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HoloBuild: HoloLens Augmented Infrastructural View

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Abstract - *In today's world of incredible innovations and jaw-dropping technologies, mixed reality is yet another emerging field. Mixed Reality has increased all the developers' excitement due to its unbelievable technologies. It is a domain where the real world and the virtual world are brought together to give a new experience where we can live the imagination. The real world and virtual world objects co-exist and interact with each other giving a new touch to the day-to-day mixed reality augmented technologies. Microsoft HoloLens is a beyond-belief device provided to us by Microsoft which helps us to get immersed into the virtual world along with utilizing the real-world objects of our environment. We propose yet another technology with the help of mixed reality which helps you live the unimaginable. This application is business-oriented and will be developed for the builders and their customers. It will provide the facility of viewing the basic infrastructural model in 3D and walking through the selected part or room of the infrastructure.*

Keywords: **Mixed Reality, Microsoft HoloLens, infrastructural view, augmented, 3D model**

1. INTRODUCTION

Mixed reality is the result of blending the physical world with the digital world. Mixed reality is the next evolution in human, computer, and environment interaction and unlocks possibilities that before now were restricted to our imaginations. It is made possible by advancements in computer vision, graphical processing power, display technology, and input systems. In our proposed software, we would use Microsoft HoloLens, a mixed reality device for the infrastructural view of the model. The HoloLens uses see-through lenses and two light engines to project the augmented content. It automatically calibrates pupillary distance, has a "holographic resolution" of 2.3 total light points and a "holographic density" of more than 2.5 light points per radian. In order to scan the environment, it uses four dedicated cameras, in addition to the depth camera and the 2 photo/video camera. Whenever a customer is about to buy a flat, they have some imaginations in their mind going on for the plan they are about to buy. The architects and the builders provide a 2D infrastructural model. But the 2D model is not sufficient for the buyer to understand the exact designing of the plan.3D models that are created help the customer to understand the look of the model but fails in an attempt to provide them with the details about each and every room.

2. LITERATURE REVIEW

In the field of augmented reality visualizing real and virtual contents simultaneously is of great importance. Google Glass and Epson Moverio are some examples of the devices that have been developed witnessing the significant progress that has been made in this area. Both the devices use a pair of eyeglasses to display augmented contents superimposed on the real surrounding environment. "Microsoft HoloLens" a recently released cutting edge AR device is attracting considerable attention with its advanced capabilities. In [1] a piece of detailed information about the functionalities which are provided by the Microsoft HoloLens is given. It also covers the technologies used in Microsoft HoloLens which makes it stand out of the crowd and let the researchers bring more advancements in this area. Microsoft HoloLens is a complete AR system that runs on Windows 10 operating system and contains a central processing unit, a holographic processing unit that is custom-designed, see-through optical lenses with a holographic projector, various types of sensors, cameras, built-in speakers, microphones, and batteries.

A two-dimensional perspective fails in an attempt to understand and express the real world. Three-dimensional geographic information systems (3D GIS) attempt to express the real world from the perspective of 3D space. [3] proposes an architecture and method to leverage the Microsoft HoloLens in 3D geographic information by using mixed reality as a carrier of 3D GIS. As mentioned in [2] three processes for developing holographic 3D GIS are the creation of the 3D asset, development of a 3D application, deployment of the application. Using the 3D geographic carrier perspective to mixed reality glasses like HoloLens has changed the traditional vision, body sense, and interaction modes which enable GIS users to experience real 3D GIS.

Building maintenance is a part of Facility Management and comprises all preventative measures taken for the maintenance of systems and tools that helps to keep the building in the required state. [3] presents a mixed reality (MR) application developed for Microsoft HoloLens that supports infrastructure maintenance works in buildings with complex structures. The solution is intended to help the maintenance staff by revealing the hidden infrastructure when they need to track and fix the infrastructure, guiding the staff in a complex task by displaying useful information. Authors of [3] explore the methodologies used in the creation of an optimal and user-friendly tool. The ability to preview the inside of a building before making any changes in it is the motivation of our application.

Indoor spaces are dynamic environments as the layout of the indoor space itself is subject to frequent changes and modifications. Existing indoor mapping systems have

limitations in terms of flexibility in complex environments. In [4], the researchers have investigated the spatial mapping capability of Microsoft HoloLens mixed reality eyewear 3D mapping of an indoor environment. The HoloLens released by Microsoft is a head-mounted mixed reality system with spatial mapping capability enabling users to interact with 3D graphical models. Microsoft HoloLens makes use of the depth sensors and cameras which enhances the spatial mapping capability making it more interactive with the 3D space.

Augmented reality (AR) allows for the spatially correct visualization of virtual content for the surrounding environment. In most of the HoloLens applications, individual virtual objects are placed in the environment of the user of the HoloLens device. The components of the building model i.e. walls, doors, etc. need to be placed in a way that ensures that the components accurately overlay their material in the surrounding of the user. [5] shows that the one-time localization for the model data is sufficient for the spatially correct augmentation of the large room with virtual objects. The authors of [5] conclude that Microsoft HoloLens is an augmented reality platform that is suited for the spatially correct visualization of building model data. Once the virtual building model content is placed to correctly overlay the physical structures of the indoor building environment, the tracking capacity of the HoloLens is sufficient to keep its apparent position stable over time independent of the changing position of the user wearing the device.

Visualizing having furniture in a room may be difficult for the people who do not have good interior imagining skills. However, virtual reality technology assists the user to place furniture in a virtual environment. This also benefits decorators to collaborate with clients and accelerate decision-making. In [6], the authors present an application that uses VR technology with the Leap Motion controller and Oculus Rift CV1 to get user's inputs by hand movement and display results respectively. [6] also covers the creation of 3D objects by 3dsMax which were then imported into Unity (game engine) as .FBX or other generic formats which are quite useful in our application.

Simultaneous localization and mapping (SLAM)is a technique for estimating sensor motion and reconstructing structure in an unknown environment. Simultaneous localization and mapping (SLAM)using cameras is referred to as visual SLAM because it is purely based on visual information [7]. vSlam can be used as a fundamental technology in various applications related to computer vision, augmented reality, and robotics. SLAM-based applications have become broadened such as computer vision-based online 3D modeling, augmented reality (AR)-based visualization, and self-driving cars. [7] focuses on initialization, tracking, and mapping which is used in the construction and reconstruction of 3D models. One of the important requirements in AR systems is the real-time response to seamlessly and interactively merging real and virtual objects. To achieve this response with a limited computational resource on AR systems various low computational-cost vSLAM algorithms.

In AR classrooms, it is necessary to allow both lecturers and students to utilize virtual teaching materials without any spatial restrictions, while handling virtual objects easily, regardless of the distance concerning the environment. To provide efficient and accurate methods of handling AR objects, the system in [8] requires only simple intuitive freehand gestures to control the user's virtual hands in an enlarged, shared control space of users. BoostHand is a freehand, distance-free object manipulation system that supports simple trigger gestures using Leap Motion. The authors in [8] implemented a virtual hand interaction system using simple trigger gestures so users can easily move their virtual hands into the far distance and manipulate virtual objects.

Dynamic hand gesture recognition is an important and challenging task in pattern recognition and computer vision communities. In [9], the authors propose a novel feature vector that is suitable for representing dynamic hand gestures and presents a satisfactory solution to recognizing dynamic hand gestures with a Leap Motion controller (LMC). [9] provides us with in-depth knowledge about the internal functionality and working of hand gesture recognition technology which is an in-built part of the Microsoft HoloLens.

3. PROPOSED WORK

Construction documentation for super structures has evolved a great deal over the past several decades. Gone are the dusty drafting tables and paraphernalia of yesteryear. Professionals in the architecture, engineering, and construction (AEC) industry rely on digital 3D models during every phase of the construction process, from pre-planning to post-completion. These models are exact replicas of the structure that they intend to build, and offer keen foresight into the decision-making process. Advancements in 3D modeling software have vastly improved the construction workflow, but when it comes to services and tools for group collaboration, the software is somewhat lacking.

When it comes to serving the product to the customers it is a great challenge for the builders and architects to deliver the exact ideas and concept regarding their models and buildings. 2D representation of the model is not sufficient for the customers to understand the exact designing of the plan.3D models that are created helps the customer to understand the look of the model but fails in an attempt to provide them with the details about each and every room. With the help of this software the customers can view each and every aspect of the project they are willing to buy. The customers can actually understand the infrastructural model by taking a walkthrough. This will help the customers to have an exact idea about the infrastructure and will help them in planning the interiors

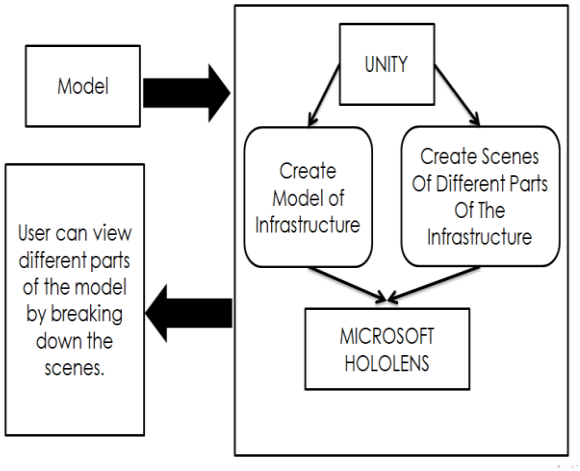

Fig -1: Proposed System

4. PROPOSED SYSTEM ARCHITECTURE

For this application the code is written using C scripts and the project is built in Unity. Unity then exports the project as a Visual Studio solution that will contain all necessary asset and code files. The project is then deployed using visual studio and finally can be viewed through the Microsoft HoloLens.

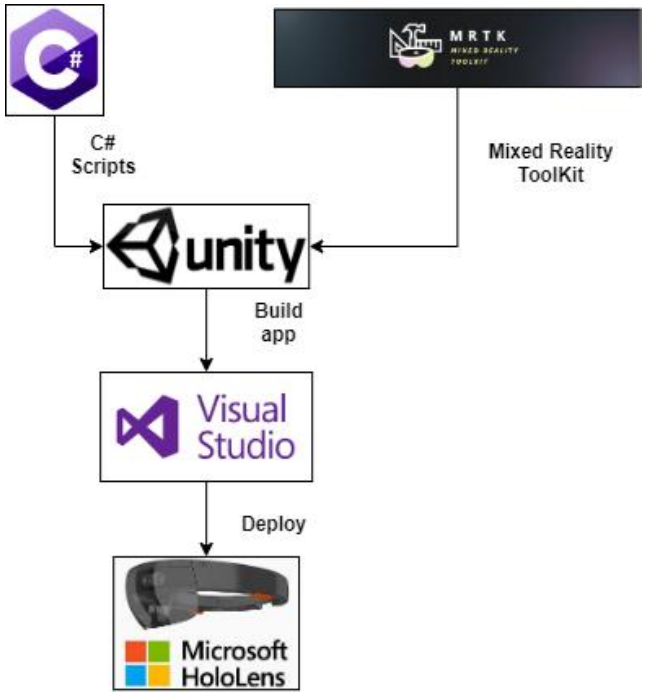

Fig -2: System Architecture

5. CONCLUSIONS

Builders can use this application to let their customers understand the infrastructure better. Users can study and get assured about the plan of the property. Users can have a walkthrough and actually take the feel of the room .Users will also be able to select the color to their walls and change the colors if needed .Users can look how different objects like chairs, tables, beds, television set, dining table, etc. can be placed and have an overall idea about the way they can plan the interiors mapping their imaginations. Microsoft HoloLens being the only investment for this application, makes it affordable for all builders. Bringing the imaginations into actual reality is the key success of this software.

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