Mixed Reality Based 3D Simulation Tool

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This review studies intensive research to obtain an MR Application for 3D Simulation of Laboratory and other related tools. The suggested framework comprises five layers: the first layer considers system components; the second and third layers focus on architectural issues for component integration; the fourth layer is the application layer that executes the architecture; and the fifth layer is the user interface layer that enables user interaction. The merits of this study are as follows: this review can act as a proper resource for MR basic concepts, and it introduces MR development steps and analytical models, a simulation toolkit, Pen tracking technology, and Head mounted display technology.

It is true that the progress of new technologies has made it more beneficial to afford the hardware and software made available AR, VR and MR in the number of domains including education (Ref. [1]). The nature of technologies provides a number of opportunities. It may help from traditional allocation of separate lessons to take care of pastoral responsibility to learning concepts. These technologies fulfill the needs of learners in the technological century. It reinvents the door of education and makes the education field interactive using appropriate virtual settings. This discussion of this works includes the reinvention of education using MR technologies. Its modified way of education fills the needs of practical lessons.

1 Introduction

Mixed Reality based 3D development simulation tool is a new virtual-real-world interactive simulation project in recent years. Our project provides a platform to make 3D objects using MR and feel like making a real world object. However a mature Mixed reality based simulation tool is still not fully discovered. In the era of mixed reality it is possible to bring the virtual world and real world together to the game. Optical see-through and video-see-through are the two types of technologies used for developing the Mixed Reality space. In optical see-through technology, the real-world can be seen directly in tools such as transparent glass. In video-see-through technology, both virtual and real objects are present in an LCD (Liquid Crystal Display). The difficulties and high cost of implementation of OST-HMD leads us to stick with VST-HMD.To apply user's actions in to the screen, we use a Pointer Pen.Pointer Pen have the access to the virtual world and it help with the simulation and building of 3D Objects.

2 Mixed Reality and its Concepts (Ref.[2])

2.1 Introduction to Mixed Reality

The development of new technologies has enabled the design of applications to create decision-making tools to solve the problems of daily life. For example, a mobile pathfinding application finds an optimum path and visualizes it for the user, which facilitates quick and accurate decision-making during an emergency situation. In fact, in designing such an application, it is very important to design easy user interaction using appropriate visualization strategies. Many computing ideas have emerged to achieve these aims, such as virtual reality (VR), augmented reality (AR), and mixed reality (MR). VR provides a computer-generated environment wherein the user can enter a virtual environment with a VR headset and interact with it. Although a lack of relation with real space was a problem in VR, AR technology solved this problem and presented a new method of visualization to enable the addition of computer-generated content to the real world. This technology creates an augmented world that the user can interact with. Despite the importance of AR, the separation of the real and virtual world is a serious challenge. This problem decreases the user immersion level during AR scenarios. MR emerged to tackle this challenge with the creation of the MR environment. This environment merges the real and virtual worlds in such a manner that a window is created between them. As a result, a real-world object interacts with a virtual object to execute practical scenarios for the user. There are three important features of any MR system: combining the real-world object and the virtual object; interacting in real-time; and mapping between the virtual object and the real object to create interactions between them. An application was developed that implemented an MR visualizing system to show blind spots for drivers. In this application, the driver uses MR see-through devices. This device shows blind spots to the driver to decrease the risk of traffic accidents. In fact, this application enhances the real environment by making invisible information visible to the user.

MR-based applications are one of the top 10 ranked ICT technologies in 2020. Various studies have been conducted on MR technology, and different survey categories created in relation to the technology. Some surveys have separately included the MR component. Despite the useful information provided in previous literature, a comprehensive study that presents a generic framework comprising all MR components needs to be undertaken. Proposing such a framework requires a comprehensive review of different domains of MR applications such as large-scale, small-scale, indoor, and outdoor applications, to make MR applications feasible for the practical use of stockholders.

Therefore, to solve this problem, we have performed a comprehensive study by reviewing published papers in academic databases and finding their logical relation to a generic framework for MR applications. This framework contains the necessary components of MR, but also addresses existing challenges and prospects. This study will be of great benefit, as it discusses the basic concepts related to MR space to help the reader become familiar with MR technology. It includes different key points associated with MR applications and the implementation such as system development steps, simulation environments, models, architecture issues, and system types. It introduces different MR application domains, providing practical perspectives to academic and private sectors

2.2 Concepts of Mixed Reality

The research results were twofold, comprising a generic framework and its necessary components for MR applications. The proposed framework is made up of five layers: MR concepts, MR systems architecture, MR Middleware, MR applications, and MR user interface (UI). The first layer describes the components of MR applications; the second and third layers are about the architecture used to integrate these components; and the final layers include the application and UI layers.

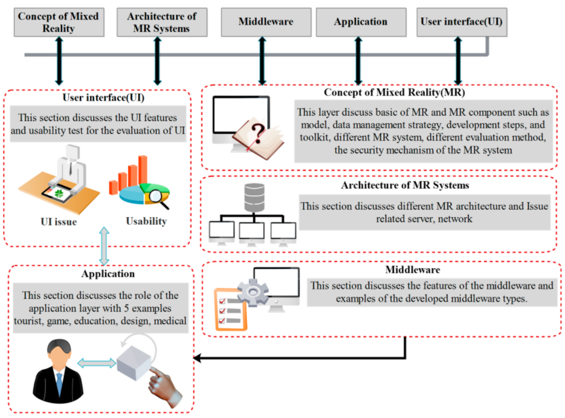

Figure 1. Research Layers

The first definition of MR is presented by the reality–virtuality continuum, which is a scale modeling real-world representation of classes based on computing techniques. On the left side of this scale is real space and on the right side virtual space (i.e., an environment generated using computer graphical techniques). The main goal of MR is the creation of a big space by merging real and virtual environments wherein real and virtual objects coexist and interact in real-time for user scenarios. Mixed Reality is a class of simulators that combines both virtual and real objects to create a hybrid of the virtual and real worlds.

MR characters may be defined using three terms: immersion, information, and interaction. Immersion refers to the real-time processing and interpretation of the user's environment. User interaction with MR space is performed without any controller, using natural communication modes such as gestures, voice, and gaze. Information refers to virtual objects being registered in time and space in the user environment. This allows the user to interact with real and virtual objects in the user environment. The first MR prototype was implemented by the US Army MR in 1990. This implementation, a virtual fixture, refers to overlaying a registered virtual object on the real space of the user to increase the performance of implemented systems.

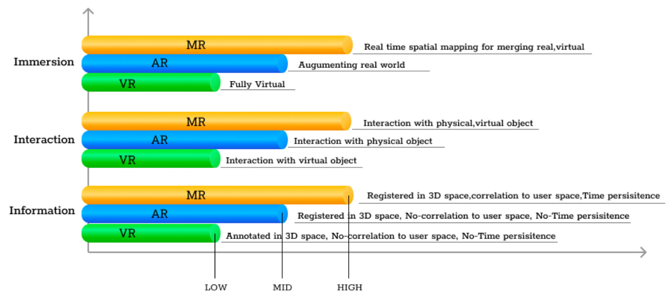

Figure 2. MR, AR and VR Comparison

Despite the importance of MR environments, there are two major challenges for creating such a platform: display technology and tracking. The MR platform needs to use appropriate display technology to provide a reasonable output with appropriate resolution and contrast. In some instances, the system needs to consider the user's perspective. Interaction between virtual and real objects requires the use of precise methods in order to track both objects.

Optical see-through and video-see-through are the two types of technologies used for developing the MR space. In optical see-through technology, the real-world can be seen directly in tools such as transparent glass. In video-see-through technology, both virtual and real objects are present in an LCD (Liquid Crystal Display). The display tools in MR can be categorized into four classes: head-mounted display, handheld display devices, monitor-based, and projection-based displays. To use a display tool in the MR space, it is necessary to pay attention to the two concepts, i.e., comfort (e.g., thermal management) and immersion (e.g., the field of view). These concepts provide ease of use that enables the execution of the scenario in an appropriate way for the user. To create an MR environment using see-through technologies, some steps are required. In the device recognition step, the types of MR tools to be used, such as see-through or camera, are identified based on the project aims. Then, these devices are set using a calibration model. In the space recognition step, modeling space is performed to model some part of the real world in the virtual environment to run the user scenario. In the object and tracking recognition steps, the real-world object is identified and tracked. In mapping recognition, registration and mapping are performed to communicate between real and virtual objects. This provides interaction between the virtual and the real object. In visual recognition, an MR service is implemented and then visualized using appropriate computer graphic techniques. This step overlays virtual objects in the real-world scene. In portable recognition, an appropriate model is used for data delivery and scene reconstruction. This model reduces unnecessary information. Portable recognition is used for the mobile device. All of these steps need an appropriate analytical model.

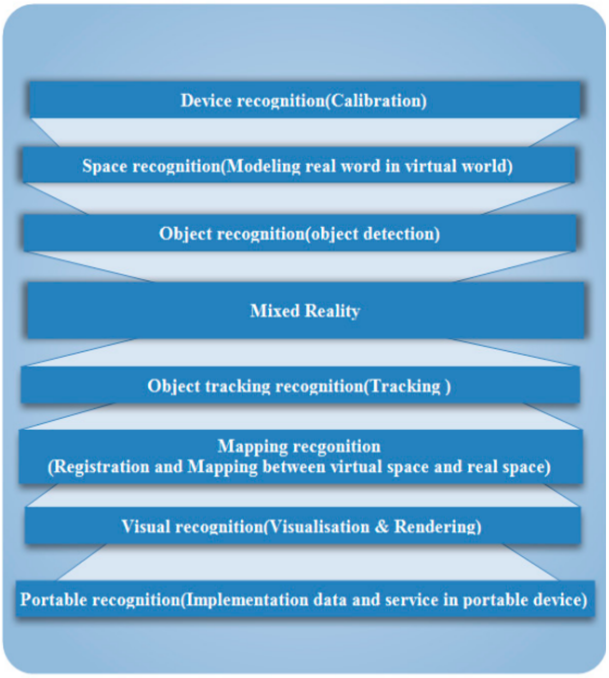

Figure 3. Mixed Reality Steps

2.2.1 Algorithm

The algorithm is an important part of any MR application. It contains analytical mathematical models to improve the accuracy of the MR system. Algorithm models are used for different tasks, e.g., calibrating the MR devices for proper use and better user interaction, modeling the real word to create the MR environment, identifying and tracking the real-world object in order to overlay virtual information related to that object, three-dimensional (3D) mapping and registration of virtual models in real space, to create interactions between real and virtual content, close-to-reality visualization of MR object and MR scene, and sending the MR output in the lowest volume to a portable device such as a mobile. The following section glimpses the details of the MR algorithm by dividing it into seven categories: calibration, the model of space and simulation, object recognition, object tracking, registration and mapping, visualization and rendering, and information transfer for portable implementation.

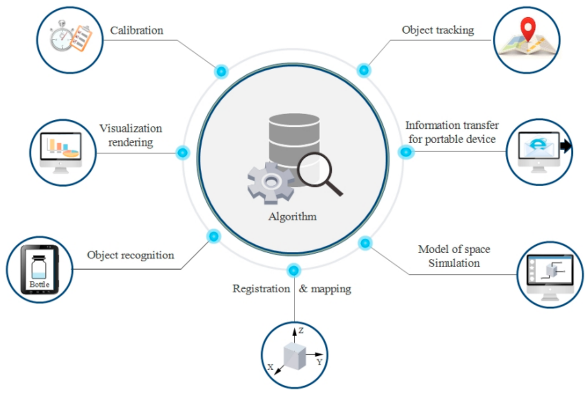

Figure 4. Mixed Reality Algorithm

3 Optical See-Through Head-Mounted Displays (Ref.[3])

Optical see-through head-mounted displays (OST HMDs) are a major output medium for Augmented Reality, which have seen significant growth in popularity and usage among the general public due to the growing release of consumer-oriented models, such as the Microsoft Hololens. Unlike Virtual Reality headsets, OST HMDs inherently support the addition of computer-generated graphics directly into the light path between a user's eyes and their view of the physical world. As with most Augmented and Virtual Reality systems, the physical position of an OST HMD is typically determined by an external or embedded 6-Degree-of-Freedom tracking system. However, in order to properly render virtual objects, which are perceived as spatially aligned with the physical environment, it is also necessary to accurately measure the position of the user's eyes within the tracking system's coordinate frame. For over 20 years, researchers have proposed various calibration methods to determine this needed eye position. However, to date, there has not been a comprehensive overview of these procedures and their requirements. Hence, this section surveys the field of calibration methods for OST HMDs. Specifically, it provides insights into the fundamentals of calibration techniques, and presents an overview of both manual and automatic approaches, as well as evaluation methods and metrics. Finally, it also identifies opportunities for future research.

In this section, we refer to this concept as locational realism. We contrast locational realism with the better-known term photorealism, which is the traditional computer graphics goal of rendering objects and scenes that are visually indistinguishable from reality. In AR, the primary goal may not be to render the glass photorealistically, but we are usually interested in the locational realism of the glass—while it may obviously be a cartoon glass, with incorrect illumination and color, we still want its location to be perceived in a manner that is indistinguishable from the location of the physical glass. In order for any degree of locational realism to be possible, the AR system must know the 6-degree-of-freedom (6DoF) pose—the position (x, y, z) and orientation (roll, pitch, yaw)—of the virtual rendering camera within the physical world. From this information, the system can determine which 2D screen pixels will be required to display a virtual object at a corresponding 3D location. The more accurately this pose can be known, the greater the locational realism. The rendering camera's pose is typically measured using a tracking system, which needs to be calibrated in order to report accurate pose estimates. It is possible for the tracking system to directly use a physical video camera within the AR system; otherwise, the tracking system tracks a fiducial that is attached to the AR system. In this latter case, even though the tracking system needs to report the pose of the AR system's rendering camera, the tracker instead reports the pose of the fiducial. This leads to the additional requirement that a secondary calibration needs to be performed, which yields the transformation between the tracked fiducial and the rendering camera. In addition, there are two major ways of displaying AR content. In video see-through AR (VST AR), the user sees the physical world mediated through a video camera within the AR system. The system receives a constant stream of image frames from the real world, and combines virtual content to these frames. VST AR can be used with standard video monitors, handheld devices such as tablets or phones, as well as opaque, VR-style head-worn displays, also referred to as Mixed Reality (MR) displays. In contrast, optical see through AR (OST AR) gives the user a view of the physical world directly, while virtual objects are simultaneously imposed into the user's view through optical combiners. OST AR is almost always accomplished through a transparent head-worn display; although microscopes and other optical devices are also possible. While both forms of AR have their respective strengths (and weaknesses), as well as various applications, this paper focuses on OST AR. Although in VST AR it is possible to use a single camera for both the video stream and the tracking camera, this is never possible in OST AR, because the "video stream" comes from the user's eye. Instead, in OST AR the pose of the head-worn display is tracked, and the AR system needs to know the transformation between the display and the user's eyes. Therefore, in OST AR a calibration procedure is always necessary.

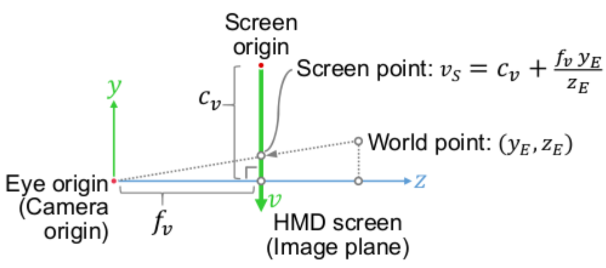

Figure 5. The y-z plane of an off-axis pinhole camera model.

4 Video See-Through Head-Mounted Displays (Ref.[4])

Current state of the art technology offers various solutions for developing virtual prototyping applications that also allow the

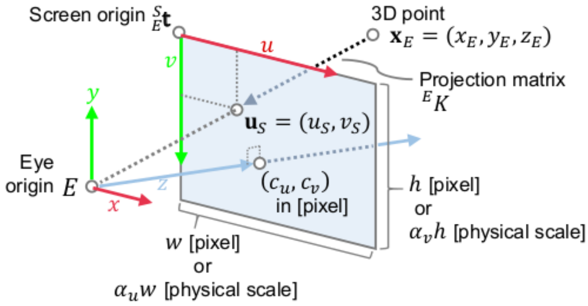

Figure 6. A 3D representation of the image plane, and related intrinsic properties of the pinhole camera model.

interaction with the real environment. In particular, Augmented Reality (AR) technologies include tracking systems, stereoscopic visualization systems, photorealistic rendering tools, hi-resolution video overlay systems that allow us to create various types of applications where the virtual prototype is contextualized within the real world. One application domain is product design: AR technologies allow designers to perform some evaluation tests on the virtual prototype of industrial products without the necessity to produce a physical prototype. This paper describes the development of a new Video See-Through Head Mounted Display (VST-HMD) that is high-performing and based on stereoscopic visualization. The developed display system overcomes some issues concerning the correct visualization of virtual objects that are close to the user's point of view. This section also presents the results of some tests about an AR application developed for product design assessment.

In case of an AR application for supporting the assessment of designed products, it is very important that the designers are able to see the virtual object from different points of view, in a stereoscopic modality, and inserted within a real context. This can be achieved using a tracked Video See-Through Head Mounted Display (VST-HMD). This type of display system simulates the user's eyes viewing system. Although this solution allows a user to see the virtual objects in a stereoscopic modality, many problems arise when the user tries to see virtual objects that are near and far from the user's point of view. These problems are related to the camera's convergence angle. In most of the video see-through display systems the camera's position is fixed, while in order to solve convergence problems the angle between the two cameras should be accommodated according to the convergence value as our eyes do. This section describes a VST–HMD system that we have developed where cameras convergence issues have been addressed and solved. The VST–HMD system here presented is an initial prototype that has been developed in order to investigate issues regarding visual parameters and ergonomic aspects. In addiction we have implemented an AR application for product design assessment where users can interact with various 3D models of a product through the use of an input remote control with the aim of assessing the designs.

4.1 Development of VST-HMD

In current VST-HMD state of the art there are many examples of experimental devices created for specific purposes but a commercial product that solves all of the visual issues discussed in the previous session doesn't exist. Consequently we have developed a VST-HMD device which supports our application for product design assessment and which solves the issue related to the visualization of objects closely. The proposed solution for solving the visualization issue is to control the convergence angle of the cameras by using two micro servos. The main objective of our research was to demonstrate the feasibility of such a visualization system; for this reason we have developed a prototype based on commercial components. The real scene is acquired by two Logitech QuickCam® Pro for Notebooks webcams that have these specifications: resolution of 640X480 @ 30fps. The display system is based on two Liteye monocular Full Color OLED displays with a resolution of 800X600. The two cameras are handled by two Dong Yang analog servos that, although having small dimensions (19.8mm X 8.0mm X 22.5mm) and weight of 4.4 g, allow us to provide a torque of 0.8kg/cm and a speed of 0.12/60° values, which is more than enough for our purposes. All components were arranged on a light safety helmet by using a specific frame designed in order to provide all of the degrees of freedom for a correct registration. Before physically making our device, we investigated some aspects in order to define the best layout of the components, and we performed a preliminary test in order to optimize the algorithm for the camera's control

4.1.1 Cameras Control System:

The geometrical studies discussed reveal that camera and display must be always aligned. However, like it has been demonstrated in, the human eye is able to adjust, in a short time, to small visual incongruities and consequently to reconstruct the three-dimensional image correctly. Starting from these assumptions we would like to demonstrate that the user can reconstruct a good three-dimensional image by using our system where the monocular displays are parallel while the cameras automatically converge toward the target object. This solution allows us to see far objects (parallel cameras and displays) and near objects (parallel displays and angled cameras) without the need of a manual registration.

The value of the convergence angle of the cameras varies according to the following formula that was derived from a simple geometrical consideration.

$$\beta = arccos\frac{\sqrt{l^2 - \frac{d^2}{4}}}{l}$$

In this formula is the distance between the object and the camera while is the user's IPD. This function, however, doesn't consider the object dimension because the distance is calculated from the centre of the virtual object thus, when the user tries to see a large model, the real distance is lower. In order to solve this issue we have corrected the formula according to the size of the virtual object that was approximated with a sphere (bounding sphere).

$$\beta = arccos\frac{\sqrt{l^2 - \frac{d^2}{4}} - r}{\sqrt{\left(l^2 - \frac{d^2}{4} - r\right)^2 + \frac{d^2}{4}}}$$

where r is the sphere radius.

4.2 Design of the VST-HMD

The layout of the components of the VST-HMD was designed in order to satisfy different morphological characteristics of the users. The optimization of the layout was achieved by using the ergonomics and human factors software Tecnomatix Jack, which is generally used to improve the ergonomics of product designs and workplace tasks. This software enables users to position biomechanically accurate digital humans of various sizes in virtual environments, assign them tasks and analyze their performance. Thanks to this software we implemented a simple routine that allowed us to check the correct positions of the monocular displays for different virtual users with different IPD and head size (Fig. 2). The obtained results are used to define the registration range of the three translational degrees of freedom (dof) of the monocular displays. These data were used to support the design of the frame where cameras, monocular displays and servos are mounted. The modeling and the virtual assembly into the digital model of the safety helmet of the frame were realized by using a CAD system. After this developing phase of digital model of the frame, we made manually the frame with light material, like aluminium alloy and plexiglass; then we assembled the other components and we fixed the frame onto the safety helmet. The weight of the device is about 850g. Fig. 3 shows the digital model and real model of the VST-HMD.

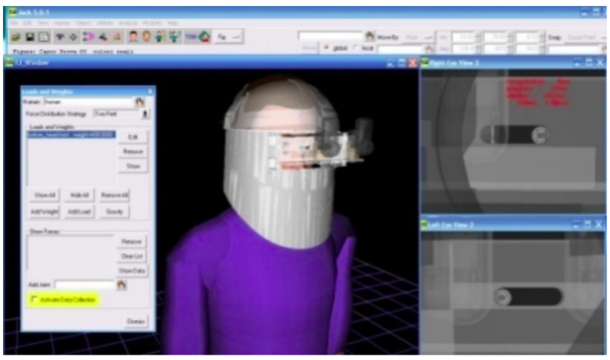

Figure 7. Components layout configuration by using Tecnomatix Jack.

Figure 8. Digital and real models of the assembled VST-HMD.

5 Why VST-HMD Over OST-HMD?

Video see-through (VST) and optical see-through (OST) paradigms have both their own strengths and shortcomings with respect to technological and human-factor aspects. The major difference between these see-through paradigms is in providing an aided (VST) or unaided (OST) view of the real world (Ref.[5])

A video see-through head mounted display (HMD) has a different viewing point than does the real eye, resulting in visual displacement (VD). VD deteriorates visuomotor performance due to sensory conflict. Previous work has investigated this deterioration and human adaptation by comparing fixed VD and real eye conditions.Here, we go a step further to investigate whether any differences in visuomotor and adaptation trends exist across 16 distinct VD conditions. The performance tasks studied were of two types: foot placement and finger touch. In contrast to our initial prediction, the results showed equal task performance levels and adaptation within about 5 minutes regardless of VD conditions. We found that human adaptation covered a variety of VDs — up to 55 mm in the X, Y direction; up to 125mm in the Z direction; and up to 140mm of interocular distance (IOD). In addition, we found that partial adaptation gave participants the interesting experience of a sense of body structure distortion for a few minute (Ref.[6])

In both systems there are two image sources: the real world and the computer generated world; these two image sources are to be merged. Optical see-through HMDs take what might be called a ”minimally invasive” approach; that is, they leave the view of the real world nearly intact and attempt to augment it by merging a reflected image of the computer-generated scene into the view of the real world. Video see-through HMDs are more invasive in the sense that they block out the real-world view in exchange for the ability to merge the two views more convincingly. The fundamental tradeoff, then, is whether the additional features afforded by the more invasive approach justify' the loss of the unobstructed real world view. One of the major advantages of video see-through HMDs is the capability of enforcing registration of the real and synthetic images. In other words, because the system has access to both the real and synthetic images, it can manipulate them in space or in time in order to register them. In the case of video see-through HMDs, real-scene images are digitized by miniature cameras and converted to an analog signal which is fed to the HMD displays.

Optical see-through HMDs typically provide from 20* to 600 overlay FOV via the semi-transparent mirror placed in front of the eyes, a value which may appear somewhat limited. Video see-through HMDs, on the other hand, can provide as large a see-through FOV as can be displayed with the viewing optics. Typical values range from 20 to 90 degrees. The straightforward method of mounting the cameras on a video see-through HMD is to separate them by the appropriate interpupillary distance (IPD) and mount them on the front or top of the HMD, or to mount them on the side of the HMD, in which case they will be separated by more than the IPD. Assuming the system has a depth map of the real environment, video see-through HMDs are perfectly positioned to take advantage of this information. They can, on a pixel-by-pixel basis, selectively block out the view of either scene or even blend them to minimize edge artifacts. One of the chief advantages of video see-through HMDs is that they handle this problem so well. The situation for optical see-through HMDs is more complex. Existing optical see-through HMDs blend the two images with beam splitters, which blend the real and virtual images uniformly throughout the FOV. While optical see-through HMDs can allow real objects to occlude virtual objects, the reverse is not easy to do since normal beam splitters have no way of selectively blocking out the real environment.

Video systems give up the unhindered view in return for improved ability to render occlusion cues; the issue of how to really perform occlusion is far from solved, however, and remains an active area of research. Video see-through systems can also guarantee registration of the real and virtual scenes at the expense of a mismatch between vision and proprioception, which may or may not be perceived as a penalty if the human observer is able to adapt to such a mismatch. (Ref.[7])

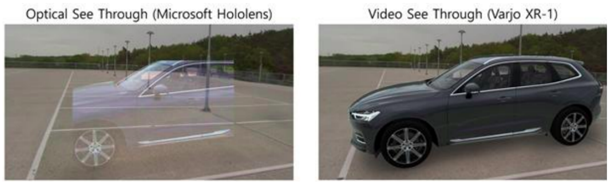

Figure 9. Difference of OST VST Display. (Ref.[8])

6 Pen Pointer Technology

The Pen pointer Technology is a 6 degree of freedom pen shaped device, mixing isotonic and isometric sensing modes. It is a stylus-shaped pen with left-button and right-button that can interact with the MR application for I/O. It allows a group of users to interact with virtual environments by means of 3D and 2D interaction techniques. The innovative design of this Pen unifies the principle advantages of existing input devices while rejecting their main limitations. This particular pen helps the user to interact with the 3d models, moving and selecting tools and objects around the virtual environment. It comes with a wireless connector to connect them to devices. Charging ports are located to recharge once the battery drains out.

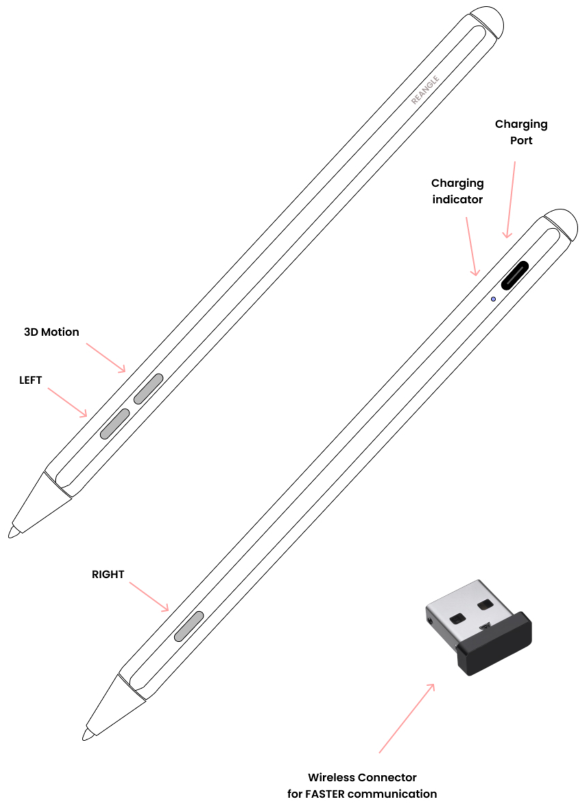

Figure 10. Pen

7 Augmented Reality Technique using Unity 3D and Vuforia (Ref.[9])

The application of Augmented Reality (AR) based on mobile terminals is a hot topic of interests for mobile applications and human-machine interaction. Mobile AR technique combines the intelligent display, registration tracking, virtual and reality convergence, and human-computer interactions through portable devices or intelligent terminals. This allows the 3D virtual object to be fully docked with the customer's actual scene, thus increasing the perceived range. This study uses Unity 3D modeling to create a three-dimensional model of the scene and to detect and track the totem functions of the Vuforia engine. It can set animation and play video. Interactions between virtual buttons and virtual reality can also be created as virtual buttons. The AR application in the Vuforia SDK is a hub that connects the virtual world with reality. The monitor of the mobile terminal merges the actual video and the virtual object, enabling three-dimensional tracking and registration. This article shows you how to design your game and apply AR technology in a Unity 3D environment

7.1 Unity 3D

Unity 3D is a cross-platform integrated 3D game engine developed by Unity Technologies Co.Ltd. It can superpose the virtual onto reality and realizes human-computer interaction with some AR development tools. It allows Vuforia SDK extension plug-ins to detect and track under the corresponding ports and creates AR applications and games. It provides ample development box functions to create games and other interactive 3D content. Unity 3D can append sunlight, fog, wind, sky box, water and other physical materials, ambient sound and animated video to the virtual scene. Meanwhile, you can browse, test and edit 3D application scenarios. Also it is available to release to the required platforms, such as Windows, iOS, Android and so on.

7.2 Vuforia SDK

Vuforia SDK is an AR software development kit for mobile devices launched by Qualcomm. It utilizes computer vision technology to recognize and capture planar images or 3D objects in real time and permits developers placing virtual objects through the viewfinder of the camera and adjusting the position of objects on the background of the camera. Vuforia SDK supports types of 2D and 3D objects including multiple target configurations, images with fewer symbol and frame tags. There is an added function in the SDK. It takes advantage of virtual buttons to detect localized occlusion. Moreover it can select and reconfigure the target image in real time and create a target set according to the scheme. The data flow diagram of the Vuforia SDK is shown in this fig. 11

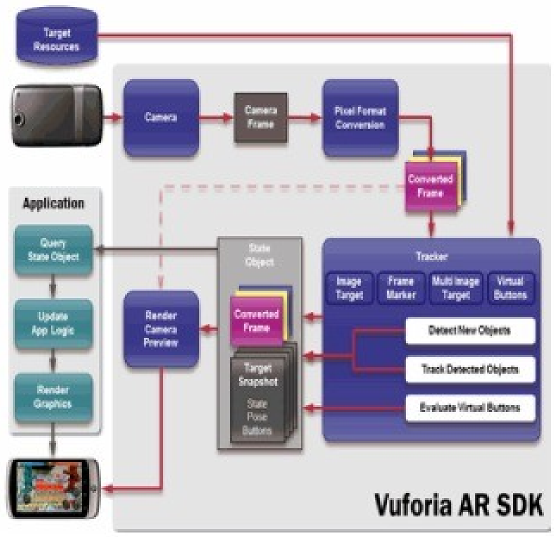

Figure 11. Data Flow Diagram of Vuforia SDK

The data stream of Vuforia SDK is divided into four modules: inputting, database, tracking and matching and render output. Mobile phones can seize images of each frame in the present real scene through the camera and then match identification objects in the database timely according to the pixel format conversion. After that, it adds preset virtual objects such as 3D models, animation or video to real scenes. It can also interact with these virtual objects, render and output information at mobile terminals

8 Conclusion

This research surveys previously published papers to propose a comprehensive framework comprising the various components of MR applications. Development of 3d simulation tools using Mixed Reality is categorized and found out the features, software and hardwares used to build the simulation. This was performed with a focus on current trends, challenges, and future prospects. The proposed framework considers important and practical points. This framework is a very useful guide to the MR space; it discusses different issues related to MR systems, such as the various development phases, analytical models, the simulation toolkit, Head mount displays and Stylus-pen technology. MR applications need an appropriate strategy to handle dynamic effects, such as sudden environmental changes and the movement of objects. The improvement of MR mobile applications requires further research related to proposing a new computer graphic algorithm to handle automatic environment construction and large data visualization with a focus on close-to-reality simulation of an important scene. Large-scale MR needs to incorporate security mechanisms owing to the presence of different levels of information such as organizations, social network data, virtual objects, users, and environmental sensors. Enriching MR content using IoT requires new architectures to handle the complexity of MR integration within the IoT platform. The design of future MR systems needs to consider related interface automation. This concept provides adaptability for the user. All of the aforementioned domains need to consider the use of new strategies based on spatial analyses with methods such as Delaunay triangulation and Voronoi diagrams to handle memory capacity and increase the quality of MR content reconstruction. The three-dimensional model of the scene is simulated by the means of Unity 3D.

We have described the development of our VST-HMD prototype that allows us to solve the issues related to the viewing virtual objects closely. We have also compared two type of HMDS, Optical-see through and Video-see through and checked why we adopt VST-HMD for our project .Optical see-through systems offer an essentially unhindered view of the real environment; they also provide an instantaneous real-world view which assures that visual and proprioception information is synchronized. Video systems give up the unhindered view in return for improved ability to render occlusion cues; the issue of how to really perform occlusion is far from solved, however, and remains an active area of research. Video see-through systems can also guarantee registration of the real and virtual scenes at the expense of a mismatch between vision and proprioception, which may or may not be perceived as a penalty if the human observer is able to adapt to such a mismatch.

From the surveys we have conducted, we have designed a mouse-like interaction system in a modern-day PC to an MR system, where a stylus-shaped pen with left-button and right-button can interact with the MR application for I/O.

Your References

The list of references should be ordered in the same order as first cited in the text. All references should be cited in the text, and using square brackets such as Ref.[1].

Acknowledgement

The surveys related to the project was concluded in which every team members collected information and research papers online and an effective discussion was held to select the most appropriate technology required to develop this project. The graphical diagrams of stylus-pen were created using Figma Software.The equations given in this survey are authentic from professional research papers. Some of the diagrams are picture samples from research papers.

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