AUGMENTED REALITY IN CONSTRUCTION USING BIM TECHNOLOGY

A Report submitted in partial fulfilment for the degree of

B. Tech

in

Civil Engineering

By

PAGIDIPALLY AJAYKUMAR 19241A0142

MIREGELLA VIJAYAKUMAR 19241A0136

MANDALA CHINNI 19241A0135

Under the guidance of

Mr. Akula Prakash

Assistant Professor

Department of Civil Engineering

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY,
BACHUPALLY - HYDERABAD

(Affiliated to Jawaharlal Nehru Technological University**)**

MAY, 2023

DECLARATION

I declare that this project report titled **"AUGMENTED REALITY IN CONSTRUCTION USING BIM TECHNOLOGY"** submitted in partial fulfilment of thedegree of **B. Tech in Civil Engineering** is a record of original work carried out by me under the supervision of **Mr Akula Prakash** and has not formed the basis for the award of any other degree or diploma, in this or any other Institution or University. In keeping with ethical practice in Thesis/Reporting scientific information, due acknowledgements have been made wherever the findings of others have been cited.

Paidipally Ajaykumar 19241A0142

Mirigella Vijayakumar 19241A0136

Mandala Chinni 19241A0135

CERTIFICATE

This is to certify that the project report entitled **AUGMENTED REALITY IN CONSTRUCTION USING BIM TECHNOLOGY** submitted by **Pagidipally Ajaykumar, Miregella Vijayakumar, Mandala Chinni** to the **Gokaraju Rangaraju Institute of Engineering and Technology, Hyderabad,** in partial fulfilment for the award of the degree of **B. Tech in Civil Engineering** is a bonafide record of project work carried out by us under our supervision.In full or in parts, the contents of this report have not been submitted to any other Institution or University for the award of any degree or diploma.

Mr Akula Prakash
Internal Guide
Assistant Professor
Department of Civil Engineering
GRIET

Dr. C. Lavanya
Professor and
Head of the Department
Department of Civil Engineering
GRIET

EXTERNAL EXAMINER

ACKNOWLEDGMENTS

We would like to express our gratitude to all the people who helped us to transform an idea into a real application.

We would like to be grateful to our project guide **Mr Akula Prakash**, Assistance professor for his technical guidance, and constant encouragement in carrying out our project at college.

We profoundly thank **Dr. C. Lavanya**, Professor and Head, Department of Civil Engineering, who has been an excellent guide and excellent source of inspiration for our work.

We are immensely thankful to Dr J. Praveen, Principal, and Dr. J. N. Murthy (Director), GRIET, who most ably run the institution and have had a major hard in enabling me to do our project

I extended my sincere thanks to one and all of the GRIET family for the completion of this document on the project Thesis/Report format guidelines.

P. AJAYKUMAR 19241A0142

M. VIJAYAKUMAR 19241A0136

M. CHINNI 19241A0135

ABSTRACT

AUGMENTED REALITY IN CONSTRUCTION USING BIM TECHNOLOGY

Augmented reality is an interactive experience of a real-world terrain and reference technology and gests and computer-generated objects in the stoner's physical terrain. It can be defined as a system that incorporates three introductory features, A combination of real and virtual worlds, Real-time commerce, and accurate 3D enrollment of virtual and real objects. AR can be used in everything from design planning to dispatches. One of the most promising new trends in the architecture, engineering, and construction (AEC) industry is BIM. The construction design is simulated in a virtual terrain using BIM. The figure, spatial, connections, geographic information, quantities and parts of the foundation, cost estimates, material supplies, and design schedules are all characteristics of a BIM model. BIM is used to improve the quality and efficiency of structures, reduce construction waste, and improve the efficiency of the construction process. We look at how BIM works in construction systems in this current design. In this project, we are working on the development of an application which visualizes the 2D into a 3D environment, which can be accessed through a Mobile phone.

BATCH – B10

P. Ajaykumar	19241A0142	Project Guide
M. Vijayakumar	19241A0136	Akula Prakash
M. Chinni	19241A0135	Assistant Professor
		Department of Civil Engineering

TABLE OF CONTENTS

LIST OF FIGURES

ABBREVIATIONS

AR – Augmented Reality

BIM – Building Information Modelling

VR – Virtual Reality

AEC – Architecture, engineering and construction

MR – Mixed Reality

UN – United Nation

USAF – United States Armed Forces

CHAPTER 1

1. INTRODUCTION

1.1 Augmented Reality:

The technologies that bring computer-generated objects into the physical environment are referred to as augmented reality (AR), which is an interactive experience of a real-world environment. It is a system that combines real-world and augmented (or) virtual worlds, allows for user interaction, and accurately combines virtual and real objects in three dimensions. AR can be used in communication and project planning, among other things. Mobile applications, headsets, and other smart devices that superimpose digital objects onto the real world typically power augmented reality.AR can assist educators by providing life-like demonstrations, and it can also assist in teaching people how to use complex equipment. AR improves collaboration, safety, construction training, and project presentation.

The combination of combinations of data, which are perceived as natural aspects of the environment, rather than as a straightforward display of data, is the primary benefit of AR. This is where digital elements go into a person's real-world perception. The Virtual Fixtures system, developed at the U.S. Air Force's Armstrong Laboratory in 1992, was one of the first functional augmented reality systems to provide users with a real experience. Commercial augmented reality experiences were initially introduced in the entertainment and gaming industries. Continually, AR applications have joined commercial industries such as education, communications, medicine and entertainment. A mobile device can be used to scan or view an image, or markerless augmented reality (AR) techniques can be used to access educational content.

1.2 BUILDING INFORMATION MODELLING:

Creating and working on digital presentations of the physical and functional characteristics of places is known as building information modelling (BIM), and it is supported by various tools, technologies, and contracts. BIMs are digitalized files that can be extracted, exchanged, or networked to help make decisions about a build asset. They often have data and are in proprietary formats. People, businesses, and in many agencies use BIM software to plan, design, build, operate, and maintain a variety of physical infrastructures, including roads, railways, bridges, ports, water, refuse, electricity, gas, and communication utilities.

BIM is one of the most promising recent developments in the architecture, engineering and construction (AEC) sector. BIM simulates the construction project in a virtual environment. A BIM model is characteristic of the geometry, space, relationships, geographic information, quantities and properties of building elements, cost estimates, material inventories and project planning. BIM is used to improve the efficiency of the construction process, reduce waste during construction, and improve the quality and efficiency of buildings.

1.2.1 History of Building Information Modelling:

The idea of Building Information Modeling (BIM) has been around since the 1970s, but it wasn't officially adopted until the early 2000s. Different countries have moved at different speeds in developing standards and adopting BIM was published in January 2019 and is based on standards developed in the UK in 2007.

1.2.2 BIM is used for?

BIM is used to create and manage data during the design, construction, and management phases. BIM creates precise digital representations by merging data from various sources, which are then maintained on an open cloud platform for ongoing collaboration.

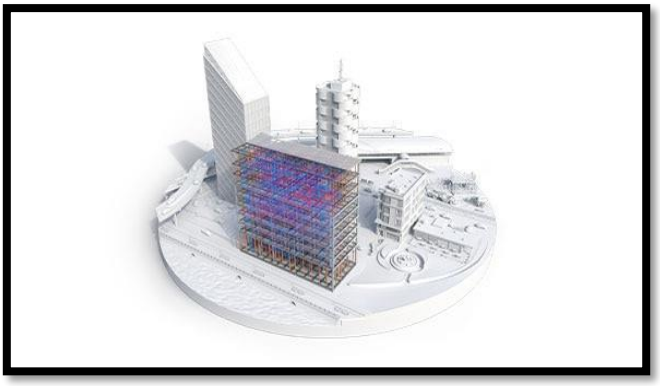


Figure 1.2.2.1: Plan

Source: https://damassets.autodesk.net/content/dam/autodesk/www/solutions/bim/fy21/plan-thumb-580x290.jpg

- **Plan**

Project planning can be improved by combining real-world data and reality capture to create context models of the existing built and natural environment.

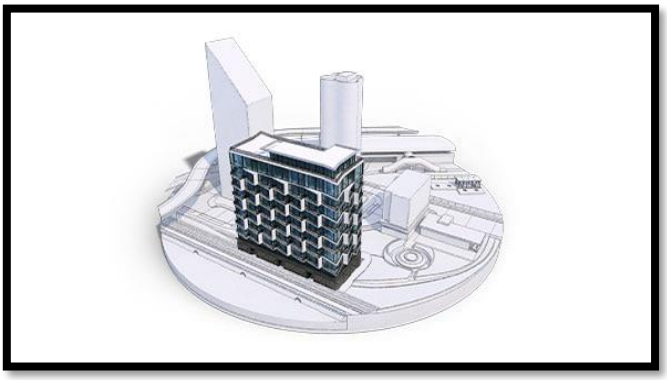


Figure 1.2.2.2: Design

Source: https://damassets.autodesk.net/content/dam/autodesk/www/solutions/bim/fy21/design-thumb-580x290.jpg

- **Design**

Conceptual design, analysis, detailing, and documentation are carried out during this phase. Using BIM data to guide scheduling and logistics, the preconstruction process begins.

Figure 1.2.2.3: Build

Source:

https://damassets.autodesk.net/content/dam/autodesk/www/solutions/bim/fy21/build-thumb-580x290.jpg

- **Build**

  Utilizing BIM specifications, fabrication commences during this phase. Project construction logistics are shared with contractors and tradespeople to ensure optimal timing and efficiency.

Figure 1.2.2.4: Operate

Source:

https://damassets.autodesk.net/content/dam/autodesk/www/solutions/bim/fy21/operate-thumb-580x290.jpg

- **Operate**

  Data from BIM can be used in finished asset operations and maintenance. Data from BIM can later be used for efficient deconstruction or cost-effective renovation.

1.2.3 Why BIM is Important??

The UN predicts that the world population will beyond 9.7 billion by 2050. Not only does the global AEC need to look for smarter, more effective ways to design and build to keep up with global demand, but it also needs to contribute to the creation of spaces that are smarter and more re-silient.

Figure 1.2.3.1: Buildings

Source**:**

https://damassets.autodesk.net/content/dam/autodesk/www/solutions/bim/fy21/why-is-bim-important-thumb-1172x660.jpg

Teams from the design and construction industries may collaborate more successfully thanks to BIM, which also enables them to retain the data they produce during the process for use in operations and maintenance. As a result, global BIM regulations are increasing. BIM is revolutionising project delivery across industries by integrating teams, data, and workflows at every level of the project in the cloud for better project results and by boosting project execution with intelligence and efficiency. BIM Interoperability is the capacity of project teams in the AEC sector to interact and communicate in a smooth manner across disciplines and industries, regardless of preferred software tools and vendors. The BIM supports intelligent data that can be used during the course of a construction or infrastructure project.

1.2.4 How BIM has connected to Augmented Reality (or) Integration of BIM with Augmented Reality:

Figure 1.2.4.1: Practicing AR

Source:https://www.advenser.com/wp-content/webp-express/webp-images/doc-root/wp-content/uploads/2022/02/featured-Integration-of-AR-with-BIM.jpg.webp

By facilitating efficient planning between architects, engineers, and contractors (AEC), Building Information Modeling (BIM) has demonstrated its value in enhancing project documentation throughout the project lifecycle to lessen disagreements and improve communication. However, BIM's contribution to fieldwork is quite limited due to the limited interaction between the real and virtual worlds.

As this conceptual model of converting virtual 3D plans into actual structures has not changed much, it is anticipated that integrating BIM with Augmented Reality (AR) will significantly increase BIM's potential application to fieldwork by incorporating computer-generated elements in real-world environments. To put this into practise, envision being able to scan a QR code to examine the whole 3D model of your home or to learn more about the components of your home and how to maintain them. Is that even possible? Without a doubt, augmented reality's (AR) help is necessary. Augmented Reality (AR) adds a layer of information and views/overlays relevant information to the digital representation, allowing users of BIM models to view and access the data hands-free in 3D. The AEC industry is all set to better understand the project lifecycle's various phases by combining BIM and augmented reality.

The benefits of using augmented reality technology include, but are not limited to:

- Reduced expenses
- increased safety and Rapid decision-making
- Improved communication among team members and stakeholders.

Figure 1.2.4.2: Auto machine Using AR

Source:https://www.advenser.com/wp-content/webp-express/webp-images/doc-root/wp-content/uploads/2022/02/bim-workflow-012.jpg.webp

The use of augmented reality is typically linked to the following in terms of BIM workflow:

During the design phase, the proposed solution is reviewed; during the construction phase, construction activities are overseen and progress is tracked; and during the operation phase, building maintenance is coordinated, inspected, and made easier.

The ability to empower the entire project lifecycle through the various phases and stakeholders involved is one of the significant advantages of integrating augmented reality with BIM,

1. **Phase of project planning:** It enables stakeholders to thoroughly visualize the project by demonstrating its social and environmental effects on its surroundings.
2. **Phase of design:** Architects and designers can evaluate and analyze designs for viability, function, and aesthetics in an immersive manner by integrating augmented reality with BIM models. Additionally, the changes are adaptable and adaptable to the requirements of the client.

3. **Phase of construction:** Bringing AR and BIM models together makes it easier for workers to understand the project. Additionally, it aids in the reduction of construction errors, enhancement of accuracy, and resolution of budget overruns in complex MEP services. Stakeholders can also benefit from this in terms of time and money savings.

4. Using safety checklists and smart glasses that can be worn, inspection and site review AR with BIM improves inspection. Power lines can be viewed using such augmented reality (AR) equipment as well as overhead and underground utilities, and in the event of a problem, AR pins, tags, or comments can be used to highlight the necessary corrective actions.

5. By giving users direct access to instructional manuals, asset representations, and information about building models, operations and maintenance AR enhances the BIM project's operations and maintenance phases.AR has the potential to enhance performance during maintenance to achieve efficiency and accuracy. Without having to carry around sheets of drawings or manuals, any augmented reality user can access all of this information by simply scanning codes or wearing AR wearables.

6. During renovations and underground construction, augmented reality (AR) wearable technology can quickly and easily reveal concealed infrastructure placements such as beams, ducts, and conduits to support the renovation process. Additionally, it enables the project team to revise and identify issues during the planning phase, making renovation simpler.

The AEC industry should embrace AR-integrated BIM as the next upcoming trend to improve project efficiency by digitally transforming job sites and improving safety as well as outcomes. If you want to learn more about how to use the AR–BIM system to have an engaging and dynamic experience throughout the project lifecycle, please get in touch with us.

1.2.5 Why We are Using Mobile Phone in the place of AR (or) VR Headset?

The device which can be anything possible, it is the great and craziest invention in the history of human evolution and science. Mobile phone provide access to PSTN (public switched telephone network). Now a days these mobile phones are using cellular technology, that is now available every where in the world, These are controlled and run teleport satellite system. It is the one of the most used device in the world. Over 90% of the population in the world own that at least one per person.

Now, the reason behind why we are using mobile phones,

- They are widely used and available for everyone.
- We can process the data into an platform based application which can acess by every person.
- We can decrease the usage of more gadgets, so that that will decrease the Radiation and excessive electricity.
- Everyone can access and it is very cost efficient.
- Processing of Application will be fast due to faster processing speed of mobile phones.
- Great display, controlling of the application is easier and customization for better User Interface.

These are the reasons we have choosen mobile phone instead of AR(or) VR headset. And mobile phones now a days are having great graphic capacity so that User Experience will be great in mobile phones.

1.3 PROJECT SCOPE

In this project, Our main aim is to develop an app using the Unity 3d tool and integrate that app with a primary school building plan Taken in Revit software. And Creating data for the app by the vuforia engine making it into Augmented reality.

CHAPTER 2

2. Literature Review

- **Andrea Revoltia et al (2022)**, empirically verified the usage of a head-mounted display (HMD) with augmented reality (AR) to help mark work on underground pipe installations in the case study. The case study's findings showed a significant decrease in on-site execution time without sacrificing accuracy. At the same time, the HMD AR had a high level of acceptability and perceived use.
- **Ayodeji Emmanuel Oke et al (2021),** Construction visualisation and simulation; project documentation; project planning, monitoring, and modification are the top five applications of augmented reality. On-site real-time information retrieval and health and safety precautions are the other two aspects. The results also demonstrated the divergent professional viewpoints on the factors. The findings indicated that, with the exception of automated measurement, there are considerable differences between the professional perspectives of the application fields. All researchers involved in the study had convergent views on automated measuring.
- **Mahmoud Albahbah et al (2021),** In recent years, a lot of academics have focused on how AR and VR technologies can be applied to CPM issues. These technologies have shown to make significant contributions to the growth of this industry in a number of areas, including cost and time management, defect management, safety management, education and training, progress monitoring and tracking, and on-site information access. The study's thorough review of the research on AR and VR technologies in CPM gives readers a better understanding of the type, extent, and focus of research activities in this field.
- **Ricardo L.Mschado and Cesar vilela (2020),** has worked mostly on Augmented Reality and Building information technology, and also recommended, that it is important to investigate how AR impacts working condition in terms of quality, execution speed, minimising losses and productivity increment. Also worked on the integration of BIM and AR.

- **Patrick Dallasega et al (2020),** Modern Industry 4.0 tools like BIM (Building Information Modelling), VR (Virtual Reality), and AR (Augmented Reality) are used to illustrate how lean construction can benefit from their use. The technique was tested using the Villego® simulation by students from the master's degree LM-33 Industrial Mechanical Engineering at the Free University of Bozen-Bolzano in Italy. All things considered, these technologies showed promise for improving Key Performance Indicators (KPIs), which include sustainability in terms of lowering material waste, overall construction time, idle time on the job site, and level of quality. While using AR with the Microsoft HoloLens was considered to be rather easy, utilising VR with the Oculus device was considered to be very challenging.
- **Zirui hong et al (2020),** has observed AR helped operators efficiently integrate and un understand processes, some of the negatives were also noticed that in process of integration occurrence, it consumes much time. It has been furtherly investigated so that it can be minimised.
- **Ricardo L. Machado et al (2020)**, According to this study, combined AR and BIM modelling has great promise for use in infrastructure, installation assembly, operations inspection, and building maintenance. Due to advancements in the capabilities of portable computers, mobile devices, and other visualisation tools in a vertical environment.
- **Clarissa Hedenqvist (2020),** has developed a prototype application based on AR to investigate opportunities and challenges to enhance learning, Tested on students by holding pretests and post-test in a mechanics course. Noticing that it helped the students to understand the concept, Then has concluded that AR will help in the learning process, He concluded that AR will help in the learning process.
- **Pampattiwar (2019),** has carried out a different strategy for inside structure using marker-based augmented reality. The customer will be able to look at a selection of furniture in this augmented reality setting, which will then display the virtual furniture they selected for the actual setting. These applications have a lot of potential for project application design and construction.

- **DrPoorang piroozfar et al (2018),** have worked on the implementation of AR solutions, for the design part of the construction, issues caused in the design part by lack of clarity and understanding can be minimized through AR. They also commented on the hat lack of AR solutions has not had resources in the AEC industry.
- **Fopefoluwa Bademosi et al (2018),** This study aims to provide construction experts and researchers with a description of the potential application of AR technology in each phase of construction projects. The study gives construction industry professionals access to the most recent research trends and advancements in the use of augmented reality, advancing the field towards widespread use for the enhancement of construction processes.
- **Claudia Calderon (2018),** has stated that AR is a complement or extension of BIM. In addition, these applications have a lot of potential during the project's design and construction phases, so more research into their integrated use is needed. Orderly flow processes must be designed, controlled, or improved to produce activities with added value and reduce waste.
- **Shakil ahmed et al (2017),** have researched AR and VR technologies in the AEC industry. They reviewed the AR and VR in the AEC industry in the era of beginning. The AR and VR development will bring impossible modifications into work and also it advances the various construction issues and helps in a better learning processes in AEC industry.
- **Ali Karji. et. al(2016),** First, integrating augmented reality (AR) and image processing programming, for instance, is challenging for each advancement's unique level of complexity. Second, these three advancements can only be used in a small number of common applications. Thirdly, there is a possibility that these three advancements' inputs and outputs are not always in sync.
- **Samant et al (2016),** The examination carried out necessary research into this kind of Augmented Reality System based on no markers and accomplished virtual home programming by utilizing the strategy for 3D remaking to obscure the scene to execute camera 3D enrollment.

- **Mehdi Mekni (2015),** has incorporated that recognition system to create a reference model of the real world. Although it is difficult to deal with object dynamics and the evaluation of various hypotheses, further research in this area may yield promising outcomes. The problem lies in creating a ubiquitous middleware that will help the augmented reality system.
- **Abdalrahman Elshafey. et. al(2015),** In order to create BIM-AR platforms that are more likely to be used and accepted by users, software developers can take into consideration important factors such as ease of use and perceived enjoyment. Users' perceptions of external control and ease of use are among the most important factors in their acceptance of BIM AR, so organizations appear to benefit greatly from providing stakeholders with training before system use.
- **Sebastjan Meza et al (2015),** According to our research, augmented reality can considerably help with project documentation interpretation at different phases of construction projects, which helps to better integrate the construction period with earlier stages of development. The claim of relevance is based on a theoretical and empirical comparison of augmented reality with well-established traditional presentation strategies using a survey of potential consumers.
- **Sara ranckohi and Lloyd Waugh (2013),** examined many articles from 1999, It was the first article published on AR. After reviewing all the articles from the first published article to till 2013, they gave a review that AR is in starting era, and the developers and AEC industry have to put an eye on it. We have limited features existing now, In the upcoming future, they will increase.
- **Chan Sik Park et al (2013),** This essay examines the problems with and needs for present defect management techniques in the building sector. Additionally, it offers a theoretical framework for construction defect management that combines building information modelling, ontology, and augmented reality (AR).
- **Park et al (2013),** has developed an application, which is augmented reality with building information modelling(BIM) to detect construction defects. This type of potential for AR technology for future use in the AEC industry.
- **Chan-sik park et al(2013),** has worked on the construction process, which has more defects coming into view that occur repeatedly, It causes affects the project schedule and cost over returns. They integrated AR and BIM and started using applications in the construction process, which concluded in minimizing defects.

- **Waugh L.M et al (2012),** has used an application named VR doc which uses AR technologies, It helped them to easily do work and feel the real environment. It proved that it is secure and fast, and further development will involve the availability of applications to everyone.
- **Yaming Li and Chengliang Liu (2012),** has worked on visual monitoring and predicting an accurate way to minimise accidents and increase the efficiency of management in the AEC industry. They used some of the 3D simulation methods. At last, they are implemented by users.
- **Yelda Turkan et al (2012),** has worked on three-dimensional (3D) laser scanners, with this investigation has shown potential for progress tracking. They got lack non-potential due to no sources available for the good development of AR. They integrated 3D laser scans with 4D models to automate the construction and progress control.
- **Vito Palmieri. et. Al (2012),** Engineers and architects have demonstrated through extensive testing that such a system may enhance historical building research. It was found that the system made it easier to access BIM data and helped contextualize information for indoor building analysis.
- **Phan. et. Al (2010),** The investigation looked at virtual furniture and changed work to create a new structure method that uses augmented reality technology for interior design instruction. Structure work has the potential to become more dynamic, beneficial, and intelligent in an AR setting. In addition, we have a warm relationship with one another and can simultaneously direct plan work and assembly.
- **Wang (2009),** has researched AR in times of 2009, given a detailed documentation review of AR in the AEC industry, and also worked on major research of 2009 on AR, last categorizes different AR technologies by advantagesand disadvantages.

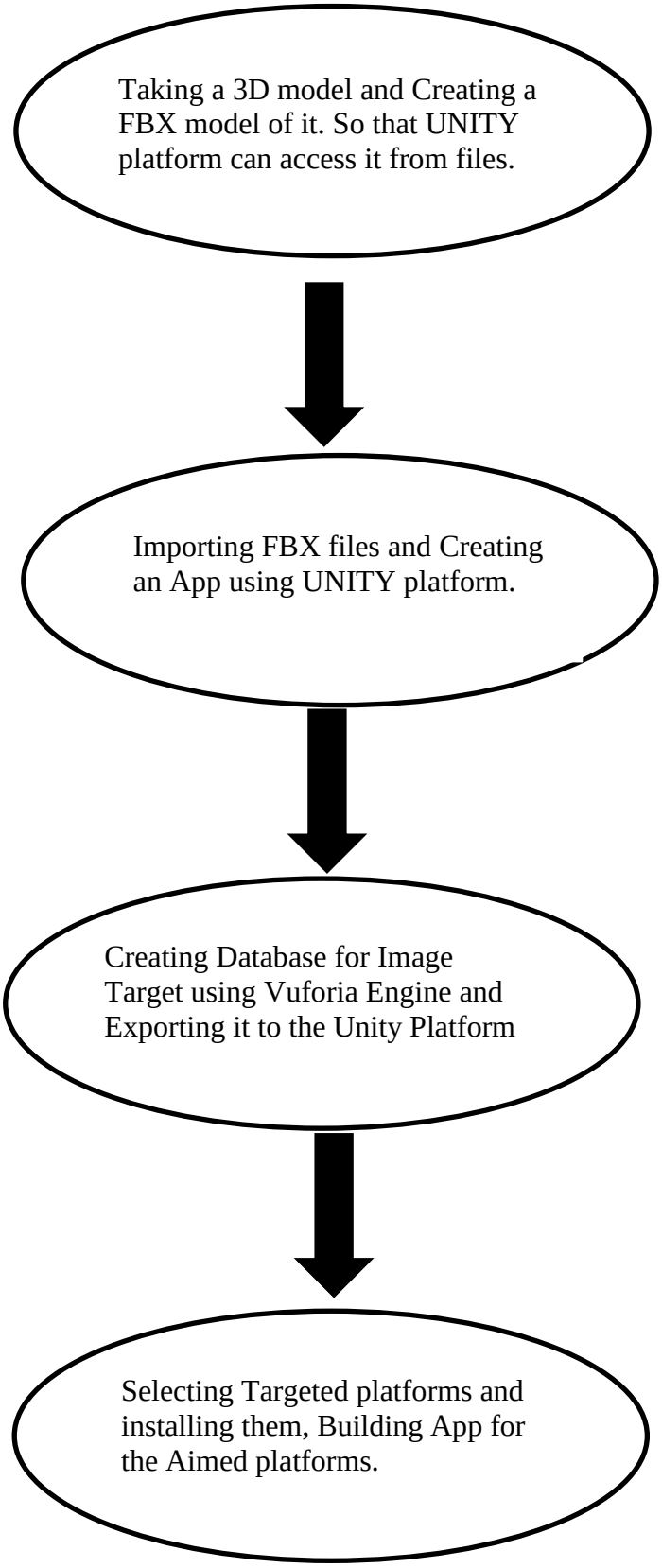
- **Jason lucus and Walid thabet (2008),** has developed an app based on AR technologies that are used for safety training for workers. The aim of it is to offer a safety training tool that can help them adequately and effectively with training purpose. They concluded that AR safety training Application is successfully implemented and It had done work easily.

- **Shin et al (2008),** has studied different types of applications of AR technologies in construction based on the suitability of technology. The research did on different work tasks, which contain more than ten classified work tasks which show the potential benefit of AR systems.
- **Xiangyu wang and Phillip S.Dunston (2005),** has worked on AR systems for the AEC industry. They prepared a prototype, which works on human abilities by using AR applications in construction. They have concluded that perceptual incompatibility occurred during the monitoring time. It was significant in performance time, working load and accuracy.

CHAPTER 3

3. Methodology

Steps for the Project:



3.1 WORKING ON SOFTWARE

Figure 3.1.1: Autodesk Revit 2023

Source: https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.pngitem.com%2Fmiddle%2FioiJmTR_transparent-autodesk-revit-logo-hd-png-download%2F&psig=AOvVaw3qahxDol9aMSrcJPIf1Td7&ust=1667037798500000&source=images&cd=vfe&ved=0CA0QjRxqFwoTCODyl-3VgvsCFQAAAAAdAAAAABAE

For architects, engineers, mechanical, electrical, and plumbing, designers, and contractors, The product is to plan a structure and design and its parts in three-dimensional, comment on the model with two-dimensional drafting components, and access building data from the structure model's database.

Revit is four-dimensional structure data displaying fit with devices to plan and track different stages in the structure's lifecycle, from idea to development and later upkeep or potential destruction.

This software is mostly used for all the works from intaial stage of the building to final stage of the building. It is also used for mechanical view and etimation. And also for electrical work and plumbing work. This software was firstly developed by a developer named Charles River, he develoed it in 1997 and This software was acquired and taken the ownership of this software by Autodesk in 2002.

Figure 3.1.2: Unity

Source:

https://www.google.com/url?sa=i&url=https%3A%2F%2Funity.com%2Fdownload&psig=AOvVaw3so5738HPcoe2kNaojyH2y&ust=1667037733223000&source=images&cd=vfe&ved=0CA0QjRxqFwoTCNCdo87VgvsCFQAAAAAdAAAAABAJ

Unity is a platform game engine developed by Unity Technologies. It was first announced, and made available as a Mac OS game engine in June 2005 at the Apple Worldwide Developing Conference. Since then, a variety of desktops, mobile phones and virtual reality platforms, It is considered easy to use for developers and is popular for indie game development.

This Platform is mostly used to create two-dimensional to three-dimensional, This platform is also acquired by USAF (United States Armed Forces). The first integrated software of Unity was developed and realeased in 2007. This platform supports maximum all of the software development platforms,

- Mobile Platforms such as Android, IOS.
- Web platforms
- Console platforms such as Playstation, Xbox
- Virtual reality platforms such as Apple AR kit, AR headset
- Windows
- Mac OS

Figure 3.1.3: Visual Studio

Source:https://venturebeat.com/wp-content/uploads/2019/11/visual-studio-logo.jpeg?w=1200&strip=all

A code editor that supports source code and IntelliSense is functionality in Visual Basic. Both an origin debugging as well as a device debug may be combined with the embedded breakpoint. A code profiler, designer for creating GUI apps, web designer, class designer, and database creative director are additional built-in tools.

With the help of Visual Studio, we can develop or code most of the website, console based coding, database designing. We can also built GUI applications, their will be tools which help in the process of designing an platform, So that Visual Studio made easier for users to learn and code.

It supports more than thirty six different types of programming languages, it allow to edit the code and debug the programes, such as

- C language
- C++
- Java, Javascript
- C#, F#
- Python, Ruby
- Node.js
- HTML, CSS etc…

Figure 3.1.4: Vuforia Engine

Source: https://images.g2crowd.com/uploads/product/image/social_landscape/social_landscape_a2b162c3b3ac82cbaa061dbf0829e678/vuforia-engine.png

Several two-dimensional, and three-dimensional target types, such as half of the cases Image Targets, 3D Goals, and a noticeable diffraction grating Marker known as a VuMark, are supported by the Vuforia SDK. Additional capabilities of the SDK include the ability to dynamically create and update target sets at runtime, localised Occlusion Detection using Virtual Buttons, and runtime image target selection.

Figure 3.1.5: Android Studio

Source: https://www.google.com/search?q=android+studio&tbm=isch&chips=q:android+studio,g_1:logo:p3o6njRKFY4%3D&rlz=1C1YTUH_enIN1023IN1023&hl=en&sa=X&ved=2ahUKEwien7zT9o_7AhXokNgFHXyDD20Q4lYoAHoECAEQJA&biw=555&bih=612

It is an software with is developed by GOOGLE, it is designed separately for Android app based development, It is available for most of the platforms, Windows, Mac OS, Linux. Android studio supports most of the all-programming languages in the world.

3.2 Case

A 66m * 54m, 3 Storey Revit 3D model is considered in the project. Integrating, target processing and building an android application is done in the Unity Platform.
The database for the application is taken from the Vuforia engine. An application has to be installed on the android platform.

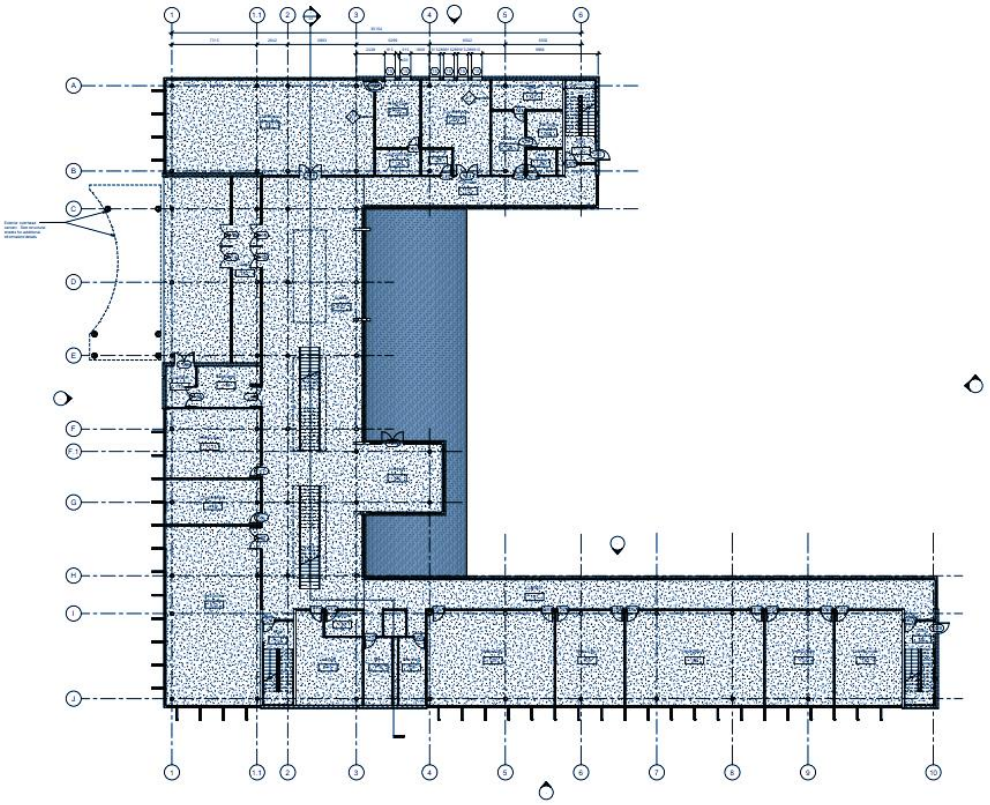
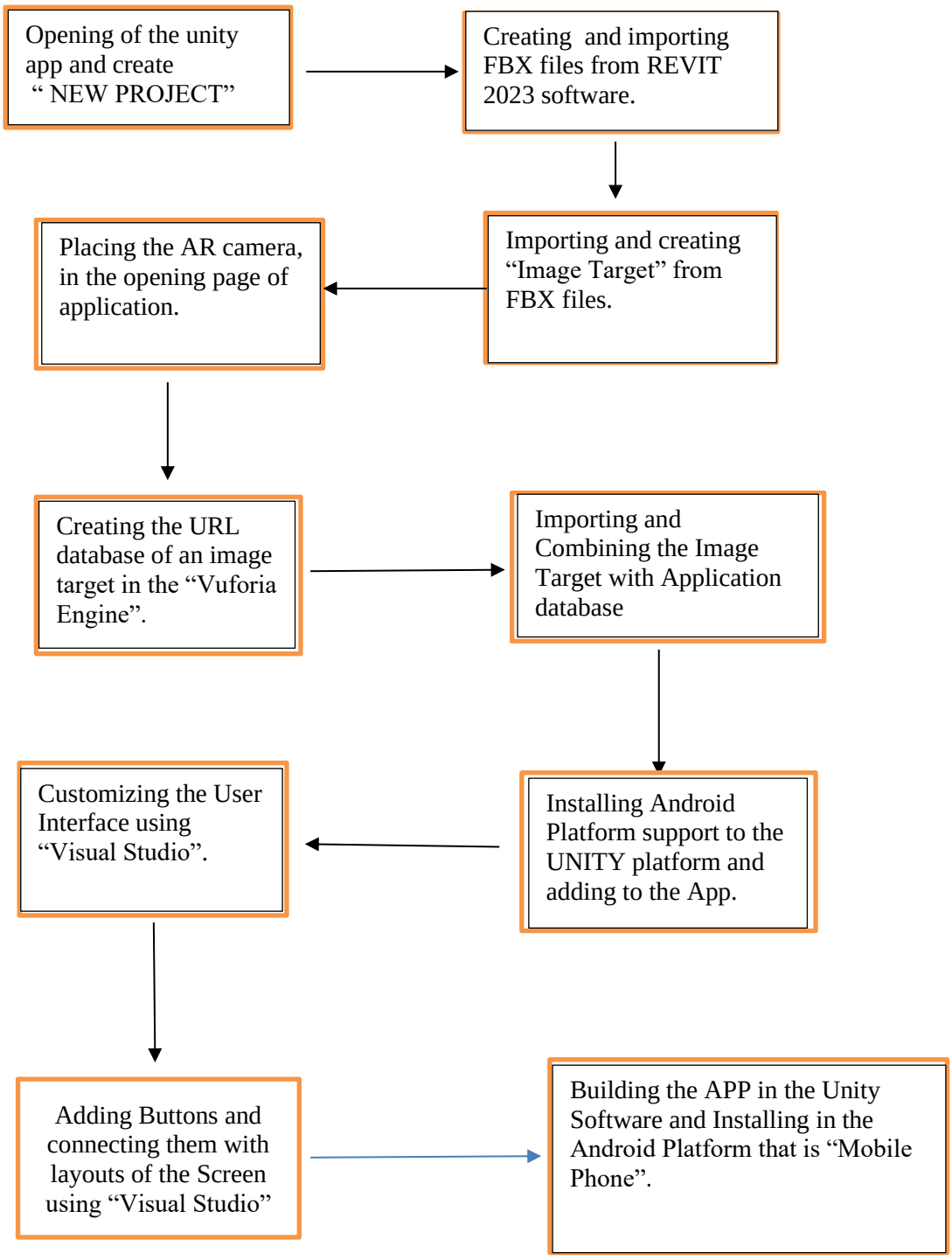


Figure 3.2.1: Plan map in Revit 2023

FLOWCHART FOR THE APP



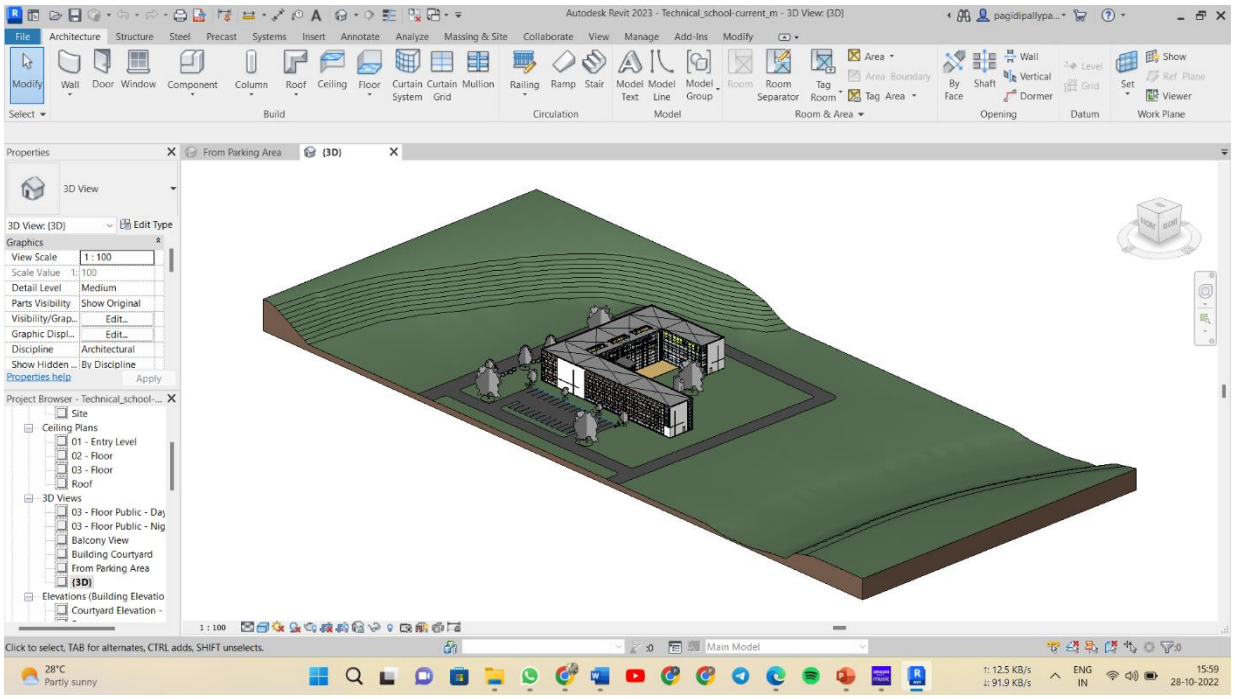


Figure 3.2.2: 3D plan view in Revit Software

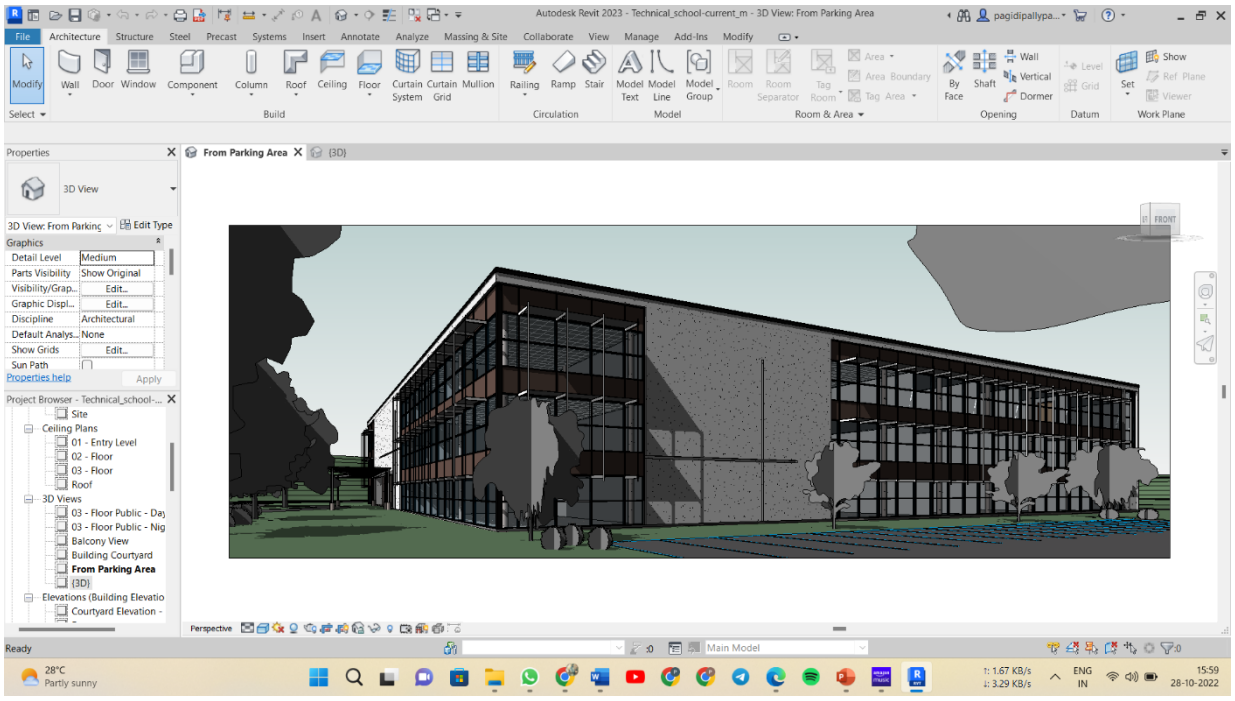


Figure 3.2.3: View of parking View Area

Step 1: Exporting the Target Image of the building In the FBX form, So that we can import it into Unity Software.

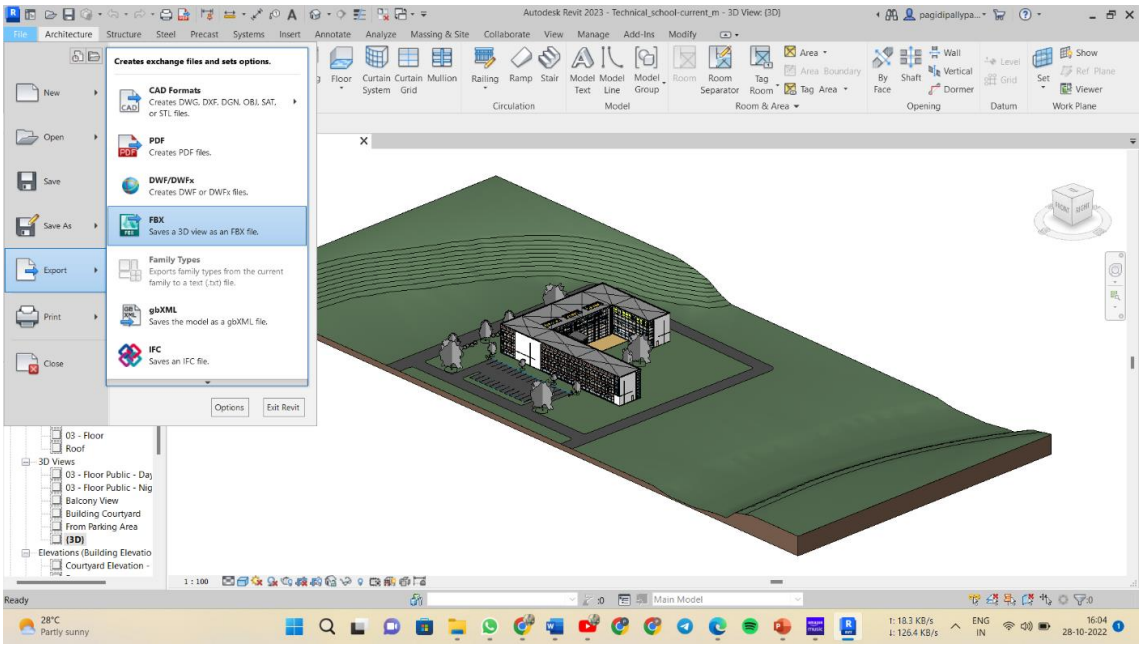


Figure 3.2.4: Exporting

Step 2: Importing 3d Models into Unity Platform and Setting them in the screen

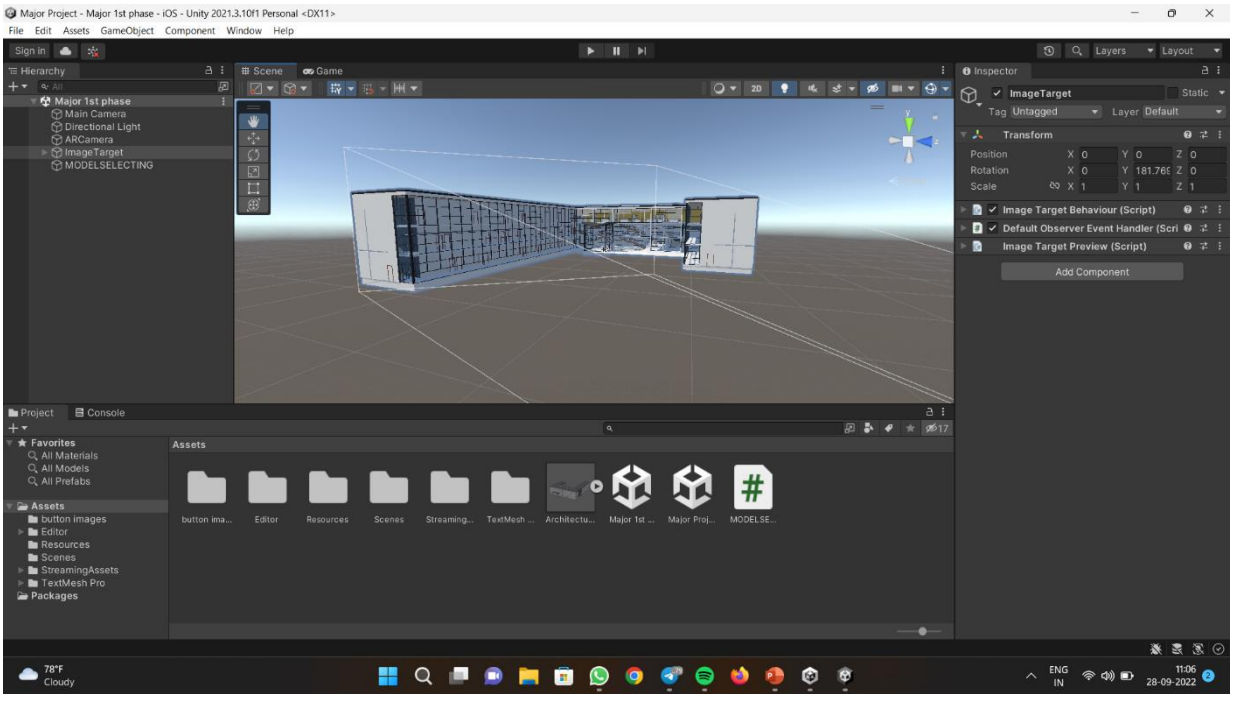


Figure 3.2.5: Imported 3D model from Revit Software

Step 3: Setting and Creating Target image for the Building Which is FBX model and Plan. Working on the Position of the Image, And the position of the AR camera.

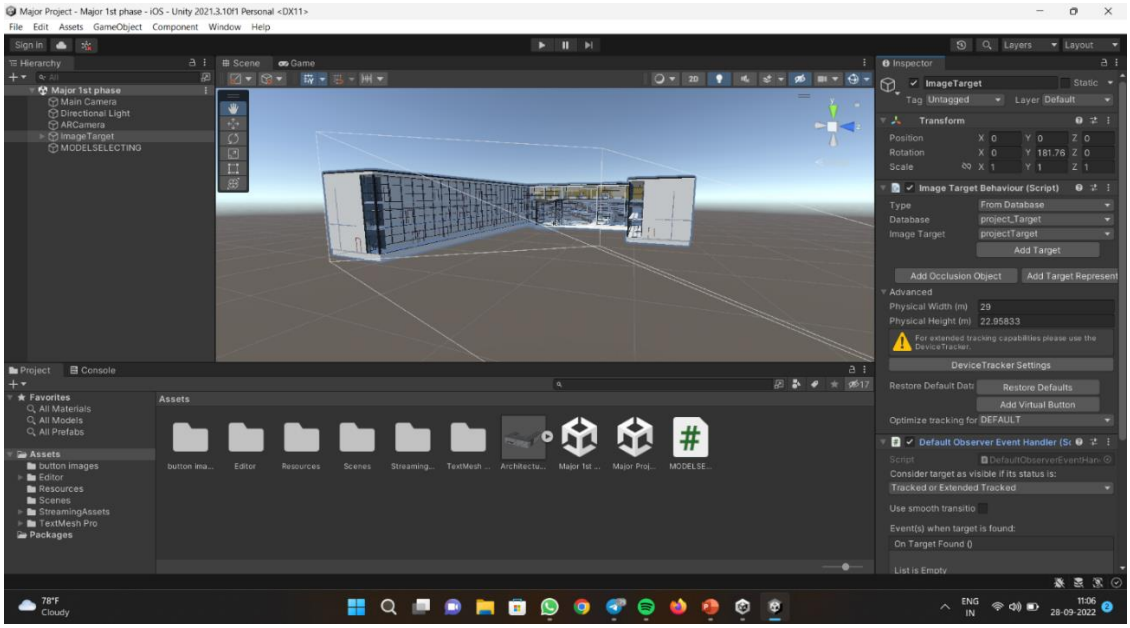


Figure 3.2.6: Settings and Target Image

Step 4: Creating and Generating a URL-based database for the app in the Vuforia Engine developer portal.

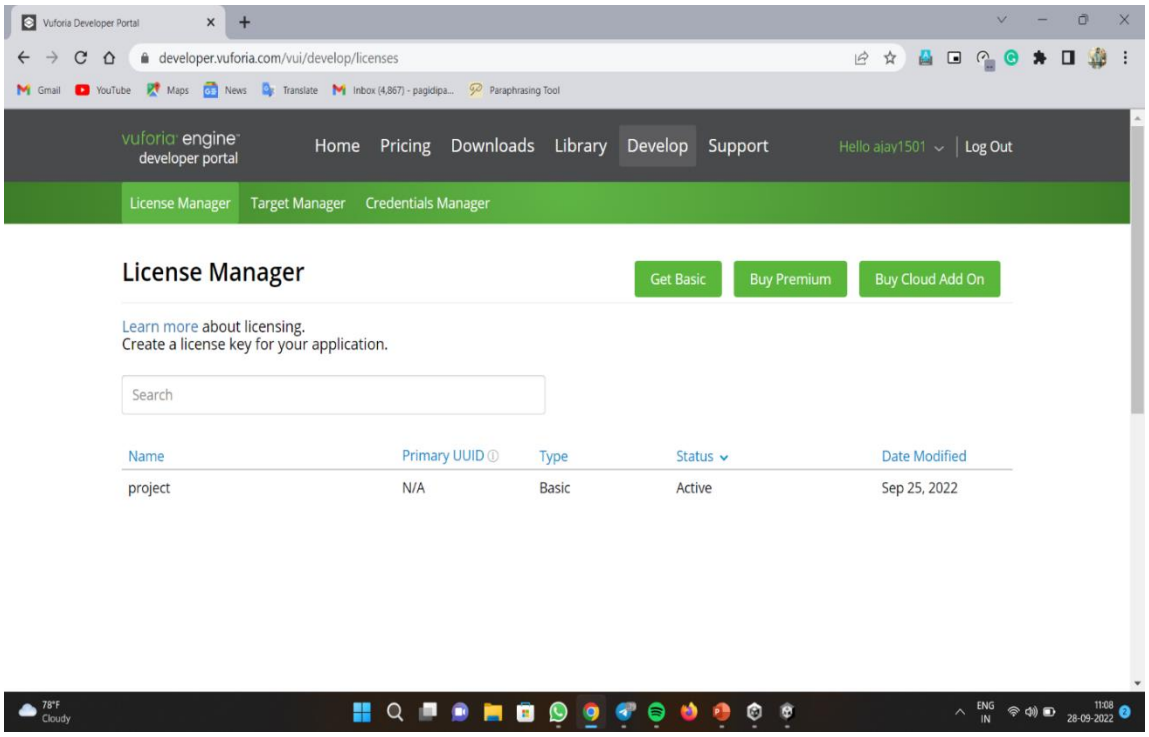


Figure 3.2.7: Creating Database

Step 5: We have to create a programming window to customize the User Interface.

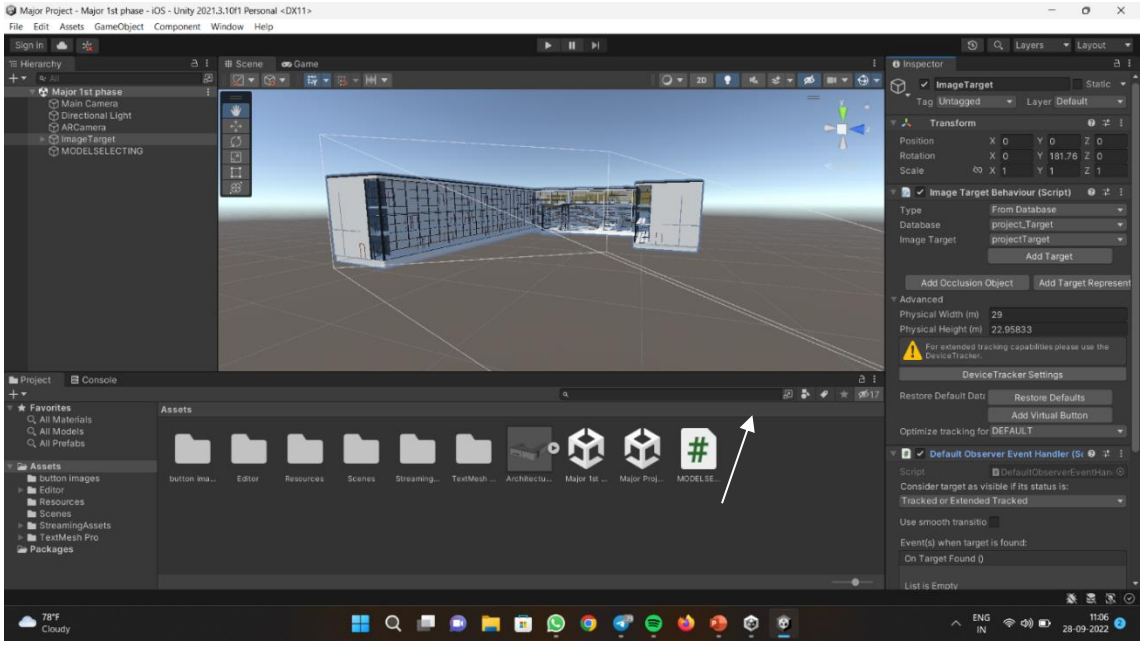


Figure 3.2.8: Programming Window

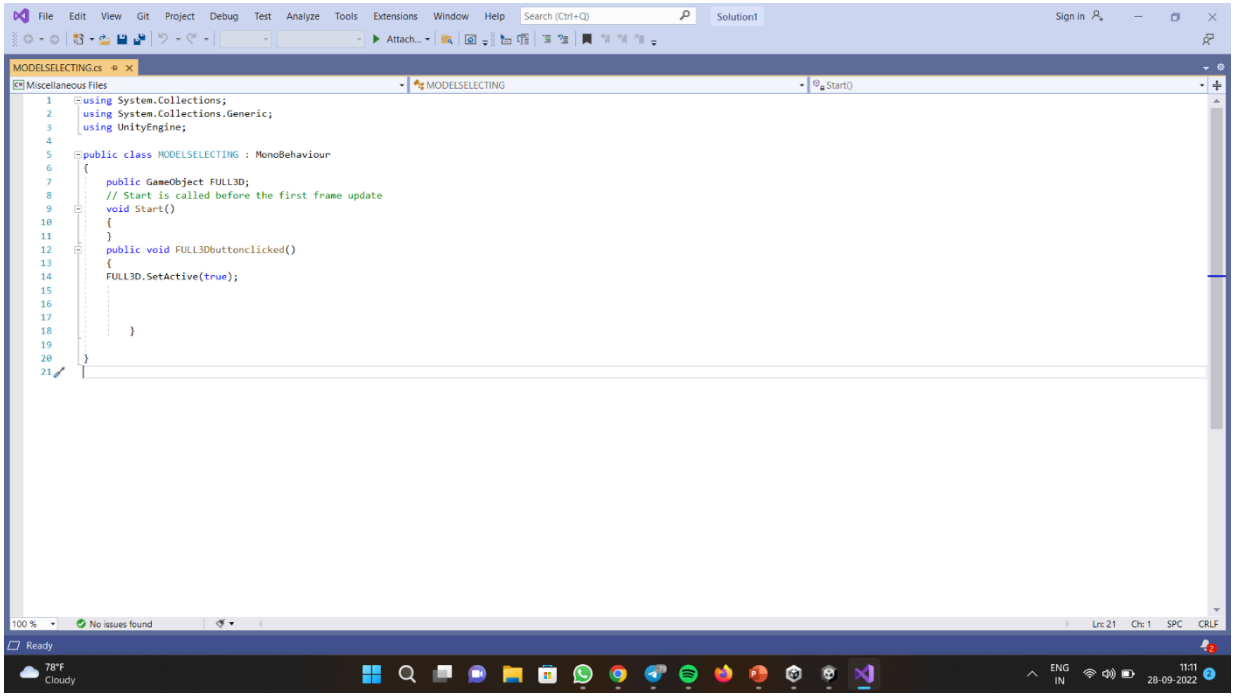


Figure 3.2.9: The UNITY platform will automatically Run the code in Visual Studio that can be applied to the app, Customizing of the User Interface will be done here.

Program for connecting buttons for UI in the screen:

```
using System.Collections;
using System.Collections.Generic;
using UnityEngine;

public class MODELSELECTING : MonoBehaviour
{
    public GameObject FULL3D;
    public GameObject Structure;
    public GameObject MEP;
    // Start is called before the first frame update
    void Start()
    {
    }
    public void FULL3Dbuttonclicked()
    {
    FULL3D.SetActive(true);
    Structure.SetActive(false);
    MEP.SetActive(false);
    }
    public void Structurebuttonclicked()
    {
    FULL3D.SetActive(false);
    Structure.SetActive(true);
    MEP.SetActive(false);
    }
    public void MEPbuttonclicked()
    {
    FULL3D.SetActive(false);
    Structure.SetActive(false);
    MEP.SetActive(true);
    }

}
```

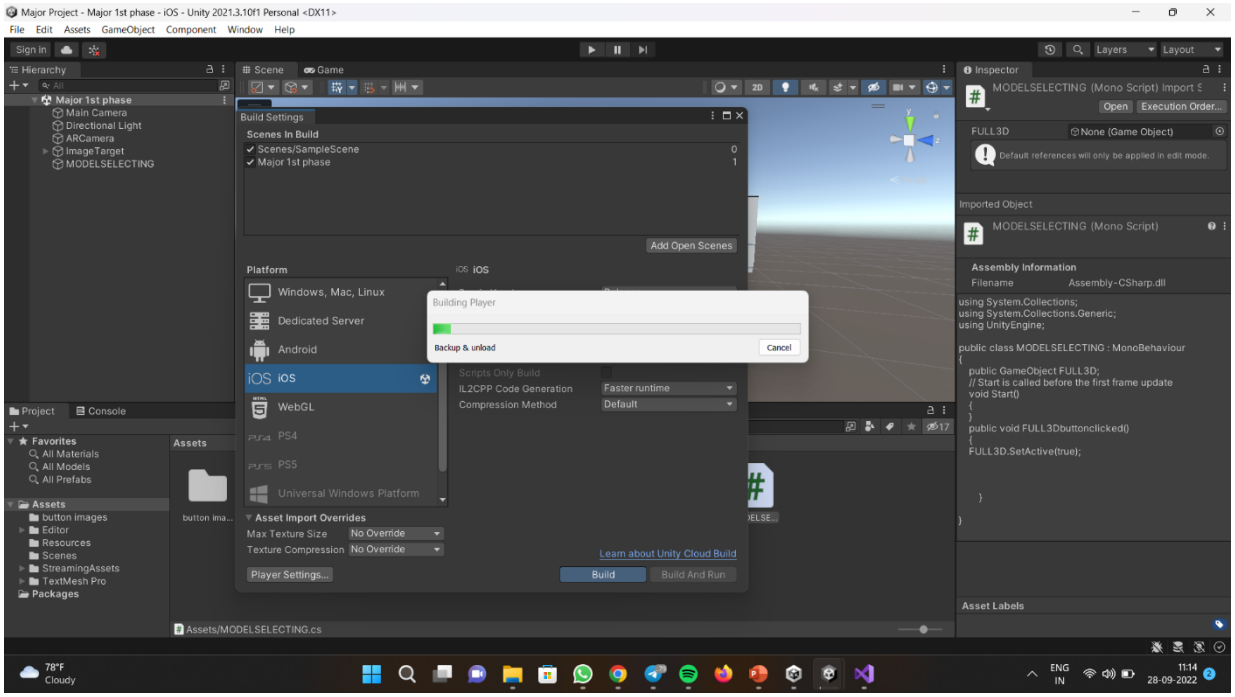


Figure 3.2.10: Importing the Code from the Visual Studio in the Unity Platform.

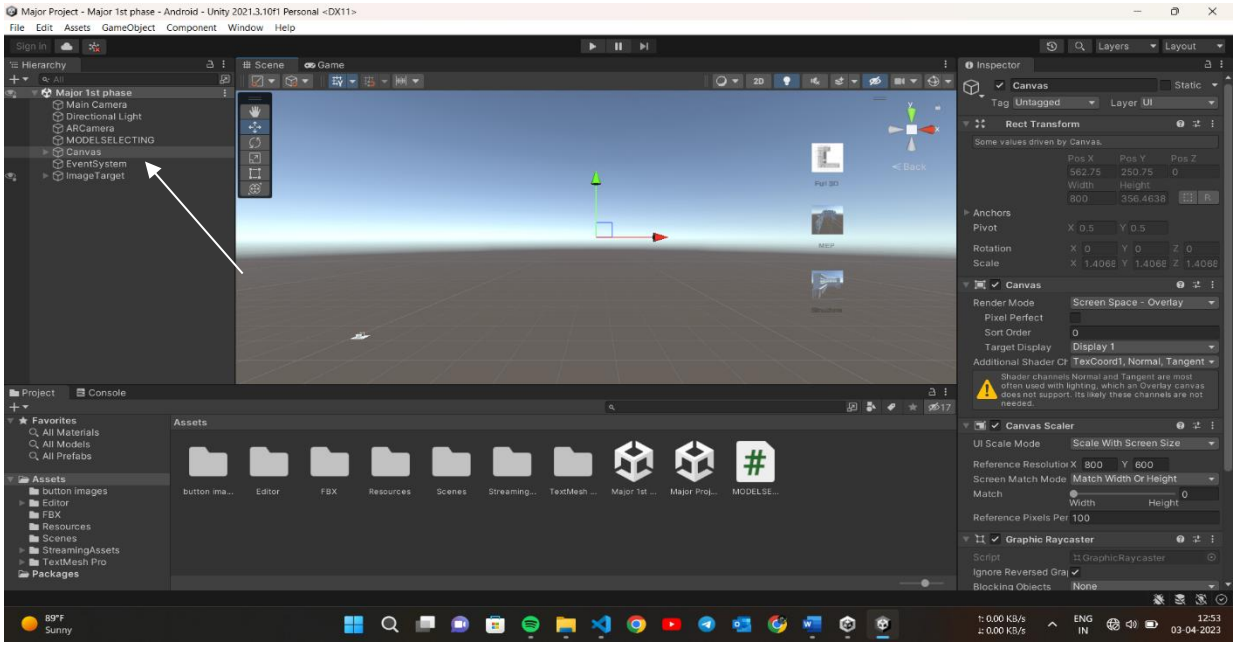


Figure 3.2.11: Designing of the Buttons In the “CANVAS” and Connect the buttons by writing Code in Visual Studio and link the buttons to the code.

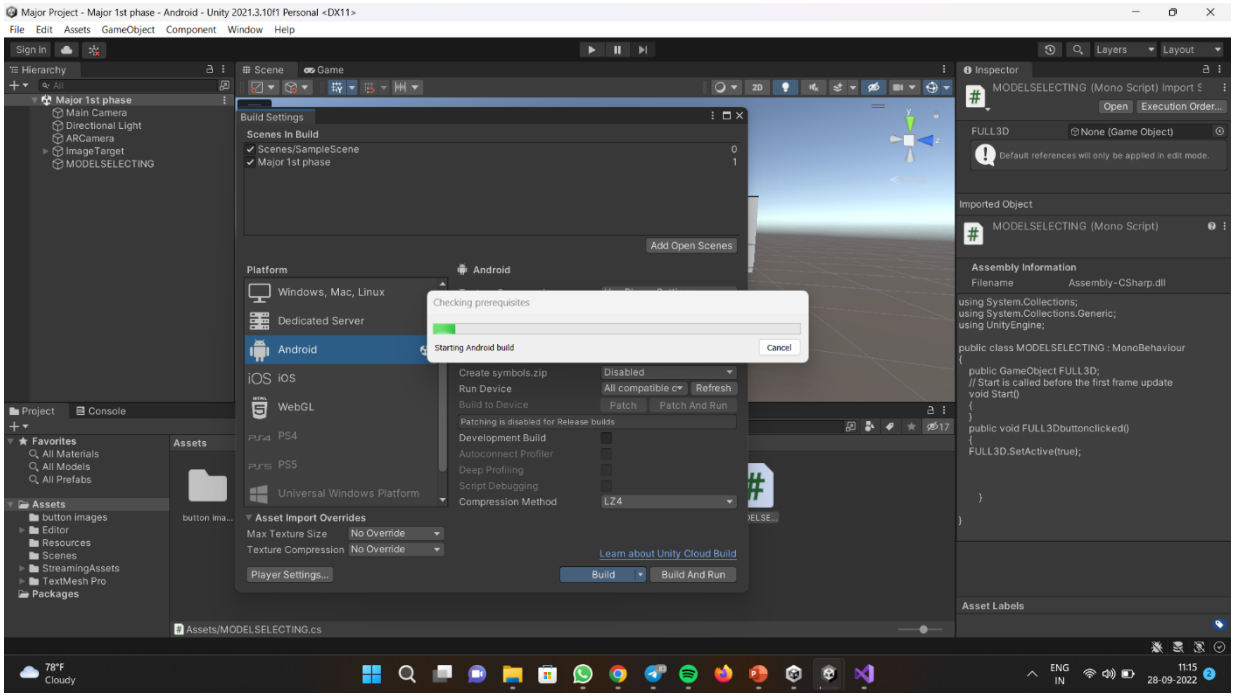


Figure 3.2.12: After setting all the designing and now, we have to select the BUILD SETTINGS, we have to select the Platform, after selecting the platform, It will run the Process and Start building the app.

CHAPTER 4

4. Results and Discussions

After building an application, have to install it on the mobile.

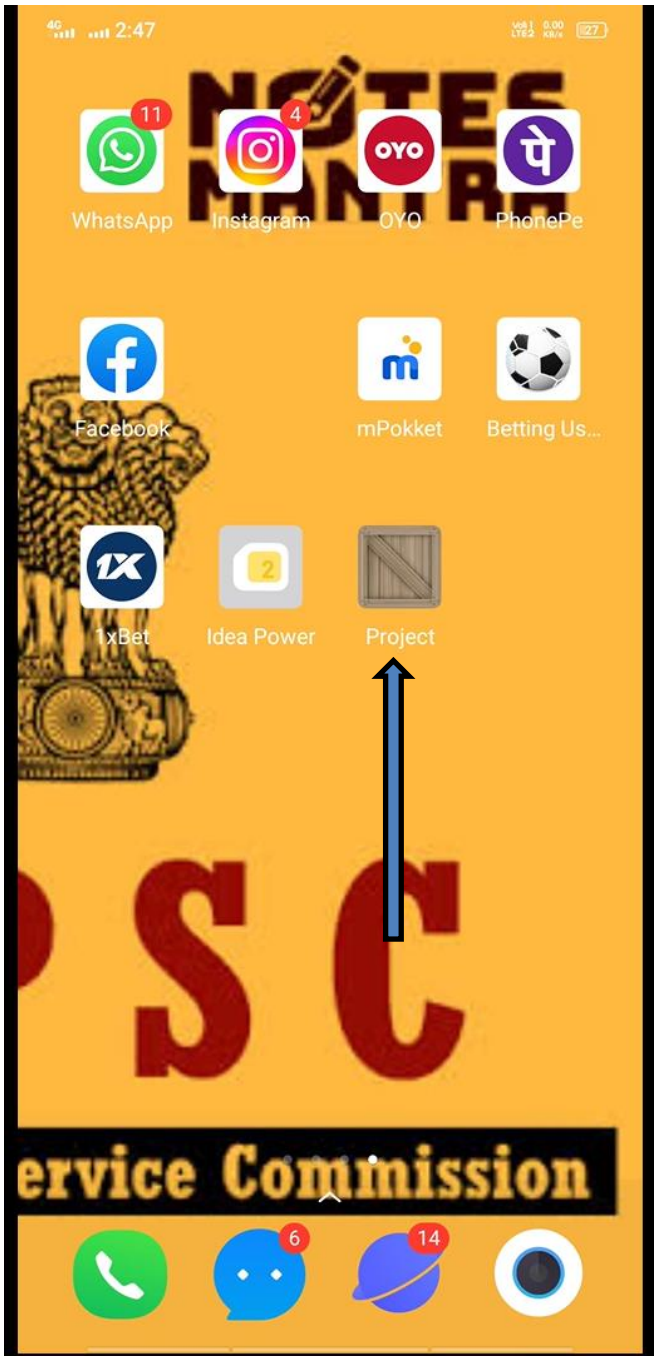


Figure 4.1: The Built application titled “Project” is installed on mobile which is running Android 13.0 Software.

Figure 4.2: Opening of the application in the mobile in Landscape mode.

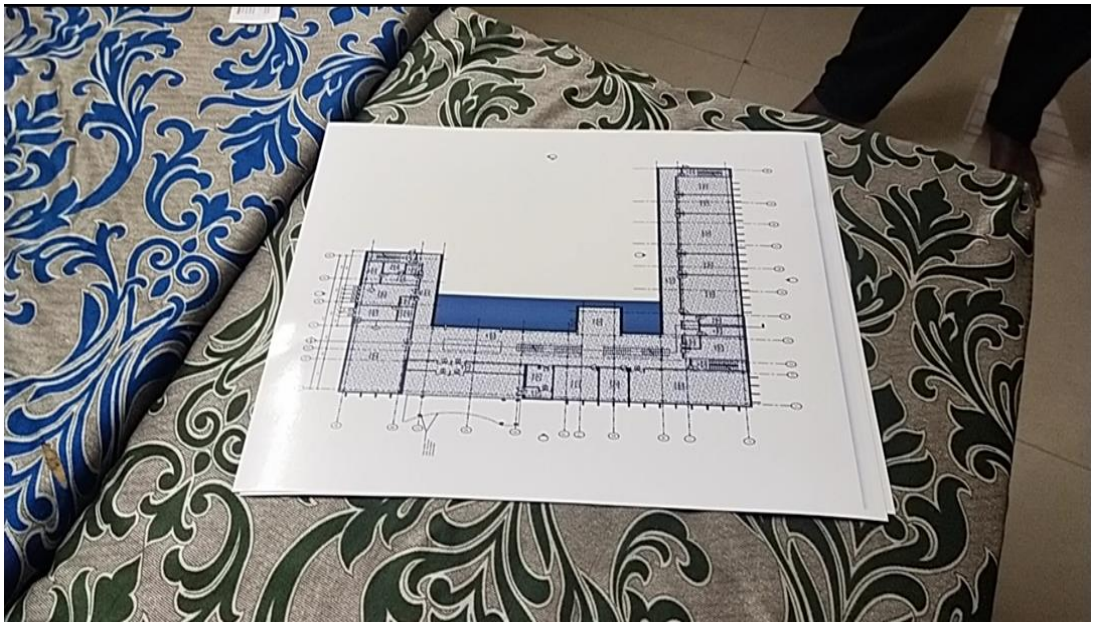


Figure 4.3: After the opening of the application, It will ask for Camera access permission, So it will open like that. We have to put the Camera on the site plan which has taken Print.

Figure 4.4: when we place the camera on the site plan, It shows a AR 3D view of the plan. We can still move the phone so that we can see the detailing of the building.

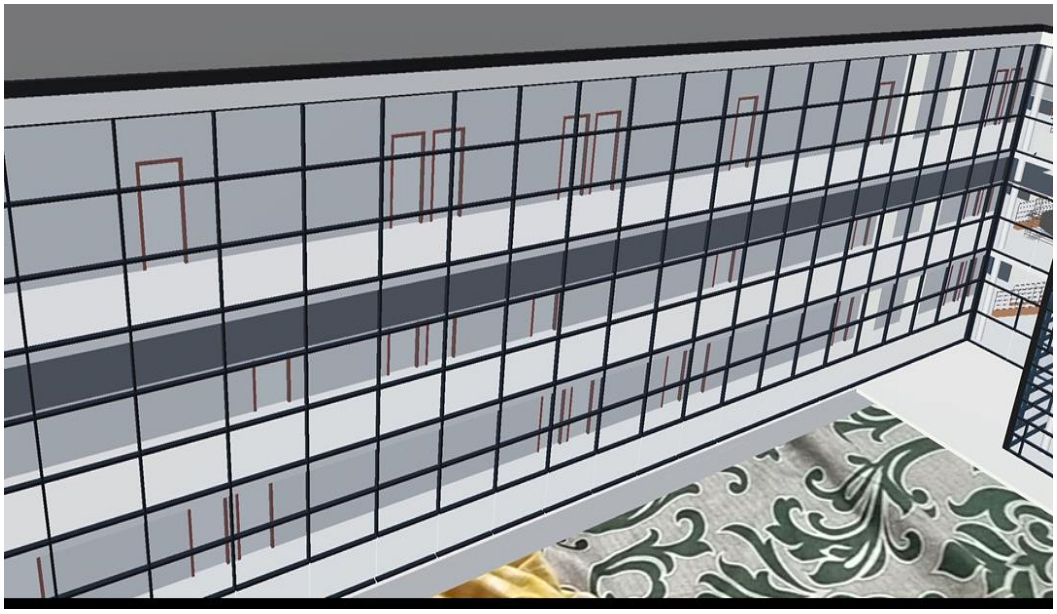


Figure 4.5: Closer Look of Site building.

Figure 4.6: Closer look 2 of Site Building.

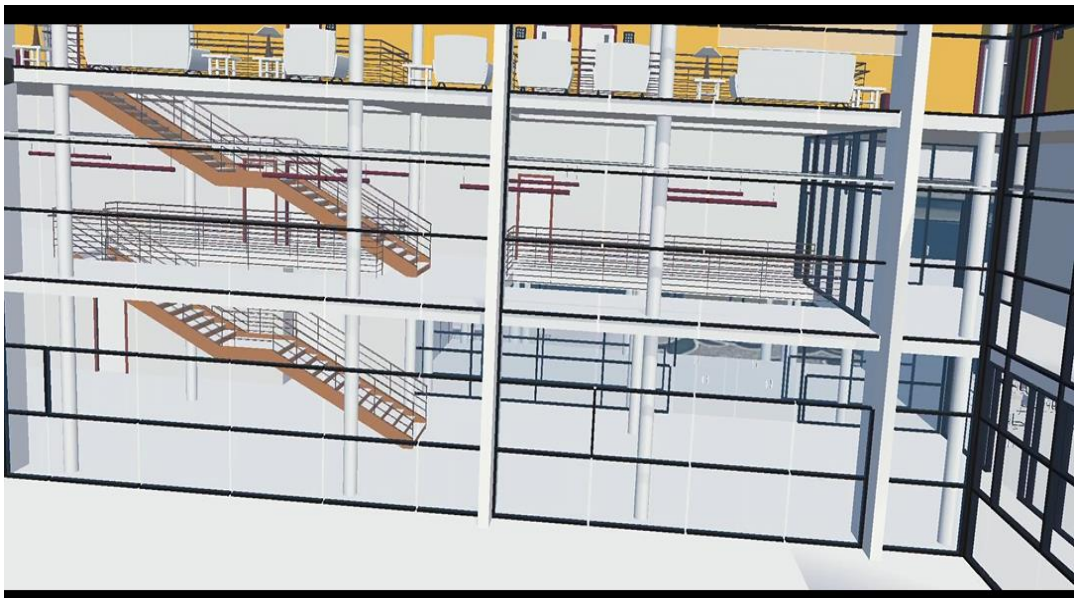


Figure 4.7: Closer look 3 of the Site Building.

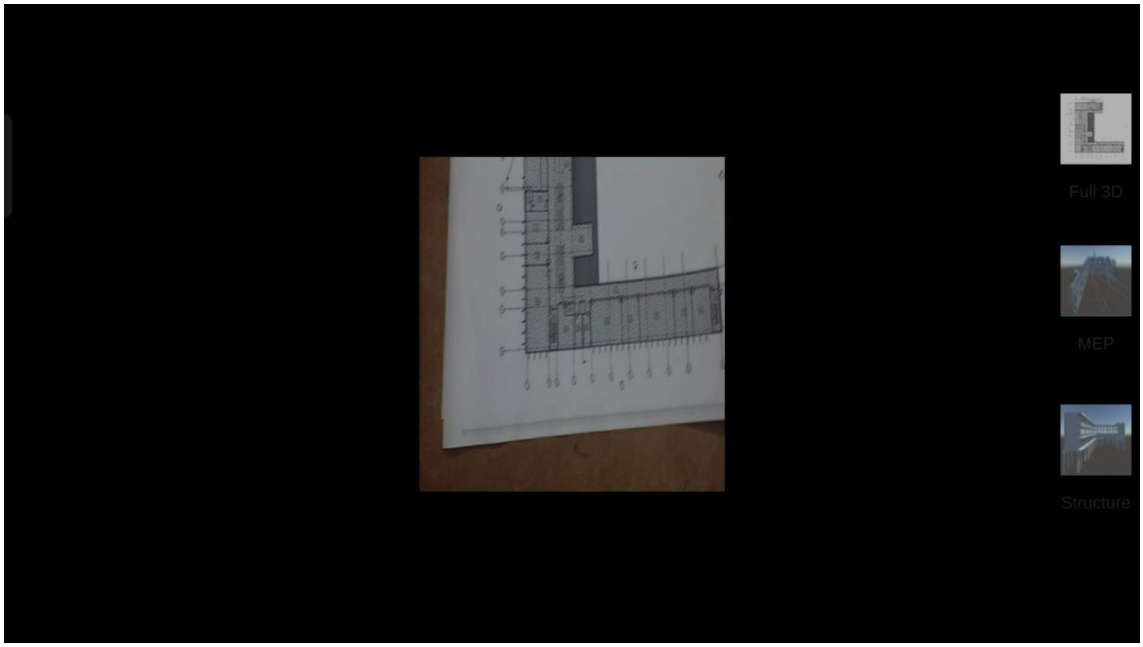


Figure 4.8: Camera and App UI

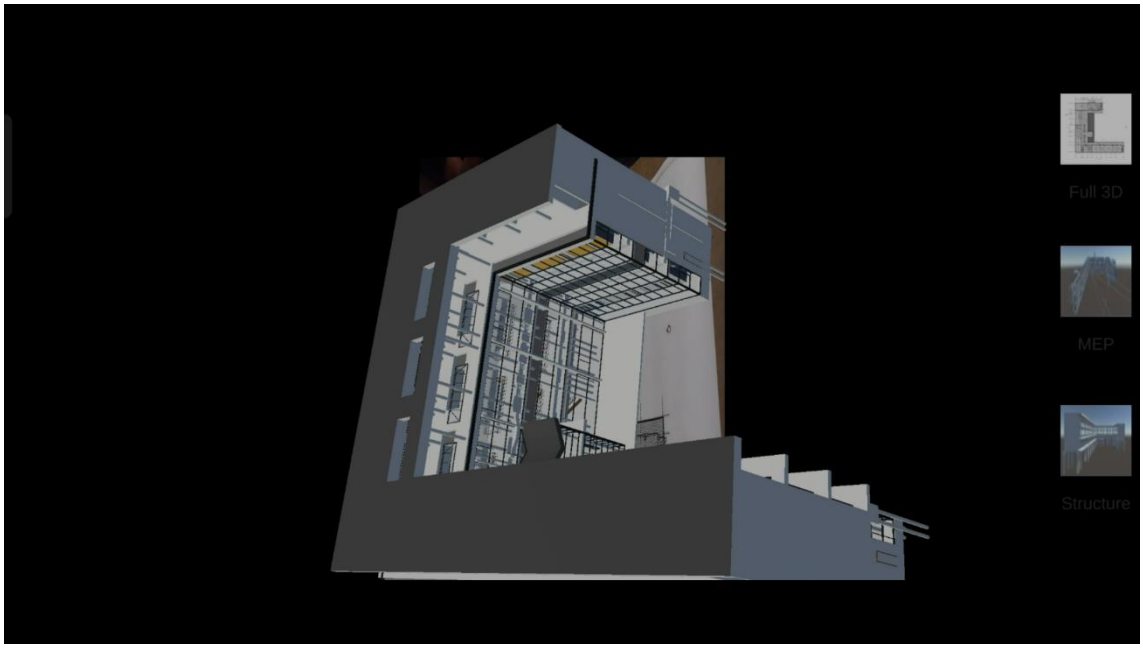


Figure 4.9: View of the Exterior Structure of the building after Pressing the button in the Screen.

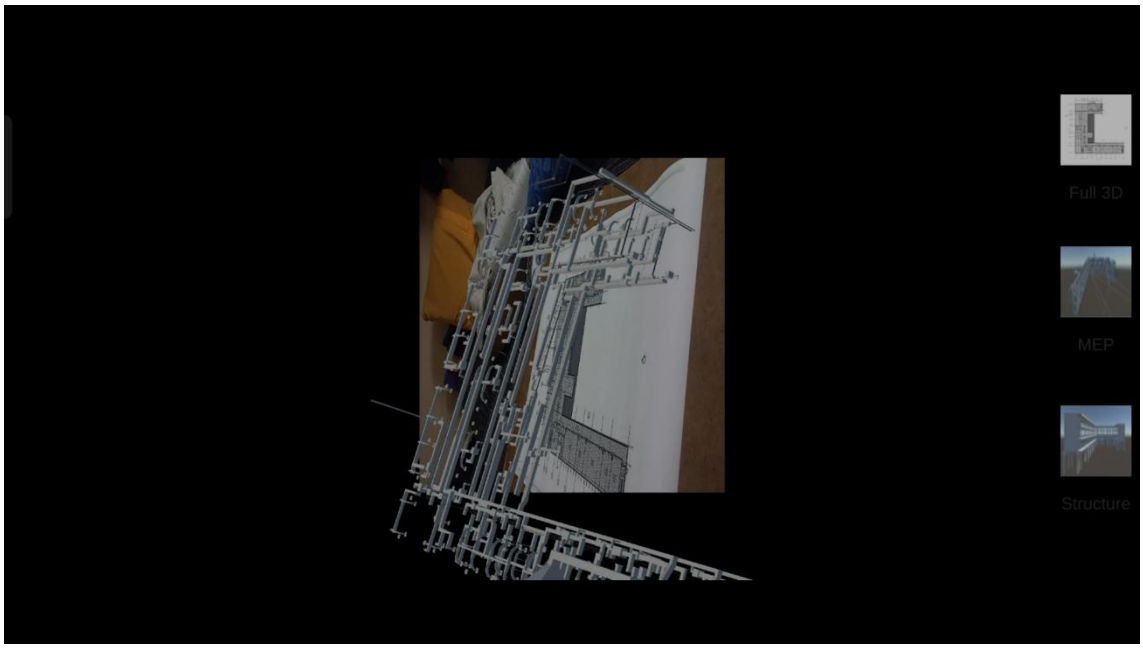


Figure 4.10: View of the Plumbing Structure of the building.

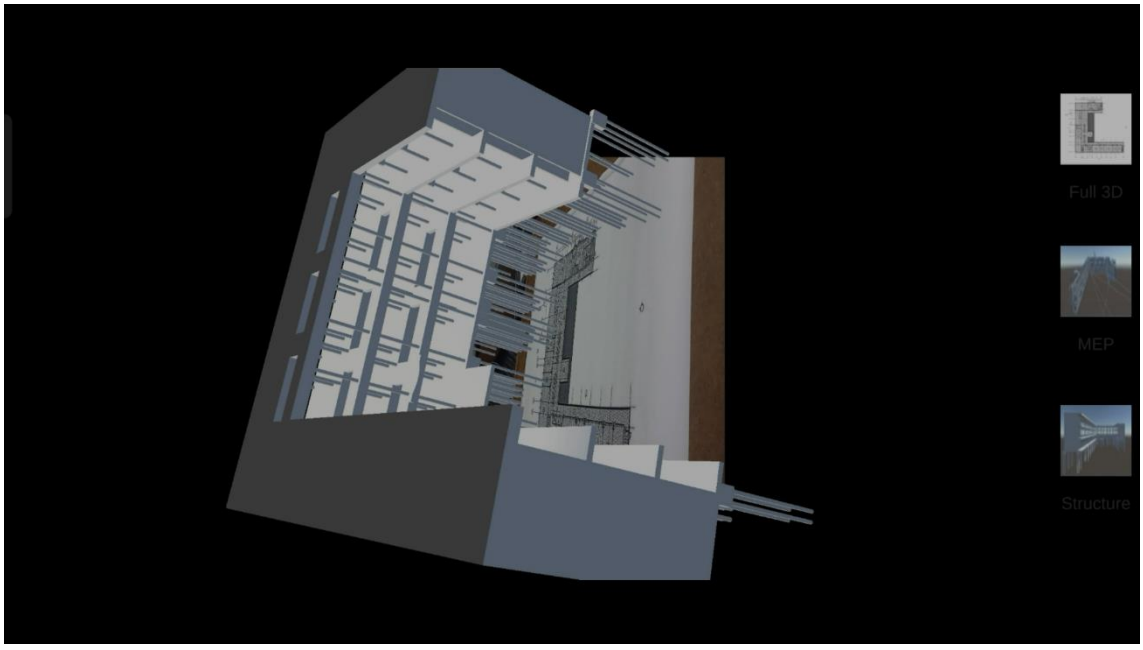


Figure 4.11: View of the Internal Structure of the building.

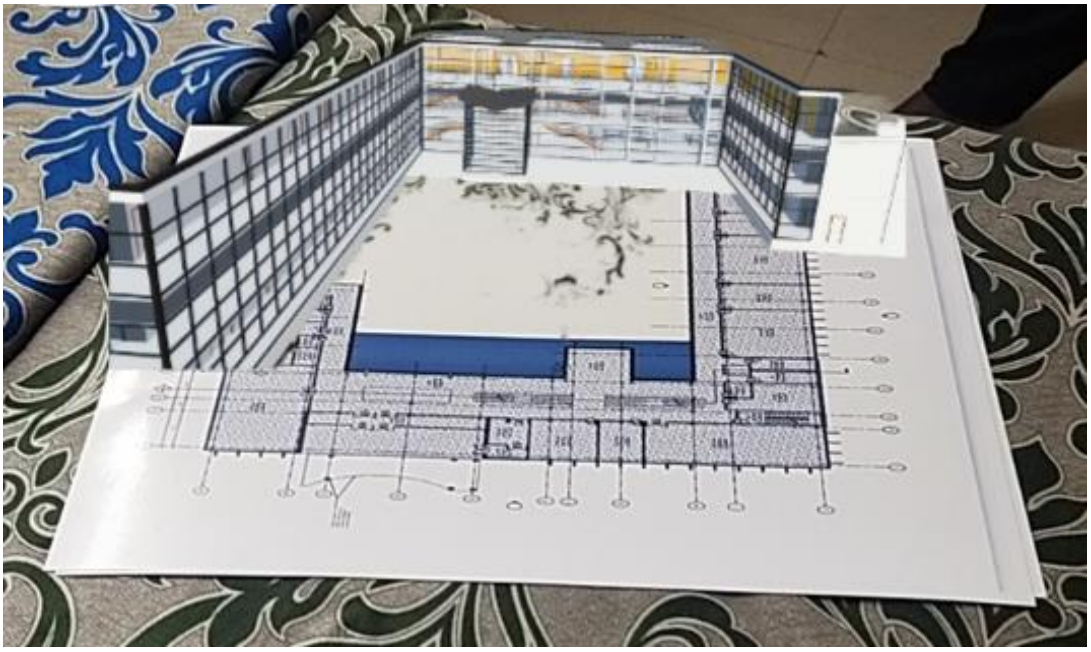


Figure 4.12: Result (Overlaying of 3D and 2D backgrounds in the app)

We have tested the app by installing it on our mobile phones, Reason behind choosing of mobile phone is, Mobile phones (Android) have a very wide open network, We can do any customizations to our mobiles without any failure. In place of VR (or) AR headsets we used mobile for Visualization purposes. And mobile phones are mostly used devices in the world. Every person has a mobile nowadays. So it is an easier way to access the app on every mobile device. After learning what we are done in the project, and seeing the result of our work, We got the idea that Augmented Reality in construction is very useful in construction, It will be the next generation of our human era. With the help of Augmented Reality, We can create anything, We can achieve distance communication, It will help in all aspects that humans cannot achieve.

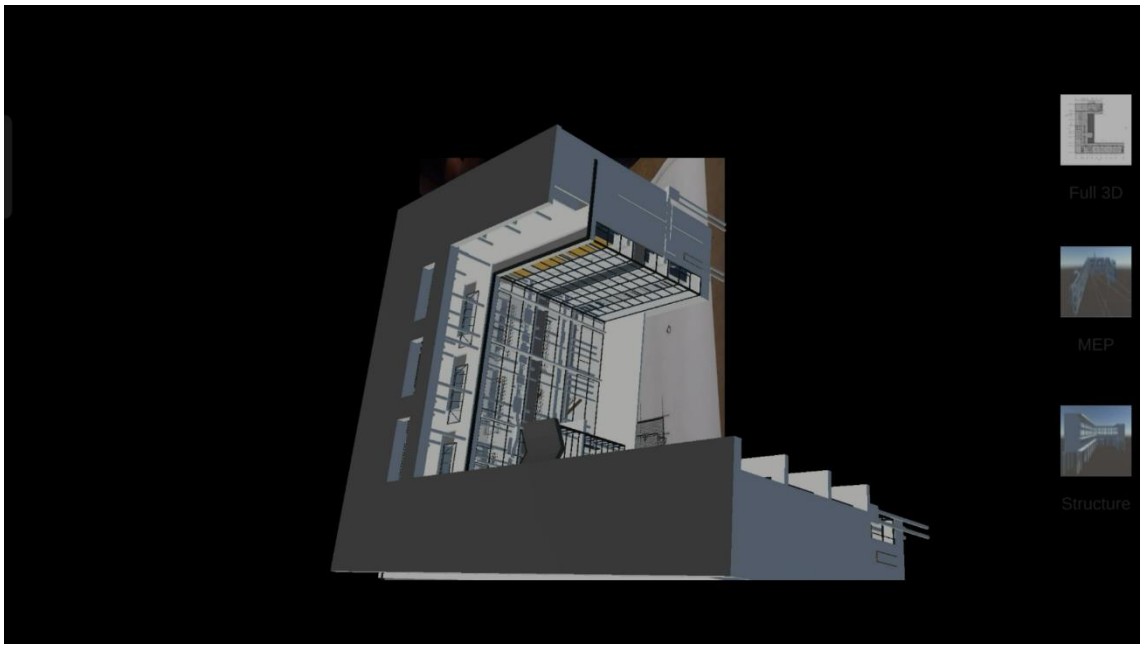


Figure 4.13: Result (Overlaying of 3D and 2D backgrounds and Buttons on the right of the screen in the app)

Revit uses the technology called BIM, which means building information modelling. This tool was introduced in the Autodesk platform, Mostly this is used for Engineers, and Architectures mostly in the AEC industry. This tool has been a great technology that evolved, It has the power to visualise the 3D dimension or environment around us, It greatly helps the AEC industry by Minimising errors, Increasing the potential of the project, decreasing the cost of a project, and Designing will be done more effectively.
AR(Augmented Reality) have the capability of allowing people to truly experience a project before it is built. Recently these technologies are using in the integration department of the construction industry. It will be an essential tool for workers' training, and it has more safety management systems, labour management, defects management, Tracking the work progress and so on…

CHAPTER 5

5. CONCLUSION

One of the major industries in the world is construction diligence. Since the first begin in the history of construction assiduity, there has been a significant transformation. Augmented and virtual reality are contributing to an incredible revision and advancement in colourful construction concerns among the myriad changes. The main goal of this study is to examine the improvements in construction efficiency brought about by augmented reality and augmented reality technology, as well as their contribution to resolving diverse construction difficulties during the past few decades. The study has shown that these unbelievable developments in AR and VR technology are significantly affecting construction diligence in a number of ways. This study demonstrates a vibrant application of VR and AR technologies. In the ultramodern building process, reality is employed for design scheduling and design progress shadowing. AR and VR are tested technologies for efficient and less time-consuming communication between various design actors. Additionally helpful robotic solutions for quality and illumination in construction design are AR and VR.

References

1. Ali karji: Ph.D. Student, Durham School of Architectural Engineering and Construction, Univ. of Nebraska-Lincoln, The Peter Kiewit Institute 117A, 1110 S 67th St., Omaha, NE 68182-0816.
2. Andrea Revoltia: 4th International Conference on industry 4.0 and smart manufacturing ,Faculty of Science and Technology, Free University of Bozen-Bolzano, Piazza Università, 1,Bolzano , 39100, Italy b Photogram, Via Angelo Custode 4, Varna , 39040, Italy
3. Ayodeji Emmanuel Oke: Smart and sustainable Built Environment ISSN: 2046-6099 Article publication date: 28 June 2021
4. Claudi calderon: DOI 10.2478/otmcj-2018-0012 Received May 30, 2018; accepted Nov 05, 2018.
5. Clarissa Hedenqvisit: Augmented Reality-enhanced warning, degree project in computer science and engineering second cycle, STOCHOLM, swedan 2020.
6. Chan-sin park, do-yeop lee, oh-seong kwon, Xiangyu wong: "A framework for proactive construct, defect management using BIM,AR and anthology based data collection. School of architecture and building science, chung-aug university, Republic of korea, Volume 33, aug 2013.
7. Chan Sik Park: Automation in Construction Volume 33, August 2013, Pages 61-71
8. Dr.Poorang piroozfar : "The application of AR in architecture engineering and construction industry". The tenth international conference on construction in 21st century (CITC-10), July 2nd – 4th , 2018,colombo, Srilanka.
9. Fopefoluwa Bademosi: Advances in informatics and computing in civil and construction engineering pp 307-313.
10. Jason Lucus and walid thabet: "Implementation and evaluation of AR application, Virginia technology, dec 2008.
11. Pampattiwar,KalyaniPampattiwar,AkshayAdiyodi,ManasviniAgrahara, PankajGamnani, "Interior Design using Augmented Reality Environment", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 5, Issue 10,pp-17789-17795, October 2016.
12. Mehdi mekni: University of Minnesota, Crookston Campus.
13. Mahmoud Albahbah: Journal of Construction Engineering, Management & Innovation 2021 Volume 4 Issue 3 Pages 151-172
14. Patrick Dallasega: 10th Conference on Learning Factories, CLF2020 BIM, Augmented and Virtual Reality empowering Lean Construction Management: a project simulation game University of Bozen- Bolzano Faculty of science and technology, Industrial Engineering and Automation(IEA), Bozen Bolzano, Italy
15. Park c, Lee Dy, Known os, Wang x: "Defect management using BIM and AR", journal of automation in construction, Elsevier 2013.
16. Phan ,Viet ToanPhan and seungyeonchoo : "Interior Design in Augmented Reality Environment", International Journal of Computer Applications, Vol 5, p.p 16- 21, August 2010.
17. Pampattiwar,KalyaniPampattiwar,AkshayAdiyodi,ManasviniAgrahara, PankajGamnani: "Interior Design using Augmented Reality Environment", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 5, Issue 10,pp-17789-17795, October 2016.
18. Ricardo: Journal of civil engineering and management ISSN 1392-3730/eISSN 1822-3605 2020 Volume 26 Issue 1:83-94
19. Richardo l Machado,cesar vile: "Conceptual framework for integrating BIM and AR in construction management", Journal of civil engineering and management ISSN 1392-3730/Eissn 1822-3605 2020 volume 26 Issue 1:83-94.
20. Sebastjan Meza: Advances in engineering software Volume 90, December 2015, Pages 1-10.

21. Shin DH, Dunston PS: “Identification of application areas for AR in industrial construction based on technology suitability”, Journal of automation in construction, Elsevier 2008.
22. Sara Rankohia and Lloyd Waugh: “Review and analysis of AR literature for construction industry”, Visualisation in engineering, Article number:9(2013).
23. Shakil ahmed,Md melrab Hossain, Md ikramal hoque: “ A brief discusiion on AR and VR in AEC industry, ISSN 1816-6075, 1818-0523,journal of system and management sciences vol.(2017).
24. Samanth, Ms.TanmayiSamant, Ms. Shreya Vartak: “Interior Design Using Augmented Reality”, International Research Journal of Engineering and Technology, Vol-6, Issue-01, p.p 1003-1007, Jan 2019.
25. Vito palmeri,Centro di progettazione: design e tecnologie dei materiali (CETMA), Brindisi, Italy.
26. Wang X: “AR in architecture and design: potentials and challenges for application” International journal of architectural computing 2009.
27. Waugh L.M, Rausch B, Engram T, Aziz f: “Inuvik super school VR documentation”, 15th International conference on cold regions engineering, Quebec,Canada,2012.
28. Xiangyu wang, Phillip s.dunston: “Compability issues in AR systems for AEC industry school of civil engineering, Purdue university, IN 47907-2051,2005.
29. Yanmingli, chengliang liu: “Integrating field data and 3D simulation for tower crane activity monitoring and alarming”, volume 27, nov 2012.
30. Yelda turkan, Frederic bosche, Carl T haas, Ralph haas: “Automated progress tracking using 4D schedule and 3D sensing technology, Department of civil engineering, university of waterloo, Canada N2L 341, Volume 22, march 2012.
31. Ziruihong,Qiqizhang,Xingsu,Hongzhang: “Effect of virtual annotation of performance of AEC industry”, collge of civil engineering, Zhejiang university, china, volume 118, October 2020.