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Development of a Training Module for Process Operation on Mixed Reality Technology

Watch the video about how the training module is created

ABSTRACT

The combination of traditional and Mixed Reality (MR) education is an important and relevant alternative to sole traditional education, providing practical training that can help students in their future careers alongside theoretical training. The role of virtual, augmented, and MR technology in education is first investigated, and in parallel with the intended training scenario, the augmented reality technology required to integrate the virtual training objects in the training module into the real world is determined. The programs and Internet of Things required to deploy the training module on HoloLens 2 as MR goggles that were deemed suitable for the training purpose were selected after considering a scenario compatible with MR in accordance with the training content. The challenges of implementing this scenario in the MR immersive environment are analyzed in terms of the characteristics of the MR device used, the physical conditions, the programs and their compatibility with each other, and the steps to achieve a better-quality vision, and to easily integrate changes in future educational objectives are detailed.

MOTIVATION

Virtual Reality (VR), and MR have brought a new dimension to learning process by being integrated into the field of education and they are increasingly being used in the context of education as they increase the comprehensibility of the content by placing the participant in any scene with a high degree of immersion [1].

There is a knowledge gap between during the engineering studies, and becoming professional after graduation when these technologies are not included [2]. There are a wide variety of engineering applications for VR, AR and MR tools. The development and application of these technologies significantly accelerate the learning process by engaging students cognitively. Consequently, not using these technologies can have a negative impact on the success of engineering students. VR, AR and MR add a new dimension to education, encouraging students to analyze, solve problems and increase success through trial and error. The lack of knowledge hinders professional development, as the retention rate of students in education without VR and AR technology is only 25%, whereas in the presence of these technologies, 80% of students retain knowledge[3].

METHODOLOGY APPROACH

Initial Phase

- **Goal:** This project introduces the fundamentals of how to create a progressive training scenario using MR technology, and the difficulties of using which programs in which environments.

- Installation of Software:
AutoCAD Plant3D, Navisworks Manage 2021, Unity Hub, Unity 2020.3.24f, Mixed Reality Tool Kit(MRTK), Windows 10 SDK, Visual Studio 2022

- The Layout design and drawn in Autodesk Plant 3D

- Convert the AutoCAD file into an OBJ format

- Drawing Piping & Instrumentation Diagram (P&ID) of the Layout

- Creation of Training Scenario:
The scenario encourages the student to understand P&ID and intervene in the system in case of emergency.

The Entrance of Holographic App Vision from HoloLens 2

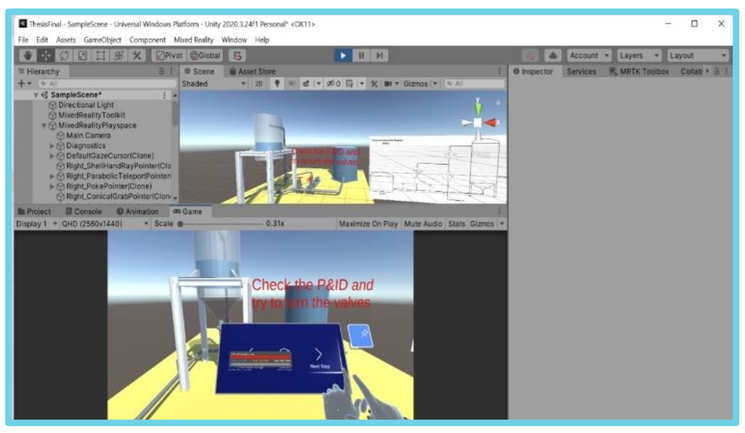
- This training model scenario allows the student to practice safety and maintenance by giving instructions at each step of the scenario.

Creation of the Training Module

- First Settings in Unity and Installation of MRTK
- Change the Plattform of Unity into UWP from the Project Settings
- Transferring the 3D Plant Model, also drawn equipment as a spare to Unity
- Transferring the images & sounds into Unity
- In Unity, MRTK components are used to create each step of the scenario.

Unity
- AppController assets are virtual objects that users interact with.

MRTK MIXED REALITY TOOLKIT
- For example, 'Near Menu 3*1' here helps the user to navigate to the next steps in the training scenario.



The View of Game Scene and MRTK Components in Unity

- GameObjects are created and customized in Unity during the steps in the scenario.

- MRTK components are subcomponents of GameObjects, and when it is intended to activate MRTK features, the codes are written to compile it with Unity's components

- For example, an alarm GameObject is created according to the scenario. First, the sound to be used in the alarm is transferred to the GameObject in MP3 format. At a certain step, a C# script is written to activate the alarm sound and the red color to be seen. Another AppController, PressableButtons, is used to silence the alarm and a C# script is written to turn off the alarm when the person wearing the HoloLens 2 touches it with their finger.

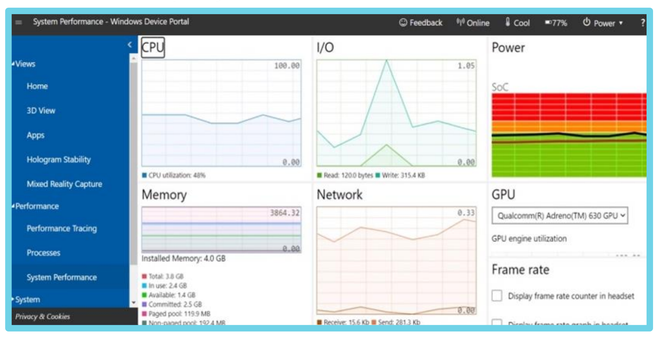
Results & Conclusion

- Create sln format of the Unity Project in Unity Build Settings
- Open the Unity sln. file in Visual Studio 2022

Visual Studio

Deployement Process

- Configuration of HoloLens 2 with the user and PC
- Debug and deploy of the sln file in Visual Studio 2022
- Debugging can take 2-3 minutes depending on the size of the project.



The System Performance Graph from Windows Device Portal

- HoloLens has a number of limitations that greatly affect the appearance of the content displayed. The instantaneous performance of HoloLens while the generated holographic application is running can be monitored in the system performance graph.

- Students have reported better long-term memory retention and reduced stress, and MR helps in understanding process engineering by allowing uninterrupted learning with external assistance. However, due to the high cost of MR and limited expertise, it may be best combined with traditional instructor-led training methods in hybrid systems.

References

[1] K. Lee, "Augmented Reality in Education and Training," TechTrends, vol. 56, pp. 13-21, March 2012.

[2] F. E. V. Anjos, L. A. O. Rochab, D. O. Silva and R. Pachecoa, "Virtual and augmented reality application in production engineering teaching-learning processes," vol. 30, no. e20190088, 2020.

[3] J. Motejlek and E. Alpay, "A Taxonomy for Virtual and Augmented Reality in Education," June, 2019.

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