Identification of technology-based mixed reality devices

A R Islami*, B Mulyanti and I Widiyat
Universitas Pendidikan Indonesia, Bandung, Indonesia

*a.ramadhani@student.upi.edu

Abstract. The purpose of this research is to identify technology-based mixed reality devices used in education. A variety of operating systems such as Windows, Android, and iOS used by the devices are reviewed in this study. It has been revealed that Hololens and HTC Vive are the most widely used devices, particularly in vocational education. Hololens mainly uses virtual reality (mixed reality) with a complete holographic computer. In the meantime, HTC Vive is a set of devices enabling its users to experience virtual reality. It is recommended that industry-driven education utilize those devices so that they are capable of adapting with industrial revolution 4.0.

1. Introduction
Mixed Reality (MR) is a series of innovative technologies that provide a framework for positioning the real world and virtual world [1], this merging of the real and virtual world is done to produce a new environment and visualization where physical and digital objects live side by side and interact in real time. MR is an overlay of synthetic content in the real world that is anchored and interacts with the real world. The main characteristic of MR is that synthetic content and real world content can react with each other in real time [2].

The use of MR simulation as a training method is very common in several fields such as medicine and aviation. Like the research conducted by Weixin Si et. al, who discussed the use of MR to guide radiofrequency ablation, this system can provide surgeons with more natural and intuitive surgical methods [3]. Then the research conducted by Huagen Wan et al, which discusses the design and evaluation of the cockpit panel on an aircraft so that pilots can learn the local guidance on the aircraft used, with the device used is the Head Mounted Display and hand-held Mobile Augmented Reality and applications on a smartphone or PC so that between the real world and virtual can interact [4]. The difference between this paper and the existing paper is to review mixed reality devices used in vocational education.

This paper discusses mixed reality tools used in vocational learning. Vocational learning processes tend to require a lot of places and large operational costs, to overcome these problems the learning process can be done virtually. Because with virtual learning, it can save operational costs of practice, provide the same knowledge and can increase student motivation [5-7]. The purpose of this study is to find out the mixed reality tools used in vocational learning.

2. Methods
The research method used in this research is Systematic Literature Review. Journal search is done to find journals that discuss mixtures sourced from a database, through search engines such as Google Scholar and Crossref. The basic data involved in this search are IEEE, Taylor and Francis, Elsevier, and
3. Results and discussion

3.1. Hololens

Hololens is one of the most widely used devices in mixed reality in vocational education. Visualization of the process of modeling, identifying and controlling a mechatronic system, which uses a virtual / mixed reality system allows students to get a faster and better understanding of the subject being studied compared to conventional educational methods [2].

Figure 1. Microsoft Hololens equipment [5].

Figure 1 shows hololens equipment consisting of a complete holographic computer, capable of running the Windows 10 operating system. This hololens makes it possible to see holograms that look like humans, and can move, change and be shaped according to user interaction or the physical environment. This augmentation occurs by reflecting digital graphics of virtual objects optically into the real world environment [5,6].

Hololens is a lightweight holographic computer consisting of a stereoscopic screen with a screen resolution of 1268 x 720 pixels per eye with a 16:9 aspect ratio and a 60-Hz refresh rate containing a color holographic lens. 4 additional cameras with built-in sensors for sensing the environment and detecting ambient light. The sensor receives user input through an inertial measurement unit which includes an accelerometer, gyroscope, and magnetometer. Hololens also has integrated speakers and 4 microphones for 2-way communication. The device's Holographic Processing Unit can handle 1 trillion calculations per second, and has 2 gigabytes (GB) of random access memory (RAM). Further specifications include 64 GB of internal flash storage and support for wireless connectivity with WiFi (IEEE 802.11ac) and Bluetooth (4.1 Low Energy). Battery life reaches 3 hours of active use or 2 weeks standby time. HoloLens has a clicker accessory, which is connected via Bluetooth, allowing users to make physical commands instead of using gaze, voice commands, and / or hand movements [7].

Here are some features that can be accessed by users when using Hololens, including [5]:

3.1.1. Spatial sound. Spatial sound is a technology that can provide sound effects that sound as clearly as real and are heard from all sides as if the sound came from a point or virtual location.

3.1.2. Gaze tracking. Is a technology that is able to show exactly what and where from each user so that it can produce stereoscopic 3D illusions.

3.1.3. Gesture input. Technology that allows users to use the "bloom" gesture to pull up the navigation menu screen, and can perform air tap gestures as if the user were selecting commands on the menu.

3.1.4. Voice support. Voice commands are permitted and developers are allowed to use the "Text to Speech" capability (i.e. voice recognition) to create voice input for applications they make on Unity.
3.2. Vive HTC VR Headset

VR Headset is a device mounted on the head, by using this headset users can get virtual reality. This VR headset consists of a head mounted display system consisting of a processor, a display paired with a processor, and a casing that has a front side and one or more lateral sides. The processor is configured to present images to the eyes of users who wear head-mounted screens. The front-facing side is substantially parallel to the plane where the screen is located. One or more lateral sides form the openings that are configured [8]. Figure 2 is an example of an HTC Vive virtual reality headset.

![Figure 2. HTC Vive VR Headset [9].](image)

This HTC Vive headset provides enhanced features, such as higher resolution, faster refresh speeds, and a wider field of view, at a much lower cost [10], covering a field of view of around 110° (around 90° per eye) through two 1080 x 1200 pixel displays with a refresh rate of 90 Hz, thus the pixel density of Vive is around 12 pixels/°, which means that each pixel can be easily and clearly when viewing an object [11]. Vive tracking operates based on the principle of inside and outside, where an external camera is no longer needed for the tracking process, instead the tracking technology used is two lasers or uses wireless called a lighthouse. The two boxes alternately send horizontal and vertical infrared laser sweep that stretches 360° in each direction [9,10]. HTC Vive consists of 3 components, namely a headset, two control components and two base station components needed to connect the real environment with a virtual environment.

The use of practicum places and equipment in vocational learning is central to the learning process. At present there are many lessons that utilize computer-based interface media, one of which is the use of mixed reality in the world of vocational education. Hololens that are connected must use the internet through a wireless network, with 802.11ac radio waves, 232 wireless fidelity (Wifi), which means that they can only be connected to networks that support 5-GHz. How to connect Hololens to a Wifi network is the same as connecting a laptop or mobile device to a Wifi network [7]. The use of Hololens in the world of vocational education is very beneficial because it can increase students' motivation and academic ability [12], when compared to students who learn traditionally, because students can directly learn through three-dimensional experiences that combine physical with virtual and allow students to interact with content which is safe and controlled [13,14]. The use of Hololens in the world of education allows teaching to access virtual environments that cannot be accessed in physical classrooms, such as being able to access virtual labs, virtual machines and industrial plants so that they can increase students' knowledge and skills more efficiently [15]. The use of this technology can also present opportunities to...
enhance teaching efforts, involve students for the better and change education, because using Hololens can display translucent holographic that is not tethered allowing one to see high-definition holograms in their study space [16].

Mix reality has another device besides Hololens, the HTC vive headset, with the HTC vive environment technology it is able to increase the interactivity and involvement of students in learning [17]. The use of HTC vive in learning serves to give students an overview of the components or devices used in the learning process, such as the process of assembling an electric motor virtually, pneumatic learning using a virtual lab and so on. By using this HTC vive learning can be more effective because students can interact directly and can provide more experiences to students [18].

4. Conclusion
The technological devices used in Mix Reality in the world of education mostly use Hololens and HTC Vive. User features that can be used from Hololens devices are Spatial Sound, Gaze Tracking, gesture input and voice support. While the use of HTC vive consists of a Headset, two control components and two base station components. The use of these two tools in learning can increase student motivation and academic ability.

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