Enhancement of Human Anatomy and Nervous System Learning Using Mobile Augmented Reality Application

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering

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APPROVAL

This Project titled "**Enhancement of Human Anatomy and Nervous System Learning Using Mobile Augmented Reality Application**", submitted by Jahidul Hasan, ID No: 161-15-6961 to the Department of Computer Science and Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 5th December 2019
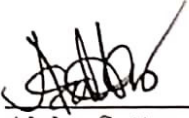
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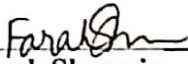Daffodil International University

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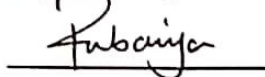Department of Computer Science and Engineering
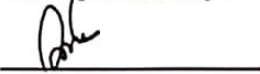United International University

DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Rubaiya Hafiz, Senior Lecturer, Department of CSE**, Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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ABSTRACT

Advancements of recent technology allows the delivery of educational materials to be highly interactive. Augmented reality (AR) is one of the most promising technology that augments reality with computer generated imagery, objects, information etc. and allows user interaction. By providing visualization and interactive 3D models, it allows students to understand any abstract concept on any time, at any place easily. In this work we have developed an AR based mobile application that can create an interactive 3D view of human skeleton and nervous system by using a target image captured a mobile phone camera. The main motive of this application is to help the medical students and school level science students to learn human anatomy and nervous system in an interactive way so that they can enhance their learning procedure. This research narrates the concept, application development an results of the pilot test. This test is conducted by the medical students of different medical colleges of Bangladesh. We have done this pilot test to get the users' experiences from technical viewpoint. According to this test we can concluded that students were satisfied with this application in terms of the features, usability, feasibility and understandability.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Augmented Reality (AR) is an emerging technology that enhance the reality with computer generated two or three dimensional images. It employs different information from real world to provide an integrated view of a particular real world object and offers interaction with it. A mobile based augmented reality application (mAR) provides mobilized, flexible and user interactive learning environment to users which is independent of time and location. Anatomy and nervous systems are some of the most important subjects especially for medical students and school level science students. Human anatomy and nervous system learning is concerned with the recognition and narration of human body structures which needs proper visualization of imagination to know the names and operations of different body organs and their activities. That's why these learning involves practical vivisection in the laboratory, where internal structure of human body and animals get revealed. This practical session is needed so that students can learn complex things more accurately.

But after completing this session it becomes difficult for students to memorize the topics because it could not grow deep rooted understanding of this subject[1]. However, mobile based augmented reality application can be one possible solution of this problem which can makes a concept fully understandable to students by illustrating a responsive 360-degree view of a model in the actual environment, actual scale, any time and at any place. Using target images collected from books or a downloaded document from websites or from printouts, a mobile based augmented reality application can scan images through the camera of a smartphone and can generate a 3D view of images that can help both the teachers and the students by giving them immersive environment. This application can also be considered as an economical option for introducing a modern aspect to 2D images and physical objects.

1.2 Motivation

While new technologies are often used to facilitate regular people's lives, they often fail to see their potential in helping student properly. Augmented reality currently offers users the opportunity to add virtual information to their real-world surroundings in real time. It also has the opportunity to not only learn in practical, but also identify every organ. Augmented Reality is one kind of solution for those students who dropping out of school too early

1.3 Objectives

Main objective of this project is Anatomy, nervous system learning. Anatomy, nervous system, and all other organs learning are some of the beginner and basic subjects in medical colleges in Bangladesh. It is quite a big challenge for any new comer Bengali-based learner to memorize these terminologies as well as their functionality since all the text books were written by English speaking background (ESB) writers. This is why we proposed a mobile-AR based application to assist and improve students self-learning skills.

1.4 Expected Outcomes

To calculate the reliability and performance of my proposed system, I have conducted pilot testing. I have involved 20 medical going students. At first the students were familiarized with the system then they learned about bones and nervous system of human body for their learning activity. Finally, students were distributed a questionnaire for capturing their responses toward my application.

1.5 Report Layout

From this report a user can easily understood the aim of this project. This report consists of five chapter. What the need of this application, how it can be work, its model, feature, what result given this system etc. included this report.

- First Chapter, provides my project introduction, motivation, objective and expected outcome
- Second Chapter provides background, related work, research summary, Future Scope of Augmented Reality and challenges

- Third Chapter provides research methodology of my project. That is research subject and instrumentation, data collection procedure, statistical analysis, implementation requirements.
- Fourth Chapter provides experimental result and discussion of my project experimental results, descriptive analysis.
- Fifth Chapter provides summery, conclusion, recommendation and implication.
- At last added all references and appendices of my project.

CHAPTER 2

BACKGROUND

2.1 Introduction

According to a report, 68.7 million (20.8% of the overall population) people in USA use AR at least once per month in 2019. Some of the applications of AR include gaming [3], entertainment, archaeology [4], architecture [5], commerce [6], tourism [7] etc. Several published works focused on utilization of augmented reality in education and most of them get positive results [8]. Study conducted by Kaya and Bicen [9] reveals that the applications augmented reality in educational environments has a positive impact and it increases the academic achievement of students. Joanne Yip et al.[10] have conducted a study on a sewing workshop and found that the use of AR videos provides better learning result in terms of learning performance and efficiency compared with the use of handouts in classes. The participants included 46 freshmen and this study showed that students learning experience and understanding of complex concepts can be enhanced through AR videos.

2.2 Related Works

Augmented Reality work increase day by day. Lot of other developers choose AR developing sector. In this year more than twenty thousand app publish base on Augmented Reality

2.2.1 Augmented – 3D Augmented Reality

Augment is a mobile app that lets you and your customers visualize your 3D models in Augmented Reality, integrated in real time in their actual size and environment. Augment is the perfect Augmented Reality app to boost your sales and bring your print to life. Add your own 3D models and custom trackers on http://augment.com.
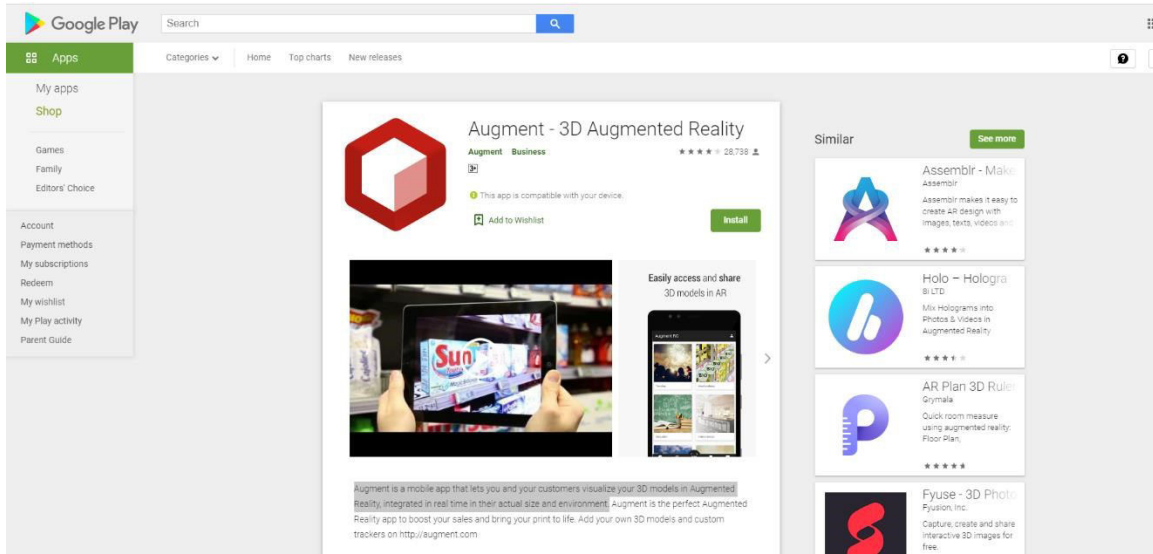
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Figure: 2.2.2.1 3D Augmented Reality

2.2.2 Pokémon GO

Pokemon Go best augmented reality apps in twenty-one century. User can play this game in real time. Player need to find the pokemon in real world environment. This app need GPS connection or Wi-Fi connection.
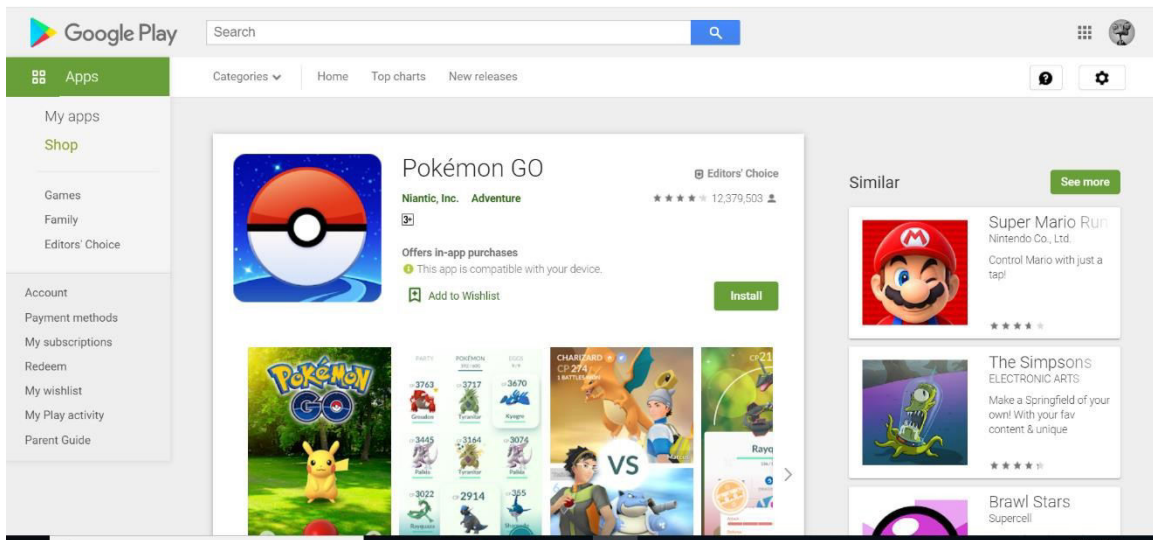
Figure: 2.2.2.1 pokemon go

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2.2.3 AR Medical

In this app explore six different organs in augmented reality. User can easily rotate and zoom into the amazing details of our 3d models. You can also touch one of the organs to start an animation
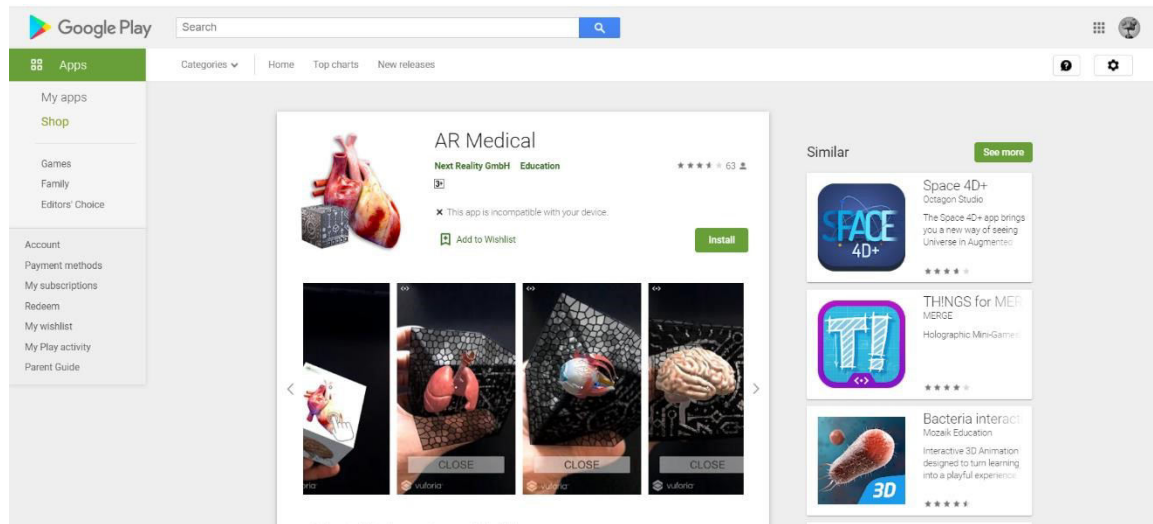
Figure: 2.2.3.1 AR Medical

2.3 Research Summary

The development and testing of an augmented reality (AR) application for teaching as well as learning anatomy, nervous system, different bones, eye etc. for human body.

2.4 Future Scope of Augmented Reality

Augmented Reality section is new in modern world. So, there are lot of future scope to this section. Augmented reality is making it really big all across the world. The future looks really bright as more and more companies are keen to jump on the craze by taking up this innovative and hi-tech technology. AR is certainly on skyline and in 2018 we're bound to see the growth on this path. This past year has been a very big year for the augmented reality technology. Google has yet again shined in AR. This year Google has launched ARCore, an augmented reality kit, that will enable developers to create AR apps for Android devices easily. Microsoft's HoloLens headset and the upcoming Windows Mixed Reality operating system indicate their strong existence in both AR and VR space. In 2019

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we can only expect this technology to flourish amongst the people and have a strong positive impact in various other fields. There are many other technologies being developed that do embrace augmented reality as a more enclosed component. Surely, things are going to improve much in times to come thus making our life easier to live.

2.5 Challenges

To developing AR application for students is very challenging task to me. I find lot of challenging part to create this application

- AR camera setup
- Target image maximum tracking accuracy setup
- 3D models create
- Database setup
- Configure the names of each 3D models
- AR camera focus on target image
- Each model zoom in and zoom out configure
- Rotation each model
- Error handle and solve the error

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CHAPTER 3
RESEARCH METHODOLOGY

3.1 Introduction

In this chapter I will discuss about some diagram and algorithm process. In diagram section I talk about Block diagram and Use Case Modeling. Also include Research Subject and Instrumentation, Data Collection Procedure, Statistical Analysis and Implementation Requirements.

In data collection procedure I create survey form and ask some medical students to fill the form. In this process I get enough information for my work. Most of the common android device support my app. In Statistical analysis process I confirm to know that this app is very useful for science background students.

3.2 Instrumentation

Use Autodesk Maya (2016) for modeling each of the 3D objects. Use Vuforia cloud server API and Vuforia database. Also use Unity 3D Game engine (version 2019, 30a2 (Alpha)) for rendering and tracking AR.

3.3 Workflow and Data Collection Procedure

First of all I create AR camera license manager. Then copy the license key into unity game engine. Then create database and add database in unity. Create 3D models and add texture in 3d model. If device target database and cloud target is match then target image will replace and show 3d model.

Figure: 3.3 1 Application Architecture of proposed approach

TABLE I Model description and available features

Models	Description	Feature
Skeletal	Labeled view of human skeleton.	Individual parts of skeleton and nervous system can be selected separately to make them clear. Rotation, zoom in/out of each model for close and detailed inspection. User can be able to capture pictures of what they are viewing in the display screen.
Bone	Bone description, Labels of each part.	
Nervous system	Labeled view of human nervous system.	
Brain	Labeled view of human brain.	
Eye	Labeled view of human eye.	

3.3.1 3D Model Building

Autodesk Maya, version 2016 is used for modeling each of the 3D objects. All the features were transformed into this software to develop models.

With the guideline of anatomical expert, each part was deconstructed within Autodesk Maya into several components and then accurately positioned according to the skeletal and nervous system. As a result this system provides more detail user understandings. Textures were mapped to make each component more realistic in 3D form. Table I shows all developed model and their features.

3.3.2 Software Development Kit

An AR extension is required for producing an augmented environment. Vuforia is a software platform that is designed for high quantity operation of AR on mobile devices. It also provides tools for creating all categories of AR experience. A mobile educational courseware application approach was employed in our proposed system. Vuforia extension was integrated into Autodesk Maya as well as Unity3D (version 2019, 30a2(Alpha)) for rendering and tracking AR. All 3D components (in .fbx file format) were exported to Unity3D software and incorporated with Vuforia. Unity 3D gives all necessary tools for labeling and describing objects to provide relevant information to students.

3.4 Statistical Analysis

The experimental results which were captured from the mobile application running on an Android mobile. After performing a pilot testing on twenty randomly chosen medical students we provided them a questionnaire for collecting feedbacks. Our intention was to find if they are interested in AR based learning environment or not. 50% of them strongly agreed, 40% agreed and 10% gave neutral feedback that through visualization AR based system provides better understanding. 35% strongly agreed and 50% agreed that this system is useful to enhance their learning.35% participants strongly agreed, 25% agreed, 5% neutral, 20% disagreed and 15% strongly disagreed that they need technical supports to use this application. Moreover, students stated" We didn't have any kind of AR(Augmented Reality) based class before"; "this system is more useful for junior rather than senior students". All of their feedbacks are plotted into a chart as shown in Fig.2
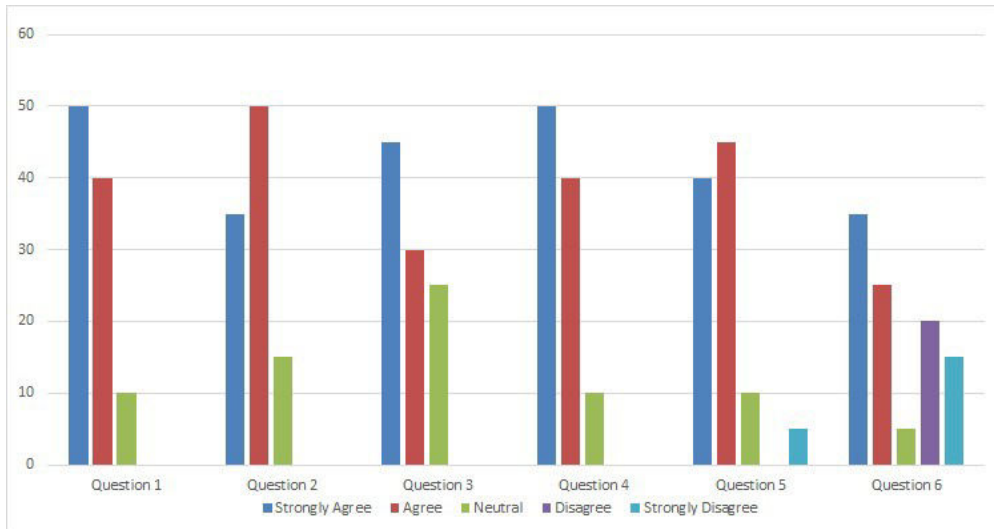
Figure: 3.4.1 Chart shows student feedbacks

3.5 Implementation Requirements

Technical requirements are the set of hardware issues that must be considered to operate a product effectively. We have selected mobile phones (both IOS and Android) to project AR objects and the minimum API requirement for the smooth running of this application is version 4.1(Jelly Bean). The target images are captured using back camera and the resultant augmentations are exhibited through front panel display screen.

CHAPTER 4

EXPERIMENTAL RESULTS AND DISCUSSION

4.1 Introduction

In this section I will discuss about Output Result and descriptive analysis of my application. I create this application for science background biological students. They need lot of lab work. Sometime all the equipment is not available in their lab. I create this application to improve student's lab performance.

4.2 Output and Experimental Results

I create medical base Anatomy and Nervous system learning (AR) application for students. I give each 3d model name to understand the students very clearly. Students can see the 3d models in real world perspective. They feel that they see the model Infront of the mobile device they can rotation the models and zoom in, zoom out the models. The see each of the models name according to the real-world perspective.

4.2.1 App Permissions

Need to Permission phone back camera to detection object also need drive permission to save the screen capture images.

4.2.1.2 Menu Bar

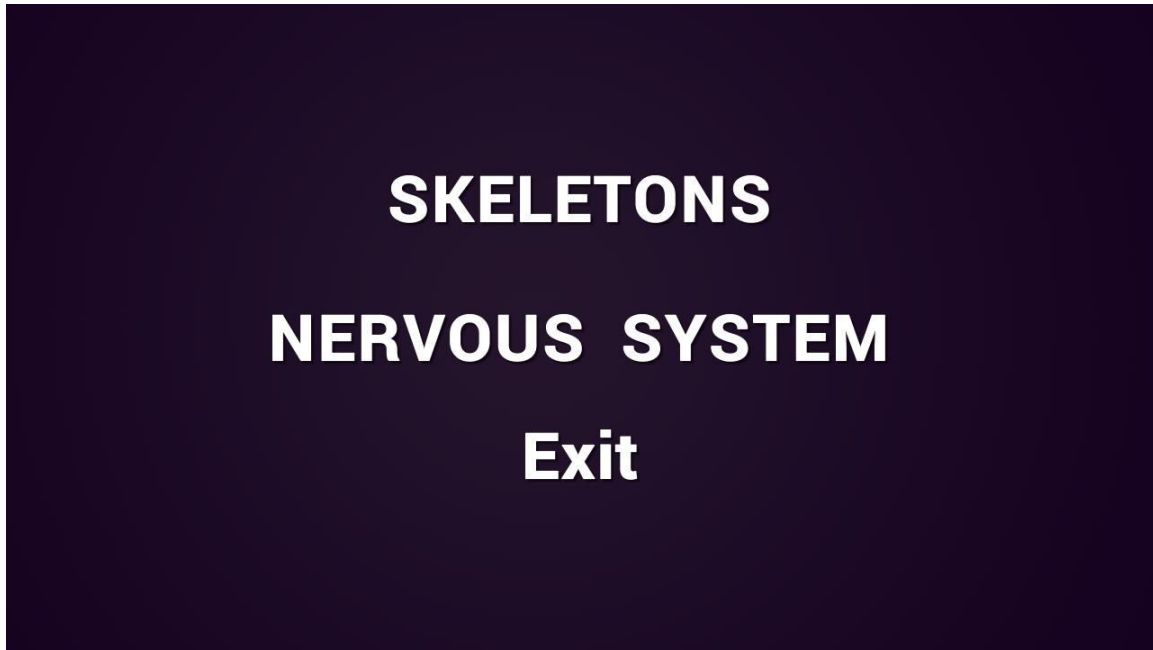In menu bar section there are three option. Skeletons, Nervous System and Exit.

Figure: 4.2.1.3 menu bar

4.2.1.3 Skeletons (Home)

If user choose skeletons button the user see home menu of all skeleton and see each object name. There are eight new buttons. Four buttons separate each skeleton object and another four buttons control the object. User can capture the images. Rotate the 3d models, zoom in zoom out the models and back to the previous menu
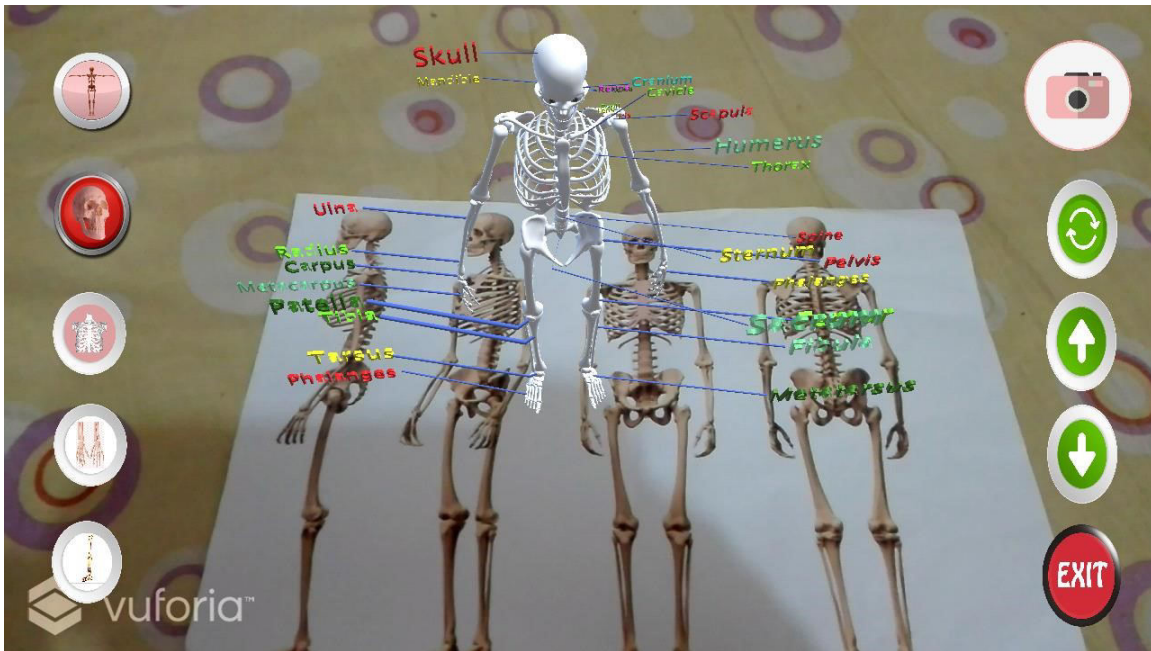
Figure: 4.2.1.4 skeleton

4.2.1.4 Skeletons (Skull)

If user choose skull button, user will see skull part only
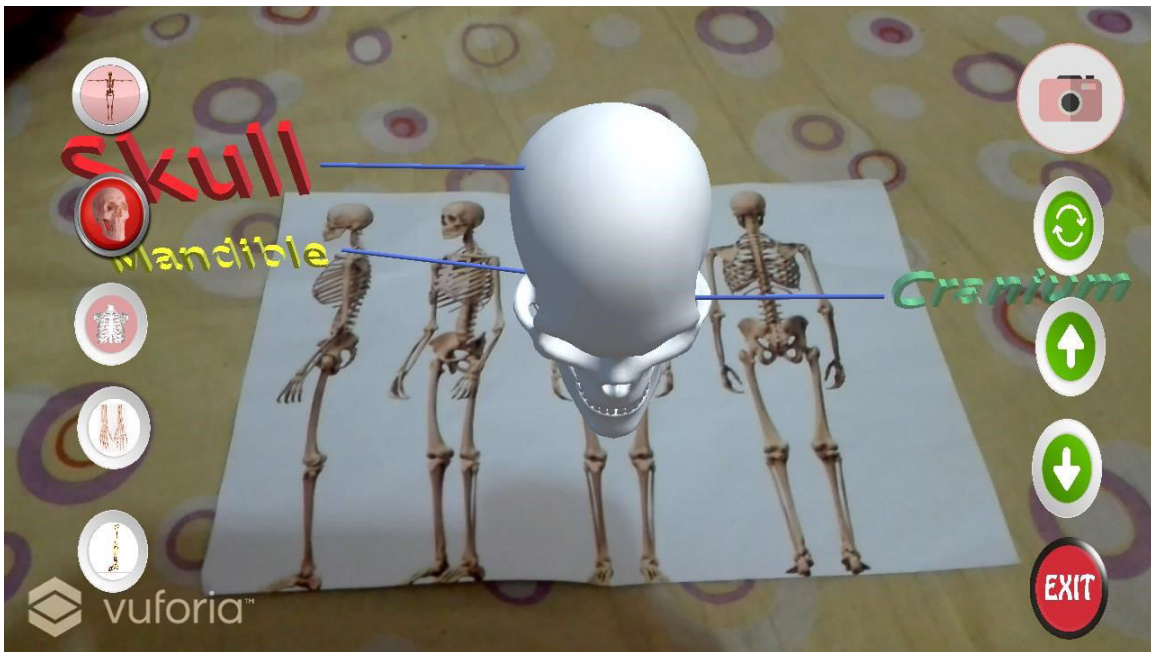

Figure: 4.2.1.5 skull

4.2.1.5 Skeletons (Chest)

If user choose chest button, user will see chest part only
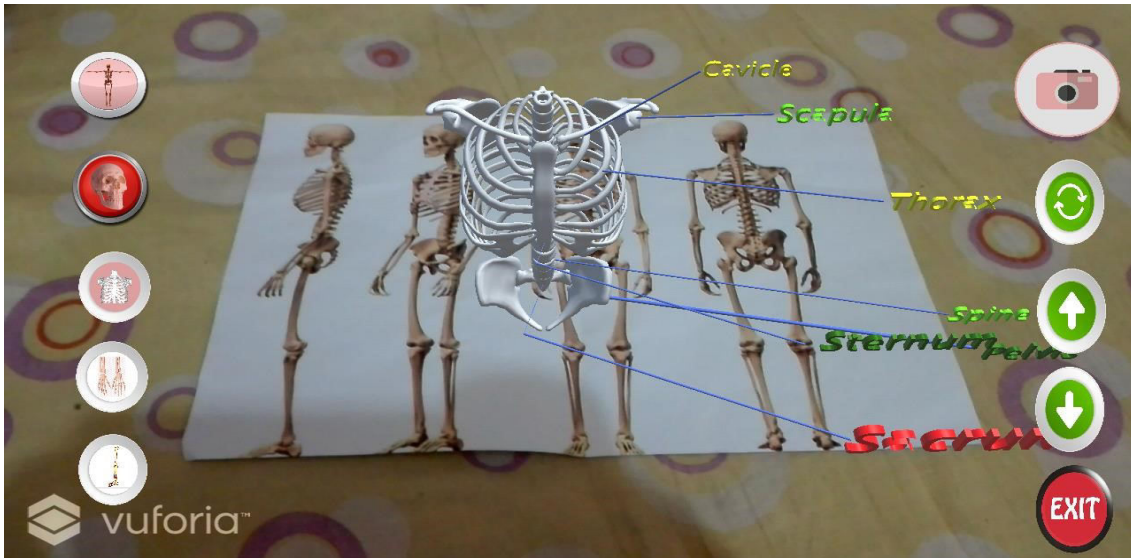
Figure: 4.2.1.6 chest

4.2.1.6 Skeletons (Hand)

If user choose hand button, user will see hand part only
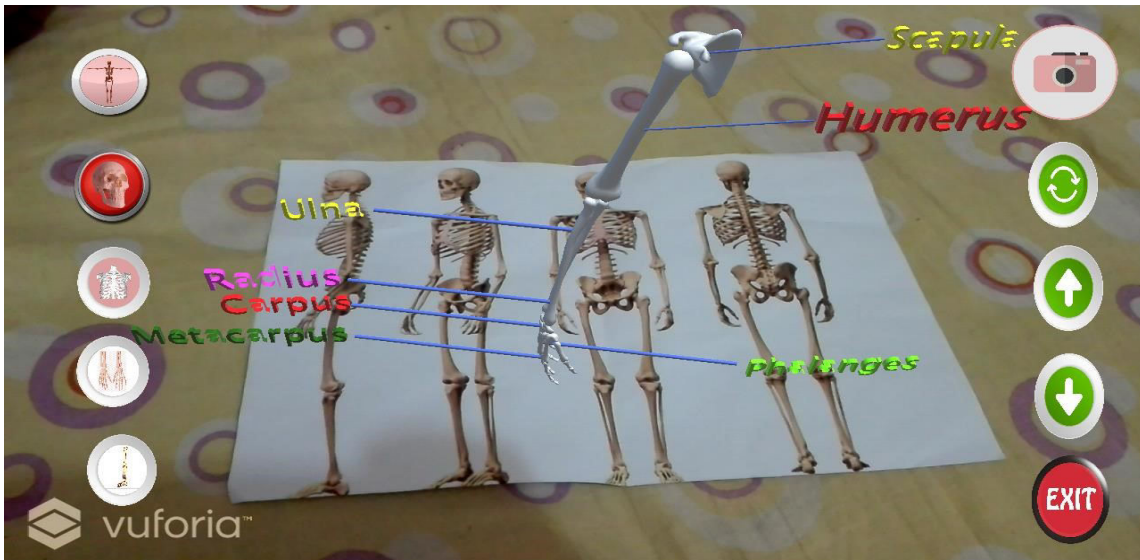
Figure: 4.2.1.7 hand

4.2.1.7 Skeletons (Leg)

If user choose leg button, user will see leg part only
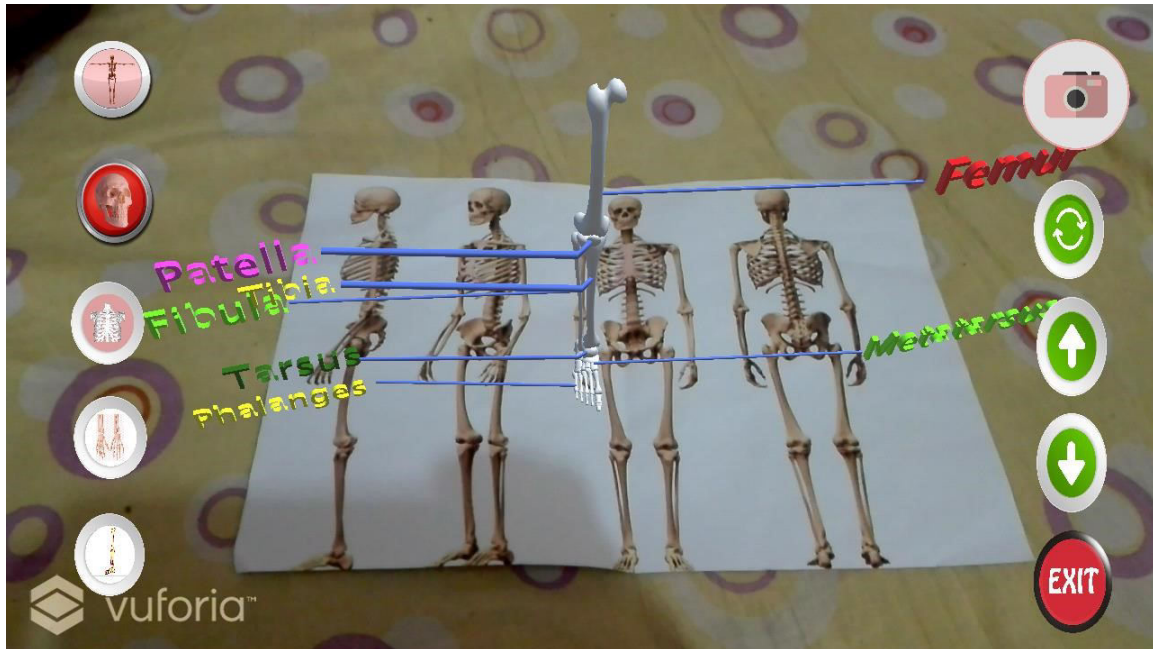
Figure: 4.2.1.8 leg

4.2.2.1 Nervous System (Home)

If user select the nervous system button user see the full nervous system of human body. User can also capture the image, rotate the image and zoom in zoom out the object. User see each object name and clear details

Figure: 4.2.2.2 nervous system

4.2.2.2 Nervous System (Nerves)

If user choose nerve button, user will see nerves part only
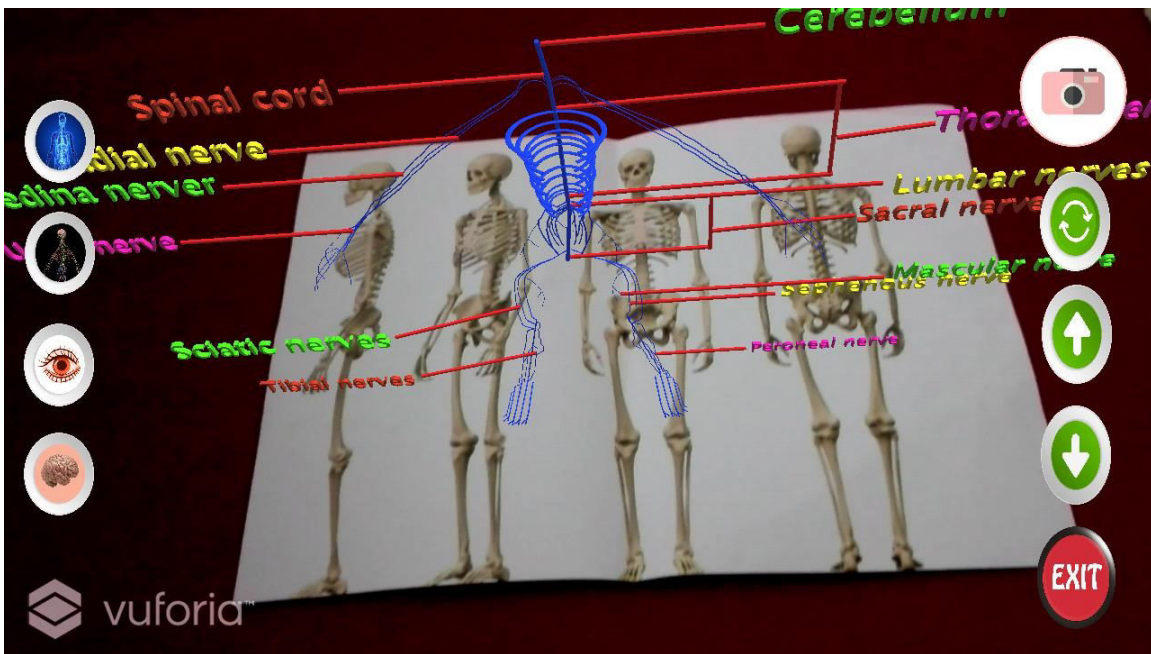
Figure: 4.2.2.3 nerves

4.2.2.3 Nervous System (Eye)

If user choose eye button, user will see eye part only
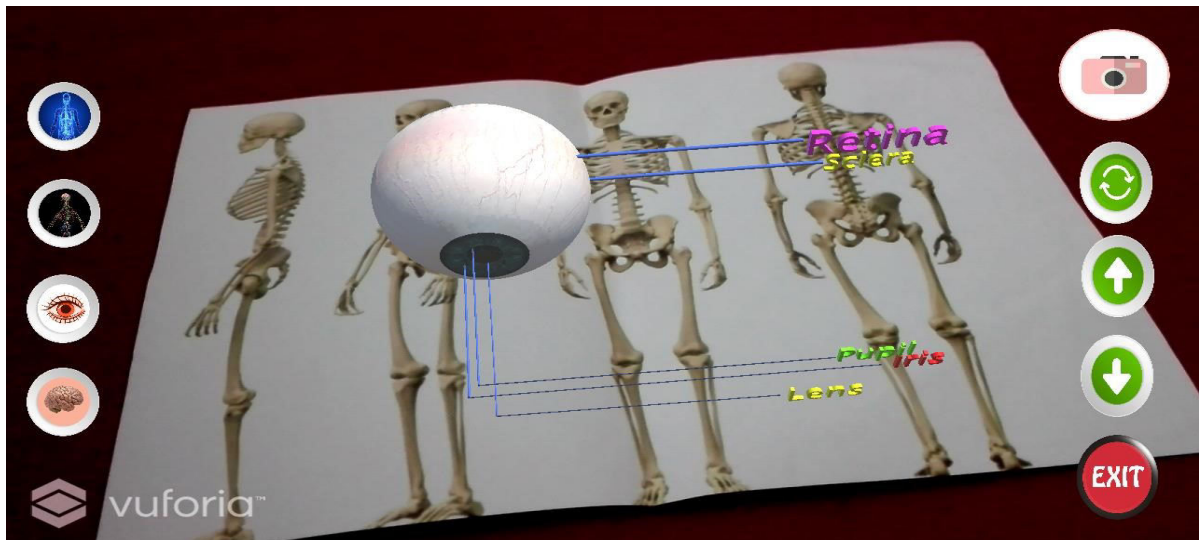
Figure: 4.2.2.4 eye

4.2.2.4 Nervous System (Brain)

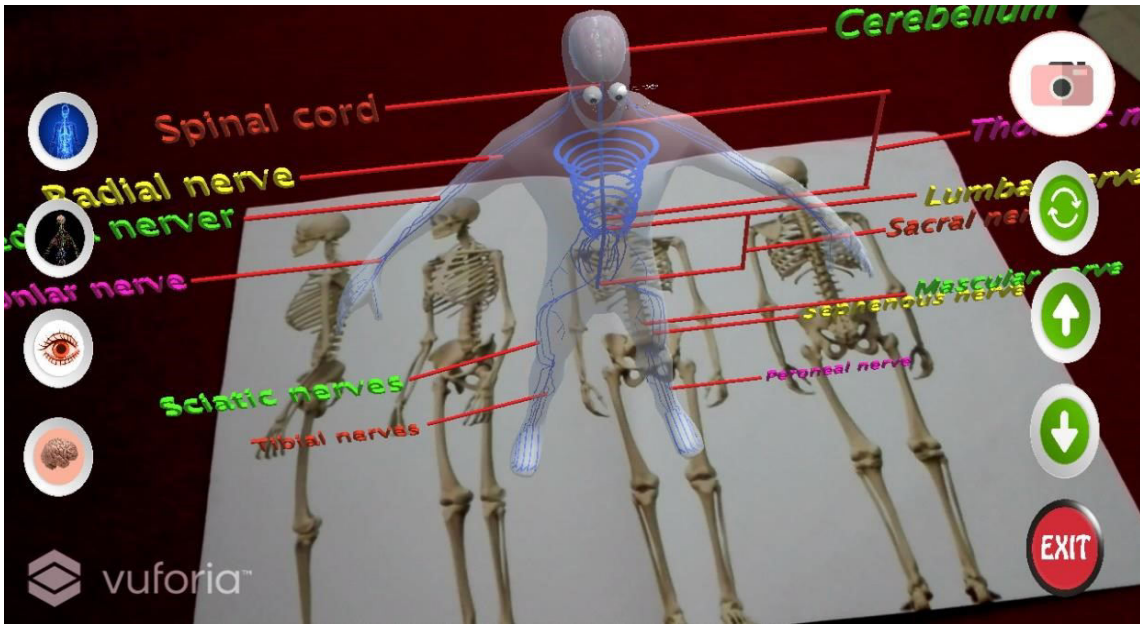If user choose brain button, user will see brain part only
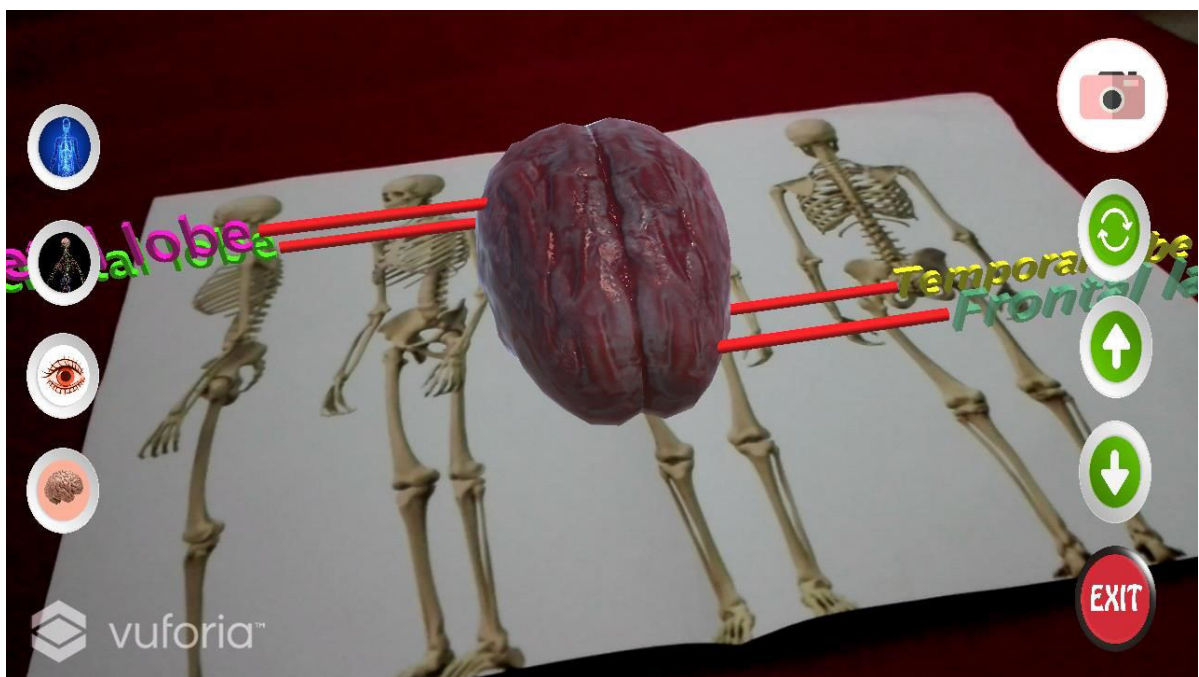
Figure: 4.2.2.5 brain

4.3 Descriptive Analysis

World move to forward. World always like update person. Augmented Reality is one of the greatest invention of modern science. Augmented reality can change the old education system. People don't need to memorize everything by reading book. In Augmented Reality system people learn from practical knowledge. Augmented Reality mainly focus on practical knowledge. Not only leaning process apply on augmented reality, user can train themselves by augmented reality. It's very easy process. People can safe their money. Normal training process people lose lot of money. I ask multiple question in medical students. Most of the students strongly agree with me that AR learning process is more effective than reading from book. Survey Fig: 4.3.1 given below.

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1. This AR(Augmented Reality) based application will help you to understand a process with proper visualization.

19 responses

- ● Strongly Agree
- ● Agree
- ● Neutral
- ● Disagree
- ● Strongly Disagree

42.1%

52.6%
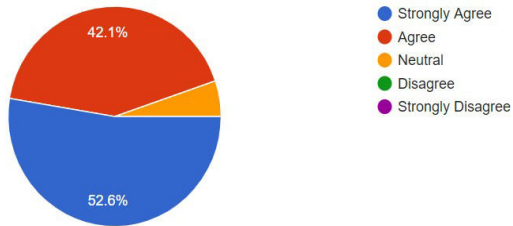
2. This AR(Augmented Reality) based application will enhance your learning

19 responses

- ● Strongly Agree
- ● Agree
- ● Neutral
- ● Disagree
- ● Strongly Disagree

52.6%   15.8%

31.6%
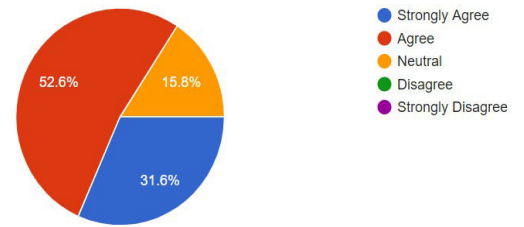
3. Class conduct will be enjoyable by this AR(Augmented Reality) based application

19 responses

- ● Strongly Agree
- ● Agree
- ● Neutral
- ● Disagree
- ● Strongly agree
- ● We didn't have any kind of AR(Augmented Reality) based class.

26.3%   21.1%

47.4%
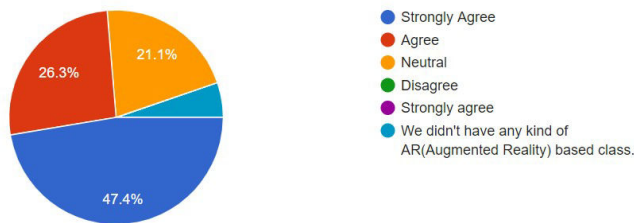
4.Will this application save the time of learning

19 responses

- ● Strongly Agree
- ● Agree
- ● Neutral
- ● Disagree
- ● Strongly agree

36.8%   10.5%

52.6%
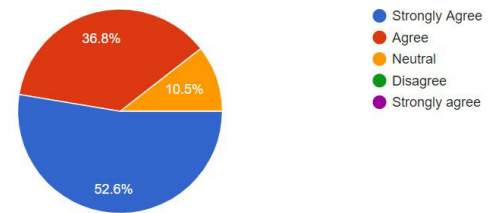
5.This application is easy to use

19 responses

- ● Strongly Agreed
- ● Agreed
- ● Neutral
- ● Disagree
- ● Strongly Disagree
- ● DON'T kno!

42.1%

Strongly Agreed
8 (42.1%)

6.I think I need supports from a technical person to use this application

19 responses

- ● Strongly Agreed
- ● Agreed
- ● Neutral
- ● Disagree
- ● Strongly Disagree

21.1%

26.3%   15.8%

31.6%
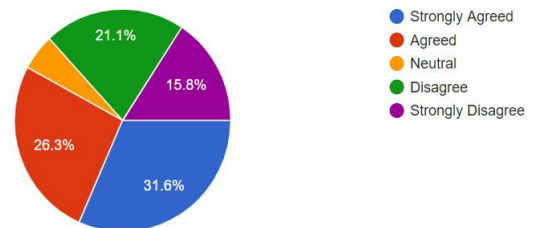
Figure: 4.3.1 Survey Responses diagram

4.4 Summary

AR education system in medical science is very useful, specially skeletons and nervous system learning process. Students will know proper details of each organs. It can be very useful for memorize.

CHAPTER 5

SUMMARY, CONCLUSION AND IMPLICATION FOR FUTURE RESEARCH

5.1 Summary of the Study

AR education system makes education easier. Medical education system is not so easy. Medical students need to memorize lot of things. Skeleton and nervous system is one of most critical part to memorize. So, I create Augmented Reality based skeleton and nervous system learning application. In this application students will learn proper details of the organ with real world perspective. They can zoom in, zoom out and rotation each organ. I give the name each organ in proper details.

5.2 Conclusions

In this report, I have analyzed different AR based application in different sectors of education. My application provides an interactive way for both medical and school level science students and instructors to learn and teach complex concepts of human anatomy and nervous system. I have got positive feedback from the end-users as well. My application works both in Android and IOS operating system, so this application is operating system independent. In future we will stress on the robustness of this application.

5.3 Implication for Further Study

AR objects from my proposed application running on an Android mobile.

- ➢ human skeleton
- ➢ chest area
- ➢ arm area
- ➢ nervous system
- ➢ eye area
- ➢ human brain

In future I include whole medical education system. Also add training session and lab experimental work. I add web search view. If user need deep learning any of the particular organ point, he can instantly search the point in web.

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APPROVAL This Project titled "Enhancement of Human Anatomy and Nervous System Learning Using Mobile Augmented Reality Application", submitted by Jahidul Hasan, ID: 161-15- 6961 to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on xx/xx/xxxx. BOARD OF EXAMINERS Name Designation Department of CSE Faculty of Science and Information Technology Daffodil International University Chairman Name Designation Department of CSE Faculty of Science and Information Technology Daffodil International University Internal Examiner Name Designation Department of CSE Faculty of Science and Information Technology Daffodil International University External Examiner DECLARATION We hereby declare that, this project has been done by us under the supervision of Lecturer Rubaiya Hafiz (Senior Scale) Department of CSE, Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma. Supervised by: Rubaiya Hafiz Lecturer Department of CSE Daffodil International University Co-Supervised by: Md. Azizul Hakim Lecturer Department of CSE Daffodil International University Submitted by: Jahidul Hasan ID: 161 -15- 6961 Department of CSE Daffodil International University ACKNOWLEDGEMENT First we express our heartiest thanks and gratefulness to almighty God for His divine blessing makes us possible to complete the final year research project successfully. We really grateful and wish our profound indebtedness to Rubaiya Hafiz, Lecturer (Senior Scale), Department of CSE, Daffodil International University, Dhaka. Deep knowledge & keen interest of our supervisor in the field of "Enhancement of Human Anatomy and Nervous System Learning Mobile Application" helped to carry out this project. His endless patience, scholarly guidance, continual encouragement, constant and energetic supervision, constructive criticism, valuable advice, reading many inferior draft and correcting them at all stage have made it possible to complete this research project. We would like to express our heartiest gratitude to Md. Azizul Hakim, Lecturer, Department of CSE, Daffodil International University, for his kind help as our co- supervisor to finish our project. His supports and encouragements speeded up our research progress. We would like to thank our entire course mate in Daffodil International University, who took part in this discuss while completing the course work. Finally, we must acknowledge with due respect the constant support and patients of our parents. ABSTRACT Advancements of recent technology allows the delivery of educational materials to be highly interactive. Augmented reality (AR) is one of the most promising technology that augments reality with computer generated imagery, objects, information etc. and allows user interaction. By providing visualization and interactive 3D models, it allows students to understand any abstract concept on any time, at any place easily. In this work we have developed an AR based mobile application that can create an interactive 3D view of human skeleton and nervous system by using a target image captured a mobile phone camera. The main motive of this application is to help the medical students and school level science students to learn human anatomy and nervous system in an interactive way so that they can enhance their learning procedure. This research narrates the concept, application development an results of the pilot test. This test is conducted by the medical students of different medical

colleges of Bangladesh. We have done this pilot test to get the users' experiences from technical viewpoint. According to this test we can concluded that students were satisfied with this application in terms of the features, usability, feasibility and understandability.

CHAPTER 1 INTRODUCTION 1.1 Introduction Augmented Reality (AR) is an emerging technology that enhance the reality with computer generated two or three dimensional images. It employs different information from real world to provide an integrated view of a particular real world object and offers interaction with it. A mobile based augmented reality application (mAR) provides mobilized, flexible and user interactive learning environment to users which is independent of time and location. Anatomy and nervous systems are some of the most important subjects especially for medical students and school level science students. Human anatomy and nervous system learning is concerned with the recognition and narration of human body structures which needs proper visualization of imagination to know the names and operations of different body organs and their activities. That's why these learning involves practical vivisection in the laboratory, where internal structure of human body and animals get revealed. This practical session is needed so that students can learn complex things more accurately. But after completing this session it becomes difficult for students to memorize the topics because it could not grow deep rooted understanding of this subject . However, mobile based augmented reality application can be one possible solution of this problem which can makes a concept fully understandable to students by illustrating a responsive 360- degree view of a model in the actual environment, actual scale, any time and at any place. Using target images collected from books or a downloaded document from websites or from printouts, a mobile based augmented reality application can scan images through the camera of a smartphone and can generate a 3D view of images that can help both the teachers and the students by giving them immersive environment. This application can also be considered as an economical option for introducing a modern aspect to 2D images and physical objects. 1.2 Motivation While new technologies are often used to facilitate regular people's lives, they often fail to see their potential in helping student properly. Augmented reality currently offers users the opportunity to add virtual information to their real-world surroundings in real time. It also has the opportunity to not only learn in practical, but also identify every organ. Augmented Reality is one kind of solution for those students who dropping out of school too early 1 .3 Objectives Main objective of this project is Anatomy, nervous system learning. Anatomy, nervous system, and all other organs learning are some of the beginner and basic subjects in medical colleges in Bangladesh. It is quite a big challenge for any new comer Bengali-based learner to memorize these terminologies as well as their functionality

since all the text books were written by English speaking background (ESB) writers. This is why we proposed a mobile- AR based application to assist and improve students self-learning skills. 1.4 Expected Outcomes To calculate the reliability and performance of my proposed system, I have conducted pilot testing. I have involved 20 medical going students. At first the students were familiarized with the system then they learned about bones and nervous system of human body for their learning activity. Finally, students were distributed a questionnaire for capturing their responses toward my application. 1.5 Report Layout From this report a user can easily understood the aim of this project. This report consists of five chapter. What the need of this application, how it can be work, its model, feature, what result given this system etc included this report. ? First Chapter, provides my project introduction, motivation, objective and expected outcome ? Second Chapter provides background, related work, research summary, Future Scope of Augmented Reality and challenges ? Third Chapter provides research methodology of my project. That is research subject and instrumentation, data collection procedure, statistical analysis, implementation requirements. ? Fourth Chapter provides experimental result and discussion of my project. experimental results, descriptive analysis. ? Fifth Chapter provides summery, conclusion, recommendation and implication. ? At last added all references and appendices of my project. CHAPTER 2 BACKGROUND 2.1 Introduction According to a report, 68.7 million (20.8% of the overall population) people in USA use AR at least once per month in 2019. Some of the applications of AR include gaming, entertainment, archaeology, architecture, commerce, tourism etc. Several published works focused on utilization of augmented reality in education and most of them get positive results. Study conducted by Kaya and Bicen reveals that the applications augmented reality in educational environments has a positive impact and it increases the academic achievement of students. Joanne Yip et al. have conducted a study on a sewing workshop and found that the use of AR videos provides better learning result in terms of learning performance and efficiency compared with the use of handouts in classes. The participants included 46 freshmen and this study showed that students learning experience and understanding of complex concepts can be enhanced through AR videos. 2.2 Related Works 2.2.1 Augmented – 3D Augmented Reality Augment is a mobile app that lets you and your customers visualize your 3D models in Augmented Reality, integrated in real time in their actual size and environment. Augment is the perfect Augmented Reality app to boost your sales and bring your print to life. Add your own 3D models and custom trackers on http ://augment. com. 2.2.2 Pokémon GO Pokemon Go best augmented reality apps in twenty-one century. User can play this game in real time. Player need to find the pokemon in real world environment. This app need GPS connection or Wi-Fi connection. 2.2.3 AR Medical In this app explore six different organs in augmented reality. User can easily rotate and zoom into the amazing details of our 3d models. You can also touch one of the organs to start an animation 2.3 Research Summary The development and testing of an augmented reality (AR) application for teaching as well as learning anatomy, nervous system, different bones, eye etc. for human body. 2.4 Future Scope of Augmented Reality Augmented Reality section is new in modern world. So, there are lot of future scope to this section. Augmented reality is making it really big all across the world. The future looks really bright as more and more companies are keen to jump on the craze by taking up this innovative and hi-tech technology. AR is certainly on skyline and in 2018 we're bound to see the growth on this path. This past year has been a very big year for the augmented reality technology. Google has yet again shined in AR. This year Google has launched ARCore, an augmented reality kit, that will enable developers to create AR apps for Android devices easily. Microsoft's HoloLens

headset and the upcoming Windows Mixed Reality operating system indicate their strong existence in both AR and VR space. In 2019 we can only expect this technology to flourish amongst the people and have a strong positive impact in various other fields. There are many other technologies being developed that do embrace augmented reality as a more enclosed component. Surely, things are going to improve much in times to come thus making our life easier to live. 2.5 Challenges To developing AR application for students is very challenging task to me. I find lot of challenging part to create this application ‣ AR camera setup ‣ Target image maximum tracking accuracy setup ‣ 3D models create ‣ Database setup ‣ Configure the names of each 3D models ‣ AR camera focus on target image ‣ Each model zoom in and zoom out configure ‣ Rotation each model ‣ Error handle and solve the error CHAPTER 3 RESEARCH METHODOLOGY 3.1 Introduction In this chapter I will discuss about some diagram and algorithm process. In diagram section I talk about Block diagram and Use Case Modeling. Also include Research Subject and Instrumentation, Data Collection Procedure, Statistical Analysis and Implementation Requirements. In data collection procedure I create survey form and ask some medical students to fill the form. In this process I get enough information for my work. Most of the common android device support my app. In Statistical analysis process I confirm to know that this app is very useful for science background students. 3.2 Instrumentation Use Autodesk Maya(2016) for modeling each of the 3D objects. Use Vuforia cloud server API and Vuforia database. Also use Unity 3D Game engine (version 2019, 30a2(Alpha)) for rendering and tracking AR. 3.3 Workflow and Data Collection Procedure First of all I create AR camera license manager. Then copy the license key into unity game engine. Then create database and add database in unity. Create 3D models and add texture in 3d model. If device target database and cloud target is match then target image will replace and show 3d model. Fig. 1 Application Architecture of proposed approach TABLE I Model description and available features Models Description Feature Skeletal Labeled view of human skeleton. Individual parts of skeleton and Bone Bone description, Labels of each part. nervous system can be Nervous system Brain Labeled view of human nervous system. Labeled view of human brain. selected separately to make them clear. Eye Labeled view of human eye. Rotation, zoom in/out of each model for close and detailed inspection. User can be able to capture pictures of what they are viewing in the display screen. 3.3.1 3D Model Building Autodesk Maya, version 2016 is used for modeling each of the 3D objects. All the features were transformed into this software to develop models. With the guideline of anatomical expert, each part was deconstructed within Autodesk Maya into several components and then accurately positioned according to the skeletal and nervous system. As a result this system provides more detail user understandings. Textures were mapped to make each component more realistic in 3D form. Table I shows all developed model and their features. 3.3.2 Software Development Kit An AR extension is required for producing an augmented environment. Vuforia is a software platform that is designed for high quantity operation of AR on mobile devices. It also provides tools for creating all categories of AR experience. A mobile educational courseware application approach was employed in our proposed system. Vuforia extension was integrated into Autodesk Maya as well as Unity3D (version 2019, 30a2(Alpha)) for rendering and tracking AR. All 3D components (in .fbx file format) were exported to Unity3D software and incorporated with Vuforia. Unity 3D gives all necessary tools for labeling and describing objects to provide relevant information to students. 3.2.3 Block diagram USER Mobile Device Vuforia Cloud Server API Target Image AR Camera License Manager AR Database Unity Game Engine 3D Models Check Image with AR Database 3.4 Statistical Analysis The experimental results which were captured from the mobile application running

on an Android mobile. After performing a pilot testing on twenty randomly chosen medical students we provided them a questionnaire for collecting feedbacks. Our intention was to find if they are interested in AR based learning environment or not. 50% of them strongly agreed, 40% agreed and 10% gave neutral feedback that through visualization AR based system provides better understanding. 35% strongly agreed and 50% agreed that this system is useful to enhance their learning.35% participants strongly agreed, 25% agreed,5% neutral, 20% disagreed and 15% strongly disagreed that they need technical supports to use this application. Moreover, students stated "We didn't have any kind of AR(Augmented Reality) based class before"; "this system is more useful for junior rather than senior students". All of their feedbacks are plotted into a chart as shown in Fig.2 Fig. 2 Chart shows student feedbacks 3.5 Implementation Requirements Technical requirements are the set of hardware issues that must be considered to operate a product effectively. We have selected mobile phones (both IOS and Android) to project AR objects and the minimum API requirement for the smooth running of this application is version 4.1(Jelly Bean). The target images are captured using back camera and the resultant augmentations are exhibited through front panel display screen. CHAPTER 4 EXPERIMENTAL RESULTS AND DISCUSSION 4.1 Introduction In this section I will discuss about Output Result and descriptive analysis of my application. I create this application for science background biological students. They need lot of lab work. Sometime all the equipment is not available in their lab. I create this application to improve student's lab performance. 4.2 Output and Experimental Results I create medical base Anatomy and Nervous system learning (AR) application for students. I give each 3d model name to understand the students very clearly. Students can see the 3d models in real world perspective. They feel that they see the model Infront of the mobile device they can rotation the models and zoom in, zoom out the models. The see each of the models name according to the real-world perspective. 4.2.1 App Permissions Need to Permission phone back camera to detection object also need drive permission to save the screen capture images 4.2.1.2 Menu Bar In menu bar section there are three option. Skeletons, Nervous System and Exit. 4.2.1.3 Skeletons (Home) If user choose skeletons button the user see home menu of all skeleton and see each object name. There are eight new buttons. Four buttons separate each skeleton object and another four buttons control the object. User can capture the images. Rotate the 3d models, zoom in zoom out the models and back to the previous menu 4.2.1.4 Skeletons (Skull) 4.2.1.5 Skeletons (Chest) 4.2.1.6 Skeletons (Hand) 4.2.1.7 Skeletons (Leg) 4.2.2.1 Nervous System (Home) If user select the nervous system button user see the full nervous system of human body. User can also capture the image, rotate the image and zoom in zoom out the object. User see each object name and clear details 4.2.2.2 Nervous System (Nerves) 4 .2.2.3 Nervous System (Eye) 4 .2.2.4 Nervous System (Brain) 4.3 Descriptive Analysis World move to forward. World always like update person. Augmented Reality is one of the greatest invention of modern science. Augmented reality can change the old education system. People don't need to memorize everything by reading book. In Augmented Reality system people learn from practical knowledge. Augmented Reality mainly focus on practical knowledge. Not only leaning process apply on augmented reality, user can train themselves by augmented reality. It's very easy process. People can safe their money. Normal training process people lose lot of money. I ask multiple question in medical students. Most of the students strongly agree with me that AR learning process is more effective than reading from book. Survey Fig:3 given below. Fig:3 Survey Responses diagram 4.4 Summary AR education system in medical science is very useful, specially skeletons and nervous system learning process. Students will know proper details of each

organs. It can be very useful for memorize. CHAPTER 5 SUMMARY, CONCLUSION AND IMPLICATION FOR FUTURE RESEARCH 5.1 Summary of the Study AR education system makes education easier. Medical education system is not so easy. Medical students need to memorize lot of things. Skeleton and nervous system is one of most critical part to memorize. So, I create Augmented Reality based skeleton and nervous system learning application. In this application students will learn proper details of the organ with real world perspective. They can zoom in, zoom out and rotation each organ. I give the name each organ in proper details. 5.2 Conclusions In this report, I have analyzed different AR based application in different sectors of education. My application provides an interactive way for both medical and school level science students and instructors to learn and teach complex concepts of human anatomy and nervous system. I have got positive feedback from the end-users as well. My application works both in Android and IOS operating system, so this application is operating system independent. In future we will stress on the robustness of this application. 5.3 Implication for Further Study AR objects from my proposed application running on an Android mobile. ‣ human skeleton ‣ chest area ‣ arm area ‣ nervous system ‣ eye area ‣ human brain In future I include whole medical education system. Also add training session and lab experimental work. I add web search view. If user need deep learning any of the particular organ point, he can instantly search the point in web. REFERENCES [1] P. K. Ganguly, "Teaching and learning of anatomy in the 21st century: Direction and the strategies," The Open Medical Education Journal, vol. 3, no. 1, 2010. [2] V. Petrock, Virtual and Augmented Reality Users 2019, March 2019 (Accessed September 30,2019). https://www.emarketer.com/content/virtualand-augmented-reality- users-2019/. [3] M. Russ, S. Keilwert, L. Angermayer, K. Achm¨uller,D. Goriup, E. Kiss, C.Mitterh¨ofer, M. Lasser, S. Koller,G. Pichler, et al., "Augmented reality systems and methods for gaming," Feb. 14 2019. US Patent App.15/672,560. [4] A. Berlino, L. Caroprese, A. La Marca, E. Vocaturo, and E. Zumpano, "Augmented reality for the enhancement of archaeological heritage: a calabrian experience," 2019. [5] R. A. Zemenchik, "System for treatment of an agricultural field using an augmented reality visualization," May 16 2019. US Patent App. 16/148,142. [6] N. Spivack and M. Hoerl, "Systems and methods of rewards object spawning and augmented reality commerce platform supporting multiple seller entities," Apr. 11 2019. US Patent App. 16/130,582. [7] D.-I. D. Han, M. C. Tom Dieck, and T. Jung, "Augmented reality smart glasses (arsg) visitor adoption in cultural tourism," Leisure Studies, pp. 1– 16, 2019. [8] J. Barrow, C. Forker, A. Sands, D. O'Hare, and W. Hurst, "Augmented reality for enhancing life science education," in VISUAL 2019-The Fourth International Conference on Applications and Systems of Visual Paradigms, 2019. [9] O. S. Kaya and H. Bicen, "Study of augmented reality applications use in education and its effect on the academic performance," International Journal of Distance Education Technologies (IJDET), vol. 17, no. 3, pp. 25–36, 2019. [10] J. Yip, S.-H. Wong, K.-L. Yick, K. Chan, and K.-H.Wong, "Improving quality of teaching and learning in classes by using augmented reality video," Computers & Education, vol. 128, pp. 88–101, 2019. [11] P. Pandey and C. Zimitat, "Medical students' learning of anatomy: memorisation, understanding and visualisation," Medical education, vol. 41, no. 1, pp. 7–14, 2007. [12] T. Blum, S. M. Heining, O. Kutter, and N. Navab, "Advanced training methods using an augmented reality ultrasound simulator," in 2009 8th IEEE International Symposium on Mixed and Augmented Reality, pp. 177–178, IEEE, 2009. [13] R. Umeda, M. A. Seif, H. Higa, and Y. Kuniyoshi,"A medical training system using augmented reality," in 2017 International Conference on Intelligent Informatics and Biomedical Sciences (ICIIBMS), pp. 146–149, IEEE,2017. [14] S. S. Jamali, M. F. Shiratuddin, K. W. Wong, and C.

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