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Augmented Reality in Architecture

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ABSTRACT: Architectural Designers and Civil Engineers have been using applications in order to be accurate about the measurements to avoid any flaws that would result in a bad construction. This was first implemented in 2004 by Trimble Navigation to represent real-time local view of the property which used 3D models before the actual building was constructed leading to one of the major fields in which AR has a major part.

I. INTRODUCTION

In this paper we are going to learn that Augmented reality is one of the major technologies that is being implemented in various fields to enhance the experience of the user that would help the designers/engineers in making a better design. These tasks may be productive or just for entertainment purposes i.e. depending on the field they are being implemented. The field targeted here in this paper is the Architectural field as the AR technology might help the customer in solving the time and cost related issues. With the help of advanced AR technologies, the information about the surrounding real world of the user becomes interactive and digitally manipulated. Information about the environment and its objects is overlaid on the real world. AR is a real-world interactive process where the user creates a virtual object over the already existing object in order to enhance the process of Virtual Reality. Whereas, VR concentrates more on the concept of creating a reality with personalized features to enhance the experience created. The primary value of augmented reality is the way components of the digital world blend into a person's perception of the real world.

The various applications of AR can be seen throughout various fields such as;

1. Medical Training
2. Retail
3. Design & Modeling
4. Business Logistics
5. Tourism
6. Education
7. Field Service
8. Entertainment
9. Public Safety

The fields that this paper concentrates on are;

Design & Modeling: From interior design to architecture and construction, AR is helping professionals visualize their final products during the creative process. Use of headsets enables architects, engineers, and design professionals' step directly into their buildings and spaces to see how their designs might look, and even make virtual on the spot changes. Urban planners can even model how entire city layouts might look using AR headset visualization

Education: While technology like tablets have become widespread in many schools and classrooms, teachers and educators are now ramping up student's learning experience with AR. The Aurasma app, for example, is already being used in classrooms so that students can view their classes via a smartphone or tablet for a rich learning environment. The AR experience allows the engineer to target the customer needs in topics such as Designing, Construction and Educational needs.

The author, J.T. Doswell from the The Juxtopia Group has produced a survey report titled Augmented Learning: Context-Aware Mobile Augmented Reality Architecture for Learning which states that, Mobile augmented reality system (MARS) based e-learning environments equip a learner with a mobile wearable see-through display that interacts with training/learning software. MARS has the potential to adapt to individual learner needs and dynamically distribute tailored instruction to improve learning performance for a lifetime. [1]

The author, J.T. Doswell from The Juxtopia, LLC, USA produced a survey report titled Context-Aware Mobile Augmented Reality Architecture for Lifelong Learning states, Virtual instructor enabled mobile augmented reality systems (MARS) have the potential to provide continuous and autonomous instruction to human learners anytime, anyplace, and at any-pace. MARS based learning provides the advantage of a natural human-computer interface, flexible mobility, and context-aware instruction allowing learners to interact with their natural environment with augmented perceptual cues.[2]

Hung-LinChi, Shih-ChungKang
Research trends and opportunities of augmented reality applications in architecture, engineering, and construction: AR, a state-of-the-art technology for superimposing information onto the real world, has recently started to affect our daily lives. AR applications are becoming mature and versatile. This paper discusses trends in AR applications for architecture, engineering, construction, and facility management.[3]

P. Dahne, J.N. Karigiannis authors of "Archeoguide: system architecture of a mobile outdoor augmented reality system" state that the system architecture of a mobile outdoor augmented reality system for the Archeoguide project. We begin with a short introduction to the project. Then we present the hardware we chose for the mobile system and we describe the system architecture we designed for the software implementation. We conclude this paper with the first results obtained from experiments we made during our trials at ancient Olympia in Greece.[4]

W.Piekarski,B.H.Thomas who published „Tinmith-evo5 - an architecture for supporting mobile augmented reality environments" presents a summary of a new software architecture we have developed, known as Tinmith-evo5, which is designed as one possible methodology for writing complex AR applications. While software for 2D environments is very mature, in the 3D case there is still missing software support that we are attempting to address.[5]

Xiangyu Wang who published "Augmented Reality in Architecture and Design Potentials and Challenges for Application" explains recent advances in computer interface and hardware power have fostered Augmented Reality (AR) prototypes for various architecture and design applications. More intuitive visualization platforms are necessary for efficient use of digital information nowadays in the architecture and design industries. As a promising visualization platform to address this need, this paper introduces the concept and associated enabling technologies of AR and also presents a survey of its existing applications in the area of architecture and design.[6]

II. PROPOSED METHODOLOGY

Unity3D: Unity is a real-time cross-platform game engine developed by Unity Technologies, first announced and released in June 2005 at Apple Inc.'s Worldwide Developers Conference as a Mac OS X-exclusive game engine. As of 2018, the engine had been extended to support more than 25 platforms

Android Studios: Android Studio is the official integrated development environment for Google's Android operating system, built on JetBrains' IntelliJ IDEA software and designed specifically for Android development. It is available for download on Windows, macOS and Linux based operating systems

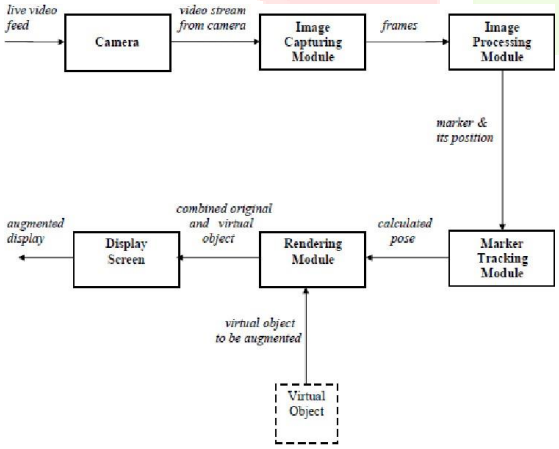
Vuforia: It is an Augmented Reality platform that is used world-wide cause of its free availability and ease of use. It is a Augmented Reality Software Development tool to produce an AR application. The image registration is done in Vuforia in order to track the AR object to be overlaid on it when we initialize the image target in Unity.

Hardware: (Mostly found in all the mobile phones nowadays)
Depth Sensor: Calculates depth and distance.
MagnetoMeter: Essentially a compass that can always tell where north is.
Gyroscope: Detects the angle and position of your phone.
Proximity Sensor: Measures how close and far something is.
Accelerometer: Detects change in velocity, movement, and rotation. Light Sensor**:**
Measures light intensity and brightness.

Software:
Platform: The operating system something gets specifically built for. e.g., Visual Studios,
Unity.
Engine: Software that can convert, power and render different types of data into content. e.g., Creating an object in Unity and adding the abilities to it.
SDK (Software Development Kit): A collection of third-party tools and frameworks that supports or adds new functionality to an app.
e.g., Vuforia, Android Studio etc.

This figure represents how the application is created using Vuforia and Unity and imported into Mobile App using Android Studios

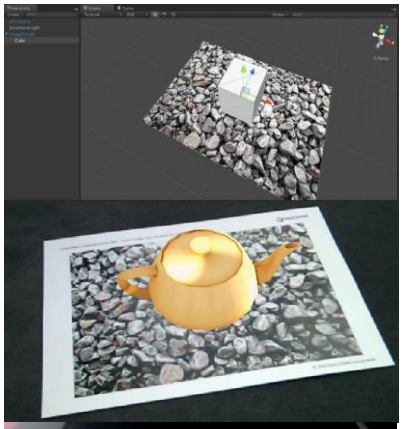
Architecture Block Diagram



AR Application Block Diagram

The initial process is to provide a feed of video that is processed using Image Capturing module in terms of frames to provide an input to the AR App, then the image processing module calibrates these frames in order to detect the registered image. Once the processing of image is done, the marker and the positions are initialized in order to attach the AR object initialized to it. Then the marker tracker module allocates the position f the AR object on the frame being targeted and calculates the position. The Rendering Module then fetches the VR object and lays the border over the frame visible where the original and virtual objects are put together. Then display screen gives us the output as an augmented result over the realworld objects.

III. RESULT



This image represents the initial marker tracking of object over the image target item. Here, we are initializing the position on the target image for the virtual object to be overlaid.

From the Warehouse present in the Unity, a VR generated Tea kettle is position on to the target image that will be represented as a registered object in the application

The image gives us the output presented by Unity in our personalized laptop once the program is run.

This image represents the AR output visible through a mobile application where the program is imported into an Mobile App using Android Studios for enhanced experience.

IV. CONCLUSION

The paper targets the basic requirements and how the AR technology is going to impact the current world requirements in terms of Education, Design and Development. The AR helps in virtually constructing architectural designs that will be cost effective and reduce unnecessary labor work. Proper customer related alterations can be implemented with no customers preferences. Architectural designing courses using VR facilities are already utilized with Lumion, implementing AR as a mobile App to present the design is a better solution to showcase how the design would look and give the generation an idea on how the AR works.

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