название: Augmented Reality and 3D modeling in daily life

Координатор: Асемгуль Дуйсенбаева

Коэффициент подобия 1:0,7
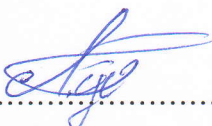
Коэффициент подобия 2:0

Тревога:0

После анализа Отчета подобия констатирую следующее:

☑ обнаруженные в работе заимствования являются добросовестными и не обладают признаками плагиата. В связи с чем, признаю работу самостоятельной и допускаю ее к защите;

☐ обнаруженные в работе заимствования не обладают признаками плагиата, но их чрезмерное количество вызывает сомнения в отношении ценности работы по существу и отсутствием самостоятельности ее автора. В связи с чем, работа должна быть вновь отредактирована с целью ограничения заимствований;

☐ обнаруженные в работе заимствования являются недобросовестными и обладают признаками плагиата, или в ней содержатся преднамеренные искажения текста, указывающие на попытки сокрытия недобросовестных заимствований. В связи с чем, не допускаю работу к защите.

Обоснование:

Допускается к защите

13.05.2019

Дата

Подпись Научного руководителя

Краткий отчет

Университет:	Satbayev University
Название:	Augmented Reality and 3D modeling in daily life
Автор:	Uzakov M.A
Координатор:	Асемгуль Дуйсенбаева
Дата отчета:	2019-05-03 11:15:00
Коэффициент подобия № 1:	**0,7%**
Коэффициент подобия № 2:	**0,0%**
Длина фразы для коэффициента подобия № 2:	**25**
Количество слов:	9 254
Число знаков:	58 269
Адреса пропущенные при проверке:	
Количество завершенных проверок:	20

Самые длинные фрагменты, определеные, как подобные

№	Название, имя автора или адрес гиперссылки (Название базы данных)	Автор	Количество одинаковых слов
1	URL_ https://www.linkedin.com/pulse/brands-must-adapt-rise-ar-david-stafford		12

14.05.2019, 14:08

2	Particle Physics Experiments at JLC (*RefBooks* - https://arxiv.org/)	ACFA Linear Collider Working Group;	8
3	URL_ https://www.linkedin.com/pulse/brands-must-adapt-rise-ar-david-stafford		7
4	URL_ https://www.linkedin.com/pulse/brands-must-adapt-rise-ar-david-stafford		7
5	URL_ https://bpmn.org/ocsmp/model-quality-literature-review.pdf		6
6	URL_ https://bpmn.org/ocsmp/model-quality-literature-review.pdf		5
7	URL_ https://www.linkedin.com/pulse/brands-must-adapt-rise-ar-david-stafford		5
8	URL_ https://bpmn.org/ocsmp/model-quality-literature-review.pdf		5
9	URL_ https://en.wikipedia.org/wiki/Simultaneous_localization_and_mapping		5
10	Particle Physics Experiments at JLC (*RefBooks* - https://arxiv.org/)	ACFA Linear Collider Working Group;	5

Документы, в которых найдено подобные фрагменты: из RefBooks i

Источник https://arxiv.org/

№	Название	Автор	Количество одинаковых слов (количество фрагментов)
1	Particle Physics Experiments at JLC	(ACFA Linear Collider Working Group;)	13 (2)

Документы,содержащие подобные фрагменты: Из домашней базы данных

Не обнаружено каких-либо заимствований

Документы,содержащие подобные фрагменты: Из внешних баз данных

Не обнаружено каких-либо заимствований

14.05.2019, 14:08

Документы, выделенные жирным шрифтом, содержат фрагменты потенциального плагиата, то есть превышающие лимит в длине коэффициента подобия № 2

№	Источник гиперссылки	Количество одинаковых слов (количество фрагментов)
1	URL_ https://www.linkedin.com/pulse/brands-must-adapt-rise-ar-david-stafford	31 (4)
2	URL_ https://bpmn.org/ocsmp/model-quality-literature-review.pdf	16 (3)
3	URL_ https://en.wikipedia.org/wiki/Simultaneous_localization_and_mapping	5 (1)

ANNOTATION

This diploma is related to Augmented Reality technology on human's daily life, analysis of AR on human brain and the development of mobile application with augmented technology for educating system.

To create the mobile application were used Unity3D game engine, Google AR Core SDK, UnityC# programming language.

Mobile application allows users to create AR scenes in flat(surf) places and play augmented videos.

АННОТАЦИЯ

Данная дипломная работа связана с технологией дополненной реальности для повседневной жизни человека, анализом AR на человеческом мозге и разработкой мобильного приложения с технологией дополненной реальности для системы образования.

Для создания мобильного приложения были использованы игровой движок Unity3D, Google AR Core SDK, язык программирования UnityC #.

Мобильное приложение позволяет пользователям создавать AR-сцены в плоских (сёрфовых) местах и воспроизводить дополненные видеоролики.

АҢДАТПА

Бұл тезис адамның күнделікті өмірі үшін күшейтілген шындық технологиясына, адамның миына арналған AR-тің талдауына және білім беру жүйесіне арналған кеңейтілген шындық технологиясымен мобильді қосымшаның дамуына байланысты.

Ұялы қосымшаны жасау үшін Unity3D ойын автоматы, Google AR Core SDK, UnityC # бағдарламалау тілі пайдаланылды.

Мобильді қосымша пайдаланушыларға жазғы (серфинг) жерлерде AR-сахналарды жасауға және кеңейтілген бейнені ойнатуға мүмкіндік береді.

CONTENT

INTRODUCTION

Nowadays, many innovative technologies have achieved significant development, including augmented reality technologies. They actually go ahead with AR implementation in all sectors of society.

It is worth noting that AR is still perceived more as something frivolous, a trick of marketers that have replaced the insertion of 3D advertising glasses in glossy magazines.

Augmented reality has great potential for development and improvement. This technology can turn the whole world in the future, make it much more convenient, more interactive and safer. A lot of companies work in the direction of the development of augmented reality technology. Many of them are focused on the introduction of this technology in the educational sphere - from preschool institutions to higher educational institutions. This technology is a kind of connecting link between two worlds - the real and the virtual. This is the main advantage of AR technology over full virtual reality (VR) technology.

Technologies of full virtual reality cause a number of well-founded threats to parents because there have already been cases when a child with his head plunged into a virtual invented world. The technologies of augmented reality by their nature are in contact with reality but do not replace, but complement it. This situation makes it possible to eliminate the possible psychological threats to the use of this technology in the educational sphere, starting from the preschool age - even if the user of the augmented reality system still does not know how to read.

Relevance. Technologies of augmented and virtual reality are constantly discussed. Already today, these technologies promise their users a lot. First of all, it is providing staff with the necessary information in the present time, holding virtual meetings, so that the meeting participants are behind one desk and much more.

The development of these technologies is at the stage of formation and development. At the same time, experts assure that virtual and augmented reality have broad prospects for development.

Methodological background research. As the industry develops and technologies improve, mixed reality may well intersect with new trends like machine learning and artificial intelligence, or applications for Internet of Things. And then we are waiting for a completely new, high-tech ecosystem of intelligent products.

1 Principles of augmented reality

1.1 Basics of augmented reality technology

After several years of sustainable development, augmented reality is finally on the verge of a great takeoff. Apple's SDKs and Google act as catalysts for the market augmented reality is becoming increasingly available, and consumer expectations for content in augmented reality are growing rapidly. For the world, the moment will come when it will become "multi-layered".

We are entering a new era of immersive computing. For the past 30 years, we have been on the path to simplifying the way we interact with technology, thanks to overcoming the barriers between the real and virtual worlds. For years, in cooperation with machines, we counted on intermediary devices, such as a keyboard and mouse. The beginning of the era of smartphones has led to the emergence of "smart" screens that can be "taped", "hooked" and with which (lately) you can "talk".

Virtual and Augmented Reality bring interaction to a new level, offering scenarios built around natural methods such as gestures and gaze, and thus shifting attention from the mobile screen to the real or simulated world around us.

Both augmented and virtual reality can be perceived as being on the immersiveness scale. At one end, we have a reality, analogue world, at the other - a virtual reality, where the user is completely immersed in a simulated environment, displaying either real places or completely imaginary. Augmented reality is somewhere in the middle, complementing the physical world in our eyes, imposing virtual objects on it. Despite the fact that there is no universally accepted definition, the next category - Mixed Reality (MR) - is often used to designate a mixture of augmented and virtual reality, allowing interaction with virtual objects on a larger scale and with tracking the surrounding world. Mixed reality (MR), sometimes referred to as hybrid reality, is the merging of real and virtual worlds to produce new environments and visualizations where physical and digital objects co-exist and interact in real time. Mixed reality takes place not only in the physical world or the virtual world, but is a mix of reality and virtual reality, encompassing both augmented reality and augmented virtuality via immersive technology. The connection between reality and virtual reality is described in figure 1.1. As an intermediate case in the virtuality continuum, it refers to predominantly virtual spaces, where physical elements, e.g. physical objects or people, are dynamically integrated into, and can interact with, the virtual world in real time. This integration is achieved with the use of various techniques.
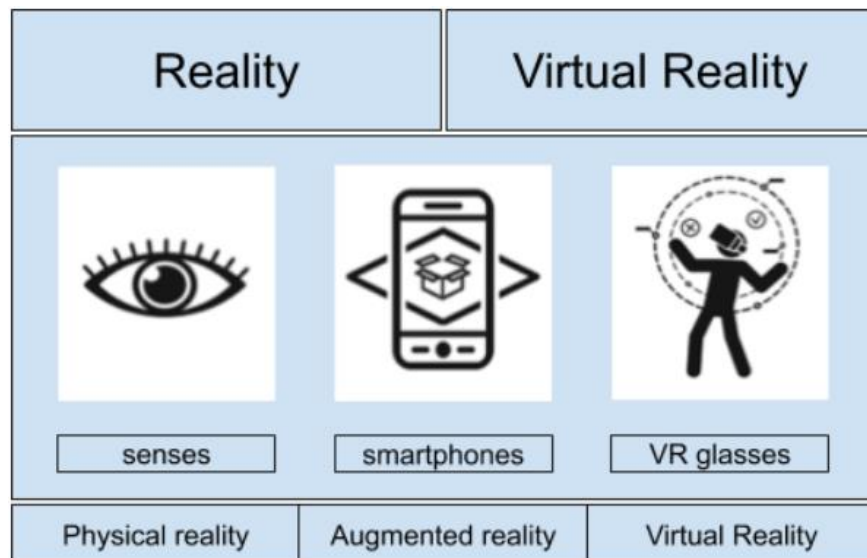
Figure 1.1- The connection between reality and virtual reality

1.2 Augmented reality devices

The tools for creating augmented reality are as follows:
- mobile devices (tablets, cell phones);
- augmented reality glasses;
- TV (or computer screen);
- gaming computer like Kinect;
- facilities for playing AR in open space;
- special facilities.

The general scheme of creating augmented reality in all cases is the following: the optical scanner (camera) of the device reads (removes) the image of a real object; the device software performs identification and analysis of the received image, selects or calculates the visible addition corresponding to the image, combines the real image with its addition and displays the final image on the visualization device. The principle of AR is shown in figure 1.2.

Recall the way to create an augmented reality with one-of-a-kind devices.

Mobile gadgets. Their practical application within the area of augmented reality is, traditionally, wonderful or promotional purposes. The camera of the pill (cellular smartphone) transfers the captured photo to a unique application that the consumer

pre-downloads to the device. When studying a photograph, this system recognizes this photo, selects the content material associated with the photograph (it is able to be textual
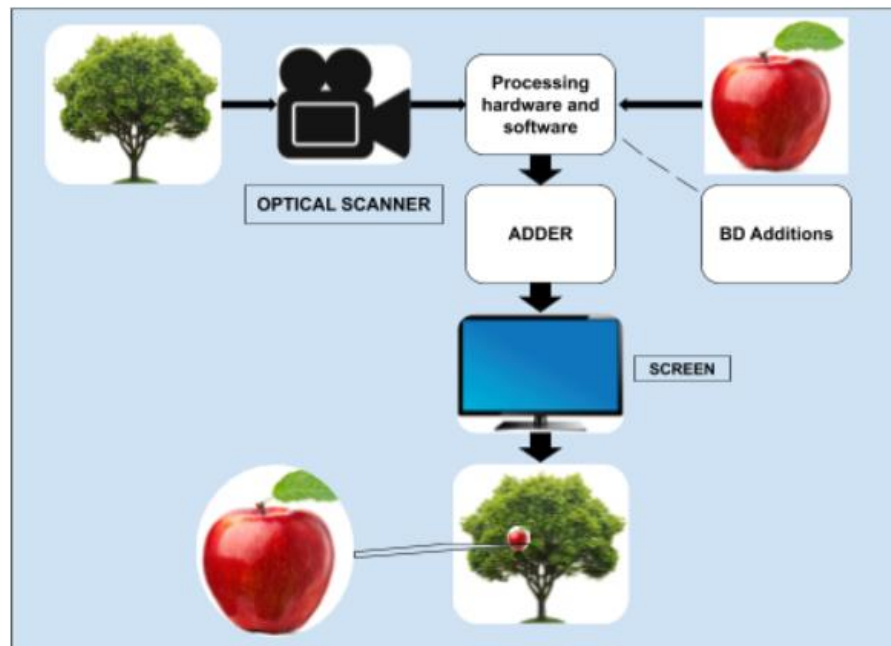
Figure 1.2 - Scheme of AR technology principle

content, video, 3-d model) and plays it towards the heritage of the picture from the digital cam.

For instance, while you hover a digital camera cellphone in an advertisement in a mag, you see on the smartphone display screen a three-dimensional photo of the product that this commercial is selling. A few applications for reproducing such augmented reality have functions for controlling this object (scaling, turning, and calling audible indicators while touching exceptional components of the object). The possibilities of visualization of augmented reality are decided most effective by the imagination of the developers of the program.

Augmented reality Glasses. It's just computerized glasses. A person who has placed such glasses on himself sees via the obvious lenses the actual international and at the same time virtual items superimposed on it.

The augmented reality glasses have an integrated system that tracks the motion of the eyes, and software that summarizes the virtual and actual snapshots allows you to create the illusion of a landscape view. As an example, ancient castles can be constructed into the real city panorama and depending on the flip of the top (look), someone sees one-of-a-kind parts of such an augmented panorama. An example of such points is the Microsoft HoloLens device

TV (laptop display screen). Normally used for broadcasting, for example, sports.
activities match. The video signal, before happening the air, is handled through a special software program that superimposes any video data at the picture. The viewer

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sees the already modified video sign, which incorporates a real and laptop picture. And regularly he does now not even recognise that he sees augmented reality. it's miles clear that the television sign on the air is going with a few put off vital for computer sign processing. This method is frequently used at some point of sports fits for drawing on the actual photograph of virtual marks and contours showing the gap to the gate, the presence of offside, and many others.

Kinect gaming pc. In truth, Kinect is a recreation controller that works with a laptop or recreation console. The controller includes a video camera that allows the software to investigate the surrounding area, the location and gestures of the participant. The system also consists of infrared intensity sensors and a microphone. The software receives a three-dimensional photograph and calibrates the sensors based totally on the level of illumination and environmental conditions, conducts recognition of facial expressions, voice, body motion. as a consequence, the player himself (and even several gamers) and the surrounding space are embedded inside the gameplay, this is, in the video picture generated by way of the sport.

Playing AR in open space. With a view to forming an augmented truth in open space, we want video cameras, a laptop with special software, a laser system. The video digital camera receives and sends the real picture to the pc, the software plays image evaluation, the laser setup draws a further photo on the actual photo with a light beam. for instance, billiard simulator works. The participant ambitions with a cue on the ball at the billiard table, the program analyzes the position of the balls, cue, participant, calculates the anticipated trajectory of the ball. The laser device tasks photos of the trajectory at once onto the pool deck. The player sees this trajectory and can adjust the position of the cue. It turns out the classic manage system with poor remarks.

Special AR funds

These include all kinds of specialized technical gadgets that differ within the manner they interact with a person and the manner they show data. despite the fact that the general principle of addition (synthesis) of actual and imaginary pix the usage of a laptop program stays unchanged. Unique gear encompasses specialized pilot helmets for simulators or actual flight situations. a few information is displayed on the helmet glass over the encircling environment; this sort of helmet tracks the location of the pilot's eyeballs.

There's also a special clinical device used for schooling medical doctors or for actual operations. within the first case, as an example, the medic is skilled to search for a blood vessel within the needle inserted into it. The real needle is a digital blood vessel, but through a complex device of hydraulic mechanisms, the doctor feels it is actual (he may even sense the pulse), and if the needle is exactly inside the vessel,

blood flows out of the tool display. within the 2d case, for instance, for the duration of endoscopic operations, an X-ray image of the tumour acquired in advance is superimposed at the image of the operated organ displayed on the display. This lets in the medical doctor to locate the tumour within the organ with greater accuracy.

1.3 The ways Augmented Reality can enhance daily life

Changing interaction methods with smartphones. To advance the improvement of Augmented Reality items, well-known technology companies such as Apple, Google released respectively AR Kit and ARCore. This collections of development tools overlay a virtual layer to the present reality, shown by a smartphone's camera.

That implies increasingly more applications will rely on the integrated or dedicated mobile's camera as the primary interface. Ultimately, it might serve as the interface for the wide majority of digital products.

For example, nowadays, most GPS applications have a top view displayed on the device screen. Custom mobile application development sooner rather than later will make the first steps to an integrated Augmented Reality in mobile devices. Consumers of Google maps can use more accurate navigation by simply pointing your device's camera in the needed direction and move an augmented, imposed path.

Gamification of daily tasks. As the term indicates, gamification a task makes it progressively amusing to perform by transforming it into a game. AR technology has all the possibilities to realize it.

Maybe a retail chain proprietor needs to support specialist profitability. If they would like employees to stock shelves more rapidly. With AR, employers could impose 3D icons on top of the shelves that need to be stocked, giving workers points when they making correct transportations. By changing this type of tasks into a game employers can increase the productivity of their employees.

E-commerce improvement. Purchasing certain types of online products can be difficult: Some items might need a closer look before the customer is ready to commit to purchasing.

That may not be a problem in the near future. For e-commerce makeup consumers Sephora has released an AR app to suggest an app that gives them a chance to "try on" makeup over photos or selfie. Swiss furniture company IKEA also has successfully released the app which allows buyers to try furniture's augmented 3D models in their houses by using simple phones with average quality cameras. Furniture can be resized and coloured at the request of the user.

These are only a couple of examples. More companies start to recognize the ability of Augmentation methods.

Making industrial design simpler. Industrial design collectives have to visualize their complete product until they manufacture prototypes. For instance, it's very expensive to match a design flaw in a brand new vehicle after it's built. Therefore professionals depend on a 3D formation to see what the completed item will look like until it's built.

AR will advance the process by permitting creators to interact with a representation of the archetype.

Increase employee safety. While working in dangerous work fields employees are always worried and aware of their surroundings. Unfortunately there always a human factor that increases the chances of human error.

Thanks to DAQRI's smart helmets people can scan surrounding to find environmental anomalies that employees could ignore, improving their safety at the end.

While working in a dangerous area it is hard to adapt and remember everything. Using Cloud Anchors employees can put marks in the right places and explain to people how to correctly fix gas pipes at home.

Helping healthcare become better. Nowadays nurses are already using AR to effectively find veins. Surgeons began to use practical procedures.

Obviously, the role of AR in healthcare will become even more important in the coming years. Soon, patients will be able to learn how to manage their own treatment with AR programs. The technology could help servicemen, as a rule, to wounded soldiers on the battlefield, when physicians are not available.

Image recognition technology already can recognize objects in real time 99% accurately according to Washington University researchers they call it YOLO (you only look once). In scientific terms, it could change the way how is cancer treated by recognizing cancer cells with nanotechnologies equipped with augmented reality.

Using object recognition people can improve the first medical help. For example, it would show where to press and how to make massages.

Community Leadership Plan. Metropolis and town leaders ought to continuously plan for destiny. Does the developer offer a brand new facility? They have to be able to are expecting what it'll look like before they get the essential permissions. With AR, architects can offer an extremely realistic description of the development in its very last form.

The fireplace branch and different local offerings may also use AR as such. they can create simulations, for example, to look at how a fire in one place can have an effect on traffic situations, the encompassing territory.

Education. Financial savings. From time to time investment is an obstacle to gaining knowledge of, freshmen and colleges both can be laid low with its absence. The augmented reality gets rid of training inequalities, it makes the contents to be had for everybody within the school room, no differences between learners.

Idea. Augmented reality, in reality, makes everything greater shiny and attractive for newcomers by using changing the study room and its contents. watching thru AR how the human coronary heart works may be tons greater attractive as opposed to analyzing about its parts from an ebook.

Learn individual. One of the maximum troubles of conventional education is the dearth of assets and time to give individualized educating to each pupil within the class. The augmented fact gives lecturers the tools they had to have modern-day statuses of every student so the trainer is aware of which learner is appearing responsibilities properly, which one is doing correct and which one needs greater commands.

Huge versions of fields. AR era can be implemented in all form of areas and ranges of information. AR gives an exceptional combination of fact and virtual reality, so the person can use real bodily devices, saving prices and lowering risks.

Constructing up a learner's creativity and hobby. Beginners usually express exclusive points of view inside the lecture room and every scholar can have an extraordinary attitude about what they may be reading. With the assist of augmented truth, they can discover and research more approximately what they're interested in. interest and creativity might surely be facilitated, and AR is the way to get your beginners' creativeness growing.

Tourism.Convenient discovery for tourists was the technology of augmented reality.

In the tourism sector, we can distinguish the following directions of augmented reality implementation:

– easy navigation. Thanks to mixed reality applications, you can find the desired path anywhere, get directions, and locate. And if you use virtual reality glasses, even pointers will appear where it is worth turning;

– information support. This technology is widely used for guided tours. Now you can do without a guide: you only need to send a gadget to a famous landmark to get all the information about it;

– virtual travel. Large travel agencies use extended reality to demonstrate the possibilities of the tour to the client. Directly in the office, he will be able to plunge into a certain area.

AR programs are also actively used to advertise travel agency services. For this purpose, special stands are used. Simply put a gadget on it to get additional information.

Game reality. Game reality can be divided into virtual games and games using elements of mixed and augmented reality. For games with elements of mixed and augmented reality can be attributed, for example, laser Tag or laser battle – a high-tech game that takes place in real time and space, using as components of augmented reality laser shots from a Blaster machine. Or the game-addition Minecraft Reality, which allows you to place in fixed geographical coordinates of the real world models of the game hit, which are created by the users themselves. Thus, the process of creating a virtual world is transferred to the real reality, and the result can be viewed in mobile devices.

Also, simple and interesting is the augmented reality game "draw 3D maze!". The player must draw a maze on a sheet of paper, starting from the start and to the finish line, on which the other person will have to virtually hold the ball. In this case, the eyes of the drawn lines are transformed into the walls of the maze, at a high level performing its function, as the software laid the laws of physics.

2 Practical application of augmented reality, market dimensions and development problems

2.1 The effect of augmented reality on the human brain

Applications with AR will evolve from one-time fun into a multipurpose tool. Today, technology is largely used as fleeting entertainment. This is reflected in two of the biggest manifestations of augmented reality: a Snap dancing doggie and Pokemon fishing.

To more fully understand the AR's ability to "amaze and arouse delight," Zappar and UK mindshare worked with leading neurobiologists from Neuro-Insight on measuring the brain's response to augmented reality. The study involved more than 150 respondents who performed six different tasks: half of them used the version of the applications with AR, and a half - the equivalent version, but without the AR. For example, half used Google Word Lens to translate a foreign phrase, and the second half typed it in the Google Translate application. The brain areas studied are responsible for the long-term coding of memory, attention, involvement, emotional intensity and approximation/distance (physical tilt or distance from the object being viewed). As far as we know, this is the first study to measure the neurological effect of augmented reality as a data carrier [1].

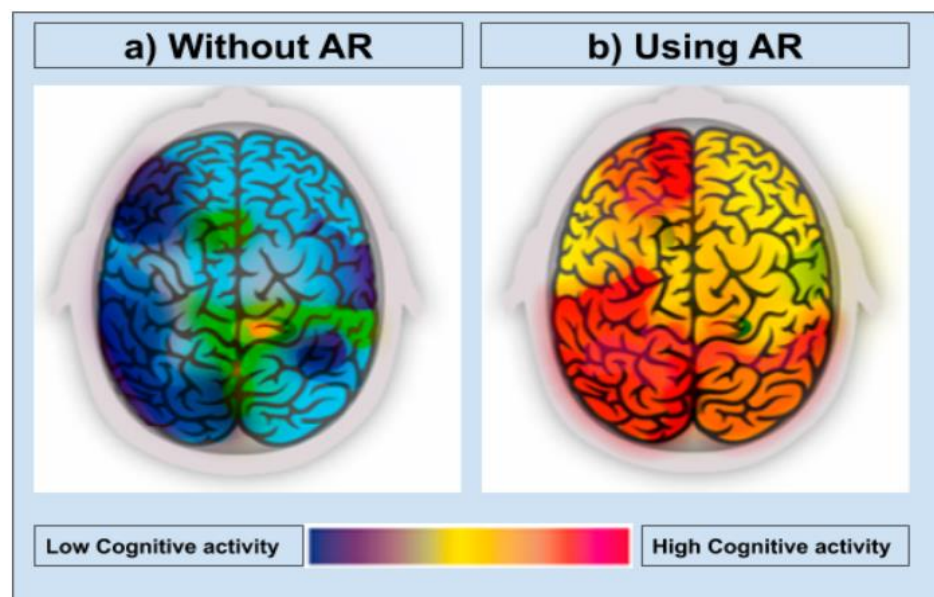Figure 2.1 - Brain activity while working with augmented reality applications

Relying on the results of the research that in the entire series of measurements of cognitive function, augmented reality almost doubled (1.9 times) greater levels of involvement compared to equivalents not related to the AR. This is a clear sign of its ability to generate more powerful returns than its counterparts. Brain activity while

working with augmented reality applications and without augmented reality imaged in figure 2.1.

The only measurement in which the level of AR effect was lower was "approach/distance" (fixing the degree to which the user wants to move in or away from the stimulus). A lower score here may indicate a sense of surprise that occurs when people see augmented reality. States of the human brain activity are represented in figure 2.2.
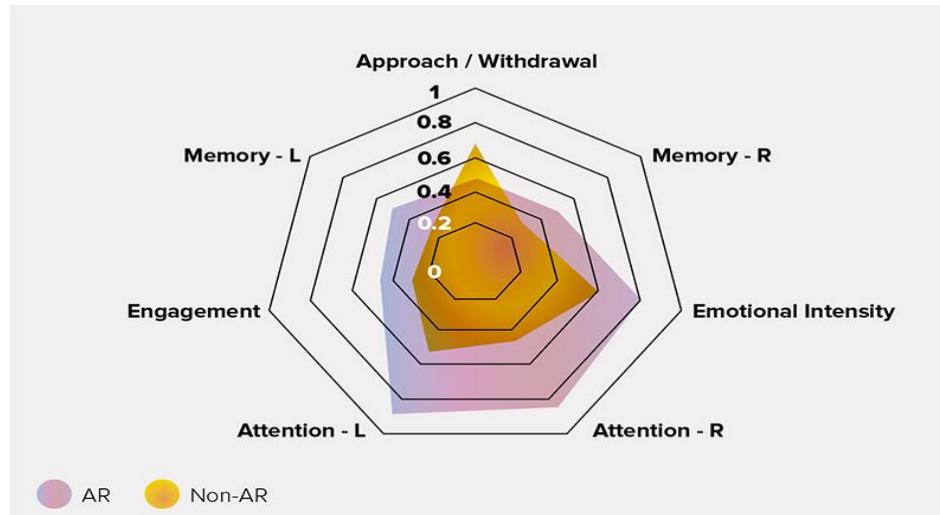

Figure 2.2 - States of the human brain activity

Although people, no doubt, will get used to augmented reality, we expect that its ability to surprise and delight will remain, as the boundaries of technology are constantly expanding with innovations.

However, there is an untapped potential for using AR to meet broader needs. In qualitative research, people who tested applications with augmented reality in their environment during the week took part. After becoming accustomed to existing ways of using augmented reality, they began keeping diaries to identify moments or events in everyday life in which they felt that the AR can be successfully used to meet emerging needs.

Popup Content. Augmented reality will increasingly provide a proactive display of personalized contextual content without user initiation.

One of the trends in the study describes the rise in consumer expectations for the addition of all new content layers, to which they can access at will. Despite the fact that augmented reality with a call to action or suggestions of various kinds will always take place, the development of the industry will be the right content that will be offered or shown to people at the right time automatically. DR will be a means of delivering information - contextual and personalized.

In our neurobiological experiment, we found that the part of the brain responsible for memory coding shows an almost threefold (2.9 times) increase in the

level of activity when using the DR version of the application compared to the version without DR. This indicates that the technology has proven to be a particularly powerful way to deliver memorable information.

Help tool. Augmented reality will become a key tool for helping people, helping lives to simply flow, reducing everyday friction between a person and his environment.

Achievements in the field of artificial intelligence open the "age of help" when intelligent digital assistants have the ability to respond to our teams and increasingly anticipate our needs. We see this in the appearance of chat bots, voice assistants and computer vision.

The underlying proposition for consumers, associated with the growing popularity of such assistance, is that technology can smooth out some of the inconveniences of everyday life, making it easier.

The AR is likely to become a key tool for this, helping to reduce friction while achieving everyday goals. The technology is integrated into an increasing number of surfaces (for example, mirrors, displays, windshields and, in particular, glasses), at certain moments it will be able to play a significant role in our everyday life.

2.1.1 People's opinion about AR glasses. More than half (56%) of respondents know about augmented reality or smart glasses; this figure rises to 66% among 18–34-year-olds and up to more than 90% among people who have already experienced the technology. Despite the fact that at least five to ten years of separate augmented reality glasses from becoming a mass consumer product, people are already anticipating how they will make life easier when solving certain problems. More than a third of respondents aged 18–34 prefer to use augmented reality without hands through smart glasses, rather than through a smartphone (even without a chance to try such glasses). Although people, no doubt, will get used to augmented reality, we expect that its ability to surprise and delight will remain, as the boundaries of technology are constantly expanding with innovations. But these types of glasses are not safe for following activities walking on pedestrian, driving cars which require full attention to them.

2.2 General provisions and problems of development in the field of education

With the use of virtual and augmented reality technologies, students of educational institutions will have the opportunity to study subjects in the virtual space, participate in historical events. Google is free of charge in schools

implementing their project Cardboard. At the beginning of 2016, more than 100 training programs were ready. In addition to schools, many educational medical institutions are interested in virtual and augmented reality projects.

Apple representatives said in March 2013 that after the launch of the educational program, the company provided educational institutions around the world with 8 million tablets, of which 4.5 million were distributed to schools in the United States. According to statistics, for three years the company presented about 7% of the total number of all released iPads.

The possible number of users in developed countries is about 200 million schoolchildren and students, of which more than 25% live in the United States (50 million students and 20 million students).

Virtual and augmented reality technologies should be primarily applied in the field of education, as the educational system must adapt to the ever-increasing complexity of processes, theories and models, students need to navigate in a large amount of information and new ways of presenting it. The perception of VR and AR technologies from early childhood will contribute to the growth of importance and adoption of technologies. Therefore, today we can say about the demand for specialists in AR and VR, both in today's conditions and in the future.

The main difficulties include the difficulty in updating previously developed educational programs.

In 2015, the market for software for the education system amounted to about $ 12 billion, of which 5.2 billion was spent on the development of school programs, 6.6 billion - on programs for Universities.

Revenue from software sales to schools and universities will be $ 300 million in 2020 and $ 700 million in 2025. According to the most conservative estimates, the education system will spend up to five years for the purchase and commissioning of 8 million virtual and augmented reality devices. It is logical to suggest that at first the system of virtual and augmented reality will become popular primarily in secondary educational institutions, and later the technology will be interested in higher education institutions. Students of engineering and medical universities will have the opportunity to conduct practical and laboratory classes using virtual space.

2.2.1 Application of augmented reality in the educational process. Proven empirically: full involvement in learning increases the level of motivation and success in obtaining knowledge. Stimulation of brain activity occurs during the observation of the picture, the most realistic. This means that with VR-technologies there is a transition to the level of information processing, a new and higher quality.

In modern conditions, the augmented reality under the control of teachers makes it possible to create innovative educational materials, organize VR

laboratories. This happens in such a way: during the lessons in computer science, the teacher introduces the software that is required for the application of the complex, and the necessary data and blank drawings are selected in the lessons of mathematics, chemistry and other subjects.

In drawing lessons, you can create 3D images using 3D graphics software. After that, all the selected and created information is collected together in a specific program, in order to obtain unique educational resources in a three-dimensional image.

After that, the hardware and software complex is placed in the office, where the learning process will be performed. Developers of educational resources may be located in other cities and even countries. Effective work on the project became real with the help of network interaction. Similar experimental laboratories are actively used in many educational institutions.

When used in education, virtual Reality gadgets open up a wide range of limitless possibilities, which include:
 − analysis of large amounts of information;
 − study of the rarest physical phenomena;
 − manipulations with various objects of the physical world;
 − participation in historical events;
 − participation in chemical experiments.

The New York Times makes public its own application, which offers a virtual walk in New York. This requires special tools. Existing hardware and software systems on the market can realize a journey to other countries and even parallel worlds. Here we are talking about Oculus Rift, the technology of Magic Leap, helmets for virtual reality Gear VR, HTC Vive, Sony, Project Morpheus.

Applications play an important role. The best for education include VR Cardboard. The program itself contains a list of images related to various fields of knowledge: mathematics, biology, anatomy, history, architecture and engineering. Its uniqueness lies in the fact that it is possible to divide the screen into two parts, which will allow children to contemplate the three-dimensional image at different angles, changing only the position of the head.

In modern conditions, the technology that previously seemed fantastic, real and already used in education: the interaction of educational institutions through the network, the integration between subjects; teleconferences and all kinds of video conferencing; electronic three-dimensional training programs, information materials for presentations; virtual lecture halls, laboratories, workshops, museums and planetariums.

2.2.2 Use of AR/VR technologies for organizing school events. In our life, in the sphere of entertainment, the possibilities offered by virtual, mixed and augmented reality are widely used. The hall of the club for the period of the party is transformed into real cyberspace.

Technologies so realistically reproduce the scenery that people actually disconnect from the real world and for a certain period of time are in the virtual world of the cyber party.

Created a great variety of technologies that offer all sorts of virtual effects, from simple decorations to unrealistically complex. The simplest is the projection of all sorts of pictures or clips on the universal access screen. This, of course, will liven up any holiday and make it more attractive than a holiday with banal-sounding music. It should be noted the most complex and most spectacular projection systems, which include High Touch and High Definition. High Touch technology refers to an interactive system that projects a video sequence onto a floor or wall surface. The most spectacular effect is that a person independently animates a video image with the help of his movements or gestures. For example, the movement of a hand can bring a star train close to itself or cause circles under the feet, only stomping through virtual water.

The projection system in High Definition format can transmit to the surface with any complexity (square, wave, ball). Moreover, the effects on complex surfaces look voluminous and realistic. Getting into a room with similar broadcast technologies, a person feels in an unreal world. During the holidays there is the possibility of implementing the effects of augmented reality also with the help of other projection systems, but all technologies are very expensive and it is not possible to apply them, for example, at school parties.

When used in the educational process, at a party or a concert of elements of augmented and mixed reality, you can use, for example, the Camtasia studio platform, suitable for working with video files or audio sequences.

With the help of this program, it becomes possible to overlay an audio sequence on pictures on a specific topic, changing the sound according to the displayed images. The application also allows you to arrange images of all sorts of special effects. Thus, the picture will change in time with the music transmitted, and provide quite an impressive spectacle.

In conclusion, it should be noted that in the modern world it is difficult to imagine even the most primitive disco without simple computer animation. Technical implementation of AR / VR technologies in most cases is expensive.
But there are also many free and publicly available applications for private events that do not require significant financial investments. If desired, you can use the most

simple applications that synchronize audio and video, the resulting presentation can be transferred to the projector on a shared screen.

2.3 Integrating AR - technologies to the education system

France is one of the countries leading the way in giving its students exposure to AR early. In 2015, the French government announced an updated curriculum for students that weaves augmented reality into their studies [2]. The government recognizes that teaching emerging technology in the public school system provides all students with the keys to understanding the contemporary technical environment and the skills to act. Education is key to mass adoption and overcoming the other challenges for augmented reality proliferation.

AR and in addition VR is also started developing in Kazakhstan and in the future may find support from the Ministry of Education and Science(MES) of Republic of Kazakhstan.

In the capital, at school-Lyceum № 73, the presentation of a new project — virtual reality laboratory — "NUR Lab" was held. As the correspondent reports BNews.kz, the Association "Bolashak" together with the team of STEAM Academy proposed to implement a unique innovative project — laboratory of augmented/virtual (AR, VR) reality "NURLab" in each school in the country.

Co-founder of STEM Academy Abutalip Mutali hopes that the project will be further supported by the MES.

"The Nur lab project is designed for AR, VR technologies (augmented and virtual reality technologies) in educational institutions. In schools, such subjects as physics, mathematics and chemistry should be taught with the new technologies... We plan that this project will be supported by the MES and further extended to the whole of Kazakhstan. We suggest that such laboratories appear before the end of 2023 in all regions of the country» [3].

"The first technology is virtual reality, that is, you can wear glasses and be in any other space. The next technology — Zspace, it is unique — it combines virtual and augmented reality. You put on your glasses like you're in a 3d movie and studying. For example, you can consider the motor, disassemble it, and where it does not work — fix it. You put on your glasses like you're in a 3d movie and studying. For example, you can consider the motor, disassemble it, and where it does not work — fix it. That is, this technology allows the child to visualize what he passes on objects. Now we train teachers to use these technologies in the educational process»

2.4 The AR development problems

Consider the list of existing problems in the field of augmented reality and options for their elimination, which can translate it into the status of the main interface technologies and arouse the interest of millions of users all over the world:

Display.Modern films are obtained in practice with a seamless insert of animated components, most of the AR-applications still look cartoony. They differ significantly from the film shown, like Avatar, and are more like some kind of Space Jam.

Creating a movie with the movements of an object or person occurs with the recording by capturing movements, and then processed by animation software. That is, the addition of reality occurs after recording the movements themselves and is subject to strict control.

In turn, AR applications perform fixation and online image creation. In this case, it will not be possible to retouch the animation after the fact, the light and shadows will look the same, regardless of the environment. Because of this animation characteristic, a sense of animation appears, which affects AR applications. There are also disadvantages when placing components, but this will be discussed below.

The problem is to be solved when using image-based lighting (IBL-Image BasedLighting). With this method of 3D rendering, there is a special camera for shooting the lighting itself, placed in a specific environment and using the result of a picture already created by a computer. The problem is that smartphones do not have enough computing power to support such and similar software applications, and it will last much longer for portable gadgets. Due to the similar state of technology to these devices, no one will add a camera to improve the outlines of objects.

Also problematic is the registration of movement - the need for landmarks. But this is more related to the second problem.

Object recognition. One of the first announced AR applications was GoogleGoggles. Correct work for registration by the user in the frame will be provided with a fixed reference point. Smartphones with a built-in gyro can resolve this issue to a certain extent, as it offers them weak proprioception. A fixed point is also needed to determine the movement of an animated object with respect to the live scene.

It is possible to eliminate it by increasing the database with which the gadget interacts, and by improving the software. Object recognition can be compared to a search result. The input information comes in, is mapped to other images in the existing database and is determined by the membership by a combination of

algorithms. But image search is a complex process compared to regular web search and calculations are late. The intellectual analysis needed to recognize a video sequence is given to a computer with a huge load.

Object recognition can be performed without the use of 2D markers and QR codes that use almost all modern AR applications. In addition, it can be the basis for creating an augmented reality browser in the physical world, with the ability to interact with real objects.

Binocular vision. People have binocular vision, so they can perceive the concept of depth, and because of this, a person feels the distance between things. This is not available with a single camera smartphone.

Consider several options in eliminating this problem. The first of these is echolocation. It is not the best option, as it creates sound pollution. You can perform it on a frequency inaudible to humans, but it can cause discomfort among animals. In addition, it cannot create a visible 3D environment using sound alone, since the echolocation data needs to be combined with the visible light data. The same applies to thermal data, although the use of echolocation is more preferable in low light. As a result, it should be noted that one of the best ways to solve this problem is what people have come to as a result of evolution, binocular vision. It turned out to implement Kinect, in trinocular mode, and the Fire Phone. He uses five cameras aimed at the user and able to determine the location in relation to the smartphone. While there are overlays in the work, but since this is an advanced technology, then, as expected, the first models contain a certain number of errors.

3 Information and software system realization

3.1 Similar apps to the developing application

Star Walk - Explore the Sky. This app is developed by Vivo Technology for both iOS and Android. This app allows users to identify the positions of the stars in the sky using geolocation of the device. It is free with limited functions for iOS and costs 990 KZT for Android users.

AR 3D Science. The application uses markers tracking method of augmented reality and 3D models to represent some objects of physics, biology and chemistry. It developed for Android devices and free of charge.

AR-Chemist. AR mobile application developed by FiPro Studio. It has pictures of chemical elements signs which the user can use as a marker to bring the elements into life.

Table 3.1 - Comparison of similar apps to the developing application

Apps	SLAM	Image Tracking	Price	Platform	Authorization
Developing application	+	+	free	Android/iOS	+
AR-Chemist	-	+	free	Android	-
AR 3D Science	-	+	free	Android	-
Star Walk	-	-	990 Android	Android/iOS	-

The application is created for Android and iOS mobile operating systems according to statistics of used operating systems (see Chart 1) and used electronic devices worldwide.

Advantages of the developing application:
− marker less tracking method;
− cross-platform;
− user registration;
− multiplayer;
− video player in augmented area.

To provide individual learning for students and give them more practical experience application detects surfaces to create working space absolutely in every place where lighting is enough. Application is equipped with AR Simultaneous localization and mapping.

SLAM is well studied in the robotics community and also used in AR tracking technology localization estimates where is the device located. Mapping is referred to as having censored data and estimates the environment and maps the environment. If Mapping knows where are the sensors located and measures distances between objects. If it doesn't know where the sensors are then it end ups with the SLAM. It will simultaneously estimate the position centre of the device and the state of the environments.
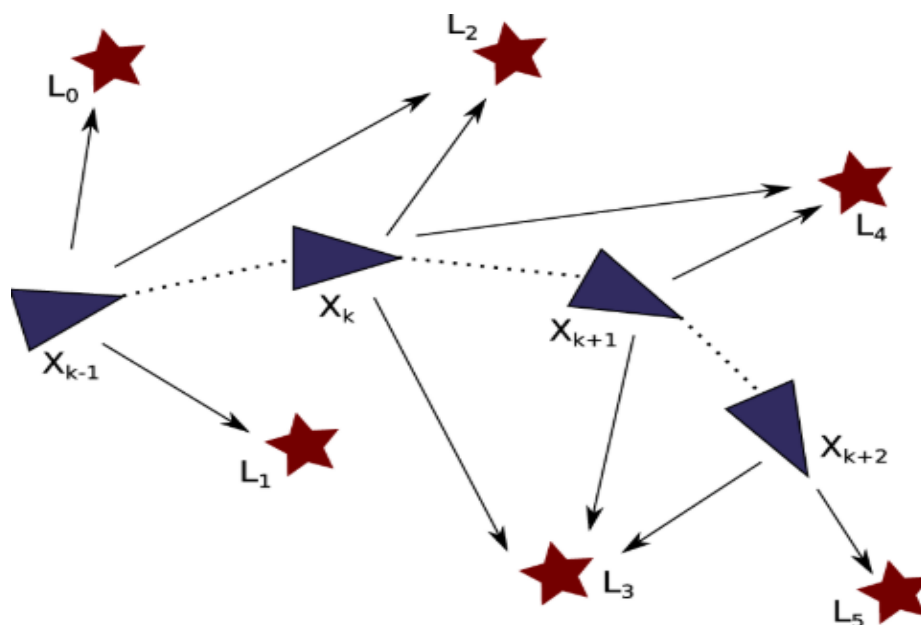

Figure 3.1 - the principle of SLAM tracking.

Localization example: There are shown positions in time so T1, T2, T3. The device moves through the environment on some trajectory. Let's consider it is in discrete time. There are landmarks something device can observe and can recognize. Localization knows where are landmarks but it does not know where is a device. And Mapping will estimate the pose of the device by using those landmarks which localization is observed. If there is any landmark changes its position then SLAM will respectively compare and changes other landmarks and the pose of the device. After detecting a comfortable position or space for working application will mark the area with the grid lines. User can put 3D objects to the marked area by tapping the phone's screen and scale objects in the right size. Application has books and a gallery of Images, trackable AR method which allows a user to navigate the camera of the device to the marker (Image) to watch the linked videos about a certain subject.

For example, detecting the picture of the solar system user can watch a video about the solar system and can remember better and quicker rather than reading about it. It stores the database of images in the cloud which is easy to update when it is needed. App has multiplayer which lets consumers work in distance in real time or leave notes in the working area.
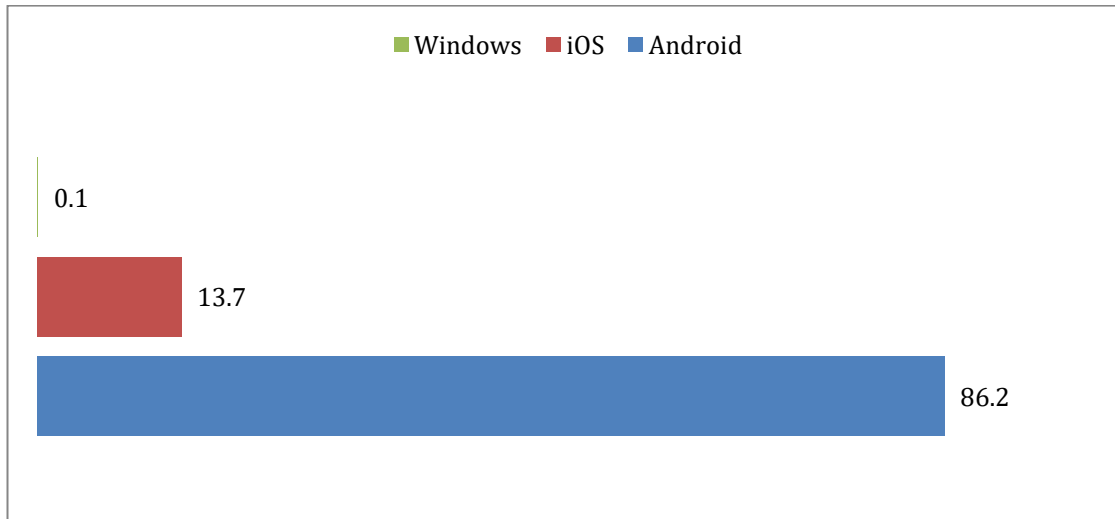

Figure 3.2 - Statistics of the mobile OS

Table 3.2 - Comparison of the AR devices

AR devices	Price range	Users	Quality
Smartphones/ with card boxes	200-1200 USD	2.1 billion	medium
Microsoft Hololens	1495 USD	Less than 100 thousand	high
Google Glass	1300 USD	Less than 100 thousand	high
Epson MoveRio	900 USD	Less than 100 thousand	high
Oculus GO	300 USD	Less than 100 thousand	medium

Formulation of the task. The concept of augmented reality includes several aspects:

− visualization - development of more sophisticated user interfaces for visualization of real-world objects;

− contextual operations (triggers) - display information about an object in the camera;

− visual instructions (assistance) - for example, an indication of the route to the object located in the immediate proximity to the user's location mobile device.

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The main difficulty in implementing the technology of augmented reality is associated with tracking. Tracking is a complex process associated with tracking the position of an observer regarding the environment.

When implementing augmented reality two main principles of its construction are used:

− token-based;

− based on the user's location coordinates.

A marker is an object located in the surrounding space, which is located and analyzed by special software for the subsequent rendering of virtual objects. Based on the situation marker in space, the program can enough accurately project on him virtual object from what will be achieved the effect of his physical presence in the environment.

Marker less technologies are often used in mobile devices and are built using special sensors: accelerometer, gyroscope, magnetometer, GPS receiver. The set of accessories necessary for the creation of augmented reality includes devices: processor, display, camera and electronics, which determines the position, GPS and compass. Thus, practically the ideal gadget for the mass distribution of AR-technologies has become a modern touch smartphone. The mobile device plays the role of a magnifying glass, looking through which the world, we get new layers of information, data and visual images. The set of accessories necessary for the creation of augmented reality includes devices: processor, display, camera and electronics, which determines the position, GPS and compass. Thus, practically the ideal gadget for the mass distribution of AR-technologies has become a modern touch smartphone. The mobile device plays the role of a magnifying glass, looking through which the world, we get new layers of information, data and visual images.

Additional information resources you can snap to your location, but it is even better to associate them with specific objects that are around. In the present application, the possibility of getting information about objects in the immediate vicinity of the user, and, objects are sorted by categories: astronomical objects.

When developing a mobile application, you need to solve the following tasks:

- interaction with mobile device sensors;

- retrieving user location data;

- taking an image from the camera;

- access to map resources;

- accessing the server;

- development of a module for fast data processing from the server;

- processing of the obtained coordinates of institutions;

- graphical display of processed data.

Methods and means of solving the problem. External resources include a set of data obtained through the Google Places API (Application Programming Interface). For the user to receive information offline, a temporary download is used the latest information in the SQLite database. For correct visualization of objects in three-dimensional space requires tracking with six degrees of freedom: three position values (x, y, z) and three angles (ϕ, λ, h – rotate around the respective axes) to determine the orientation. To solve these tasks apply a variety of approaches. V the presented work uses optical tracking, since one camera is enough for its operation without any special additional external devices and the image coming from the camera which is used as the image objective reality, and for processing for tracking purposes. And in this case, the position of the camera as an observer is monitored directly.

The paper uses an algorithm for determining the GPS coordinates of the user, the overlay them on the coordinate grid of the city map and search for the obtained coordinates of the nearest objects in the selected category.

The algorithm for determining the location the user is reduced to a transformation tracking with six degrees of freedom in the usual geodetic coordinate system and consists of three stages:

- getting GPS coordinates, this data obtained from a mobile GPS device apparatuses;
- convert the GPS coordinates of the mobile phone location into a geocentric rectangular coordinate system (ECEF – Earth Centered, Earth Fixed) on the map cities. The transformation of the usual geographical coordinates into rectangular is caused by the need to transfer the spherical the surface of the planet onto a plane map because it is more convenient to look for the position of the point in rectangular (rectilinear) coordinates. This kind of calculus is called the Gauss – Kruger projection;
- the conversion of ECEF coordinates to geodetic coordinate system ENU (east,
north, up) is executed because, to the person, it is more convenient to use two-dimensional maps, despite the fact that the surrounding person space is three-dimensional.

As a result, we get the coordinates of the East, North and top. Subsequently, these data used to determine the nearest places and display them in augmented reality.

To obtain the effect of augmented reality in the work, the image coming from the camera of the device was used real-time and graphic labels, superimposed over the image. The location calculation and the relevance labels and calculates the algorithm discussed above.

Development of a conceptual model. For the implementation of the software product, the following diagram of application use cases was developed.
The user can perform the following actions:
- choice of place categories;
- view the distance to this location;
- view detailed information on the selected location;
- change of viewing modes (augmented reality, map, list);
- add favourite places.

Development of the overall structure hardware and software system:
- package with model – contains all C# classes describing the object model of the system;
- with Package controllers used for communication layer Model with layer View;
- library – third-party library package;
- view Package – a package that contains layers of the graphical representation.

The following classes were developed to implement the declared functionality:
- locationHelper – a class that implements the algorithm for converting ENU coordinates to GPS coordinates;
- places – class describing the General model of the place object»;
- ARPoint, a class that translates the object "Place" in the point of augmented reality;
- AR Camera – a class that implements interaction with a mobile phone camera and overlay markers on the resulting image;
- AR overlay view class receiving information in external resources;
- activity – main startup class.

3.2 Information Database Description

To store processing data in "Image Recognition" subsystem it is necessary to have the following database ImageDATABASE, which contains table Images. Descriptions and purpose of the table below.

The table Images, located in the database ImageDATABASE, it stores images which are used in tracking. Structure of the table shown in table 3.3

Table 3.3 - Description of the table Images

FIELD	DESCRIPTION
Name	Name of the image
Width	Width of the image
Quality	Identifies the quality of images

3.3 Application Software Structure

The structure of the application software is presented in picture 2.1. It contains:

− system software . The application implemented for a local server MAMP on Windows 7 OS, on Apache Server for Android OS devices;

− instrumental Software.The program is implemented in the PHP programming language used on the web server side to dynamically generate HTML pages using the hypertext markup language HTML and the query language SQL, as well as to process the client-side functions using the C # Script language;

− application software.

The client-side application includes:

− play function. With this feature, students and teachers can choose game modes like Slam and Image;

− edit function. The student can transform the position of the chosen object and scale it or rotate the viewing angle;

− add function. This feature allows the client to choose objects from objects panel and add it to the scene.

Application has main menu where user can choose the straightly to play a game or register or log in with already created account. The main menu contains three buttons and each button have functions on "click button" which loads next scene after button is pressed. Main menu structure is shown in figure 3.3
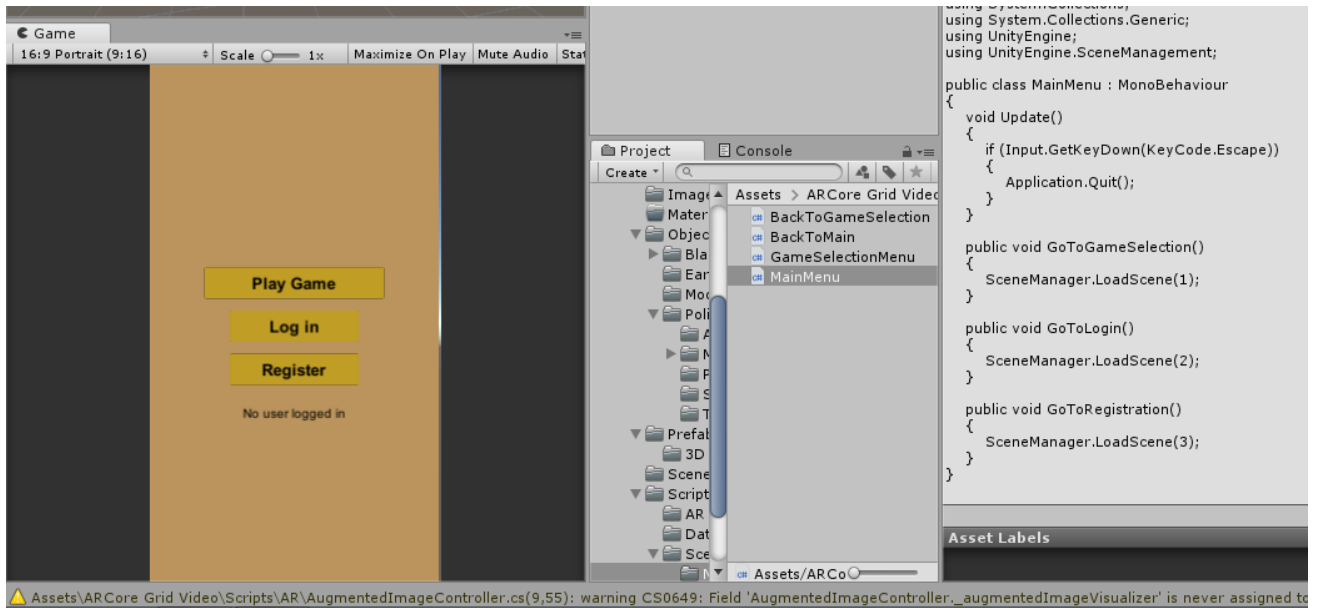
Figure 3.3 – Structure of main menu

Before creating database mobile application must be illustrated with User Interface components like button, text input field, label, canvas and background image or color. As it represented in picture 3.4. Registration menu needs button called "register" and two text input fields for "username" and "password" fields. Application also needs two labels called "Name" and "Password".
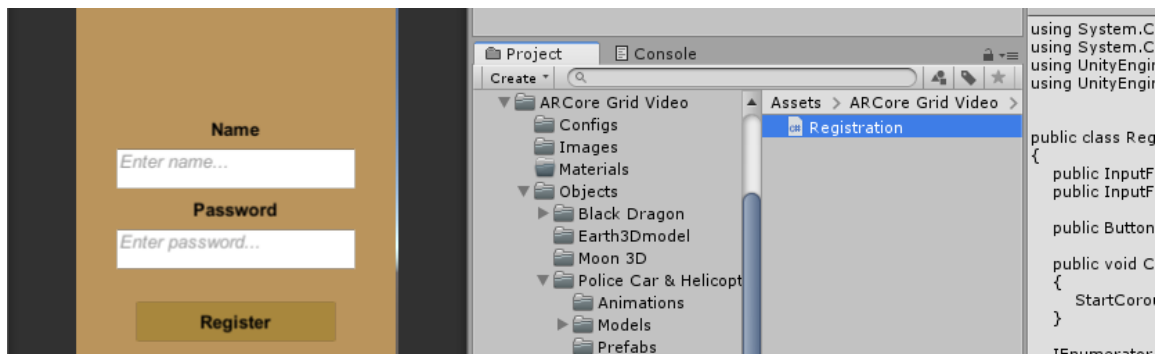

Figure 3.4 – Creating registration scripts for authentication

Login menu is basically similar to registration menu except the "log in" button and Login Script which processes the sign in part of the application.

Developing application includes SLAM scene. Scene contains buttons as following "Edit", "Add", "Rotate", "Scale", "Move". The scene contains AR Core Device, AR Camera, AR Controller components which are responsible for detecting surfaces and regulated the device camera. AR camera has AR Camera Script, AR Controller has "AR Controller Script". AR Core Device contain AR Camera and "AR Session Script". AR Session contains AR session configuration for plane finding mode like "Vertical" and "Horizontal", Augmented Image database and camera focus

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mode. As shown in figure 3.5. It also contains two panels which are disabled before buttons "Edit" and "Add" are pressed.

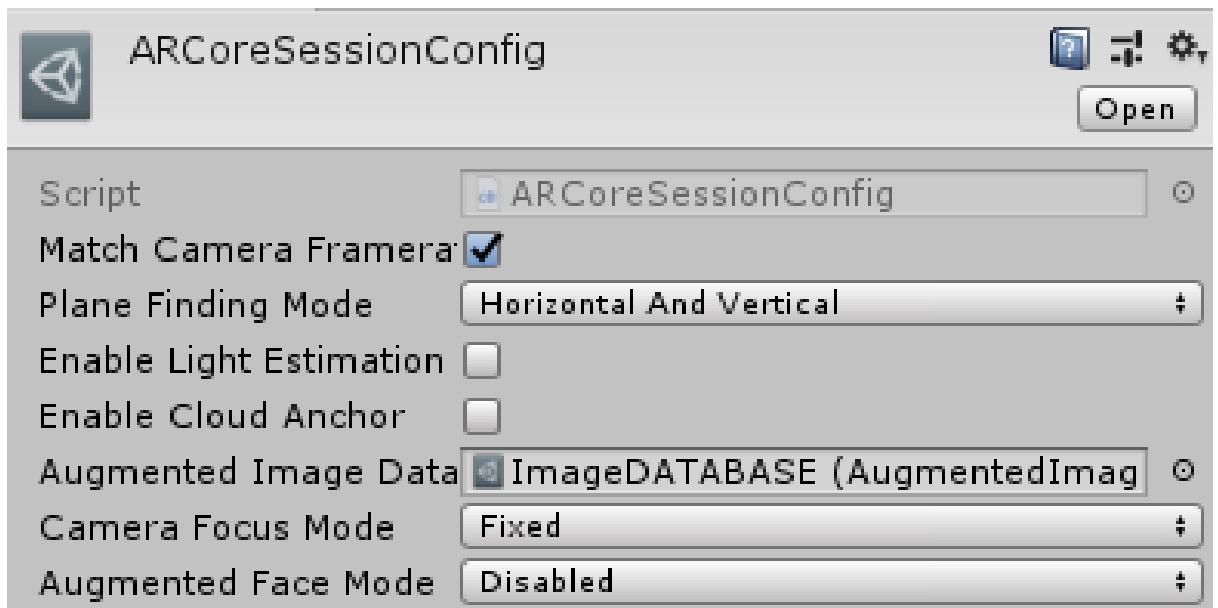

Figure 3.5 – Creating SLAM menu for application

3.4 Justification of programming language choice

There is two main technical software solution for creating a mobile application, they are "Unity3D Engine" with "Visual Studio 2017", "Unreal Engine 4" with "Visual Studio 2017" and "Android Studio". For creating a mobile application is used Unity3D with Visual Studio 2017.

C# Programming language. C# is a programming language that combines object-oriented and context-oriented concepts. Developed in 1998-2001 by a group of engineers led by Anders Heilsberg at Microsoft as the main language of application development for the Microsoft platform .NET. The C# compiler is part of the standard installation of .NET itself, so you can create and compile programs on it even without tools like Visual Studio.

C# belongs to a family of languages with C-like syntax, of which its syntax is closest to C++ and Java. The language has strict static typing, supports polymorphism, operator overloading, pointers to class member functions, attributes, events, properties, exceptions, comments in XML format. Having adopted a lot from its predecessors — C++, Delphi, Modula and Smalltalk — C#, based on the practice of their use, excludes some models that have proven to be problematic in the development of software systems: for example, C# does not support multiple inheritances of classes (unlike C++) or type output (unlike Haskell).

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Unity3D version 2018.3. Unity is a cross-platform game development surrounding. Unity allows you to create packages that run on extra than 20 distinct operating systems, along with personal computers, game consoles, cell gadgets, internet applications, and more. unity became released in 2005 and has been evolving ever given that. the main blessings of Unity are visual improvement surrounding, cross-platform guide and modular system components. The disadvantages encompass difficulties in running with multicomponent schemes and problems in connecting external libraries. Since about 2016 Unity also offers cloud-based services to developers, these are presently: Unity Ads, Unity Analytics, Unity Certification, Unity Cloud Build, Unity Everyplay, Unity IAP ("In app purchase" - for the Apple and Google app stores), Unity

Table 3.4 - Comparison of Engines

Engines for AR	Unity3D 5	Unreal 4	Android Studio
Platform	Cross-platform	Cross-platform	Android
Price starter	Free if revenue < 100.000 USD	Free if revenue < 50.000 USD	Free
Price	75 USD	5% from revenue	
Programming language	C#, Unity Script, Boo	C++/Blueprint	Java

Multiplayer, Unity Performance Reporting, Unity Collaborate and Unity Hub. Unity supports the creation of custom vertex, fragment (or pixel), tessellation and compute shaders. The shaders can be written using Cg, or Microsoft's HLSL. During its first ten years as a product the paid versions of Unity were sold outright; in 2016 the corporation changed to a subscription model.

Microsoft Visual Studio is a Microsoft product line that includes an incorporated software improvement environment and some of the other tools. Those products can help you increase each console packages and applications with a graphical interface, together with support for windows forms technology, as well as web sites, internet applications, net services in both local and controlled code for all systems, supported via Windows. Visual Studio includes a source editor with support for IntelliSense technology and the ability to easily refactor code. The built-in debugger can work as a source code level debugger, as well as a machine level debugger.

3.4.1 Used technical resources. In the development and debugging process of the diploma project was used the following technical facilities:

Main development computer:
- Processor Intel Pentium 2020M 2.4GHz, 2MB L3 cache;
- RAM 4GB DDR3 Memory;
- GPU Intel HD Graphics;
- Hard drive disk 500GB;
- Flash drive Transcend 8GB USB 3.0;
- Printer Hewlett Packard DJ 940c;
- Monitor 15.6 HD Acer CineCrystal LED LCD
- Standard keyboard
- Mouse Logitech G502
- OS Windows 7 x64

Testing device Sony Xperia:
- Processor Qualcomm Snapdragon 835
- RAM 4GB
- Hard drive disk 64GB
- Display 5.5 inch
- Camera 19MP Motion Eye
- OS Android 9 Pie

Table 3.5 - Comparison of AR SDKs

AR SDKs	AR Core	AR Kit	Vuforia	Wikitude	MAXST
Platform	Android	iOS	Android/iOS/Windows	Android/iOS/Windows	Android/ iOS
Price Starter(Non-Commercial)	Free	Free	Free	Free	Free
Price	Free	99 USD	499 USD	2499 USD(Full Pack)	599 USD(Full Pack)
SLAM	Yes	Yes	No	Yes	Yes
Object Tracking	No	No	Yes	Yes	Yes
Image Tracking	Yes	Yes	Yes	Yes	Yes
Cloud Services	Yes	Yes	Yes	Yes	Yes

3.4.2 Processing and loading**.** The application is called by installing android application package(.apk) file to operation system Android which is available for mobile devices and android emulators in personal computers. After installation is

completed a mobile application is ready to start and only requires tapping on the icon in working desktop of operation system Android.

3.4.3 Input data. Input data of the mobile application is images, surf areas which are captured by device camera mention above in testing device section.

3.4.4 Output data. Output data of a mobile application is linked pieces of information and stored 3-dimensional objects

CONCLUSION

In this work, were analyzed the use of augmented and mixed reality technologies in human life and in education. To reach the goals following problems were solved:

− studied technical support for creating virtual and augmented reality;

− studied the application of AR-technologies;

− studied the general provisions and problems of development in the field of education;

− considered the benefits of AR in the educational process;

− studied the effects of AR on the human brain.

Summing up, it is worth making the following conclusions.

Arguing about the level of education, it can not be missed the educational programs that train personnel for the augmented reality market. Kazakhstan still lacks full-fledged government programs of this kind. As results of the research show that Augmented reality can increase the performance of the human brain but also simplifies daily life. All technologies which are invented and developed had a purpose to make human simple and comfortable, but it can not make it easy. AR - technology is the next stage in the interaction of man and machines (HCI - human-computer interaction) - a discipline that is interdisciplinary, and includes engineering, psychology, philosophy, cybernetics, which does not have basic theoretical knowledge today. The limitation can be considered an indefinite taxonomy of all variants of human-computer interaction in a multi-space (AR & VR & MR-space), the paradigm of ubiquitous computer calculations.

Summing up, it is worth pointing out that one of the most important tasks of the development prospects is the understanding of the essence of all types of the above-considered realities, the definition of all parameters relating to optimization and their classification characteristics in the field of education. It is necessary to consider existing concepts from the angle of paradigm with ubiquitous calculations and natural interaction with the environment.

The goal embedded in the development perspectives is a completely new taxonomy of realities that can be used when classifying interactions with virtual objects and all sorts of interactions of the machine-man system.

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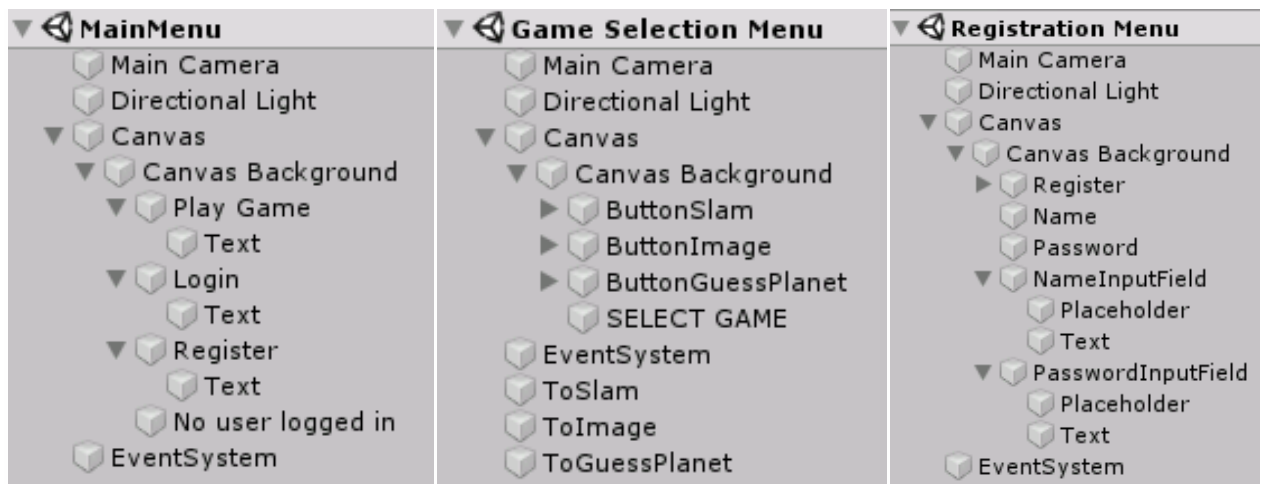
Appendix A

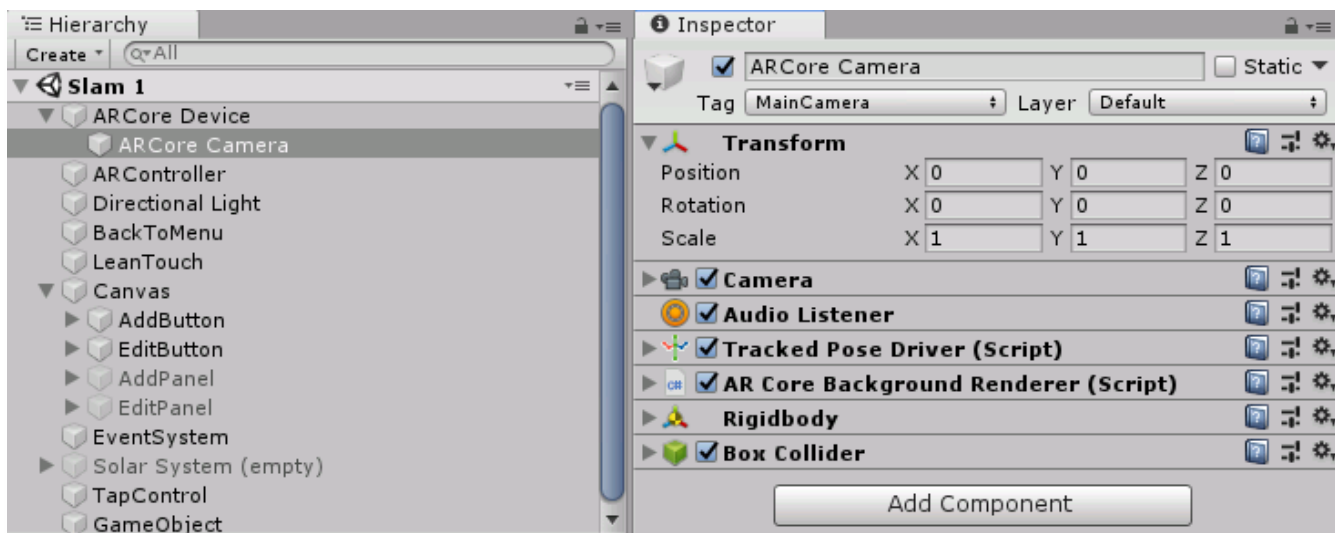Figure 1 – Structure of the Main, Game Selection, Registration menus
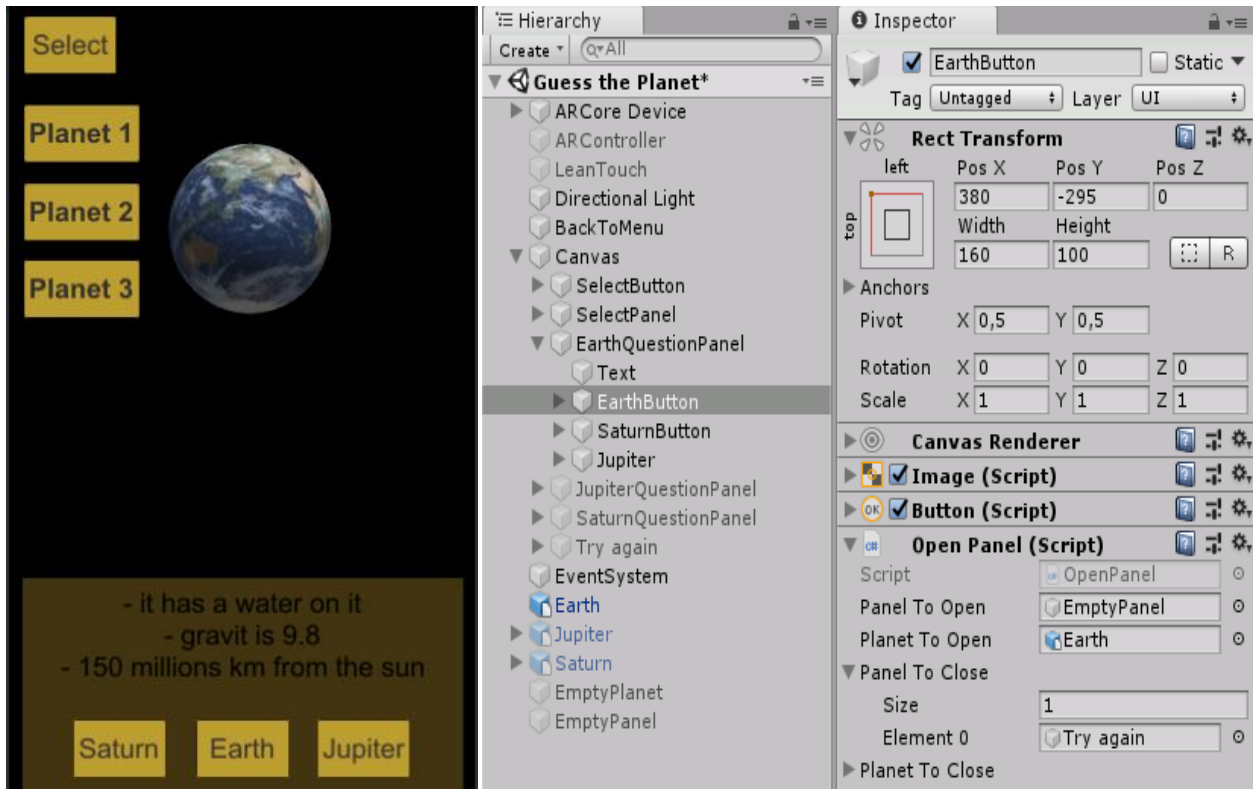

Figure 2 – Hierarchy and Inspector of the SLAM menu

Figure 3 – Game scene, hierarchy and Inspector of the Guess menu
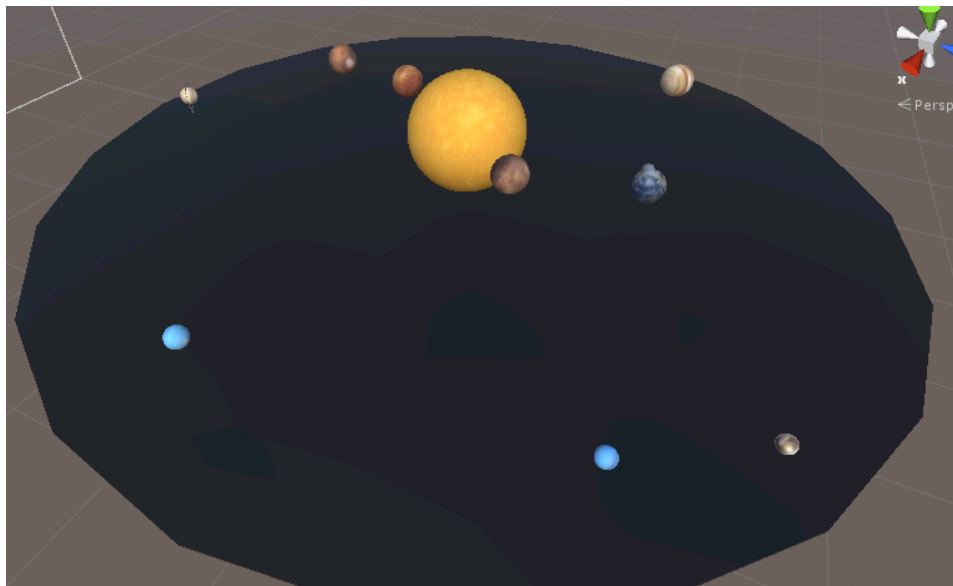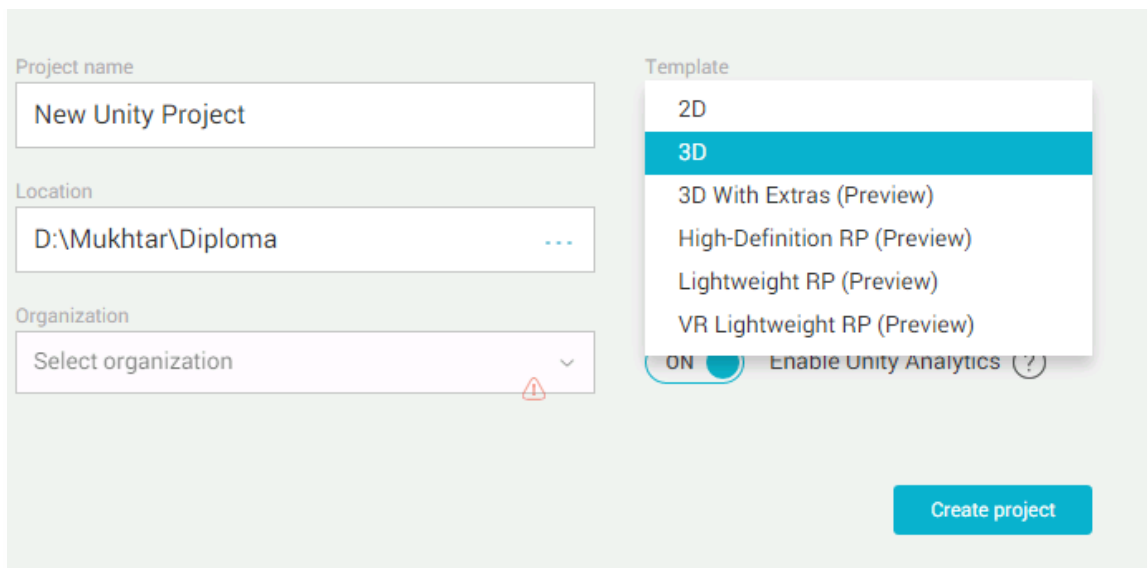
Figure 4 – Realization of Solar System in Emulator

Figure 5 – Creating project in unity3D
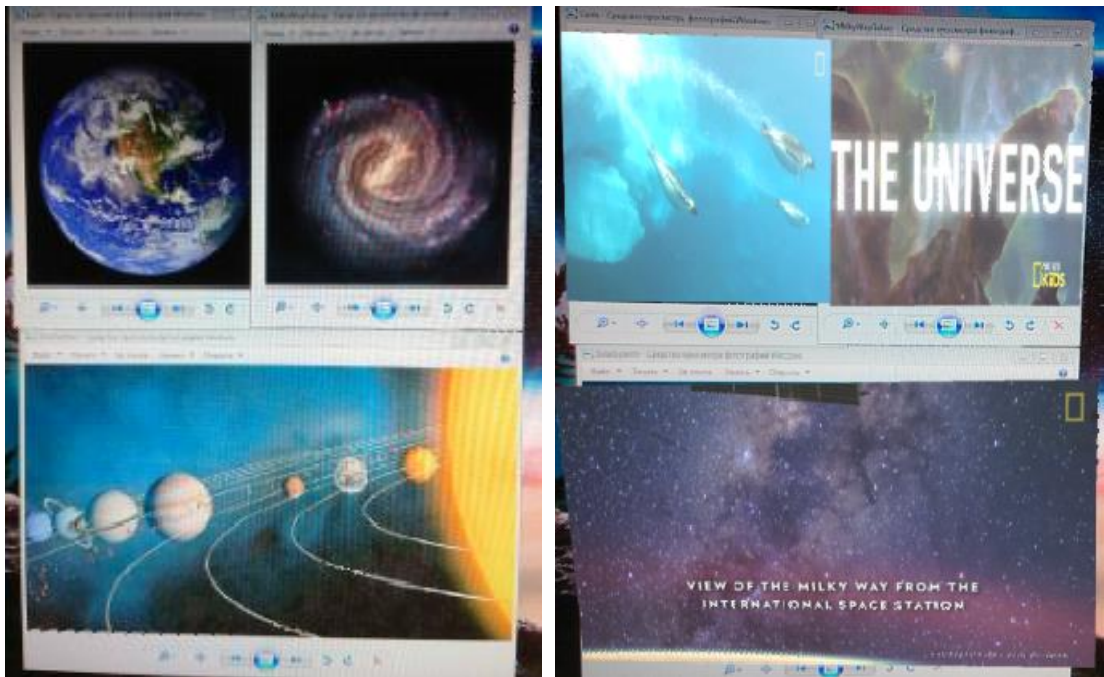

Figure 6 – SLAM ground detection process

Figure 7 – Image tracking process

Appendix B

Script 1 – AR Controller

```
void Update()
  {
    if (Session.Status != SessionStatus.Tracking)
    {return; }
    Session.GetTrackables<TrackedPlane>(m_NewTrackedPlanes, TrackableQueryFilter.New);
    for (int i = 0; i < m_NewTrackedPlanes.Count; ++i)
    {
      GameObject grid = Instantiate(GridPrefab, Vector3.zero, Quaternion.identity, transform);
      grid.GetComponent<GridVisualizer>().Initialize(m_NewTrackedPlanes[i]);
    }
    // Check if user touches the screen
    Touch touch;
    if (Input.touchCount < 1 || (touch = Input.GetTouch(0)).phase != TouchPhase.Began)
    {return;}
    //if user touched any tracked planes
    TrackableHit hit;
    if (Frame.Raycast(touch.position.x, touch.position.y, TrackableHitFlags.PlaneWithinPolygon, out hit))
    {ObjClone = Instantiate(Obj, transform.position = hit.Pose.position, transform.rotation = hit.Pose.rotation) as
GameObject;}
```

Script 2 – Grid Visualizer

```
public void Awake()
  {
    m_Mesh = GetComponent<MeshFilter>().mesh;
    m_MeshRenderer = GetComponent<UnityEngine.MeshRenderer>();
  }

  /// <summary>
  /// The Unity Update() method.
  /// </summary>
  public void Update()
  {
    if (m_DetectedPlane == null)
    {return; }
    else if (m_DetectedPlane.SubsumedBy != null)
    {
      Destroy(gameObject);
      return;
    }
    else if (m_DetectedPlane.TrackingState != TrackingState.Tracking)
    {
      m_MeshRenderer.enabled = false;
      return;
    }
    m_MeshRenderer.enabled = true;
    _UpdateMeshIfNeeded();
  }
  /// <summary>
  /// Initializes the DetectedPlaneVisualizer with a DetectedPlane.
```

Continuation of appendix B

```
/// </summary>
/// <param name="plane">The plane to vizualize.</param>
public void Initialize(DetectedPlane plane)
{
    m_DetectedPlane = plane;
    m_MeshRenderer.material.SetColor(
        "_GridColor", k_PlaneColors[s_PlaneCount++ % k_PlaneColors.Length]);
    m_MeshRenderer.material.SetFloat("_UvRotation", Random.Range(0.0f, 360.0f));
    Update();
}
```

Script 3 – Augmented Image Visualizer

```
public class AugmentedImageVisualizer : MonoBehaviour
{
    [SerializeField] private VideoClip[] _videoclips;
    public AugmentedImage Image;
    private VideoPlayer _videoplayer;
    void Start()
    {
        _videoplayer = GetComponent<VideoPlayer>();
        _videoplayer.loopPointReached += OnStop;
    }
    private void OnStop(VideoPlayer source)
    {gameObject.SetActive(false); }
    void Update()
    {
        if(Image == null || Image.TrackingState != TrackingState.Tracking)
        {return; }
        if (!_videoplayer.isPlaying)
        {
            _videoplayer.clip = _videoclips[Image.DatabaseIndex];
            _videoplayer.Play();
        }
        transform.localScale = new Vector3(Image.ExtentX, Image.ExtentZ, 1);
    }
}
```

Script 4 – AR Core Session

```
namespace GoogleARCore
{
    using System.Collections.Generic;
    using GoogleARCoreInternal;
    using UnityEngine;
    /// <summary>
    /// A component that manages the ARCore Session in a Unity scene.
    /// </summary>
    [HelpURL("https://developers.google.com/ar/reference/unity/class/GoogleARCore/ARCoreSession")]
    public class ARCoreSession : MonoBehaviour
    {
        /// <summary>
```

```
/// The direction of the device camera used by the session.
/// </summary>
/// <remarks>
/// Note that changing this value will trigger a re-initialization of session. ARCore
/// tracking data (e.g. Trackables) are not shared between cameras.
/// </remarks>
[Tooltip("The direction of the device camera used by the session.")]
public DeviceCameraDirection DeviceCameraDirection = DeviceCameraDirection.BackFacing;
/// <summary>
/// A scriptable object specifying the ARCore session configuration.
/// </summary>
[Tooltip("A scriptable object specifying the ARCore session configuration.")]
public ARCoreSessionConfig SessionConfig;
private OnChooseCameraConfigurationDelegate m_OnChooseCameraConfiguration;
/// <summary>
/// Selects a camera configuration for the ARCore session being resumed.
/// </summary>
/// <param name="supportedConfigurations">
/// A list of supported camera configurations. Currently it contains 3 camera configs.
/// The GPU texture resolutions are the same in all three configs.
/// Currently, most devices provide GPU texture resolution of 1920 x 1080,
/// but devices might provide higher or lower resolution textures, depending
/// on device capabilities. The CPU image resolutions returned are VGA, 720p,
/// and a resolution matching the GPU texture.</param>
/// <returns>The index of the camera configuration in <c>supportedConfigurations</c> to be
/// used for the ARCore session.  If the return value is not a valid index (e.g. the value
/// -1), then no camera configuration will be set and the ARCore session will use the
/// previously selected camera configuration or a default configuration if no previous
/// selection exists.</returns>
public delegate int OnChooseCameraConfigurationDelegate(
    List<CameraConfig> supportedConfigurations);
/// <summary>
/// Unity Awake.
/// </summary>
[SuppressMemoryAllocationError(Reason = "Could create new LifecycleManager")]
public virtual void Awake()
{LifecycleManager.Instance.CreateSession(this); }
/// <summary>
/// Unity OnDestroy.
/// </summary>
[SuppressMemoryAllocationError(
    IsWarning = true, Reason = "Requires further investigation.")]
public virtual void OnDestroy()
{LifecycleManager.Instance.ResetSession();}
/// <summary>
/// Unity OnEnable.
/// </summary>
[SuppressMemoryAllocationError(
    Reason = "Enabling session creates a new ARSessionConfiguration")]
public void OnEnable()
```

```
{LifecycleManager.Instance.EnableSession();}
/// <summary>
/// Unity OnDisable.
/// </summary>
[SuppressMemoryAllocationError(
    IsWarning = true, Reason = "Requires further investigation.")]
public void OnDisable()
{LifecycleManager.Instance.DisableSession();}
/// <summary>
/// Registers a callback that allows a camera configuration to be selected from a list of
/// valid configurations.
/// The callback will be invoked each time the ARCore session is resumed which can happen
/// when the ARCoreSession component becomes enabled or the Android application moves from
/// 'paused' to 'resumed' state.
/// </summary>
/// <param name="onChooseCameraConfiguration">The callback to register for selecting a
/// camera configuration.</param>
public void RegisterChooseCameraConfigurationCallback(
    OnChooseCameraConfigurationDelegate onChooseCameraConfiguration)
{m_OnChooseCameraConfiguration = onChooseCameraConfiguration;}
internal OnChooseCameraConfigurationDelegate GetChooseCameraConfigurationCallback()
{return m_OnChooseCameraConfiguration; }
}}
```