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Model of Virtual Tourism as an Alternative of the Concept of Architecture Tourism Post Covid-19 in Bandung City, Indonesia

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Abstract

The tourism sector as one of the sectors that has been hit by the Covid-19 pandemic needs a new breakthrough to enter a new normal era. Amid the ongoing paradigm shift and a number of new protocols will be implemented to welcome the new normal conditions in the tourism industry. The tourism sector in Indonesia, which has been absorbing many jobs, has been hit hard by the Covid-19 pandemic. Coupled with the difficulty of predicting when the pandemic will end, it is necessary to take smart steps in maintaining the sustainability of the tourism industry in entering an era of new norms. The new normal era brings new roles, new roads and expectations in the tourism sector. Digitalization that is growing rapidly and rapidly requires adaptation to new conditions and rearranging business strategies and models so that they can survive in the new normal era by adjusting technological developments. The development method used in this research is the Multimedia Development Life Cycle (MDLC). MDCL as a method for designing multimedia tools by emphasizing the 6 stages of multimedia development. The tools used in this application are PT GUI, Eclipse, and Google Maps. The objects of historical and heritage buildings that become the Sate Building, Villa Isola, the Geological Building, the Asian Africa Museum, and the Merdeka Building are made using immersive photography techniques. By representing information in the form of panoramic images, the 360⁰ makes it easy for users to visually display information from historical and heritage buildings in Bandung. The tourism model is virtually a possible form of tourism in the future.

Keywords: new normal, the tourism industry, multimedia development, virtual reality, technological development

1. Introduction

The tourism sector [1] and the creative economy play an important role [2] in development in Indonesia, this can be seen from the direct and indirect gross domestic product (GDP) and employment [2]. According to data from the Indonesian

Ministry of Tourism and Creative Economy (2012) the tourism sector [2] and creative economy contributed 11.8% to Indonesia’s GDP, and 14.66% to total employment [3].

The strategic plan for the development of the tourism industry in collaboration with the ILO and the Australian government as partners of the Indonesian government builds a consensus to build a strong tourism industry. This collaboration involves stakeholders ranging from the government [2], social partners, communities, industry, and the general public [2]. Given the richness of natural and cultural resources that Indonesia has is major potential in the domestic and foreign tourist market [2, 4].

The city of Bandung as one of the tourist destinations in Indonesia relies on tourism potentials such as historical buildings, nature, culture, culinary, fashion, recreation, and entertainment [2]. This potential attraction makes natural resources [2] to come in the framework of (a) heritage tourism; (b) shopping and culinary tours; (c) educational tours; (d) recreational and cultural tourism; and (e) MICE (Meeting, Incentive, Convention, Exhibition) supported by adequate geographical, natural and urban planning, as well as good accessibility [2]. In maintaining the sustainability and existing potential, a programmed, structured, and controlled tourism development model is needed [2]. Tourism activities as the main sector of Bandung City have been started since 1920 [2]. Since the construction of the Cipularang toll road and the construction of a high-speed train linking Bandung City and Jakarta. This tourism sector provides a major contribution to increasing PAD/regional own revenue, almost 70% of Bandung’s regional own revenue comes from the tourism sector. Where the tourism sector is a prima donna that continues to need to be improved.

The city of Bandung as one of the cities of past cultural heritage has superior values to be preserved, where the existence of the city of Bandung with its rich architectural styles/styles is its main attraction as a tourist destination and cannot be separated from the history of the development of Bandung City itself [2]. The long history of the city of Bandung has left many historical buildings that make Bandung one of the cities with art deco architectural heritage in the world and was once dubbed the most complete architectural laboratory with various old buildings that inherited the style of architectural beauty in Indonesia [2].

Meanwhile, tourism is a system that develops efforts by emphasizing the value of policies and strategies, as well as promotional patterns that are always synchronized with business development strategies in tourism planning [5, 6]. Mill and

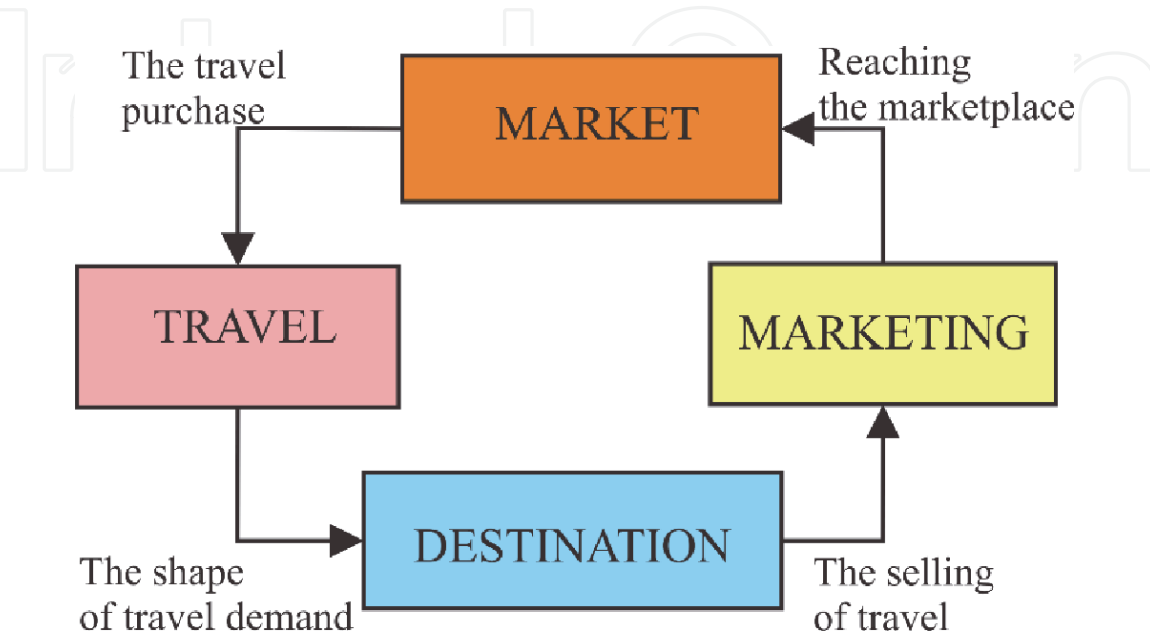


Figure 1.
Tourism elements. Source: Goeldner & Ritchie [6].

Morison describe tourism as a system into four elements, namely demand, travel, destination, and marketing (**Figure 1**) [5–7].

The four elements are related and influence one another, thus making the system run well. Based on this tourism model, from the demand aspect to the marketing aspect in the context of tourism, it will continue to grow in line with the role of business technology by utilizing increasingly strategic IT in all aspects of the business. Online technology trends such as e-commerce have changed new faces in all lines of human life, including the tourism sector. Especially amid the Covid-19 pandemic, in which all sectors collapsed. One of the economic sectors most affected by Covid-19 is the tourism industry sector. So far, the tourism sector which relies on the potential of tourism objects directly as a force in attracting domestic and foreign tourists is one of the worst-hit sectors, there are no more tourists, both domestic and foreign tourists [2].

The use of e-commerce in the tourism sector is known as e-Tourism terminology, where tourism is profiled and information is disseminated using the internet as a potential business trend. Initially, e-Tourism was intended to fulfill information needs through creative media and the development of innovative information systems [5, 8]. It is believed that e-Tousim's role as a medium for tourism promotion that is low budget and high impact, in which the adoption of appropriate information technology will bridge the high budget for infrastructure and facilitate user understanding.

2. Theoretical framework

2.1 Tourism and the tourism potential of the City of Bandung

According to Yoety tourism is a trip that is carried out temporarily from one place to another with the reason that it is not for business or earning a living at the place visited but solely for enjoying the trip for sightseeing and recreation or fulfill various desires [9]. Tourism is also several activities, especially those related to economic activities that are directly related to the entry of foreign culture [9].

The wealth of natural resources, cultural diversity, as well as the wealth of historical heritage that Indonesia possesses is a very large base for economic development and development, especially through the tourism sector [8].

According to Butowski tourism is the main sector in promoting economic and service growth [2, 10, 11]. So that in tourism planning and development [2, 10–12] it is necessary to consider several approaches [2], including: (a) Continuous Incremental, and flexible approach (in the sense that planning [2] is a process that is takes place continuously based on the needs and the results of existing feedback); (b) System Approach [2] (tourism as a system relationship needs to be planned through system analysis); (c) Comprehensive approach [2] (a tourism development approach that holistically considers institutional elements and the environment as well as socio-economic implications); (d) integrated approach (tourism development approach as an integrated system in plans and forms of development in the area); (e) Environmental and sustainable development approach [2] (a tourism approach starting from the planning process, development and management of natural and cultural resources is maintained/does not experience a decline in quality, and environmental analysis becomes the main point); (f) Community approach [2] (an approach to tourism development by maximizing community involvement starting from planning, making decisions that have an impact on socio-economics); (g) Implementable approach [2] (tourism development that formulates plans and recommendations into reality, as well as application of program techniques and strategies); and (h) Application of systematic planning approach [2] (an approach applied in tourism planning based on the logic of activities) [2, 10, 11].

The city of Bandung is the prima donna of park tourism in Indonesia apart from Bali and the city of Yogyakarta, where the city of Bandung has uniqueness, beauty, and extraordinary industrial creativity. It is recorded that almost every weekend, both domestic and foreign tourists are always visited. There are 14 (fourteen) potential tourism clusters in Bandung, including: (a) Shopping and health tourism clusters on the Sukajadi-Setrasari-Pasteur road; (b) Cluster tours for traditional arts and culture and handicraft industries along the Padasuka-Suci route; (c) Historical and Heritage tourism clusters on the Braga-Asia Africa-Cikapundung route; (d) The textile industry tourism cluster in Cigondewah; (e) Cluster of traditional cultural arts and MICE tours in East Bandung; (e) Cluster of spiritual tours and shopping tours on the Gegerkalong - Setiabudi route; (g) Clusters of entertainment tours, shopping tours, Geotourism on the Alun-alun - Sudirman - Otista - Gardujadi - Pasirkaliki routes; (h) Cluster of nature recreation tourism, cultural tourism, handicraft industry tourism on the North Dago - Puncut route; (i) Cluster Heritage tourism, education, natural and artificial recreation, convention tours, religion on the Gedung Sate - Gasibu - Sabuga route; (j) Cluster of culinary tours, Heritage tourism, Education, Entertainment and Recreation, Geotourism on the route of Ir. H. Juanda (Dago) - Merdeka - Riau; (k) Heritage tourism clusters, shopping and culinary tours, knitting Industry tours on the Gator Subroto - Binongjati route; (l) Cluster of shopping tourism and handicraft industry tourism in Cibaduyut; (m) Culinary tourism cluster in Burangrang; and (n) Cluster of shopping tourism in Cihampelas [2, 3].

The development of this cluster is a consequence of the development and changes of the city as well as market demand, as happened on Jalan Ir. H. Juanda, which was originally a non-commercial area, turned into a commercial area which made it a new destination, which is a very busy shopping tour.

2.2 Globalization and the environment: between economic growth, transport, and environmental degradation

Globalization training on an integrated market formation process for goods, services, capital, knowledge, and factors of production around the world. Where globalization catalyzes demand and supply scenarios in international markets by means of exchanges of merchandise and services. Globalization is also a growth in the economic growth achieved by developing countries, but if viewed from an ecological aspect it is not sustainable because globalization is not a policy tool. Globalization has a significant effect on the environment and climate change [13–15]. This is in line with the opinion of Jorgenson and Kick regarding the connection between the environment and global economic processes [16]. Globalization has increased the relationship between emissions and economic growth on changing ecological footprint [17, 18]; the influence of globalization on environmental degradation which causes environmental damage [13, 15, 19]. Khan and Ullah applied an autoregressive distribution lag (ARDL) model to examine the relationship between globalization and CO2 emissions in Pakistan [20]; research on two-way causality between globalization and CO2 emissions in Saudi Arabia from 1971 to 2016 [21]; the relationship between financial development, globalization, and CO2 emissions in Asia Pacific Economic Cooperation (APEC) countries from 1990 to 2016 [22, 23].

Several research results have been conducted on the impact of globalization, among others: the impact of globalization and; tourism against environmental degradation by Sharif et al. in China in the 1978Q1-2017Q4 period [23]. This is supported by the results of research by Yu et al. in Thailand which show that logistics and operations related to transportation are positively correlated with the

entry of tourists, where logistics and transportation provide access for tourists to a tourist spot [24]. Yu et al. mandate for the government to enforce environmentally friendly practices in logistics and transportation operations, as well as to improve the safety and security of tourists which can reduce the harmful effects on environmental sustainability, which inspire criminal activity, so as to attract foreign tourists [24]. The same research was conducted in Malaysia by Syarif et al. related to the role of tourism, transportation, and globalization that affect the environment using quantitative ARDL approaches [25].

Syarif's research results show how important logistics and eco-friendly benefits for economic growth in disadvantaged areas, can increase job opportunities, and as a solution for protection and development. The government must encourage the development of low-carbon ecotourism and achieve both tourism and economic development [25].

2.3 Sustainable tourism

The concept of sustainable tourism development [2] has been discussed since the 1980s. According to Butler [26], sustainable tourism is a constant answer to current tourism problems [2, 13]. Butler divides sustainable tourism into 2 (two) ways, namely: (a) seen from a semantic approach, sustainability as a guarantee of long-term survival following the market, and (b) seen from the concept of sustainable development [2], in the sense of creating sustainable tourism as regional development without violating the principles of sustainable development [2, 14, 15].

Ceballos-Lascurain [29] introduced the concept of ecotourism and since then began to develop [2] with various terms about alternative tourism [16, 17], including green tourism, soft tourism, nature tourism [18, 19], environmentally friendly/ environmentally sensible tourism, responsible tourism, discreet tourism, appropriate tourism, ecoethnotourism [2, 10, 11, 17–25]. With an evaluation approach that juxtaposes new forms of tourism with the old model (mass tourism in nature) [2].

According to Niezgoda sustainable tourism is the relationship between tourism [2], the environment, and development [30] (**Figure 2**).

Based on **Figure 3**, sustainable tourism [2] is aimed at realizing sustainable development and tourism development itself. According to Farrell & Twining-Ward [34] the sustainable tourism approach must be based on an interdisciplinary approach [2], this is because the level of complexity and uncertainty in the behavior of tourism systems and systems that affect it does not guarantee satisfactory results [20, 21]. Furthermore, Farrell & Twining-Ward [34] conveyed a new concept of



Figure 2.
Conceptions of sustainable tourism. Source: Permana et al. [2].



Figure 3.
Virtual reality. Source: Amazon.com dan VIVE developers.

sustainable tourism with the term “comprehensive tourism system and complex adaptive tourism systems (CATS)” [2, 21, 22]. Farrell and Twining-Ward [34] divides into 4 (four) areas that affect sustainable tourism, namely: ecosystem ecology, ecological economics, global change science, and complexity theory [2, 21].

2.4 Virtual reality (VR)

The development of Information and Communication Technology (ICT) is increasingly being felt by its benefits in various aspects, especially in the industrial sector including the tourism industry in it [23, 24]. Chen and Sheldon [38] state that the tourism sector is an industry that requires the provision of diverse information, therefore the information provided will be more effective through the development of multimedia, communication, and information systems [8, 23–37]. Based on data from Boston Consulting Group 2000, almost 80 percent of the tourism industry transactions (e-tourism) are made via the internet. This is very reasonable because consumers will enjoy tourism products or services located in different areas from service providers. Therefore the tourism industry is an interesting sector to be developed and researched [26, 27]. Where e-Tourism transactions include obtaining information, purchasing tourism products and services ranging from hotel room rentals, tour travel packages, purchasing transportation services (planes, trains, and travel) [8, 25].

Along with the development of sustainable tourism insights [28, 29] and new trends in the use of ICT have indirectly brought many changes in various sides of people’s lives including those related to the phenomenon [43] of travel and tourism activities [28–31]. Media Virtual Reality (VR) as a technology [32, 33] that invites users to interact with the environment in the virtual world is simulated using a computer so that users feel they are in that environment [32–46].

VR technology is a technology that allows users to interact with an environment that is simulated by a computer (computer-simulated environment), which is an environment that is actually imitated from the original or that only exists in the imagination. Virtual reality environments generally present a visual experience, which is displayed on a computer screen or through a stereoscopic viewer, some simulations even include additional sensory information, such as sound through speakers or headphones, motion sensors, vibration and grip [47].

The need for visualization and interaction commonly carried out in various disciplines can be optimized by applying VR technology which is currently trending. Several VR applications are currently being used in the world of entertainment, broadcasting, design, simulation, and training as well as for the tourism

sector. However, in Indonesia, this technology has not been used for matters related to crucial fields such as medicine, industrial/automotive engineering, as well as those related to conservation such as architecture, cities, archeology, and history. Even though the VR application offers a variety of innovative solutions for efforts to accelerate high technology to maximize performance and products [47].

VR technology [48] is an interface technology between humans and machines that can simulate people as if they are in a natural environment including sight, hearing, movement, and other actions [49]. This condition can not only clearly describe the real environment, but VR also allows users to observe the virtual environment and feel like they are in that place [23, 32].

VR as one of the innovations that can be used in e-Tourism invites users to interact with an environment that is simulated by a computer. According to LaValle [52], VR displays a pseudo-reality environment [50] by presenting a visual experience displayed on a computer layer [39, 40] or through a stereoscopic [41, 42] viewer where some simulations include additional sensing information such as sound displayed through headphone speakers [5, 39–43].

VR as technology has made a big difference in the history of human thought and is currently becoming a trend to help improve performance and product quality. VR is a technology created so that users can interact with an environment that is simulated by a computer. A simulated environment can be similar to the real world, a representative virtual reality experience by including a simulation of a combination of sensory results (visual, audio, touch). Computers help simulate a real object by generating a three-dimensional (3D) atmosphere to make the user physically involved.

The main components of this system hardware are the VR engine or computer system, input devices, and output devices. In general, the input device is responsible for interaction, the output device for immersive sense, and the VR engine or computer and its software for accurate control and synchronization of the entire virtual environment [24, 44] (**Figure 4**).

Based on the image, the input device is a means for users to interact with the virtual world. This device sends signals to the system about the user's actions, thereby providing the appropriate reaction back to the user via the output device in real-time. These devices can be classified for example as tracking devices, point-input, bio-controllers, and sound devices. VR Engine or computer is a data processor and storage. Real-timing, graphic display, and image processing are some of the important factors and can take up time in the operation of the VR system so it must be selected according to the character of the application requirements.

The choice of VR Engine depends on the application field, the user itself, input and output devices, the level of immersive and graphic output required, because the VR Engine is responsible for calculating and producing graphic models, object rendering, lighting, mapping, texturing, simulation and so on. to be displayed in real-time. The computer as a VR Engine also handles interactions with users and functions as an interface with input and output devices. The output device is a device that receives feedback from the VR Engine and presents it to the user via a suitable output device to stimulate the senses. Several classifications of output devices based on the senses are graphic (visual), audio (hearing), haptic (touch or style), smell, and taste. The visual display is the most popular output in a VR system

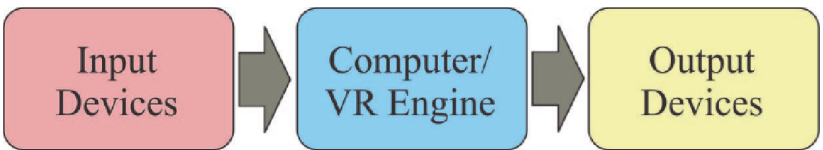


Figure 4.
VR system stove. Source: Bahar [48]; Mazuryk and Gervautz [53].

whereas other types of displays are complementary. Visual displays are devices dedicated to the user’s eye presenting a 3D world.

There are six categories of visual displays, each of which provides a different level of immersion, namely desktop displays, head-mounted displays (HMD), arm-mounted displays, single-screen displays, surround-screen displays (CAVE, Panoramic screen) and volumetric displays [35, 45, 46].

3. Methods, objects and research locations

3.1 Research methods

The research method used is the system development method of the Multimedia Development Life Cycle model (MDLC model) (Figure 5).

The stages of this MDLC model [51] are:

- 1. Concept [48] is the stage for determining the purpose of the application (entertainment, learning) and who is the program user (audience identification), determining the type of application (presentation, interactive). This concept stage is the basis for designing both size and target applications. The output from this stage is usually in the form of a narrative document to reveal the project objectives to be achieved.
- 2. Design [48] is the stage of making technical specifications for the program architecture, appearance, and material requirements for the program. At this stage the specifications are made in great detail, making it easier for the material collecting and assembly stages. The use of storyboards is used to describe a description of each scene by including all multimedia objects and links to other scenes.
- 3. Material collection [48] is the stage of collecting materials following the needs that are done. These materials include clip art, photos, animation, video, or audio. This stage can be done in parallel with the assembly stage. However, it is also possible for the material collecting and assembly stages to be done linearly and not parallel.

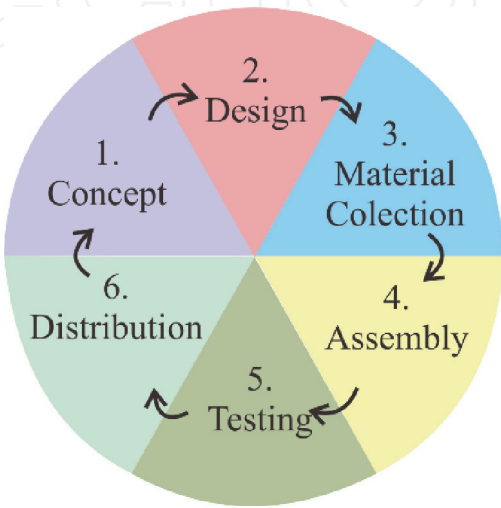


Figure 5. MDLC model. Source: Hendrati and Hendrati [51].

- 4. Assembly [48] is the stage where all multimedia objects or materials are made. Making the application is based on the design stage.
- 5. Testing is the testing phase carried out after completing the assembly stage by running an application or program and seeing whether there is an error or not.
- 6. Distribution [48] is this stage, the application will be stored in a storage medium. If the storage media is not sufficient to accommodate the application, compression of the application will be performed. This stage can also be called the evaluation stage for developing finished products to make them better. The results of this evaluation can be used as input for the concept stage of the next product.

According to the MDLC drawing, it is divided into 2 (two) main stages, namely the data and architectural visualization phase (concept, design, material collecting) and modeling (assembly, testing, and distribution).

A. Concept

The concept presented the user title, object, input, and output of the MDLC model.

Title	Model of virtual tourism as an alternative of the concept of architecture tourism post Covid-19 in Bandung City, Indonesia
User	Tourist
Object	Multimedia contents, namely photos and videos of historical architectural buildings in the city of Bandung
Input	Photos, videos, and texts about the historical architectural buildings of Bandung
Output	360 ⁰ photos and text

B. Design

The concept of the MDLC model is designed for users by carrying out 6 (six) activities starting from viewing the start page, viewing the map, selecting map coordinate information, selecting tourist attractions, viewing tourist spot information, and viewing the 360⁰ display as shown in the picture (**Figure 6**).

From the design in the image, a design is made using the class diagram for virtual reality, where the class diagram consists of 4 classes, namely the Welcome Activity with the variable used is my button. For the MapView class, the variables used are mySpinner, place, URL, view, and descButton. The place variable connects the map view, description, and panorama classes, which determines the photos and description of tourist attractions that will be displayed in the description class and the panorama that will be displayed in the panorama class.

C. Material collection

The data of this study were conducted using several primary and secondary data collection methods, namely, the researcher took data from the management documents of several architectural tourist attractions from historical buildings in the city of Bandung, in the form of photos, videos, and information. Also, the researchers took direct documentation of each historical building object in the city of Bandung by taking direct photos, where the photo session began by selecting

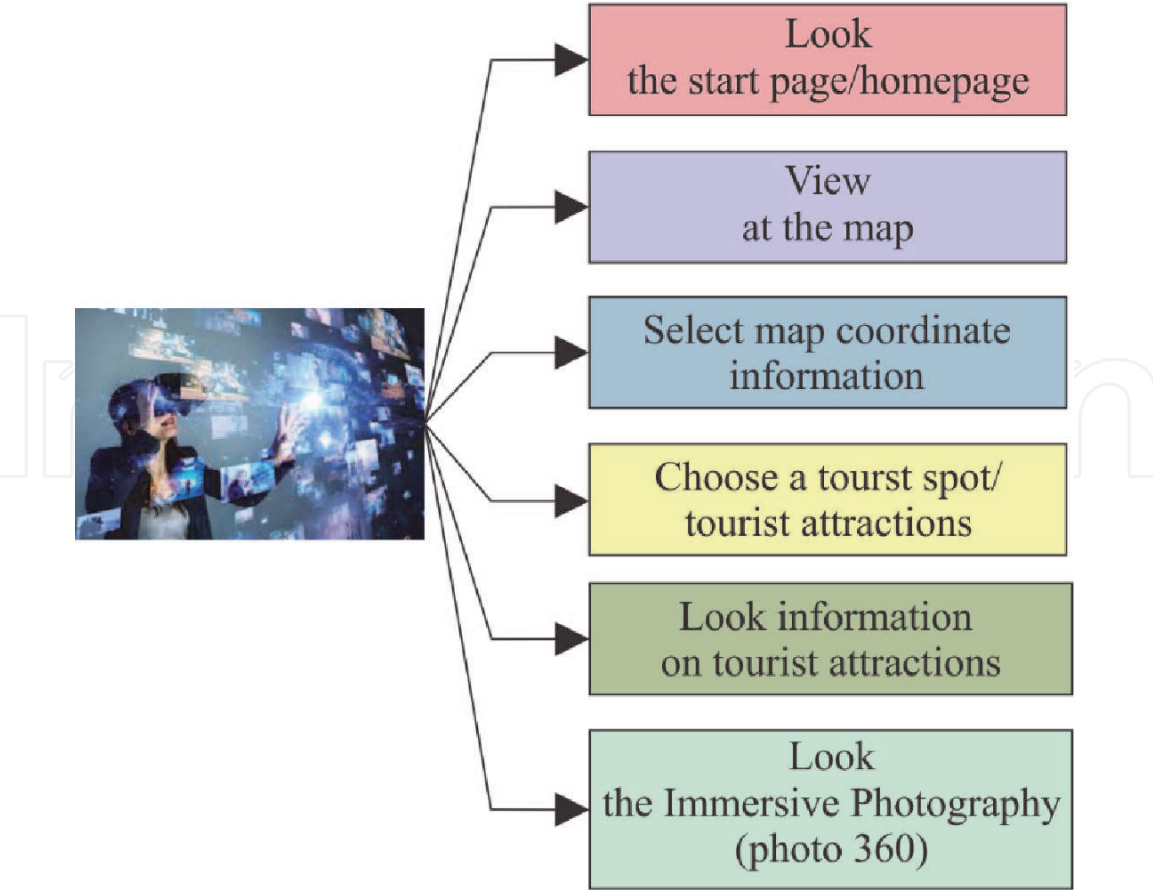


Figure 6.
Use case. Source: compiled from various sources, 2020.

which point would be the center of the 360⁰ photos. Then a tripod and pano head was placed above that point. After that, a camera with an 8 mm lens was mounted on the pano head. After that, the photo is taken rotating to the right, top (zenith), and bottom (nadir). To complement and be more interactive, videos taken directly from each historical building object are used, so that the results with VR are expected to be more realistic and users can feel like in a real environment [50].

3.2 Location and object of research

The research location is in the city of Bandung which is spread over several areas (SWK), namely (1) SWK Bojonegara, (2) SWK Cibeunying, (3) SWK Bandung Kulon, and (4) SWK Maleer (**Figure 7**).

No	Building	Description
1.	Gedung Sate	This building is now the government building of West Java Province which has a skewer ornament on the roof. The meaning of the 6 ornaments symbolizes the cost of forgiving this building which reached 6 million guilders. The architectural style is a mixture of European-Indonesian building styles..
2	Gedung Geologi	The Geology Museum was founded on May 16, 1928. The establishment of the Geological Museum is synonymous with the existence of the Dutch during colonialism in Indonesia and also the influence of the world, where Central European geologists at that time were intensively conducting many geological and mining investigations in Indonesian territory. At that time Europe experienced an industrial revolution in the mid-18th century and very much needed many types of mining materials which were used as

No	Building	Description
		industrial base materials. In 1850, the Dienst van het Mijnwezen institute was formed. This institution later changed its name in 1922 to Dienst van Mijnbouw which was tasked with investigating geology and mineral resources throughout the Indonesian archipelago. The museum has been renovated with a grant from JICA. After undergoing renovations, the Geological Museum was reopened..
3.	Museum Konferensi Asia Afrika	This museum was originally used by an association of elite European citizens living in Bandung called Societeit Concordia. The corner of the building facing Jl. Asia Afrika-Braga used to be in the form of a rigid corner. And then renovated to be circular like now.
4.	Gedung Merdeka	Gedung Merdeka with the Museum of the Asian-African Conference is a different building built by the Asian-African Conference designed by architect A.F Aalbers, while the Merdeka building by architect Wolff Schoemaker. The independent building was formerly known as the Schouwburg Concordia, which was the venue for the Societeit Concordia to perform and party.
5.	Gedung Bank Indonesia (De Javasche Bank)	Javasche Bank is one of the buildings built by the Dutch Hindi government under the leadership of Herman William Daendles as part of the development of the center of government in Bandung. Javasche Bank was built in mid-1909, designed by architects Edward Cuypers Fermont and Hulswitt. After independence, in 1953 it was taken over and inaugurated as Bank Indonesia.
6.	Villa Isola	The building is located at Jln. Dr. Setiabudhi 229 Bandung with this unique architectural design, is now used as the rectorate office of the Indonesian Education University. When viewed from afar, this building looks like a cruise ship. The previous owner was Dominique Willem Berrety who is of mixed Indo-Italian descent who is known as the king of the media.
7	Hotel Savoy Homann	The hotel was designed by architect A.F. Aalbers using a streamlined art deco style. This hotel is one of the historic hotels in Bandung because it was the place to stay for representatives of the 1955 Asian-African conference participants. In addition, the world famous comedian Charlie Chaplin has stayed at this hotel twice.
8.	Hotel Preanger (sekarang Prama Grand Preanger)	This hotel is the design result of Ir. Soekarno when he was an assistant architect for Wolff Schoemaker. Hotel Preanger is located at the junction of Jln. Asia Afrika and Jl. Big Lengkong. Before the hotel building was in the art deco architectural style it is today, it used to adopt the baroque style of the building.
9.	N. I Escompto M.I.J	This building was used by the first bank in Bandung, namely N. I Escompto M.I.J. Before occupying a location at the intersection of Jl. Asia Afrika and Jl. Banceuy, this bank is located on Jl. Independent. Until now, this building is still being used by the BRI bank with the addition of a tall and unique building on the clock tower with Roman numerals attached to that hour. The number four is not written with the symbol (IV) but with the symbol (IIII).
10.	Nedhandel NV	It is a building that was used by a bank from the Netherlands. This building is located on Jl. Asia Africa. The architectural style of this building adopts a neo-classical style by using materials imported from Europe. Now this building is used by a state-owned bank.
11.	Gedung DENIS	This building was formerly occupied by NV. De Eerste Nederlandsch-Indische Spaarkas (NV DENIS) which is a building as a sister building to Savoy Homann. The architectural style adopts both streamlined art deco and a tower. Now this building is used by BJB Bank
12.	Gedung Pensil	It is called the pencil building because the roof is pointed like the tip of a pencil. It is located in the Asia-Africa Simpang Lima area. This

No	Building	Description
		building was previously used as the office of the world’s leading lubricating oil agent.
13.	Gereja Katedral Santo Petrus	This church is located at the intersection of Jl. Merdeka and Jl. Java is the design of the architect Wolf Schoemaker. When viewed from above the church building forms a symmetrical cross
14.	De Majestic	This building was previously called the Concordia Theater which is one of the legendary cinemas in Bandung. It was in this theater that the first film produced in Indonesia, namely “Loetoeng Kasaroen” was screened on Bumi Priangan. Currently, the building is located on Jl. Braga has been revitalized and is returning to function as a cinema and performing arts.
15	Dakken	This Dutch colonial era house is now used as a cafe and restaurant. This building is located on Jl. Riau Bandung, which is now a shopping center, distro and factory outlet. This building attracts attention because of its classic design with a tapered tower on one side.
16	De Driekleur (Gedung Tiga Warna)	This art deco building is located on Jl. Dago. Now, this building is being functioned by a national bank. The meaning of De Driekleur itself in Indonesian is three colors. But that does not mean this building has three colors on the body of the building. The meaning of these three colors refers to the Dutch flag which has three colors. Now it functions as a BTPN bank.
17	Warenhuis De Vries	This building used to be the first department store in Bandung. This building is a place for plantation bosses in the Priangan area to buy their necessities. Before being used by a private bank today, Dr. Vries was also used as a Padang restaurant, clothing shop, and butcher shop in different periods.
18	Swarha	The building, which is located next to the Grand Mosque of Bandung, used to be a hotel. During the 1955 Asia Africa Conference this hotel was used by journalists. Swarha itself stands for Said Wiratmana Abdurrachman Hassan, who is one of the rich traders from the Middle East. This building is now known as Indra Busana

Source: Compiled from various sources, 2020.

Of the 18 (eighteen) historical building objects in the city of Bandung, 5 building objects were taken, namely Gedung Sate, Vila Isola, Geology Building, Asia Africa Museum, and Gedung Merdeka. Documentation consists of photos and videos as shown in the table (**Table 1**).

No	Name	Photo and video						Total
		Horizontal		Zenith		Nadir		
		Photo	Videos	Photo	Videos	Photo	Videos	
1	Gedung Sate	8	3	4	1	4	1	21
2	Villa Isola	9	4	4	1	4	1	23
3	Gedung Geologi	8	3	4	1	4	1	21
4	Museum Asia Afrika	8	3	4	1	4	1	21
5	Gedung Merdeka	8	4	4	1	4	1	21

Table 1.
Taking photos and videos of historical architectural buildings in Bandung.

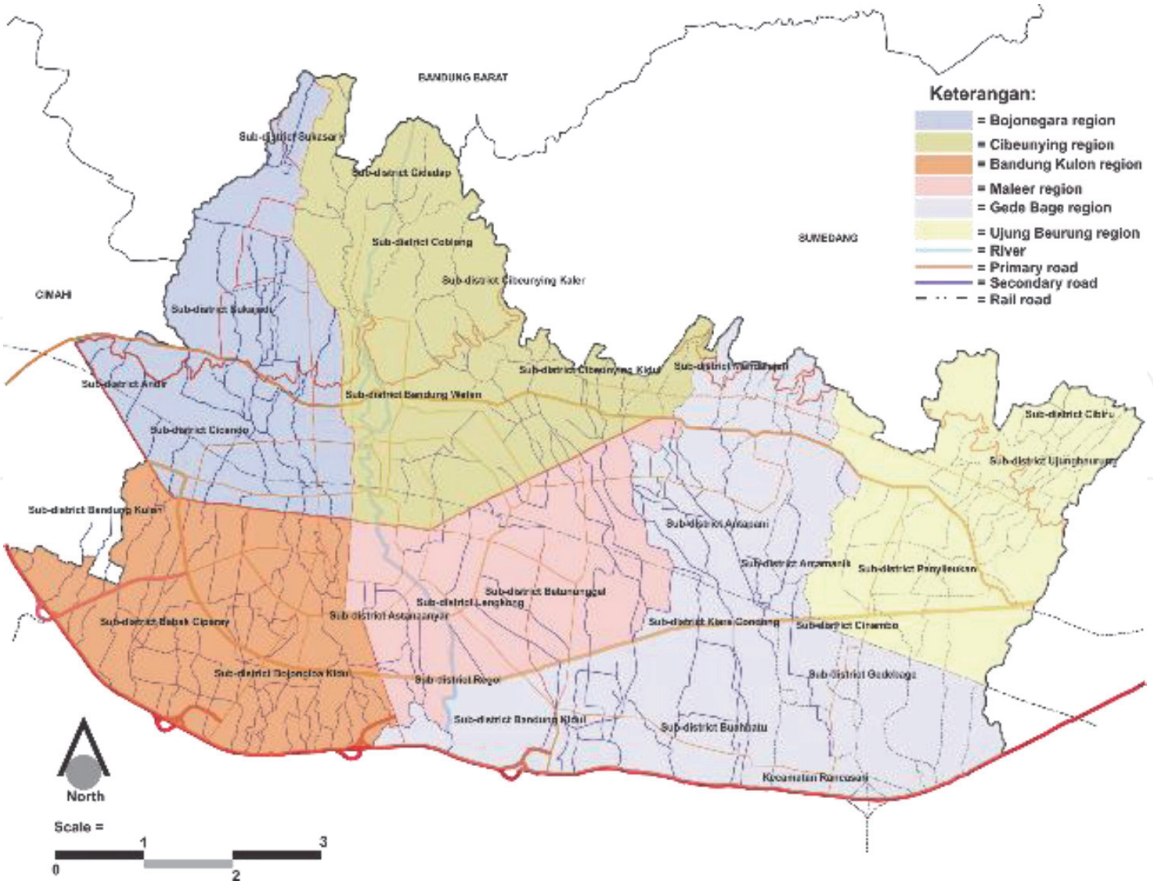


Figure 7.
Map of Bandung City. Source: processed from digital and Google map, 2019.

4. Results and discussion

Amid the Covid-19 pandemic, everyone cannot travel for tourism, so the tourism sector is severely affected. Moreover, it is related to the domestic MICE (meeting, incentive, convention, and exhibition) industry. This condition needs to be more exploratory by holding virtual tourism or virtual events. The use of VR technology for various purposes has been very developed, including for the tourism sector. VR is used in the tourism sector only to disseminate information, but during the Covid-19 pandemic, it can be developed into a virtual tourism development model. This virtual tour invites tourists to surf virtually directly by visiting tourist objects following their tourist destinations.

Making content about historical building tourism objects containing information about these tourism objects. The content can be accessed for free with limited features. If virtual visitors want complete content, they must pay for tickets (online) as if entering a tourist attraction directly. Heritage buildings as a legacy of colonial architecture in Bandung during normal times were visited by many domestic and foreign tourists. Currently, it is very potential to build a virtual tourism model, where tourists are invited to surf to visit several historical architectural buildings. The virtual tour will allow visitors to surf and explore all tourist objects.

Based on the design that has been made, the next step is the assembly stage, where through development using panoramic photos (using PG GUI software, making maps (taken from Google maps), and creating program code (using eclipse software). The results of this assembly are based on application design. a virtual tour that has been adjusted to the results of the analysis carried out previously, namely the 5 objects of historical and heritage buildings in the city of Bandung

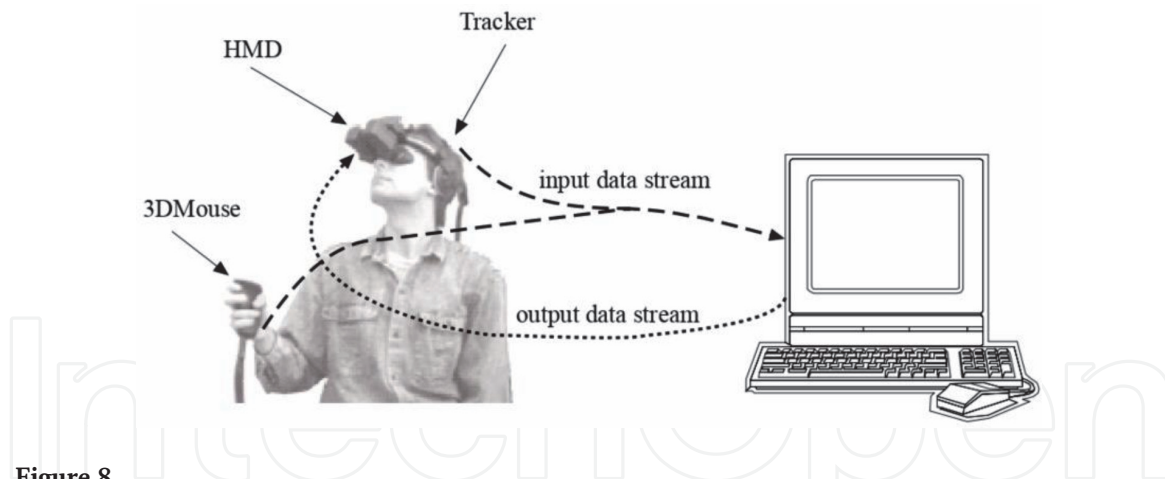


Figure 8.

Basic components of VR immersive application. Source: Mazuryk and Gervautz [53].

through immersive photography techniques so that the results can display interactive visual information.

The implementation of the virtual tourism model with the MDLC approach is divided into 2 (two) main stages, namely, the first part is the data and architectural visualization phase, and the second part is the modeling phase. In this modeling phase, wake up after the design and coding phase is complete, where at this stage it contains several models which are a combination of virtual modeling and the results of video or photo recording 360°. After a new modeling system is made, it is run and observed to see the performance of the system. This process includes 2 views, namely the main menu display and the 360° photo display (**Figure 8**).

Implementation of the system on the main menu display is a step to put the system so that it is ready for operation. This process aims to confirm the design modules so that the user can provide input to the system developer. As for the photo display, 360° is used to view the results. This stage is used the Google cardboard application as a VR tool that uses a smartphone as a platform/layer.

The testing and distribution stages are used for testing and packaging the application. Testing is done using Alpha testing, namely by running the application and seeing whether there is an error or not. The test results went well, and the content and buttons from the navigation function as intended. The distribution stage is the final stage of application packaging. Where in this virtual tour application, the application file is packaged into an executable file (.apk) and then packaged into a self-extractor file of type.apk. This file can only be run on mobile phones with the Android operating system.

5. Conclusion

VR as one of the applications offers the opportunity to reconstruct and invite users to experience virtual space as real conditions. VR modeling is very useful, especially in the field of architecture which is aimed at reconstructing historical and heritage buildings, so that users are invited to virtually surf and tour the past. Through the application of VR, it can enhance the experience of real and pseudo-spatial collaboration as a contribution to education for the younger generation and public appreciation, namely through reconstruction and chronological sequence of events in history.

The development of a virtual tourism model for historical and heritage buildings in the city of Bandung can be concluded that:

- a. To be able to display and run the virtual tourism model the most needed factor is a good and stable internet connection so that content display will be smooth and fast.
- b. The use of panoramic images of 360⁰ can represent and make it easier for users to accept and understand what is presented/conveyed.
- c. The implementation of panoramic photos in the VR application for tourism of historical and heritage buildings in Bandung can be further developed by more professional developers.
- d. It is necessary to develop the quality and size of the panoramic photo according to the type of photo image using the Panorama GL library.
- e. Where in the future, the use of VR technology needs to be further developed to inspire public participation in supporting the socialization and preservation of historic and heritage buildings, especially those in Bandung, generally in cities in Indonesia, both for educational, socio-cultural and tourism purposes.

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