American International University-Bangladesh (AIUB)

Augmented Reality based Magazine Book For Historical Places of Bangladesh

Thesis

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Declaration

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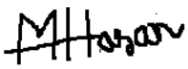

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Abstract

"Augmented Reality (AR) is the integration of real-world objects with real-time use of information in the form of text, graphics, audio and other virtual enhancements. In mobile augmented, a client can see virtual particles superimposed on live video of this display reality utilizing visual following or plan rendering. The tourism sector is very important for the economy of any country. There are many tourist sectors in our country. But they are not well-organized and attractive. Augmented reality technology is still new in Bangladesh. We have seen in various articles that this technology is being used successfully. To implement the tourism sector, we have proposed the development of augmented reality-based magazine books in our research. We used Vuforia SDK for this and developed the graphics part ourselves. Then we have selected our magazine book places and designed the app accordingly. Finally. we have evaluated how effective this system could be where 50 people attended and most were satisfied about the effectiveness of our magazine book in the tourism sector.

Keywords: Augmented Reality, Mobile Augmented Reality, Tourism Sector in Bangladesh, Vuforia Target Library, Unity Game Engine, Feedback Analysis.

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CHAPTER 1

Introduction

1.1 Overview

Augmented reality (AR) is the ongoing utilization of data as text, graphics, audio, and other virtual enhancements integrated with real-world objects (Grinberg, Daniel, Gabby and Eli Luria,2015). Mobile Augmented reality is portable. Because where you need you can take it and use it. New innovation like Mobile AR depends on expanded and that can be utilized on cell phones, for example, cell phones, headsets, glasses (Nincarean, 2013).

AR innovation is as of now utilized in a number fields, for example, medication, instruction and reenacted preparing among others (Akçayır, Murat, and Gökçe, 2017). It is additionally utilized inside the travel industry part, expecting to improve the vacationer experience. Without going there a vacationer can comprehend the magnificence of a spot by utilizing portable mobile augmented reality. The traffic jam problem is irritating and waste of time (Turcotte, Martin, 2011). For this the tourists lose their interest to visit famous and beautiful place of Bangladesh.

Our AR based system will give an interactive magazine to tourists. The system that we will create with the assistance of versatile will give travelers perception, 3D pictures, recordings of verifiable spots of Bangladesh. For developing the system, we will use Vuforia SDK, JDK, JRE and we also use Unity 3D for developing mobile application. The system will offer them a chance to appreciate the excellence of the famous place without going there. That will represent Bangladesh as a modern country, that's our critical thinking. By basically putting the magazine picture before the cell phone gadget tourists can find out about the verifiable spot in Bangladesh.

1.2 Background

Augmented reality is an intelligently involvement of a real-world environment where the objects that dwell within the genuine world upgraded by computer-generated perceptual information now and then over numerous tactile modalities, counting visual, sound-related, somatosensory and olfactive. Augmented reality can be characterized as a framework that fulfills three fundamental highlights: a combination of genuine and virtual universes, real time interaction, and exact 3D enrollment of virtual and genuine objects.

On mobile devices like Smart phones, tablets, the augmented reality works like a magic window. The main breakthroughs of mobile augmented reality between 1968 and 2014. Mobile augmented reality has generally produced on final decade as well as explains what mobile augmented reality is (Feiner, S., MacIntyre, B., Höllerer, T., & Webster, A.,1997).

The Sword Damocles was the first head-mounted display of the world. That was created by Ivan sutherland in1968 (icg,2010).

In 1974, Myron Krueger built a project that was called, 'Video place', which assembled a projection system and video cameras that made shadows on the screen. This setup made the client feel as in spite of the fact that they were in an intuitively environment (Wikipedia,2010). The first real operational augmented reality system is Virtual Fixtures that was created by Louis Rosenburg in 1992. A robotic system places information on best the specialists work environment to assist with efficiency. This system may be thought of as an early form of what most AR systems as of now do today. In 1994, the first theater production was created to use augmented reality.

In 1998, Sportsvision conducts the 1st and Ten line computer system. This system appeared the actual virtual yellow first down marker during a live NFL game. A variation of this virtual first down marker is presently a standard in all televised football games today and is a big part of the augmented reality history (R. Azuma,1997).

In 1999 nasa built a crossover manufactured vision framework that coordinates expanded reality in their x 38 shuttle the expanded reality innovation was utilized to assist improve route amid their test flights. In 2000, Hirokazo Kato built the world's first open source Software library ARToolkit (Feiner, S., MacIntyre, B., Höllerer, T., & Wearing, T.,1999).

In 2003, Wagner and Schmalstieg introduce the first handheld AR system on a “personal digital assistant”, it operates in favor of AR on smart devices (Damala, A.,2007)..

In 2009, Esquire magazine, in collaboration with Robert Downey Jr., applies augmented reality in their print media. Barcode on the magazine can be scanned with the Software on everyone’s computer who has it, the readers can expertise about augmented reality content. In this year, AR Tool Kit makes augmented reality accessible to Internet browsers. In 2014 Google has created AR glasses so that users can enjoy immersive experiences (M. Li, B. H. Kim, and A. Mourikis,2013).

1.3 Problem Statement

The existing tourist magazine books are not interactive for tourist. Because all the tourist magazine books which provide by tourist guide is hard copy based that can feel bored and not so attractive with them. The significance of an historical place can’t explain properly with plain text or book pictures. In hard copies of a magazine, there are lack of details with the normal pictures. This generation are not interested in reading books. For this they search in internet to see some details and videos to get a good overview of the tourist spot more efficiently. Absence of interaction with the plain text book doesn't attract the tourist to hold their interest.

The main existing magazine is books are not interested because of the plain texts. This issue can be solved quite easily by graphical and animated content instated of hard copies. To solve the existing issues, we are proposing a magazine book that has some attractive graphical 2D,3D image of the spot and also have audio-visual, animation and videos. This system helps to make the historical place more significant.

1.4 Objectives

The inspiration behind the thesis is to design a framework for AR-based live undertaking for vacationer, which will increase the interest of tourists in the beauty of Bangladesh. In this exploration, we are proposing to build up an intuitive Augmented Reality based framework for live going for traveler.

- To design a framework for tourist to enjoy the beauty of Bangladesh.
- To develop a mobile Augmented Reality (AR) system using this Framework to enhance the tourist interest in Bangladesh famous places.
- In our system we will use images, videos which will increase the interest of tourists towards famous places of Bangladesh which is not available in any other mobile system.

1.5 Significant

The system we are proposing is Mobile Augmented Reality (AR) based which is helpful for tourist. The system has some potential significance as a helping media for the tourist. Some of those are:

- The system is integrated with some videos and several attractive relevant images.
- 2D/3D images, animations, and videos will help tourist to visualize the famous places.
- As the image and animations are responsive, tourist can directly interact with the system by tilting the device.
- The framework will help tourists straightforwardly appreciate the magnificence of Bangladesh.

1.6 Summary

Mobile augmented reality is the most utilized and most well-known media on the planet today, which is valued and acknowledged by all, because it is not real but gives a sense of reality.

Mobile augmented reality is a colossal field and it is turning out to be more mainstream step by step. An assortment of advancement units are utilized here to make an interactive software.

There are numerous celebrated and mainstream places in the nation however it is beyond the realm of imagination to expect to introduce them to the sightseers appropriately, to take care of this difficult we will make a magazine book which will assist the travelers with appreciating the well-known spots of Bangladesh through Mobile Augmented Reality (AR).

Our primary objective is to expand the enthusiasm of the individuals in far off nations towards the magnificence of Bangladesh.

In this undertaking we will utilize responsive 2d and 3d pictures and video which will expand the excellence of Bangladesh and tourist will be anxious to see the magnificence and celebrated spots of Bangladesh.

CHAPTER 2

Literature Review

2.1 Overview:

In this chapter, the literature review about AR, Mobile AR, Vuforia, unity game engine,3D modeling, related works for tourism using AR, and magazine books will be covered. This chapter will narrate the definition of various terms like AR, Mobiles AR in chronicles. It will also cover examples of how AR is used in real life and how to connect virtual life with real life. How Vuforia works, its history for development, and how it connects mobile with augmented technology will describe part of Vuforia. This chapter will also cover the 3D Images, 3D animation and Videos which will be shown using our system. What 3D modeling is, how it works. In the last part we will cover some related works for traveling using AR.

2.2 Augmented Reality

Augmented Reality is an innovation that mainly give the experience of real-world environment. Augmented Reality is mainly a modification of Virtual Reality (Azuma, 1997). According to Horizon Report (2011), Augmented reality brings a noteworthy potential to supplement information delivered by means of computers, versatile gadgets, video, and indeed the printed book. The AR is very utilized and don't require costly hardware stuffs. AR can be easily implemented in smartphones, laptop or computers. AR, with its layering of information over 3D space, does modern recognition with the world and prescribed that AR ought to be grasped inside some a long time to provide a other way to educate, learn, explore, or invent (Horizon Report, 2011). By taking benefits of virtual items or information covering physical items or environments, makes a mixed reality in which virtual items and real-world exist together in a significant way to increase uses of augmented learning (Dunleavy, Dede & Mitchell,2008). Technologically, the devices utilized within the virtual situations play a critical part within the creation of effective virtual experiences. According to the writing, can be recognized input and output gadgets (Burdea et al., 1996). Now-a-days augmented reality used in various fields as for gamming, military training, education sector, medical sector (Alexander et al., 2017). As indicated by many research (Cheng & Tsai, 2013), Augmented Reality Technologies gives special benefits in the education

sector. AR encourages students to study as it gives real visualization about real objects (Dede, 2009). It inspires students to research in-depth to gain more skills (Sotiriou & Bogner, 2008).

2.3 Mobile Augmented Reality

In this era, smartphones can do lots of heavy tasks like sending or receiving mails, can record high quality audio or videos, captures high quality images and also can handle high quality games (Lee, Yang, Kim, Kim & Choi, 2009). Now some high configuration 2d and 3d games can be played on smartphones. These new features of smartphones are rapidly growing and many features are connected with AR interface on phones. Utilizing a handle AR interface on a cell phone, a client can see virtual particles superimposed on live video of this display reality utilizing visual following or plan rendering. The Mobile Augmented Reality -based mobile apps and mobile advertising market is now more than $732 million (Juniper Research 2009). A different smartphone AR communication method can likewise be utilized to control these virtual articles, for example, performing interpretation, scaling to change the area, rotation, posture, and size of virtual items in space (Bai, Lee & Billinghurst, 2012). A virtual object can be a basic content, a two-dimensional shape, a three-dimensional shape or indeed a video. Utilizing a handle AR interface on a cell phone, a client can see virtual particles superimposed on live video of this display reality utilizing visual following or rendering. Using movable fiducial markers in the dynamic sections of the application. AR as another medium is interesting for schooling, for example, exhibition halls. The joining of AR upgraded shows can run AR display to a whole new display by utilizing AR effects (Höllerer, Feiner & Pavlik, 1999). Convenient AR advancement can offer a curiously substitution for the ordinary sound tape visit control. Visit guides are a common application subject for versatile AR investigate, not completely since they appear the quality of phone AR, to be particular to display valuable information enrolled to inactive regions in reality.

2.4 Tourism sector in Bangladesh

Bangladesh is full of natural beauty. Bangladesh's tourist places incorporate historical monuments, resorts, picnic spots, beaches, wildlife of various species, forests and tribal people. Activities for tourists include angling, water skiing, river cruising, hiking, rowing, yachting, and sea bathing (ISBN,2011). In 2014 125,000 tourists visited Bangladesh. This number is awfully low comparative to total population. Starting at 22 May, 2019 the all-out nearby populace numbering 166,594,000 occupants. This gives a proportion of 1 traveler for each 1,333-local people. In 2019, contribution of travel and tourism to GDP (% of GDP) for Bangladesh was 4.4 %. Though the contribution of Bangladesh in traveling and tourism to GDP (% of GDP) varied significantly in recent years, it tended to rise through 2000 - 2019 period ending at 4.4 % in 2019 (Wikipedia,2013). This means that, the tourism sector has great potential for the development of a developing country like Bangladesh. But tourist spots in Bangladesh are not concentrated in any particular place. For this, if tourists want to see a famous place in Bangladesh, they have to go to that place or collect images from the web. There is no interactive system for tourists to enjoy the beauty of the famous place of Bangladesh without going there.

2.5 Vuforia Target Library

Vuforia is an SDK for creating AR apps for Android, iOS, and UWP (Universal Windows Platform). It uses computer vision technology to recognize and track planar images and 3D objects in real time. It was initially created by a Qualcomm company and its release version could only recognize text. In 2015 the SDK was bought by PTC Inc. The new owner focused on advertising Vuforia as an SDK for industry apps, but it is also used in mobile development. (Wikipedia) Vuforia SDK is used as a connector of mobile with the augmented reality world (Peng & Zhai, 2017). The latest versions of Unity have a built-in Vuforia, so the developers no longer need to torment themselves over installing the SDK. One of the main features of Vuforia is image recognition in real-time — Image Target. The Vuforia SDK supports a variation of 2D and 3D target categories including ‘markerless’ Image Targets, 3D Model Target, and a type of addressable Fiducial Marker, known as a VuMark. Supplementary features of the SDK contain 6 degrees of freedom device localization in space, confined Obstruction Detection using ‘Virtual Buttons’, runtime image target selection, and the capability to create and

reconfigure target sets programmatically at runtime.((Wikipedia)It also increases the virtual ability for developers for locating and aiming and also three-dimensional objects along with other data. So that users can adjust the location of virtual elements along with real objects using the mobile screen in life. In this way, the display of virtual objects and real environments seems similar to the user view.

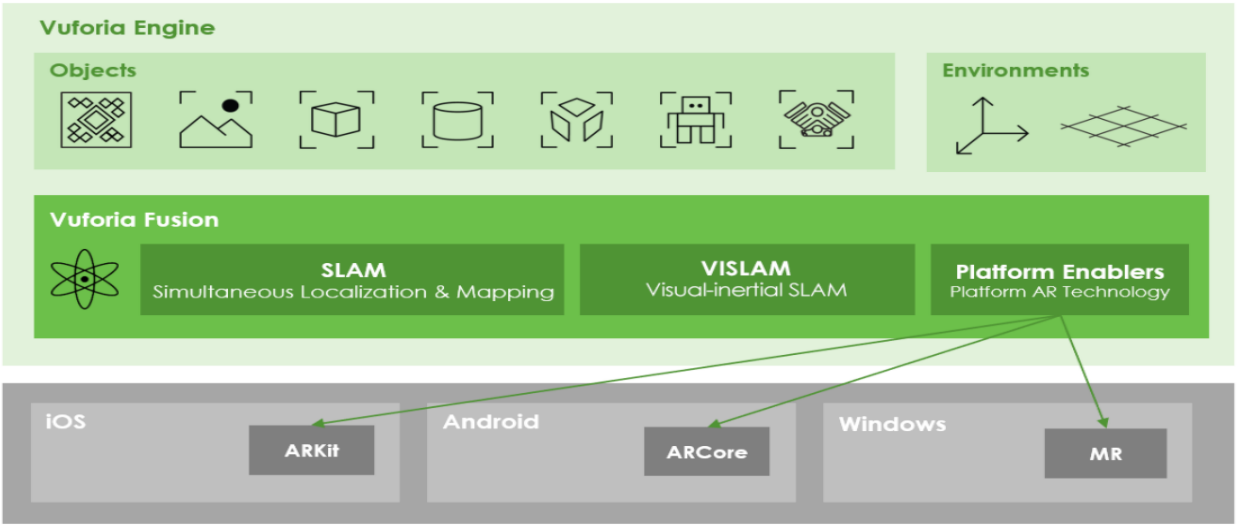

Fig 2.5: Vuforia Engine (Vuforia Fusion)

2.6 Unity (Game Engine)

Unity is a cross-platform game engine created by Unity Technologies. The Unity game engine was launched in 2005, pointing to "democratize" diversion improvement by making it available to more developers. (Axon & Samuel, 2016; Brodkin & Jon, 2013). Another year solidarity was named runner up within the best utilize of mac os x illustrations category in apple inc's apple plan grants smykill jeff 2006 solidarity was at first discharged for mac os x afterward including bolster for microsoft windows and web browsers brodkin. (Smykill & Jeff, 2006). Unity was initially released for Mac OS X, later adding support for Microsoft Windows and Web browsers. (Brodkin & Jon, 2013).

In 2007, Unity 2.0 was introduced with nearly 50 modern features. (Cohen and Peter 2007). Unity 3 was launched in september 2010 with highlights extending the engine's design highlights for desktop computers and video diversion supports. (Girard and Dave 2010). And dave 2010 a May 2012 overview by game designer magazine demonstrated solidarity as its best diversion motor for portable stages gamasutra 2012 in november 2012 solidarity advances Rendering transform Unity

4.0. This Adaptation included directx 11 and adobe streak bolster modern activity devices called mecanim and get to to the linux see. (Tach and Dave 2012) The Verge said of 2015's Unity 5 discharge: "Unity begun with the objective of making diversion improvement generally accessible".

2016, Unity Advances reported In December that they would alter the versioning numbering system for Solidarity from sequence-based identifiers to year of release to adjust the versioning with their more visit discharge cadence; Unity 5.6 was therefore followed by Unity 2017(Batchelor and James 2007). Unity 2017.2 underscored Unity Technologies' plans beyond video games. Included modern apparatuses such as timeline which permitted engineers to drag and drop movements into diversions and cinemachine a savvy camera framework inside diversions (Nanalyze 2017). In June 2020, Unity introduced the Mixed and Augmented Reality Studio (MARS), which provides developers with additional functionality for rules-based generation of augmented reality (AR) applications (Sprigg and Sam 2018).

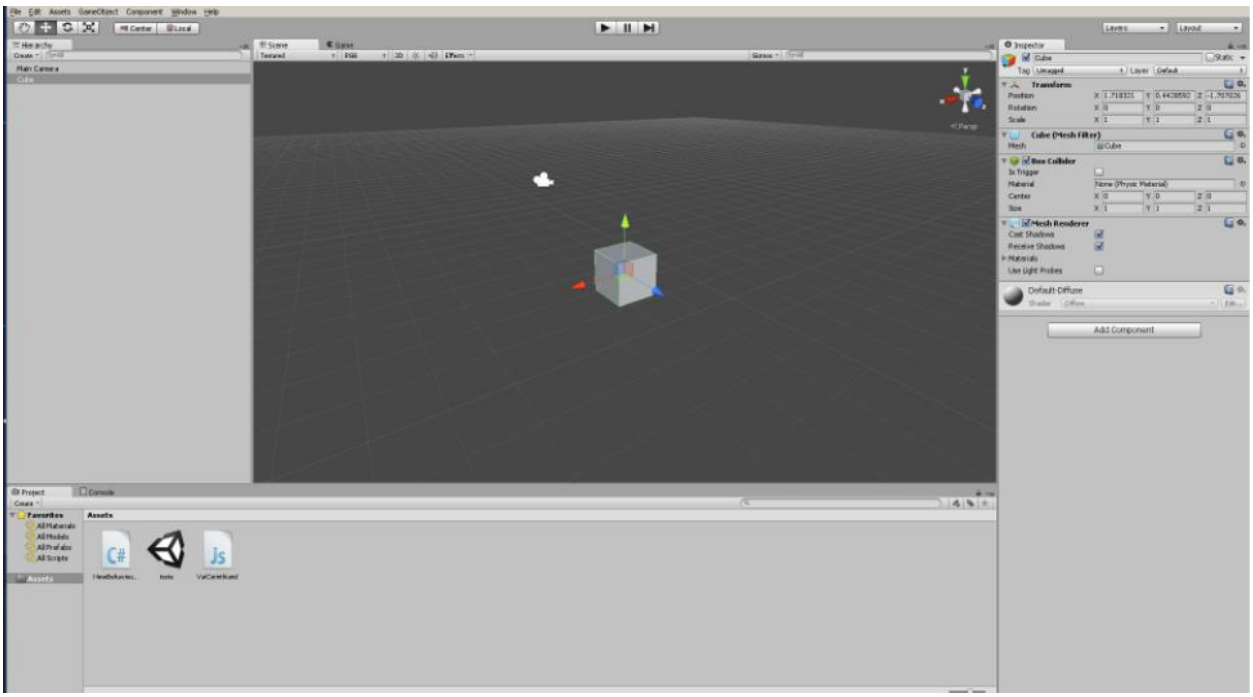

Fig 2.6: Unity Game Engine

2.7 3D Models and Multimedia:

3D computer graphics use a third dimensional representation of geometric data that is stored in the computer for the purposes of performing calculations and rendering 2D images. (Wikipedia)

The objects in 3D graphics are often referred to as 3D models. 3D model is the technique of producing a mathematical representation of any surface of an object in 3D via specialized software. (Wikipedia) A 3D object can be generated automatically or created manually by deforming the mesh or manipulating vertices. (Wikipedia) The 3D model is to be used for two critical subsystems of the system architecture, i.e. positioning and visualization of virtual objects. (Sisi Zlatanova ,2001) Through 3D rendering, a model can be displayed visually as an image. Rendering transform a model into an 2D image by simulating light passage to get photo-realistic images. (Wikipedia)

3D animation is the method of creating pictures that are motioning in a digital environment that is three dimensional. Through manipulation of 3D models inside 3D software, image sequences can be transferred, which gives the illusion of movement based on how objects are manipulated. To visualize the virtual objects there is no details required but the correct shape and orientation of the real objects will be needed.

In our application, users will visualize 3D images, animations and videos for relevant images that are in the magazine. These3D models, animations, and videos will be stored in the database. When the application recognizes the marker of the image, it brings the 3D model up with respect to that image. Along with 3D models our application will also have some multimedia. We will use some videos with respect to the pictures. The videos will be gathered from Youtube and modified by Unity for integration purposes. When the AR application detects the marker by scanning the target image, it plays the specific video on the mobile screen with audio.

2.8 Related Work for Traveler using AR

There are a ton of studies and test usage created for coordinating virtual or enlarged reality frameworks in social legacy site for traveler to build the intrigue. Specialized sound, specifically, is regularly used to pass on limited data, either supplementing or totally filling in for visual components (Sawhney and Schmandt, 1998). Portable increased reality offers the client the chance of having a live perspective on their environmental factors expanded with extra viable data (Kourouthanassis, Panos, et al, 2015). Many works have been done in this sector using vuforia sdk kit and in below we have demonstrated some of those.

TowerAR: This is an Android app that allows you to view audio 3D and 2D images of historical places of Piazza dei Miracoli, Pisa (Mihai,Raffaello,Florin,Cristian,Octavian,Machidon and Marcello,2011). The application was created utilizing Metaio SDK library. The MAR experience can be appreciate through just by a Samsung Galaxy Tab S2 tablet. It shows itemized data of the particular historical place when they take the telephone before the particular landmark. Each Picture contains a description of the landmark of the particular notable time frame.

Fig. 1. The TowerAR app main components

Fig. 2. The 3D models of the Leaning Tower used for the time-based guide (years 1180, 1280 and 1360)

Fig 2.8.1: Tower AR

iTacitus : It is an interesting venture and it was created by European Researchers. It is an intelligent venture which speak to social site of the nation to the traveler. It distinguishes the area and direction of a cell phone or tablet in space and dependent on this information a locally mixed media content is put into the picture with different content data, sound, video, photos or 3D activity in the genuine space-time (Jiri, Pavla,2015).

Fig. 1. (a) real space-time; (b) real space-time with augmented reality.

Fig 2.8.2: real space-time; real space time with Augmented Reality

2.9 Summary

In this section, we have secured how AR is utilized, all things considered. What's more, how it associates the virtual existence with reality. Augmented Reality is utilized for creating various kinds of virtual game or application for various sorts of individuals, similar to kids, vacationer, general individuals. The utilization of AR innovation is expanding step by step on the planet since it needn't bother with any costly equipment. Vuforia is a free AR SDK, which is valuable and flexible to develop an AR framework and system. Unity is a cross-stage game motor created by Unity Technologies, first declared and delivered in June 2005. TowerAR and iTacitus are the instances of AR related work which are famous in Pisa and Europe

CHAPTER 3

Methodology

3.1 Overview

This research methodology helps to establish the structure of research such as, strategies, methods, theoretical tests and section of philosophy and research methods. This paper provides and explains the section of the research technique. This chapter explains the research strategy for the appraisal objectives appeared in the first chapter. This chapter also clarifies the model of structure used to create portable AR (Augmented Reality) system.

3.2 Research Methodology

The principal objective of this research is to build a tourist guide magazine using Prisma3D (prisma3D, 2020), Audio-visual which is integrated into Vuforia library (vuforia,2020). The general purpose of the research work is to create an intelligent Augmented Reality based Android OS application for tourists. To build this application we have combined potential images supported by vuforia using integrating those images into an open source vuforia library that will permit the user to utilize them. The research methodology has been talked about in two parts: development methodology and evaluation methodology.

3.2.1 Development Methodology

In this research, the development strategy that will be followed is Software Development Life Cycle (SDLC). System Development Life Cycle (SDLC) is software that is systematic approach to design and development that assures high quality and surpassed client's expectations, reaches perfection. It has shorter iteration and easier in testing and debugging stages. It is easier to control the risks as high-risk tasks are completed first (Pendharkara, Rodgerb, Girish,2008).

SDLC consists of a foolproof plan that explains specific software, planning, building and maintenance procedures. Each stage of the SDLC has its own process that feeds into the next stage.

SDLC basically divided into five to seven phases, based on the project's scope project managers can combine, split, or omit steps. For this application, five steps will be followed.

1. Planning and Making prototype
2. Requirement collecting and Analysis
3. Development and Implementation
4. Software Testing
5. Deployment

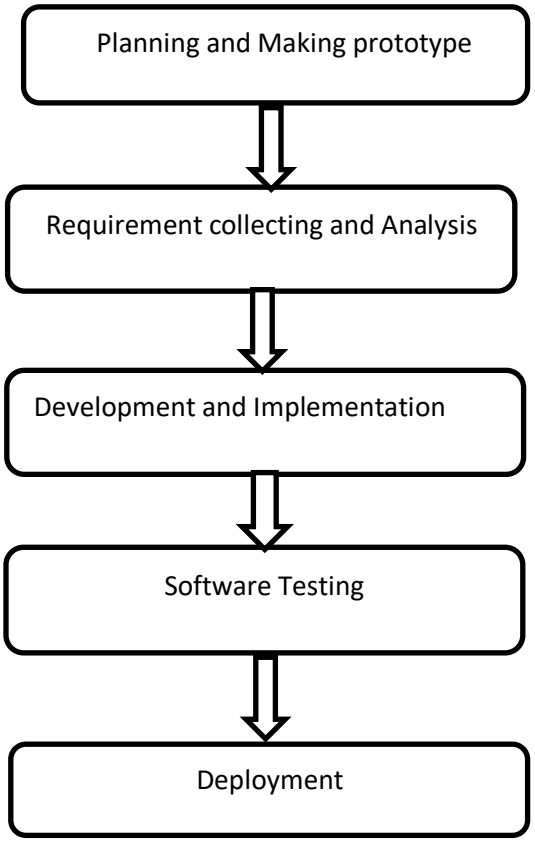

Figure 3.1: Software Development Life Cycle (SDLC)

1. **Planning and Making prototype:**

In this phase, the terms of the project are evaluated which includes determining the labor cost and material costs, making a schedule with target goals, and creating the project's groups. The project scope and purpose of the application is defined in planning phase. Planning also sets boarders to help the project from expanding from its original purpose.

2. **Requirement collecting and analysis:**

This is the most fundamental stage in SDLC. In this phase, all requirements and relevant information are gathered. Defining the needed resources to build the project also falls under the requirements. Necessary documents and data were collected from various sources. Once all requirements analysis completes, the SRS document is created to define and document the software's needs. This research depends on android smartphones, the Android platform was considered for this project. Android SDK is free and it was downloaded from Google Developer Server. Vuforia library was used for this research.

3. **Development and Implementation:**

In this stage, the gathered requirements in the SRS document is used to make designs for product architecture. The main objective for mobile augmented reality, was getting a moving picture. A smartphone camera is used to catch the constant picture. Android SDK has necessary camera API. To develop the project, unity id used. To play the video and sound after the picture target was discovered.

4. Software Testing

Testing is one of the most censorious processes of SDLC. Testing helps to perform a extensive assessment of software and make sur that the product fulfills the requirements. This phase of the SDLC helps to identify all the bugs and errors in the software. If software bugs are not resolved before deployment, they can badly affect the software's business.

Before testing can begin, the project team develops a test plan. The testing plan includes the testing types which will be used. They are resources for testing, how will the software be tested, testing teams for each phase, and test scribbles, which are instructions each tester uses to test the software. Testing starts once the coding is complete and the modules are released for testing. Troubleshooting was done to fix the bugs and issues that were found in the framework.

5. Deployment

The deployment phase is the final phase of the SDLC, which takes place in the production environment after testing the product. The purpose of the deployment stage is to make the product is ready for a real environment by all users of the product. The deployment phase consists of some parts which include deployment preparation and procedures, product deployment, transferring ownership of the product, and closing the deployment phase.

3.2.2 Framework

The architecture of the system:

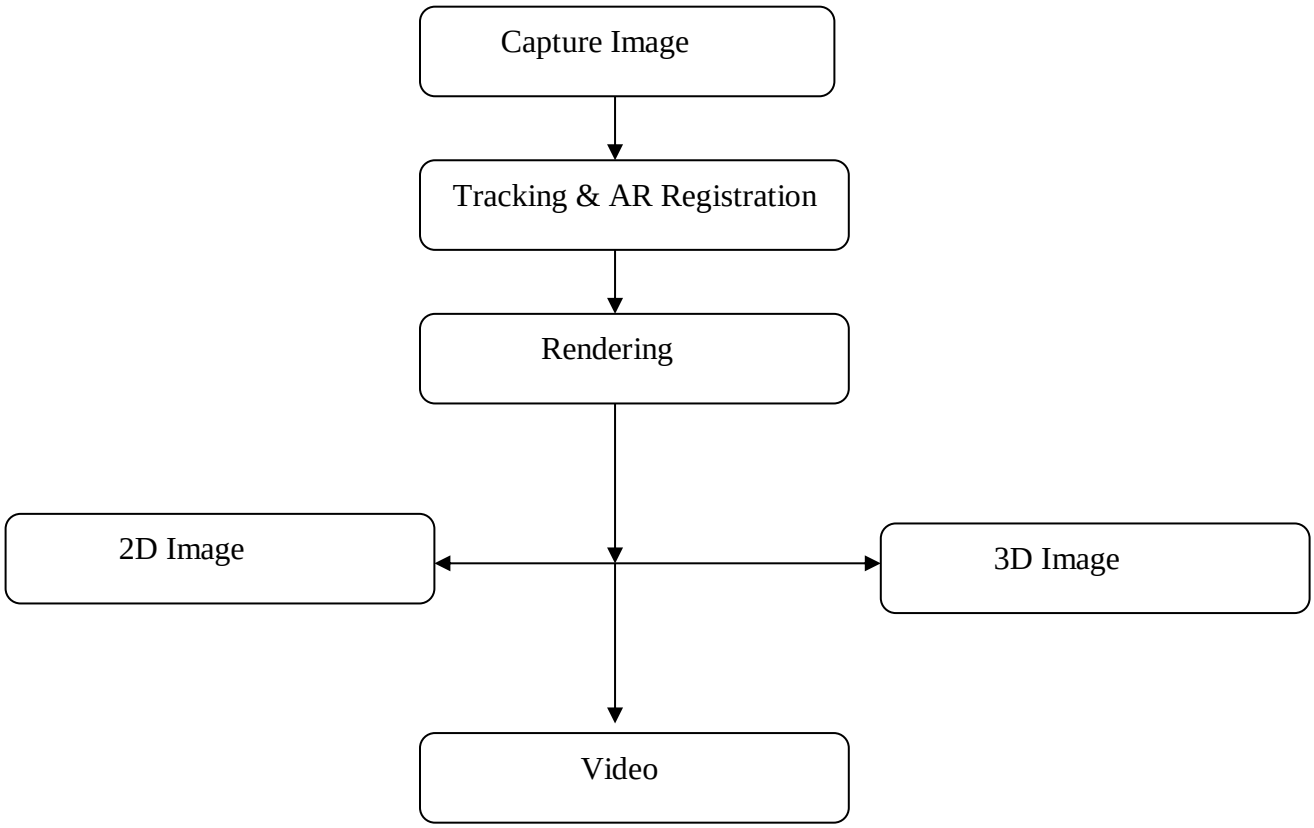

Figure 3.2.3: The architecture of the system

The flowchart of the system:

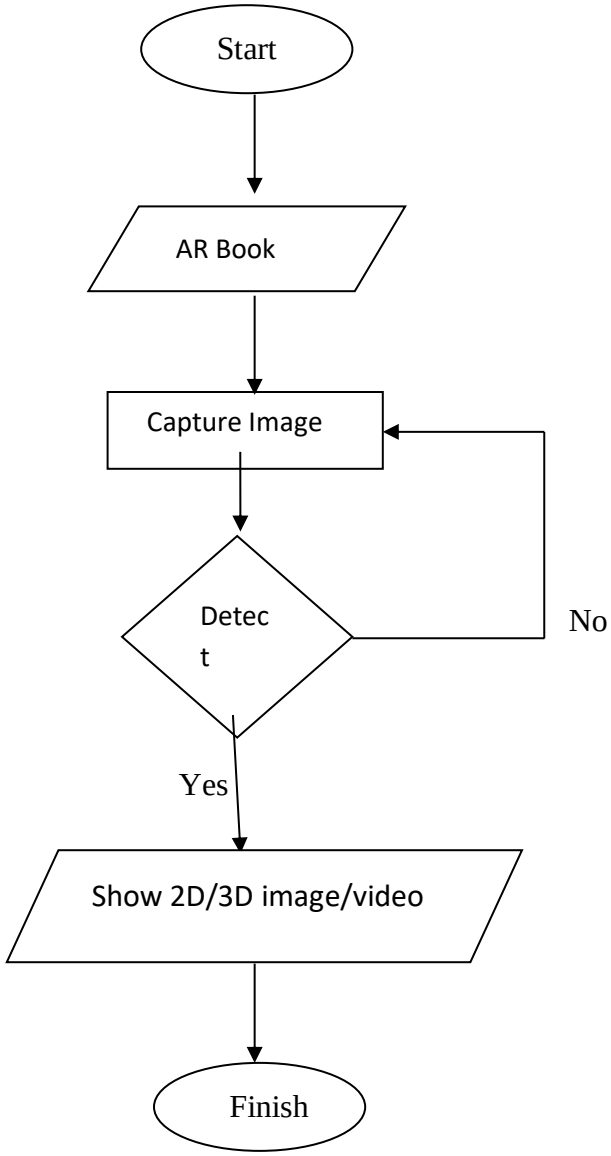

Figure 3.2.4: The flowchart of the system

3.3 System development

We have to expertise the accompanying processes to make the product.

3.3.1 Data Collection

At this stage, all the modules are included with solidarity 3D and then the modules are tested. We used an Android cell phone to collect the essential information. We have taken pictures of some historical places and taken accurate information about their location and history which will be interestingly highlighted in our book so that tourists from outside of our country can express their interest in visiting these places through our magazine book.

3.3.2 Integration and testing

During the test we face a few problems. The ideal result was present on the screen even after the objective image was lost. Sometimes only video was played without any sound. Sometimes the video was not playing when we started the application. At last, we found all our problems and bugs.

3.4 Evaluation Methodologies

Evaluation techniques for this exploration was totally founded on User Experiences, Evaluation and Technical Evaluation. Client fulfillment and encounters were main goal in this examination.

3.4.1 User Evaluation

The Interactive application for travelers was tried through the users. The assessment has been completed to decide the adequacy and effectiveness of the application. The majority of the client's state that they are fulfilled subsequent to utilizing the application. As the focused-on clients is traveler, their encounters utilizing this application was completely checked as they are understanding the interfaces or not.

The subject of this exploration was to assist tourists with building up an application so they can appreciate the excellence of the spot, without heading off to the verifiable spot of Bangladesh.

Users from various segments of the general population were taken to improve user's criticism. Investigating was done to fix the bugs, which was found in client appraisals.

3.4.2 Technical Evaluation

Execution estimation was done on the framework to test the specialized assessment in outline every second.

3.4.3 Development Questionnaires

Research Instruments

The explored instruments of this investigation are considered as AR-based Interactive learning Media for traveler, assent structures, client foundation polls, one lot of client errands, and client input surveys on their criticism on the vacationer helping application.

- **Equipment Used**

The application testing was led in Xiaomi Redmi Note 8 Pro, Samsung A7, OnePlus 8 and Oppo Smartphones, Asus ROG Zephyrus M15 GU502LW Core i7 10th Gen RTX2070 8GB Gaming Laptop. Every one of them are worked with more than 1.6 GHz processors, individually 8 GB RAM and most of them are 4 GB of RAM. Every one of them are fabricated with a committed 3D equipment quickening agent and all module were pre-introduced.

- **User Task**

They were given 15 minutes to finish the client task. A few arrangements of the errand relegated to test the Graphics, Audio Visuals, Interface, and Interactions. All the functionalities of the framework were tried through the accompanying exercises. 3D model, Video playback were tested as to whether it performed or not.

Table 3.4: User task table

Interactive Application for travelers	
SL.	**Task**
1	Utilized an Android camera to identify the picture on the book, to begin playing the association was pre-set alongside the picture.
2	A specific image was used to detect animation with 2D / 3D images or video playback.
3	Used a specific image to test the 3D model pop-up and video playback.

3.4.4 Evaluations

Client establishment information was assembled through the client overviews. All the individual reviewers were cell phone clients and able of utilizing PCs. The members were given a part of usefulness assignments. The task is mainly about the testing about the user usefulness and effectiveness of the framework. The tasks were to open the application and distinguish the picture of an historical place set from the magazine on an Android phone. That would show the 2D, 3D and videos of that historical places. Following, the members were to check whether the different markers were precisely distinguished and played the intelligently media modules as required. Members were asked as to whether they seem play out these tasks successfully or required bolster from the examiners. Members were moreover inquired to comment on each work whereas performing the tasks.

3.4.5 User Feedback Questionnaire

The individuals were drawn closer to grant their feedback ensuing to wrapping up all the tests. They were given three choices –

1 Very Satisfied
2. Satisfied
3. Neutral
4. Dissatisfied
5. Very Dissatisfied

This evaluation was exceptionally supportive to rate this model.

Budget

In this research, we have used some instruments to create this application. It takes some budget for this. This is mentioned below:

Table 3.4.6: Budget table

No	Instruments	Budget
1	Laptop	70,500
2	Mobile	20,000
3	Internet connection	10,000
4	Miscellaneous	5,000

3.5 Summary

The System Development Life Cycle (SDLC) was used for development this methodology. The android stage was focused on to execute a versatile AR framework, which is based on Java. A few fundamental libraries and other assets were collected amid the assets collection arrange. They were mainly Android SDK, Android JDK, IDE. Local camera API from SDK was utilized to capture real-time Pictures and Video. Picture library was utilized to do picture handling capacities such as grayscale change and thresholding on real-time pictures. Vuforia Library was utilized for AR enrollment. The Application was integrated with video module to perform video visuals within the portable AR environment framework in like manner.

CHAPTER 4

Design & Development

4.1Overview

This section talks about the execution of the examination, which was led an intelligent magazine book for voyager dependent on Android's versatile AR framework. This section likewise examines the turn of events and execution of illustrations and general media modules. Likewise, this section presents the consequences of studies directed to figure out which Expresses AR-based designs aptitudes and client fulfillment.

4.2 Design of Magazine Book

Plan a magazine is the principal assignment to build up an application. For this, utilizing some acclaimed places image of Bangladesh with the portrayal we have made the magazine book. By checking those images tourist can visualize the 3D/2D picture or video. A few pages are referred to underneath:

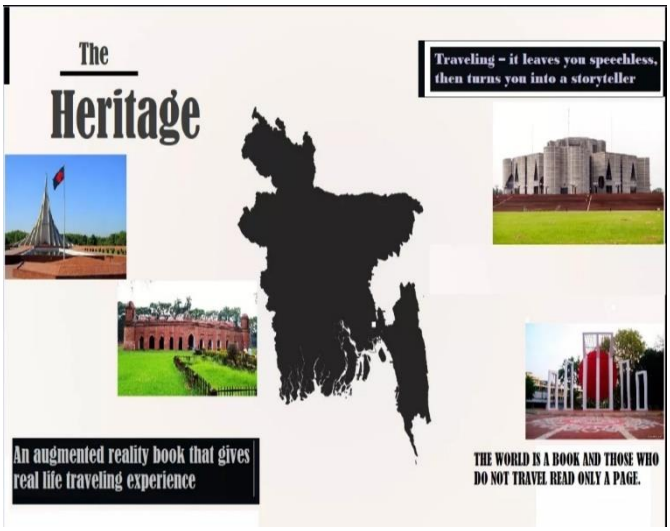

Figure 4.2.1: Cover Page of the magazine book

We implement 3D model for this cover page.

Shaheed Minar (Martyr Monument):

Figure 4.2.2: Second page of the magazine book, Shaheed Minar

The Shaheed Minar may be a national landmark in dhaka bangladesh set up to commemorate the saints slaughtered amid the bengali dialect development exhibits of 1952 in East Pakistan (Bashir Al Helal,2012).

As soon as the marker detects this picture, a 3D model of martyr monument will appear on the smart phone's screen.

National Parliament House:

Figure 4.2.3: Third page of the magazine book, National Parliament House

National Parliament House, was planned whereas the nation was still portion of a pakistan by planner louis kahn the complex is one of the biggest administrative complexes within the world comprising, comprising 200 acres (McCarter, Robert, 2005). National Parliament House is located at Sher-e-Bangla Nagar in Dhaka capital of Bangladesh. In the application we have added 2D model of national parliament which appears when the picture got identified.

Shaṭ Gombuj Moshjid:

Figure 4.2.4: Fourth page of the magazine book, Shaṭ Gombuj Moshjid

The Shaṭ Gombuj Moshjid is the largest mosque in Bangladesh from the sultanate period (Bari, MA,2012). It has sixty pillars, which support eighty-one exquisitely curved domes that have worn away with the passage of time. It is located in Bagerhat and a UNESCO World Heritage Site. For Shaṭ Gombuj Moshjid, we have used video.

Ahsan Manzil:

Figure 4.2.5: Fifth page of the magazine book, Ahsan Manzil

Ahsan Manzil is situated on the bank of the river Buriganga at Islampur in old Dhaka (Alamgir,2012). It is was the official residential palace and seat of the Nawab of Dhaka. It has been turned into a museum recently. In this system we have rendered a 2D image for Ahsan Manzil.

National Martyrs' Memorial :

Figure 4.2.6: Sixth page of the magazine book, National Martyrs' Memorial

National Martyrs' Memorial is the national landmark of Bangladesh, set up within the memory of those who kicked the bucket within the Bangladesh freedom war of 1971 which brought freedom and isolated Bangladesh from Pakistan (Amin, Shahidul,2012). The monument is located in Savar, about 35 km north-west of the capital, Dhaka. It was designed by Syed Mainul Hossain and built by Concord Group. In this application we have rendered a 3D model for it.

Figure 4.2.7: Last Page of the magazine book

We implement video for this last page.

4.3 Implementation

For executing the framework, right off the bat we catch video and after that we track the framework. We changed some code in the framework in C# language. We utilized some capacity likewise, for example, play, pause. Those are given beneath.

4.3.1 Capturing Video

In this exploration, an android cell phone's inherent Android camera API is utilized for catching the video. The ongoing picture was caught by a Smartphone camera for AR tasks. We have utilized the default content given by solidarity for opening the camera and video catch alternative. We have changed a smidgen in the delivering part for play/stop video, which is given beneath:

```
public void OnTrackableStateChanged(
    TrackableBehaviour.Status previousStatus,
    TrackableBehaviour.Status newStatus)
{
    if (newStatus == TrackableBehaviour.Status.DETECTED ||
        newStatus == TrackableBehaviour.Status.TRACKED ||
        newStatus == TrackableBehaviour.Status.EXTENDED_TRACKED)
    {
        Debug.Log("Trackable " + mTrackableBehaviour.TrackableName + " found");
        onTrack.Invoke();
        OnTrackingFound();
    }
    else if (previousStatus == TrackableBehaviour.Status.TRACKED &&
             newStatus == TrackableBehaviour.Status.NOT_FOUND)
    {
        Debug.Log("Trackable " + mTrackableBehaviour.TrackableName + " lost");
        onLost.Invoke();
        OnTrackingLost();
    }
    else
    {
        // For combo of previousStatus=UNKNOWN + newStatus=UNKNOWN|NOT_FOUND
        // Vuforia is starting, but tracking has not been lost or found yet
        // Call OnTrackingLost() to hide the augmentations
        OnTrackingLost();
    }
```

Figure 4.3.1: Capturing Video

At the point when the application is begun, the cell phone camera will consequently on. At the point when it finds the suitable picture then it shows the ideal video or 3D/2D model/picture into the versatile screen. For a portion of the spots, it will show video and for other people, it will show 3D models. To play video we have called "VideoPlayer.Play()" into the capacity "OnTrackingFound()". At the point when the objective image (marker) is lost the video shape will likewise vanish. To do this specific occupation we have called "VideoPlayer.Pause()" into the capacity "OnTrackingLost ()". Other 3D models will show as per its picture targets. At the point when the objective picture (marker) was lost the 3D model will likewise vanish.

4.3.2 Tracking and AR Registration

Augmented Reality needs continuous marker location. Complex computation of AR enrollment of the ongoing video transfer and the 3D world is additionally required in Augmented Reality. At the point when the tracker recognizes any famous spot picture (marker) and it coordinates the objective picture, which is transferred in the Vuforia information base, if it finds any, at that point it shows the video,3D or 2D picture of the place. Else it shows the genuine objective picture.

```
public void OnTrackableStateChanged(
    TrackableBehaviour.Status previousStatus,
    TrackableBehaviour.Status newStatus)
{
    if (newStatus == TrackableBehaviour.Status.DETECTED ||
        newStatus == TrackableBehaviour.Status.TRACKED ||
        newStatus == TrackableBehaviour.Status.EXTENDED_TRACKED)
    {
        Debug.Log("Trackable " + mTrackableBehaviour.TrackableName + " found");
        OnTrackingFound();
    }
    else if (previousStatus == TrackableBehaviour.Status.TRACKED &&
             newStatus == TrackableBehaviour.Status.NOT_FOUND)
    {
        Debug.Log("Trackable " + mTrackableBehaviour.TrackableName + " lost");
        OnTrackingLost();
    }
    else
    {
        // For combo of previousStatus=UNKNOWN + newStatus=UNKNOWN|NOT_FOUND
        // Vuforia is starting, but tracking has not been lost or found yet
        // Call OnTrackingLost() to hide the augmentations
        OnTrackingLost();
    }
}
```

Figure 4.3.2: Tracking and AR Registration

The function “OnTrackingFound()” is called if a match is found and the function “OnTrackingLost()” is called when the target image is lost. Also the function “OnTrackingLost()” is called when the tracker did not find any match.

4.4 Rendering

4.4.1 3D Model

There are one 3D Models we have utilized in our framework. 3D Models are worked with the assistance of Prisma3D and coordinated into the framework utilizing Unity (unity,2020). At the point when the application perceives the marker of the picture, it brings the 3D model up concerning that picture. 3D models are referenced underneath:

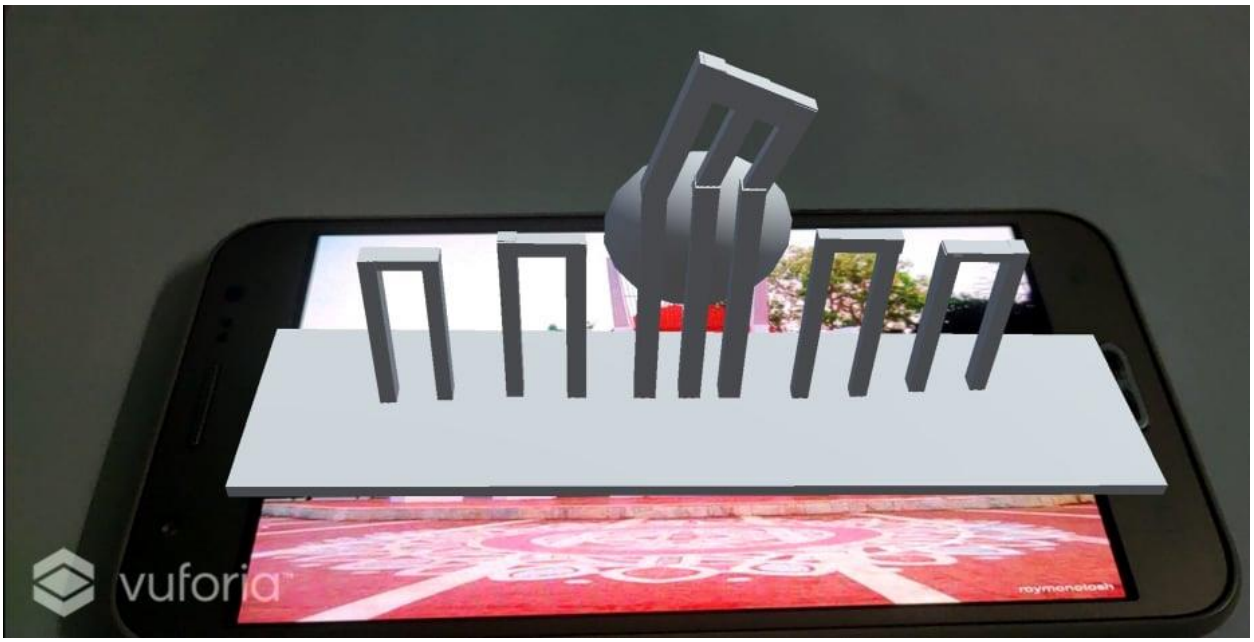

Figure 4.4.1.1: 3D model of Shaheed Minar

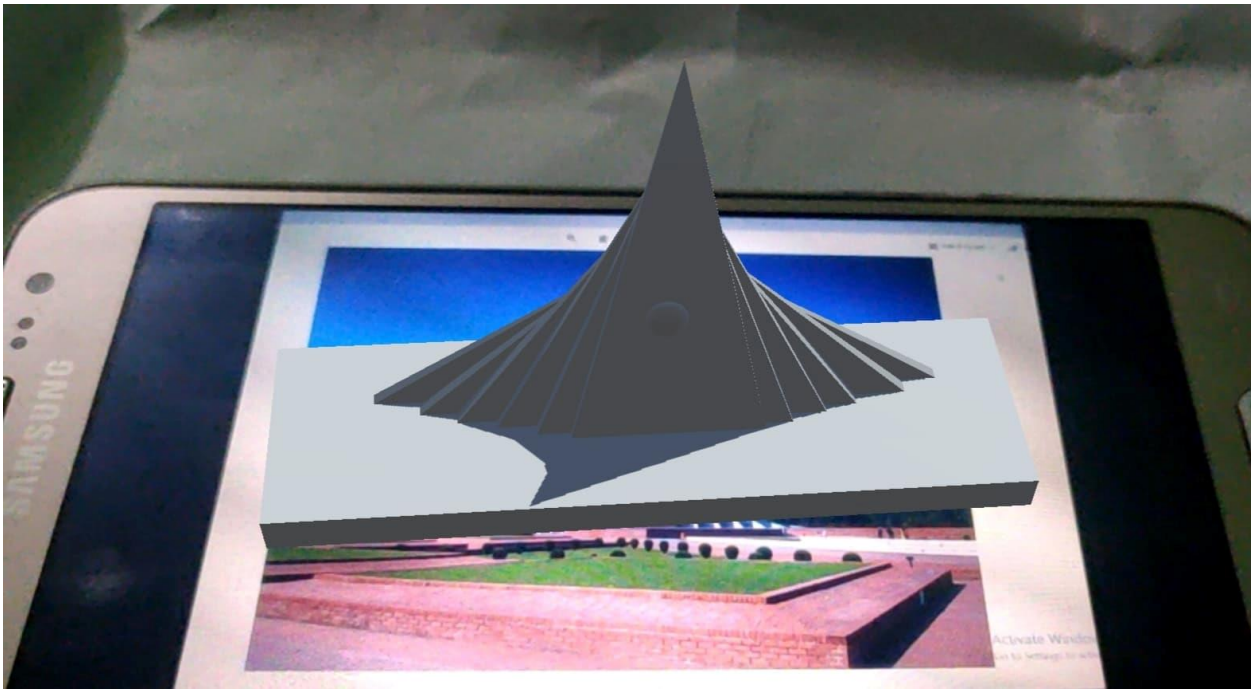

Figure 4.4.1.2: 3D model of National Martyrs' Memorial

4.4.2 Video

There is one video we have used in our system. We gather video from web and composed into the structure using Unity. Right when the application sees the marker of the image, it brings the video up worried that image. Image of video is referred to underneath:

Figure 4.4.2.1: Videos of historical place

4.4.3 2D Model

There is one 2D Model we have utilized in our framework. 2D Models which coordinated into the framework utilizing Unity. At the point when the application perceives the marker of the picture, it brings the 2D model up concerning that picture. 2D model is referenced underneath:

Figure 4.4.3.1: 2D models of historical places

4.5 Evaluation

This segment presents the consequences of the information dissected for the study that was done to assess the member's view of productivity and fulfillment. 50 people were given a survey about the framework dependent on the designs and mixed media modules alongside the assets (Application and Images). We gathered reactions in a few classes to assess the system. Those are referenced beneath:

Table 4: We assessed the client's encounters riding the application. The recorded reactions are referenced underneath:

No	Statements	Feedback			
1	How familiar are you with Augmented Reality (AR)?	Very	Have idea but Never used	A bit	Not at all
		30% (15)	46% (23)	22% (11)	2% (1)

No	Statements	Feedback		
2	Have you faced any kind of problem regarding 3D/2D Model Rotation and video playing while using the Application?	Yes	No	Slightly
		20% (10)	62% (31)	18% (9)

No	Statements	Feedback				
3	Will you recommend this application to tourists?	Strongly recommended	Recommended	Neutral	Not recommended	Strongly not recommended
		34% (15)	60% (30)	4% (2)	2% (1)	0%

No	Statements	Feedback				
4	Do you think this application will have a great impact on the Bangladesh tourism sector?	Strongly agree	Agree	Moderately agree	Disagree	Strongly disagree
		59.2% (29)	38.8% (19)	2% (1)	0%	0%

No	Statements	Feedback				
		Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
5	Please introduce your satisfaction level by using the Application?	46% (23)	48% (24)	6% (3)	0%	0%

4.6 Discussion and Analysis

For the evaluation, we have surveyed 50 individuals from various work fields. All of them was well acquainted with Android cell phones. They followed the testing rules for the trial and switch the image of the spot as they need to see the 3D/2D pictures/video. All the assessment was smooth and the reaction season of the framework was amazing.

Functionality Task of the Application (Table 4):

As we have collected the feedback of 50 individuals on the primary effectiveness on AR-based tourism magazine, our first concern was about the familiarity with Augmented Reality. From the survey result we got to know that 30% of the people has very well working acquainted with AR and 46% of them has clear idea about AR. From this part we have acknowledged that the majority of people used our application were all known of this technology. The second inquiry was about

the efficiency of 3D/2D model rotation and video playing. Here we have got 62% complete positive response and 18% of people faced a little issue. In the third question, we have asked our users, if they would recommend this application to the tourists all over the world. The majority of the people recommended this application to the tourists. The next question was the most important of all. Here, we wanted to know about the great impact and contribution of our application on Bangladeshi tourism section and most of the people strongly agreed. At last users have introduced their satisfaction level after using the application and the response was quite positive.

4.7 Findings

We evaluate the system by 50 peoples and collect their response. At the very first time, they faced some problem and they suggest us to solve this. After that we had successfully solve the problem and collected their response again. At that time they feel happy and they have said that they will definitely suggest the tourist to use this system, because the AR system is very potential in tourism sector.

4.8 Summary

This section mostly examines the execution in two sections that are delivering and 3D virtual articles. Furthermore, this part talks about the client assessment that was directed to assess the usefulness of the arrangement of 3D modules. Intuitive media for tourist was created utilizing the portable AR framework. Larger part appraised the framework to be proficient, powerful, and scored exceptionally as far as client fulfillment. The aftereffect of the member's fulfillment demonstrates that the execution of 3D module was effectively actualized into the versatile AR framework. Our next question

CHAPTER 5

Conclusion

5.1 Overview

This chapter includes a summary of the achievements and conclusion of this research. The limitation of commitment and research are similarly mentioned here. The main goal of this research was to create an AR based magazine book through which tourist can get an idea about some of the most popular historical places in Bangladesh and choose them as places of entertainment and then they can enjoy the beauty of the places. The purpose associated with this is to integrate 3D learning with the framework of vuforia(vuforia,2020) and unity(unity,2020) engine for android smartphones and to be able to learn about them. In addition, the productivity of the system and the completeness of the client were tested. Presentation estimates indicate satisfactory results for AR mobile systems that meet research objectives.

5.2 Review of AR in Bangladesh perspective

Augmented reality technology is completely new in Bangladesh and in the domain of mobile application development. Many people have no idea about this technology. AR Technology is very useful in foreign countries. Using this technology other countries are advancing more and more. They use this technology in medical training, educational purpose, entertainment purpose etc. AR is very beneficial in simulation purpose which can give a real-world experience. Few Bangladeshi software companies are working on AR technology with important government-led initiatives, including the Digital Bangladesh program. Good feedback on AR based work has been found in different papers and in different places. So if we can give people an idea about the benefits of using an AR based system, then AR technology will play an important role in the development of Bangladesh in the future.

5.3 Review of AR related work

Now-a-days AR is the most hyped technology all over the world. Mainly this system covers some features like combination of real and virtual worlds, 3D representation of objects (Rosenberg, Louis B., 1992). The AR is exceptionally utilized and don't require exorbitant equipment stuffs. AR can be effortlessly actualized in smartphones, tablet or computers. Smartphone AR communication strategy can moreover be utilized to control these virtual articles, for case, performing elucidation, scaling to alter the range, turn, pose, and measure of virtual things in space. The most recent adaptations of Solidarity have a built-in Vuforia, so the engineers not ought to torment themselves over introducing the SDK. In the recent update, Unity presented the Blended and Expanded Reality Studio, which gives developers with extra usefulness for rules-based era of expanded reality (AR) applications. 3D activity is the method of making pictures that are motioning in an advanced environment that's three dimensional.

5.4 Development of Tourist Magazine

The Tourist Magazine book was created subordinate on the proposed structure utilizing the Vuforia library and Unity Game Engine for the Android Smartphones. Vuforia was utilized in this framework for picture following and Unity Game Engine was utilized for AR rendering. The framework was made in two areas Information Collection, Integration, and Testing. Information was assembled utilizing Android Smartphone cameras and various resources like online communications stages. Integration and testing for the framework were done physically.

5.5 Implementation of Video and Virtual Model

The virtual demonstrate was organized utilizing by Prisma3D (prisma3D,2020). Prisma3D is one kind of mobile application, it is easy to use and better than any other application for developing 3D model. In this structure control features the solid shape, circle, pyramid and lines were controlled to structure the 3D model of the historical locations. In this inquire about, Unity's work within the taking after and AR enrollment systems were utilized. At any point the tracker

recognized a marker coordinating the picture exchanged within the database, it called the capacity "OnTrackingFound()". In the event that no coordinate was found, at that point the system called the "OnTrackingLost()" work.

5.6 Survey

Evaluation is very important for this research. This assessment was important to know how much impact this type of technology could have on Bangladesh. We tested the system with 50 people. We have done this survey ethically. We have done our survey with honesty, impartiality, fairness and equity and dedicated to the protection of the public health, safety and welfare. That means we have followed the code of ethics. Many of them had an idea about AR and many did not. For those who had no idea about this system we explained about AR and after understanding it they tested the system. Following the evaluation methodology, 5 questions were asked, after their use, based on the feedback**,** it was found that it can have a good impact in the tourist sector of Bangladesh.

5.7.1 Significance of the Study

AR technology works wonders to make historical places more attractive to tourists. As a result of developing this application in this research, foreign tourists will be able to easily enjoy the attractive view of historical places through interactive 3D model. And in our AR based magazine book, 3D picture and 2D has been explained in a very interesting way so that tourists are fascinated by the beauty of these places in Bangladesh. When tourists want to know the details of the historical place of their choice, it shows the desired video and 3D model on the mobile screen. It's a complete package.

5.7.2 Sustainability

If this technology has a good impact on the tourism sector, it will last a long time because we will always update our magazine book that was made for our tourists. As a result, if this technology can be used in other sectors of Bangladesh and get good benefit, then our country will move forward towards development and sustainability of this technology will increase.

5.8 Limitation of the Study

While doing the testing, some drawbacks of the application were identified. Those are Uncertainty. When it's time to recognize the pictures, our application only identifies the pictures that have database entry. Consequently, different markers that might be available containing a relative picture don't get recognized. Moreover, in inadequate lighting markers might not get recognized well. As physical alliance is not a part of this application, users will not be able to control the 3D models or videos through their finger touch.

5.9 Recommendation for Future

AR is an engrossing area and many researchers may be interested in this field. We have come up with some suggestions that may be helpful for future researchers. In this study, we have covered some selected historical places of Bangladesh. Historical sites with great significance offer tourists a chance to satisfy their travels to archeological sites. We have not been able to include all the historical places of Bangladesh in our research.

The following works can be done in future research such as:

1. Other interesting places in Bangladesh such as Lalbagh Fort, Kotila Mura in Comilla, Sompura Mahabir in Naogaon, Shalban Bihar in Comilla, Mahasthangarh in Bogra can be included
2. More 3D effective and more interesting videos can be added to make the application more interesting.

3. It could also be implemented for IOS.

4. This application can be published publicly through play store by dealing with any organization.

5.10 Summary of the Research

The purpose of this research is to develop an application using Mobile Augmented Reality for Android Smartphones that will encourage and enlighten tourists around the world about the Bangladeshi cultural heritage and rich history. In the literature reviews we discussed about Augmented Reality, Handheld Augmented Reality, rendering, interaction, and Augmented Reality Applications. The research methodology chapter splits into two segments, development and evaluation. For developing the application, we have used the Software Development Life Cycle (SDLC). For the testing, we have used hands-on experience on the AR System and evaluating their satisfaction and efficiency. From the evaluation report, we acknowledged that the application meets its expectations, and user's feedback was satisfactory. To sum up, the mobile AR system was implemented successfully and could be upgraded with new features and should keep on maintenance.

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Appendix 1

Section1: Personal Information

Option	Answer
Email Address :	
Name :	
Occupation :	

Appendix 2

No	Statements	Feedback			
1	How familiar are you with Augmented Reality (AR)?	Very	Have idea but Never used	A bit	Not at all

No	Statements	Feedback		
2	Have you faced any kind of problem regarding 3D/2D Model Rotation and video playing while using the Application?	Yes	No	Slightly

No	Statements	Feedback				
3	Will you recommend this application to tourists?	Strongly recommended	Recommended	Neutral	Not recommended	Strongly not recommended

No	Statements	Feedback				
4	Do you think this application will have a great impact on the Bangladesh tourism sector?	Strongly agree	Agree	Moderately agree	Disagree	Strongly disagree

No	Statements	Feedback				
		Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
5	Please introduce your satisfaction level by using the Application?					