Augmented Reality based Interior Designing System

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***Abstract*—In this project we aim to reduce the time and effort required in home interior designing. This product not only reduces the time in planning but also gives you greater sense of idea on the end result. In our product we showcase different varieties of products in home design as an AR catalogue. Existing products in the catalogue can be further modified to suit your own needs. The modifications can be related to size, orientation, color, texture etc. The estimated cost of product setup is also calculated as you make changes ensuring that you don't cross your planned budget. When it comes to interior design, we are faced with issues such as waiting for interior designers to show up at the site to provide product samples. Furthermore, we need more time to calculate the estimated cost and to create 3D models and designs for the customer to see what the final result will look like. Even after getting the 3D models, if the customer is not satisfied again the same amount of time is taken to come up with alternative ideas. This wastes the time and effort of both parties making the task more expensive and unsatisfactory. By superimposing virtual items onto an agent's visual field, augmented reality (AR) technologies 'augment' regular perception. A young but expanding topic of technological philosophy is the philosophy of augmented reality. Research on the phenomenology of augmented experiences, the metaphysics of virtual objects, and other ethical challenges related to AR systems, such as (but not limited to) concerns with privacy, property rights, ownership, trust, and informed consent, are all currently being done in this subfield.**

***Index Terms*—augmented reality, interior designing, unity, AR catalogue**

I. Introduction

Traditional design practises include advising and helping clients who have depended on a combination of verbal and 2D drawings. Through this the designer may also need to redo the 2D drawings for the same if the client changes his mind. The medium of approach is obviously limited to the number of justifications the consumer may provide the designer for the specific location of an item. This is simple to do using an augmented reality application strategy. A sector where augmented reality hasn't been able to fully take hold is interior design. People today are technologically savvy and use cellphones that support augmented reality. Therefore, the idea of developing an application based on interior design moves the designers closer to becoming technologically advanced.AR enables users to access virtual material that is seamlessly integrated with the real world via a sensory experience beyond reality. Customers may access services more easily thanks to web advantages like native cross-platform capability and lightweight design, which also helps to promote Web-based apps widely. Along with Web browsers, a lot of contemporary mobile applications include hybrid (Native + Web) designs, which benefit from cross-platform compatibility and robust interactivity. These infrastructures provide a single platform for the marketing of Web AR on a large scale. We define Web AR as a specific Web AR implementation technique in this paper. It enables real-time user interaction with both physical and virtual objects. Users can interact with the real world by using augmented reality technologies.

Identify applicable funding agency here. If none, delete this.

II. General Background

Interior designing field is vast and ever growing, there is a lot of effort and time consuming tasks which relates to the field of interior designing. To solve this aspect is the main object of this project. We're looking at the origins of interior

design history and the seven great decorators who created a name for themselves when the business started to gather steam in the early 1900s. The profession of interior design has been around for little over 100 years. Here is all you need to know about interior design history, from the time of the Ancient Egyptians to the present. Interior design naturally came into being to tightly coordinate with building architecture before the profession gained popularity. The emergence of middle-class life and the intricate architecture that gained prominence throughout the industrial revolution coincided with the profession of interior design. The pursuit of optimal spatial use, together with consideration for user comfort and practical design, continues to drive the advancement and life-improving potential of the interior design profession as it exists today.

III. PROBLEM DEFINITION

When it comes to interior design, we are faced with issues such as waiting for interior designers to show up at the site to provide product samples. Furthermore, we need more time to calculate the estimated cost and to create 3D models and designs for the customer to see what the final result will look like. Even after getting the 3D models, if the customer is not satisfied again the same amount of time is taken to come up with alternative ideas. This wastes the time and effort of both parties making the task more expensive and unsatisfactory, and also if the user is not satisfied with the end result or want to renovate its hectic and time consuming following the traditional way.

IV. MOTIVATION

Home is not just an enclosed structure with 4 walls, its a place where an individual spends most of his/her time, comes to relax, and feels at peace. So to design such a place according to a persons wish and redesign it whenever and however they want shouldnt be a hassle. So to make interior designing easier and for making structures feel like home is one of the main purpose of building this app

V. OBJECTIVES

The objectives of this work are:

- The project's primary goal is not to replace interior designers, but to provide them with a helping in interior designing.
- It helps in making the visualization of interior design much faster and easier.
- Modifications in the interior design can be done hassle free.

VI. PROPOSED SYSTEM

A technology that enables users to visualize the appearance of a space with new furnishings and a variety of other goods without actually purchasing or moving anything. As cameras and sensors in everyday gadgets continue to improve, augmented reality (AR) is becoming less reliant on images or QR codes and moving towards markerless experiences. In marker-less augmented reality applications, we can integrate sensors to identify a user's virtual world and create an augmented reality experience without markers.

A wide range of furniture products may be seen in 3D in different angles, with the option to zoom in and out and interact with, among other things, opening cabinet doors and pulling out drawers. The choice has boosted conversion rates for goods featuring 3D models, plainly demonstrating how popular this feature is with customers.

The further development of the project includes addition of variety of furniture, ability to change the textures and appearances of the furniture, platforms,surfaces, walls etc. Moreover, a feature to allow users to calculate furnishing expenditure in real-time will also be added in the coming builds.

VII. SYSTEM DESIGN

To improve user perception and experience, the suggested solution builds on marker-less augmented reality. The location and orientation of an object in respect to its surroundings can be determined using positional tracking techniques, such as markerless tracking. This feature is crucial for both augmented reality (AR) and virtual reality (VR) since it allows the virtual environment to adapt to the user's viewpoint and position, as well as enabling the placement of AR content to match the real world. Unlike marker-based motion tracking systems that require the use of specialized optical markers, marker-less positional tracking is more flexible and adaptable. Additionally, it does away with the need for a prepared environment, such as one that incorporates fiducial markers. A marker-less approach to motion tracking extends the potential applications by enabling users to move around in a room or unfamiliar environments without relying on markers for position detection. The basic concept of this technique is to use a camera to capture images of real objects and then overlay digital 3D models on top of them. The proposed remedy builds on marker-less augmented reality to enhance user perception and experience. Positional tracking techniques, including markerless tracking, can determine the location and orientation of an object relative to its surroundings. This is an important aspect of both augmented reality (AR) and virtual reality (VR) as it allows the virtual environment to respond to the user's field of view, perspective, and the positioning of augmented reality content in relation to reality. Marker-less positional tracking is more versatile than marker-based motion tracking systems since it doesn't require specialized optical markers or a prepared environment, such as one with fiducial markers. Unlike marker-based tracking, marker-less tracking enables users to move freely in an environment or unfamiliar surroundings while still receiving positional information. The proposed approach involves using a camera to superimpose digital 3D models onto real objects.

VIII. Literature Review

The project is meant for supporting interior designing professionals who will be able to make quick 3D models for their clients. Here are some of the major technologies that we implement in our system as literature surveys.

A. Live Texturing of Augmented Reality Characters from Colored Drawings

Augmented reality (AR) has a solid chance of making a difference in this circumstance by acting as a link between actual actions and digital improvements. By utilizing digital technology's full potential and appeal, augmented reality (AR) enables us to give classic pastimes like colouring a new focus. In this post, we present a colouring book software that combines animated cartoon characters with coloured illustrations in augmented reality. Children colour in actual colouring books while also checking their work on consumer-grade tablets or smartphones. In this technique, a video feed is used to identify a sketch, which is then augmented with an animated 3D character that matches the child's coloring. The character is textured in real-time to provide a more immersive experience for the child. Numerous challenges must be overcome in order to accomplish this goal. First, just the parts of the character that are visible are given texture information in the 2-D coloured artwork. It is necessary to build a surface for the areas that are obscured, such as the character's back. The character's visage could be reflected in the back of their head via naive methods like mirroring, which provide poor results. Additionally, if several parts of the parameterization intersect, texture mapping will show apparent seams if not given particular care. Our method has several key advantages. Firstly, because we use live updates, any color changes made by the child are immediately reflected in the 3D model. This imposes a significant constraint on our compute budget, which we have addressed by developing efficient texturing algorithms. Secondly, real-world coloring books have pages that are curved due to the binding, which poses a challenge to tracking and texturing. To overcome this, we have developed a resilient tracking algorithm that can accurately capture texture from the correct 2D areas. Additionally, we have developed a technique for monitoring deformable surfaces in real-time and correcting surface deformation using an outlier rejection approach. Our unique texturing method avoids common issues like mirroring artifacts and parameterization seam artifacts and can be used to apply recorded texture from a 2D colored drawing to both visible and occluded parts of a 3D character in real-time.

B. Haptic Sense of rigidity in Augmented Versus Virtual Reality

Virtual reality and augmented reality are gaining popularity among both the general population and academics. Despite having many of the same technology underpinnings, AR and VR offer various forms of visual input. A crucial distinction is whether actual objects are visible to the user or not. The aim of this research is to investigate the difference in haptic perception of a virtual object's stiffness between virtual reality (VR) and augmented reality (AR). In order to achieve this, we conducted an experiment where participants were able to interact with a virtual piston both inside a physical environment and a virtual rendition of the same scene, using a Microsoft HoloLens. During the experiment, participants were able to press on the virtual piston, perceive its firmness, and compare the experience between AR and VR using a force-feedback haptic device.

C. Comparison of Microsoft HoloLens Generations 1 and 2's close-range accuracy with Vuforia Image Targets

In this research, a black-box approach is utilized to investigate the accuracy and effectiveness of the first and second generations of Microsoft HoloLens for close-range tasks, in combination with Vuforia Image Targets. The practicality of utilizing augmented reality (AR) on optical see-through (OST), head-mounted devices (HMDs) for various tasks, such as assembly, maintenance, or instructional purposes has been previously demonstrated. Minor localization mistakes may usually be tolerated in most of these applications since precise alignment of the manufactured and actual pieces is not necessary. The precision limitations of the first and second generations of Microsoft HoloLens, when used in conjunction with Vuforia Image Targets for close-range operations, pose a significant obstacle for potential applications. The achievable accuracy of these iterations is still largely unknown for activities that require greater precision, such as composite manufacturing or medical surgery support. To assess and compare the suitability of these devices for more accurate tasks, the authors developed a system. Additionally, the approach can be extended to a wide range of devices, providing a framework for comparing both current and future technologies. The study examines the performance of test subjects in identifying the perceived position of holographic cones, with the spatial transformation of the preset ImageTarget determined using the image recognition program "Vuforia."

D. Effect of virtual reality on consumer store experiences on emotional states and perceived store attractiveness

This study aimed to determine if virtual reality (VR) experiences of a store can positively impact customers' perceptions of the store and lead to favorable attitudes towards the online retailer. The study used 360-degree-based VR store videos captured at a fashion retailer as the VR stimuli (106 data) and the same store's website as the website stimuli (107 data) to compare the effects of the two types of experiences on consumers. The results showed that the VR store experience improved the perceived attractiveness of the store and generated more favorable emotions compared to a regular retail website. The study also found that the relationship between the two retail experiences and the emotions they elicited was not influenced by the customers' familiarity with the store, suggesting that VR technology can be effective regardless of a customer's prior knowledge of the business. Additionally,

the study used text analytics to gain insights into customers' VR store experiences. Overall, this study provides online retailers with an effective strategy to create an engaging and attractive store experience using VR technology and highlights the superiority of VR over websites in enhancing shop appeal, an area that has not been extensively studied.

E. Use of ARHUDs in automated driving helps prevent accidents due to malfunctions.

In an autonomous driving vehicle it is a must to ensure that the drivers are capable of taking over the vehicle if in case any malfunction occurs. It would be much more difficult in urban areas where the traffic is particularly more complex and time-consuming to evaluate. Augmented reality head-up displays (ARHUDs) have the potential to assist drivers with monitoring tasks by displaying driving-related information in the driver's field of vision.

To evaluate the effectiveness of ARHUDs, a driving simulation experiment was conducted with 52 participants. The experiment compared the effects of an ARHUD and a Baseline concept in a largely automated urban drive where participants experienced both a longitudinal malfunction and a lateral fault. The outcomes indicated that implementing the ARHUD significantly reduced take-over times, resulting in fewer accidents. There were no differences in the take-over quality between the two proposals for those who avoided accidents, but the ARHUD scored significantly better for both trust and usability.

However, the study also revealed that regardless of the design, the high incidence of collisions showed the need for a backup level for partially autonomous urban driving. Overall, the results suggest that ARHUDs may be beneficial in preventing crashes in the event of failures, but much more significant measures are required for ensuring safety in autonomous driving.

F. Software for augmented reality markerless interior design

Despite the significant progress made in digital technology, digital architecture has not kept up. Our software represents a step in the right direction as it enables customers to view a 3D model of furniture without the markings getting in the way, providing a more realistic and immersive experience. With the help of our augmented reality app, this model can be viewed and modified in real-time.

This study proposes a new approach to incorporating augmented reality technology into interior design projects by allowing users to interact with 3D virtual furniture data through a dynamic user interface. This enables users to view virtual furniture in a more realistic and engaging way, enhancing the design process.

G. Modern technology, Challenges, and Insights for Mobile Augmented Reality's Promising Future with Web AR

Mobile augmented reality (Mobile AR) is becoming increasingly important in both academia and business. Currently, the two most widely used platforms for Mobile AR applications are hardware-based and app-based Mobile AR. However, the hardware-based approach is known to be expensive and inflexible, while the app-based approach is cumbersome for cross-platform deployment, requiring extra downloading and installation. Compared to other approaches, Web-based AR (Web AR) can offer customers a wider Mobile AR experience since the Web has already been widely adopted as a lightweight, cross-platform service delivery platform. With the development of 5G mobile communication networks, the effectiveness of mobile communications may improve even further.

H. Utilizing augmented reality technology in interior design

This article explores the use of augmented reality software with a 3D interior model in interior design projects. Interior design typically involves presenting clients with 3D prototypes of their proposed designs during the conceptual design phase. However, to better address clients' needs and preferences, an augmented reality interior design system is proposed. This system involves creating a 3D structural model during the conceptual design phase and then selecting the hard-soft decorating strategy and specific decoration needs.

To ensure a balance between structure and function, a hard decoration modelling framework is developed for design project improvement and assessment. Additionally, in order to enhance clients' understanding and involvement in the interior design project, specialized stereoscopic equipment can be used to reproduce augmented content and sensory information of decorative materials, furniture, and appliances for soft decoration as an AR 3D interior prototype.

I. Manufacturing Uses for Virtual and Augmented Reality

This essay focuses on the application of augmented reality (AR) in manufacturing, an area that has received less attention despite the technology's widespread use in fields like gaming, education, entertainment, and more. The essay explores various scholarly studies that have looked at how AR can be applied in different manufacturing processes, including product design, robotics, facility architecture, maintenance, CNC machining simulation, and assembly planning.

The essay highlights the importance of maintaining conformity with industry norms and procedures to ensure that users do not experience a significant shift when adopting this new technology. It also discusses some of the challenges and potential directions for the future development of AR technology in manufacturing.

VII. Product Model

Our product is a user-friendly mobile application.It provides a good user interface. The product is inpired from iKea Place App which is a similar app for placing virtual furniture in a markerless plain. Our products differs from this as it provides realtime budget calculation, ability to change orientation and product texture colour etc. The application not only applies to placement of furniture but also to create a virtual environment,

to design a room from scratch, trying out the possible flooring ceiling, wallart etc.

Fig. 1. Architecture diagram

IX. Module Description

1)Launch Screen: The application is developed in an android platform, launch- ing the app from the home screen takes you to the app launch screen. This screen contains main settings, new project, existing projects, product catalogue.

2)Main Settings: This module includes the settings such as limiting the amount of ram usage, theme selection, marker-less or markerbased. Furthermore, the option to connect the account to google, backup your data, buy me a coffee is also included.

3)New Project: In this module we can name the projects according to the rooms that we are furnishing. It is saved as a seperate file so that we can access and edit the project if any further changes have to be made.

4)Existing Project: In this module we can name the projects according to the rooms that we are furnishing. It is saved as a seperate file so that we can access and edit the project if any further changes have to be made.

5)Project Catalogue: This module contains the database of the furniture that can be viewed and placed as an augmented reality object. There is also an option to scan a pre-existing object and convert it to an AR object of suitable orientation. Also, other elements in home interior designing such as tiles, wallpaper, wall art, clocks, carpets etc can also be included in the catalogue.

X. REQUIREMENTS

HARDWARE REQUIREMENTS

1) Chipset: Intel core i3 and above
2) Battering: 4GB and above
3) Hard Disk: 50GB

SOFTWARE REQUIREMENTS

1) Developing Operating System: Windows,Ubuntu or MAC

Comparison Table

Paper	Technique	Advantages
Effective close-range accuracy comparison of Microsoft HoloLens Generation one and two using Vuforia ImageTargets	Vuforia SDK Tracking sensors Calibration software Computer vision algorithms	Implementation of Augmented Reality on optical see-through(OST), head-mounted devices (HMDS) has been useful in variety of applications which includes assembly , manufacturing, maintenance, education etc.
Consumer store experience through virtual reality: its effect on emotional states and perceived store attractiveness.	3D modeling and animation software VR headsets Eye-tracking technology Biometric sensors	It helps in gaining more number of consumers willing to buy the products.It is more effective than a traditional website, in attracting the customers.
Live Texturing of Augmented Reality Characters from Colored Drawings	3D modeling and animation software Image processing Augmented reality Mobile devices	Method for live texturing an AR character from a colored drawing updates the texture of the 3-D character at every frame by copying pixels from the drawing or any other 2d image, so due to this the image will be more clear.This is an easy way of implementing ar or turning a 2d image into augmented reality,and is used in many applications like for designing, kids ar apps, etc.
Markerless Augmented Reality based Interior Designing System.	1. SLAM (Simultaneous Localization And Mapping) technology. 2. 3D modeling and rendering 3. Cloud-based storage and sharing 4. Realistic lighting and shading	Method for live texturing an AR character from a colored drawing updates the texture of the 3-D character at every frame by copying pixels from the drawing or any other 2d image, so due to this the image will be more clear.This is an easy way of implementing ar or turning a 2d image into augmented reality,and is used in many applications like for designing, kids ar apps, etc.
A Promising Future for Mobile Augmented Reality—State of the Art, Challenges, and Insights	Enabling technologies for web AR 1) Web RTC 2) Web Assembly AR software development kits (SDKs) Cloud-based computing	Hybrid Tracking Mechanism. Sensor-Based Mechanisms:QUICK RESPONSE.Vision-Based Mechanisms

2) Target Operating System: Android or iOS (Cross-platform capable)
3) Development Tool: Unity Game Engine
4) Plugins: AR Foundation, AR Core, XRKit Plugin

CONCLUSION

The further development of the project includes addition of variety of furnitures, ability to change the textures and appearances of the furnitures, platforms, surfaces, walls etc. Moreover, a feature to allow users to calculate furnishing expenditure in realtime will also be added in the coming builds. Below you can find the future scopes of the project:

1) Add more variety of items for the customers to choose from.
2) Add more textures and colours so that there can be more options.
3) The users will get automatic suggestions depending on their choice of furniture and the room space.
4) The customer and the designer will be able to chat in the application itself.

ABBREVIATIONS

Augmentative reality degrees of freedom, central processing unit, and Virtual reality with full immersion FPS stands for frames per second, and GPU, or graphics processor, HPU stands for holographic processing unit, IMU for inertial measuring unit, and IoT for internet of things. Interpupillary distance (IPD) Line of Sight, Infrared, Mixed Reality, or MR, Pixels per inch, optical head-mounted display Red, Green, and Blue (RGB) Extended reality (XR) and virtual reality (VR)

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