The Potential and Challenges of Virtual Reality in Indonesia

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Abstract

Virtual reality is a technology that allows humans to interact with virtual environments. The use of VR is now widespread in various fields. However, their use in Indonesia is still very limited because of the price. This paper describes the use of VR and the reasons for the importance of implementing VR and its potential development and challenges that may arise from its use. Literature search are conducted using Google Scholar machine learning for journals published after year of 2000 with several search keywords. The search through Google Scholar is continued to several academic databases such as IEEE Xplore, Scopus, and ScienceDirect. Result show that VR can have benefits in various fields ranging from business, training, engineering and design, medical, entertainment, education, architectural design and prototyping, virtual manufacturing, mobile and gaming, and others. In Indonesia, VR has only been used in the tourism and entertainment sector, such as console games and video games. This is because the price of VR is quite expensive and requires high processor specification. Another important issue is related to the distrust of this technology. Implication of this result are discussed.

Keywords
Virtual reality, VR in Indonesia, VR challenge, literature study.

1. Introduction
Virtual reality (VR) is an artificial environment that can make users feel real interaction with the environment through simulation using computer hardware and software (Onyesolu 2009). Nowadays, VR is widely used in various fields such as games, e-learning, training, entertainment, and others. The rapid development of VR in industry 4.0 is due to the advantages of VR which can provide new solutions that have a chance to be more efficient in a manufacturing environment (Liagkou et al. 2018). The benefit of VR in the industry has been proven to reduce design and production costs, maintain product quality, and overcome many technical problems (Liagkou et al. 2018). The development of 5G internet connection will improve the experience using VR, so the development of VR will accelerate (Liagkou et al. 2018).

Different from Indonesia, the use of VR in developed countries are very diverse. The utilization of VR growing rapidly in the industry, gaming, entertainment, and experimental events (Syamimi et al. 2020). In medical area, VR and video gaming are used as one of the newest approaches related to rehabilitation for stroke sufferers (Laver et al. 2017). The combination of VR with machine learning is also used in the field of education in the form of surgical training (Rogers et al. 2020). VR is also widely used in the tourism sector, especially in the aspects of management, marketing, entertainment, education, accessibility, and heritage preservation (Guttentag 2010). VR has the potential for virtual experiences as a substitute for visiting a site that is threatened and can't be visited directly (Guttentag 2010).

Recent statistics show that the estimated VR used worldwide in 2020 is $18,8 billion (Alsop 2020). Between 2020 and 2027 the annual growth rate of VR and AR in Asia Pacific, Europe, North America, and South America will reach 21.6% (Grand View Research 2020). The gaming and entertainment sector has adopted VR a lot, with a growth forecast to reach $92,31 million by 2027 (Grand View Research 2020). China and US are the largest investors related to VR technology which spent $5,8 million and $5,1 million in 2019 (Lin 2020). There is a prediction in 2030 as many as 23 million workers will use AR and VR, because this technology will bring benefits to all industries with increased processes efficiency, more interesting training, and collaboration with an increasingly diverse range of people (PwC 2019).

With the large potential for use of VR, it is very unfortunate that the development of VR in Indonesia is still relatively slow (Budiansyah 2019). It is stated that Indonesia is still difficult to implement VR technology (Wartaekonomi.co.id 2019), due to high price of VR apparatus.

1.1 Objectives

This paper aimed to investigate the existing use of VR in Indonesia compared to the potential use of VR based on the previous research in developed countries. This research will explain the factors that have hindered VR development in Indonesia and how to overcome it. It is expected that the use of VR in Indonesia can be increased.

2. Literature Review

Vince (2004) states that virtual reality is a system that describes computer technology so that it is possible for users to see a display generated by a computer and similar to real conditions. Over the last few decades, the word virtual has become one of the most exposed words in English, virtual universities, virtual pets, virtual exhibitions, virtual doctors, virtual museums, and others due to virtual reality (VR) (Vince 2004).

The ability of VR and AR to create immersive experiences in combining virtual and physical environments coupled with information filtering capabilities will make it possible to introduce VR in the training process and workspace (Yin et al. 2020). The many benefits and conveniences offered by VR have caused its use to grow rapidly in many sectors (Mazuryk and Gervautz 1996). Mazuryk and Gervautz (1996) stated that the communication between humans and computers or commonly called HCI (Human Computer Interaction) that is easy, powerful, and intuitive so that users can see and manipulate the environment is also the reason why VR develops.

According to research conducted by Mazuryk and Gervautz (1996), there are several applications of VR as follows.

1. Data visualization and architecture
   The existence of data collection needs to be visualized so that it is more easily seen and accessed by humans because the use of visualization will provide a more intuitive interaction. An example is the Virtual Wind Tunnel application developed by the NASA Ames Research Center which functions to manipulate the virtual smoke stream in the airflow on a digital model of the aircraft.
2. Modeling, designing, and planning
   In VR modelling, it is possible to see in real-time the object space being modelled. Users can change the colour, texture, and position of objects and observe the entire environment when a change is made.
3. Training and education
   The existence of great benefits such as more secure security and high efficiency as well as low costs mean that VR is often used for training. One of them is the use of flight simulators in aircraft flight training and the training of medical students in performing endosurgery operations.
4. Entertainment
   Prices continue to decline and increasingly massive developments have caused VR to be used in the entertainment industry. Its uses include video game vendors such as SEGA and Nintendo and several variations of low-cost PC-based VR.

3. Methods

The method used in this research paper is a literature study or systematic review using Google Scholar machine learning for journals published after year of 2000 with several search keywords as shown in Table 1. The search through Google Scholar continues to several academic databases such as IEEE Xplore, Scopus, and ScienceDirect. The selection of keywords focuses more on the application of VR technology to facilitate classification related to the potential of VR.

Table 1: Literature search keyword

Search String	Result
Virtual Reality	4
Virtual Reality in Indonesia	15

Table 2: Literature search keyword (cont.)

Search String	Result
VR in tourism	6
VR in education	6
VR in health	5
VR in Industry 4.0	6
VR Challenges and Opportunities	6
Total	**52**

4. Data Collection

Based on the literature study that has been carried out, several publications are obtained that are in accordance with this research. A summary of the research results and the challenges of implementing VR can be seen in Table 2 below.

Table 3. State of the art

No	Author	Key of Findings	Limitation and Challenges	Field of Application	VR Type
1	Subawa et al. (2021)	Increase Bali's economic growth because Covid-19, tourists were restricted to visit Bali with VR.	Pay attention to the readiness of the device that is used.	Tourism	VRM (Virtual Reality Marketing)
2	Wardijono et al. (2017)	Developing 3D graphics modeling of Indonesia National Monument and displayed in a website.	There are no animated elements such as human, animal, or moving vehicle.	Tourism	3D Image (Unity3D and WebGL)
3	Suryanto and Kusumawati (2017)	RnD about making a VR application for Lawang Sewu that can run on android with gyroscope sensors.	Not mentioned	Education	Google Cardboard
4	Kustandi et al. (2018)	- Efficient and effective in simulation learning. - Train students to innovate learning models	Not mentioned	Education	Google Cardboard
5	Kurniawati et al. (2019)	- VR-based games are an effective intervention to improve skills in children with SENs. - Help children to focus on finding, selecting, and pointing the objects.	The calm conditions of the participants in playing will produce a maximum score	Education	Google Cardboard SDK and Unity 3D
6	Adriyanto and Triani (2015)	- Interactive way to observe photos in a wide-angle panorama. - Explore tourist destinations and experiencing deeper than statistic view.	Not mentioned	Tourism	VR Panorama (Mobile based)
7	Zuli (2018)	- Application of FAST Corner Detection algorithm and MDLC. - Describe the 3D object in real-time and facilitate user about the information about the campus.	In the early development stage, has not been implemented.	Information media	-
8	Wahyudi et al. (2018)	- Provide a realistic view and natural interaction. - Enhances the experience of exploring the virtual world for heritage sites.	- Improve interaction using leap motion. - Evaluate performance by comparing multi-device.	Tourism	Samsung Galaxy Gear VR and VR Box
9	Putra et al. (2016)	Provide new experience for the user and a good 3D visualization	Required great processor performance to run smoothly on smartphones.	Tourism	Google Cardboard
10	Tahyudin et al. (2020)	- Support manager to provide interesting information. - Get a new unique experience in exploring nature. - Increasing number of tourists in Cilacap.	Adding value activities with interactive experiences, entertainment, and games during the trip.	Tourism	VR Box
11	Fauzi and Gozali (2015)	VR creates immersive and new sensation advertisements about tourism.	Not mentioned	Tourism	Oculus Rift DK2
12	Valentino et al. (2017)	Development of flight simulator using VR that able to provide sensations like being in a plane cockpit.	Going to the era of portable that permeated whenever and wherever	Education	Samsung Galaxy Gear VR

Table 4. State of the art (cont.)

No	Author	- Key of Findings	Limitation and Challenges	Field of Application	VR Type
13	Kurniawati et al. (2020)	- VR simulation using VAKT method for Autism Spectrum Conditions (ASC). - VR to explore biology learning for senior high school students.	There are limited features of supporting VR applications as learning media in education.	Education	Google Cardboard
14	Sihite et al. (2013)	- Development using 3Ds Max - Video interaction using. Universal Studio Texture Lite package. - People can understand the historical value and learning it with pleasure.	Not mentioned	Education	Unity 3D (Mobile Based)
15	Wardijono et al. (2018)	- Created 33 virtual traditional houses of the province in Indonesia and show them via the website. - User can control the virtual reality models with a keyboard and mouse.	Add virtual environment with a more dynamic object.	Tourism	Blender Software and Unit 3D

5. Results and Discussion

Of the 52 papers found using the selected keywords, 15 papers were describing the results related to VR development in Indonesia, the summary can be seen in Table 2. From the research that has been done in Indonesia, most of the research are about the potential use of VR in tourism and education. Of the 15 papers found, 8 papers used VR in tourism and 6 papers discussed the use of VR in education. This is because tourism is one of the biggest income earners in Indonesia (Fauzi and Gozali 2015). The utilization of VR in the tourism sector is for example panoramic VR to enhance the experience more than just viewing photos or 2D images (Adriyanto and Triani 2015). Another use of VR in Indonesia is to visualize the National Monument and its surroundings and the form of 3D objects via a website (Wardijono et al. 2017). VR is also used as an educational medium for historical heritage sites which are often under-promoted (Suryanto and Kusumawati 2017). Making a 3D viewer application to facilitate a more interesting and interactive history learning process is done using VR (Sihite et al. 2013). In the field of tourism, especially related to hospitality, VR is used to explore the property. In this case, visitors do not have to imagine a hotel by opening a photo or website, but they can make virtual visits to hotels, restaurants, spas, or fitness centres (Nayyar et al. 2018). One of the uses of VR in tourism is the experience that travellers can feel related to tourist destinations that will be visited in detail and have real feelings or can be called bird's-eye views (Nayyar et al. 2018).

The potential for using VR for tourism is getting bigger because of Covid-19, this is due to social distancing and the prohibition of going to tourist destinations (Subawa et al. 2021). Before the pandemic, VR was used as a tool to introduce natural tourism in Indonesia (Fauzi and Gozali 2015, Tahyudin et al. 2020, Wardijono et al. 2018). Pandemics have also resulted in changes in the tourism and hospitality industry related to the changes in tourist lifestyle, tourist behaviour, and tourist preferences both in the long and short term (Wen et al. 2020). The use of VR as a tourist promotion activity, especially to increase tourist visits in certain tourist destinations (Adachi et al. 2020). The use of VR is one of the Indonesian government's efforts to promote Indonesian tourism (Subawa et al. 2021).

First use of VR in the field of education is related to the existence of the learning theory. VR is often used in the field of education because learning is more interesting and fun, so students won't get bored quickly (Piovesan et al. 2012). Also, the use of VR has been shown to increase motivation and attention and reduce costs by using a virtual environment created through VR (Piovesan et al. 2012). Nanyang Technological University is one of the first campuses to use VR to simulate its campus with 3D virtual technology. This campus 3D simulation aims to help new students easily identify their campus.

In the field of education, VR is used for instance in flight simulator training (Valentino et al. 2017). The use of VR in simulator training stimulates student motivation because the appearance of the simulations designed is like playing online games so that it makes understanding the material easier (Kustandi et al. 2020). In addition, VR is also expected to be effective as a learning tool for children with special needs (Kurniawati et al. 2020). VR-based games are proposed as an effective and fun intervention to improve children's skills with Special Educational Needs (Kurniawati et al. 2019).

Other uses of VR are in the medical field. There are several uses of VR, including related to medical and surgical training, emergency training systems, training for mental-disease professionals, and training for clinician-patient relationships (Mantovani et al. 2003). In addition, there are several specific task training in medical field, such as training for arthroscopic knee surgery (Mabrey et al. 2000), VR orthopaedic surgery (Tsai et al. 2001), VE for oesophageal intubation training (Kesavadas et al. 2002), and VR training and assessment related to laparoscopic skills. Besides that, VR can be used to overcome and the presence of several phobias such as a phobia of heights, flying, and phobia of spiders (Mandal 2013). VR can also be used to treat post-traumatic stress disorder (Mandal 2013).

Other uses of VR are in the manufacturing and industrial fields. Increasingly complex design and demands to increase productivity and efficiency are the problems faced today. Workers or engineers must be able to adapt due to the unstable market (volatile market) and the limitations of current technology, so that there needs to be continuous development and innovation related to teaching and training methods so that they are always in line with developments (Kuts et al. 2018, Stachová et al. 2019). VR is used to demonstrate and visualize teaching so that learning is more effective because it depicts a real work environment (Taxén and Naeve 2002). The concept of learning factories was introduced to modernize the learning process and make training process procedures more realistic. Furthermore, the use of virtual reality in manufacturing is providing education to increase manufacturing sustainability in industry 4.0 (Salah et al. 2019).

VR in manufacturing sectors is also applied in 3D network technology using 3D desktop visualization which can be useful to reduce transportation time between locations and thus result in the lower cost by utilizing high-end VR technology (Lawson et al. 2016). Another opportunity for VR development in the future is the increase in multi-sensory feedback related to the introduction of 3D sound in the field of manufacturing, switchgear assessment, and factory-simulation for air quality investigations. The use of VR for market research will also continue to grow given the reduced costs and ease of moving physical equipment to multiple locations (Lawson et al. 2016).

Recently, VR also used for social purpose because VR technology allows people to achieve multi-dimensional interactions without meeting in person (Wang 2020). Nowadays, people access social media through smartphones and laptops, but in the future, VR will be widely used to transform physical activities into virtual activities (Wang 2020). This change occurs without changing the purpose of communication so that people around the world can communicate and relate.

There are considerable differences regarding the use of VR in Indonesia with developed countries. The use of VR in Indonesia is still dominated by the entertainment sector, such as playing games, watching videos, tourism as well as being used for research in the field of education (baktikominfo.id 2019, Wartaekonomi.co.id 2019). The application of VR technology is still low due to the high price of VR. A complete VR unit can cost up to IDR 40 million and is usually destined for the first world country. In Indonesia, the VR trend in 2019 is increasing compared to 2017 as seen from the demand for services that increased by 2.5 times (Soenarso 2019). 5 out of 15 papers related to the use of VR in Indonesia use Google Cardboards. It shows that low-cost HMD VR such as google cardboards are quite popular in Indonesia. So, it is necessary to develop other types of low-cost VR to expand the scope of VR utilization. Many VR producers have started to launch standalone VR devices because of the potential to target the middle segment because of the affordable price. Technology is expected to achieve a growth of 54.7% compound annual growth rate for the next 5 years (Soenarso 2019). Another challenge related to VR adoption in Indonesia is related to cultural aspects, namely a form of distrust of this technology. So, there is a need for education to make more people recognize the benefits of VR. This is because by inviting people to understand this technology people will understand the benefits it offers (PwC 2019).

The development of VR technology not only has a positive impact but also has a negative impact and challenges in its development. This challenge is divided into two, namely technical challenges and cultural challenges (Gandhi and Patel 2018). These challenges will be difficult to avoid, so the best way is to minimize them. The cultural challenges related with legal issues that have not been resolved, such as virtual violence, sexual harassment, and virtual assault, which often occur. Related to the technical challenges, one of them is that the features and data in VR must be streamed via the internet so that a minimum of 300 kb/second internal bandwidth is required to function (Gandhi and Patel 2018). Other reasons are the need for computer systems with high-powered processors to create a suitable virtual environment and the low cost of interfacing (Gandhi and Patel 2018). This results in the cost of this technology are expensive and cannot be accommodated for the middle to lower class.

Based on the technology type used, 9 out of 15 studies show that Head Mounted Display (HMD) VR is the type of VR that is most often used today because of its compact use and have the higher level of immersion compared with the other type VR (Mandal 2013). User experienced a higher experience, richer interaction with passive gaming elements, higher flow rate, and deeper immersion in the HMD VR than in desktop settings (Tan et al. 2015). However, the use of HMD VR is proven to cause greater VR sickness when compared to other types of VR (Somrak et al. 2019). Symptoms of VR sickness include discomfort, nausea, drowsiness, headache, sweating, disorientation, eye fatigue, fatigue, mood swings, and vomiting (Mittelstaedt et al. 2019). Apart from VR sickness, the use of VR also intersects with the mental workload, defined as the demands of tasks imposed on the limited information processing capacity of the brain (Wickens 2008). It is necessary to understand the relationship between the virtual environment and the cognitive processes of its users (Harris et al. 2020).

6. Conclusion

Currently, VR has been widely used in various fields such as business, training, engineering and design, medical, entertainment, education, architectural design and prototyping, virtual manufacturing systems, mobile and gaming, ergonomics and human factor analysis, and others. In the future, the use of VR will be more widespread and more advanced. However, the use of VR in Indonesia is still limited to game consoles, entertainment and tourism, as well as in the education sector due to many limitations, such as expensive prices that cannot be reached by middle to lower class Indonesians, besides there are limited features in the VR application that is used and requires a great processor to use VR. Another important issue is people still find it difficult to trust VR technology and are reluctant to learn about its benefits. The development of VR is moving quite slowly, but it is expected to reach the enlightenment stage and develop rapidly in the next five years. So, it is necessary to do further research to minimize the challenges and negative effects arising from the use of VR.

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