Jurnal Mantik, 5 (2) (2021) 1006-1015

Published by:Institute of Computer Science (IOCS)

Jurnal Mantik

Journal homepage: www.iocscience.org/ejournal/index.php/mantik/index

Implementation Of Mobile Bimx System On Uma Kabuong Limo House Virtual Restoration

Muhd. Arief Al Husaini

Department of Architecture, Engineering Faculty, Riau University, Jl HR Soebrantas km 12,5 Kampus Bina Widya, Pekanbaru, 28293, Indonesia

E-mail: muhd.arief@lecturer.unri.ac.id

ARTICLE INFO

Article history:
Received: 30 July 2021
Revised: 12 August 2021
Accepted:15 August, 2021

Keywords:
BIMx, Uma Kabuong Limo, Restoration, Malay

ABSTRACT

Indonesia has many potential heritage buildings, one of which is Uma Kabuong Limo in the Kampar district. The Uma Kabuong Limo building was damaged and restoration measures were needed. Conventional methods give rise to the potential availability of mobility of building data. This study aims to use BIMx mobile technology system as a restoration method that produces virtual simulations. This research is qualitative descriptive research with simulation and modeling research method, which utilizes technology in producing models and can simulate the building environment to be restored. The object of the research was the Nurdin family's Uma Kabuong Limo in Belimbing Island Village, Kampar Regency, Riau Province. The result of this study is to successfully build the Uma Kabuong Limo model and can be simulated in the BIMx application. The use of BIMx provides ease of the process and avoids mistakes in the decision-making of the restoration of the Uma Kabuong Limo building.

1. Introduction

Uma Kabuong Limo is a residence of mainland Malay people found in the Kampar district of Riau Province. Belimbing Island people in Kampar Regency predominantly use Uma Kabuong Limo as a place to stay. Uma Kabuong Limo has five aisles or contents with different functions. This building reflects the social status of the community. The social status is seen through the quality of the building, the better the quality of the building, the higher the social status of the owner. The quality of the building is indicated by the use of durable wood materials, the size and shape of the building, and the use of various carvings [1]. Uma Kabuong Limo building is generally a heritage building from generation to generation, so the average building age is over 50 (fifty) years or more.

The last 2 (two) decades there has been a change in the way of settlement, namely the transfer of the old settlement area in the village of Belimbing Island to a new settlement area. The new settlements did not apply the rules of old village space and the house was changed in shape [2]. This resulted in the number of Uma Kabuong Limo buildings being damaged. Flooding and climate change accelerated the damage of Uma Kabuong Limo. Until 2021 Uma Kabuong Limo buildings are left 4-7 buildings in Kampung Pulau Belimbing I. The damage needs to be addressed immediately so that the remaining buildings do not suffer damage.

Based on the rule that buildings that have significant value seen from history, application of technology, science, cultural value can be categorized as cultural heritage [3]. The building needs conservation to become a bridge of past architecture science with the present. Cultural heritage objects are not only as memories of the past but also as a spirit of identity that can describe the nation's culture while serving as a source of value, knowledge, and culture. So that the old buildings that have the potential of cultural heritage need to be maintained or conserved. Conservation is the concept of the process of managing a place or space or object so that the cultural meaning contained in it is well preserved [4].

Accredited "Rank 4"(Sinta 4), DIKTI, No. 36/E/KPT/2019, December 13th 2019.

In addition to the limitations of expert problems in the process of architectural conservation in the region is the limitation of adapting the development of technology. The application of architectural technology in the area is still slow. The option that is often done in the area is the use of conventional technology in architectural processes. Currently, stakeholders in Kampar District do not apply new technology in architectural activities so generally use conventional technology [5]. One of the characteristics of conventional technology is the use of a lot of software so that the low integration between software. Currently, the use of paper is still high in the process of planning, implementing, and supervising the construction field. one of the weaknesses of this system is easily damaged paper, misalignment between data, and difficulty accessing information data in the field.

Architectural technology developer vendors are currently competing with time in providing technology to facilitate architectural activities. One of the conservation activities needed is detailed information related to the implementation of supervision of heritage buildings. Conservation can adapt to advances in information technology without losing its purpose [6]. One of the conservation efforts using technology is the presentation of graph database modeling on IFC data of Malay architecture [7]. One of the newest methods that can facilitate Uma Kabuong Limo conservation activities is the use of the BIMx application. This application is based on the building information modeling method. This method makes it easy to quickly access communication and integration between data. This study implemented a mobile-based data system using BIMx Hyper Model. This application is available on mobile devices so it is easy to carry during field visits in the restoration activities of the Uma Kabuong Limo building.

2. Literature Review

2.1. Modeling Techniques of Building Information Modelling

Currently, technology in the field of construction is growing rapidly so that the approach of building information modeling (BIM) is highly recommended in the construction process. The construction process is an activity that takes place for a limited period, with a certain allocation of resources, and is intended to carry out tasks whose objectives have been set [8]. Conventional construction developments have the weakness of separating data into multiple files. The separation of these files will provide an integration error gap, thus creating a potential construction process error [9]. Currently, the density of construction is needed so that the recommended files are merged into one [10].

BIM refers to a combination or set of organizational technologies and solutions that are expected to enhance inter-organization and discipline collaboration in the construction industry and to improve productivity and quality of building design, construction, and maintenance [10]. BIM is a domain of extensive knowledge in the Architecture, Engineering, Construction, and Operations (AECO) industry [11]. The promising benefits of efficient resource management motivate research to address the uncertainty of building conditions and the lack of documentation prevalent in existing buildings [12].

Parametric objects are also called "smart models" and all related smart model elements are connected to a database containing data [13]. Building information modeling covers all aspects of the building from the planning stage to the management, maintenance, and restoration of heritage buildings to provide an opportunity to manage the heritage building process [14]. Nowadays the development of mobile applications is growing rapidly and has been used in various fields including architecture. An application is a single unit of software created to serve the needs of activity [15]. The application uses the operating system (OS) of the computer and other applications that it supports. Specialist software applications as programs with incorporated documentation designed to perform specific tasks. The diversity and complexity of BIM technology are visible in many areas such as the environment, buildings, construction, monuments, structural frameworks [16]. Furthermore, it is said that BIM application was developed towards heritage building information modeling (HBIM) by showing the stages of data collection, data processing, database creation through parametric to 3D virtual models.

2.2. Architectural Conservation

Conservation is the whole process of maintaining a place to maintain its cultural significance [17]. Cultural heritage and its value must be maintained dynamically by protecting, developing, and utilizing it [3].

Accredited "Rank 4"(Sinta 4), DIKTI, No. 36/E/KPT/2019, December 13th 2019.

Conservation is an effort to restore heritage buildings in concrete steps through regional revitalization, repair, restoration, or revitalization. Buildings have a character that distinguishes them from other buildings through the arrangement of diversity and intensity of architectural object characteristics. In addition, it can also be seen from the composition of the basic elements of the object shaper such as shapes, lines, colors, and textures [18]. The restoration process allows for removal actions on additions that have the potential to reduce the value of cultural heritage. Restoration is based on respect for existing materials, and all evidence of identification and analysis so that the value of the inheritance is revealed as before [19].

3. Research Method

This study is a qualitative descriptive study to understand a central symptom so that researchers can interview participants by asking common questions [20]. Furthermore, analysis and information will be published in a written report. Qualitative descriptive research is considered appropriate to look for value, public perception, and also the ongoing process of change [21]. Data reading analysis used is synchronic reading that is an effort to synchronize information and data obtained at the same time [22]. The research method is simulation and modeling research. This method is widely used in architecture to provide a design proposal experience in the form of "virtual reality" before moving on to the development stage. This simulation is useful when ensuring the scale and complexity of the design. Model engineering in computers provides a subjective dimension lesson on the relationship of human habits in the context of [21].

Figure. 1. Research Methods

This research was conducted in 5 stages. First, data collection is conducting field surveys. Field surveys are conducted on object measurement and shooting, interviews of research object owners, and recording. Second, the analysis is to perform the field data sorting stage to provide the main data needed for the modeling stage. Third, model making is making Uma Kabuong Limo model on building information modeling (BIM) based software. The software used is Archicad 24. Fourth, create a Hyper Model for the BIMx mobile application, transferring bim model data to the mobile application. Fifth, the use of BIMx is the confirmation of data that can be opened in the BIMx application. The object of this research is Uma Kabuong Limo belonging to the Nurdin family. The selection of such objects is based on age and the building has the completeness of the architectural components of Uma Kabuong Limo. The object of this research is in Belimbing Island Village, Kuok District, Kampar Regency, Riau Province.

Figure. 2. Research locations and objects (Google Earth Sensing, 2021)

Accredited "Rank 4"(Sinta 4), DIKTI, No. 36/E/KPT/2019, December 13th 2019.

4. Research Result and Discussion

Other Malay-patterned buildings have been widely researched such as Rumah Godang Koto Sentajo and Rumah Suku Akit by Gun Faisal and John Firzal contained in the Malay wood carving article: The Godang house at Koto Sentajo and Study of Vernacular Coastal Architecture: The Construction of Akit's House in Rupat Island. While the Malay building Uma Kabuong Limo has not been studied further. This research is a continuation of previous research on the principles of tropical architecture of Uma Kabuong Limo buildings that resulted in a book on the principles of tropical architecture Uma Kabuong Limo to complete the study of Riau Malay architecture.

Other Malay architecture research still uses conventional models so this research seeks to make modeling using information technology based on building information modelling (BIM) to give rise to new methods in reviewing Malay architecture. In conservation research, cultural heritage buildings already exist using building information modeling (BIM) such as Waljiyanto and Chintya in three-dimensional modeling articles (3D) of cultural heritage buildings using cloud data points. As well as Sangaji et al in the article on the application of building information modelling (BIM) in the design of buildings. Both articles are still in the BIM modeling stage while the study further applies the BIMx application as a model presentation on mobile systems after the BIM modeling process.

4.1 Survey Uma Kabuong Limo

Many Uma Kabuong Limo buildings are no longer functional because the owners have moved to new areas. The change of residence that occurred in Kampung Pulau Belimbing caused many buildings of Uma Kabuong Limo to be damaged. In the survey, activity obtained the percentage of damage 40 % - to 100%. The percentage of damage 40 % - 65 % found damage to architectural elements and structural elements so that the building is classified as severely damaged. While the percentage of 100% is the building in the get has been completely damaged or collapsed. In this research, the object has been analyzed that the building suffered severe damage up to 65 %. Damage is seen on the structure columns, beams, stairs, and roof frames. Damage to architectural elements is seen on walls, windows, ceilings, and floors. Based on the damage, conservation efforts are needed for the building to be re-maintained. The proper maintenance action is the restoration of the building to its original form.


Figure. 3. (Left) View from the South. Figure. 4. (Right) Damage to Building Components

4.2 Uma Kabuong Limo in Building Information Modelling

In the early stages of virtual restoration, the creation of research object models in building information modeling (BIM) based software was carried out. The software used is Archicad 24 with an education version license. The process of model engineering in this software provides advantages such as data that can be developed in real time, data can be integrated 2 Dimensions and 3 Dimensions, data can be transferred to other BIM software with IFC data format, and can work together with online base or IoT. In the early stages of preparing basic needs such as toolbars and palattes on the tools window. In addition, prepare project map and view map according to the needs of images such as floor plans, views, pieces, and other images. Next prepare the layout book by preparing the image header so that the image will be well identified. The next stage is the creation of models on each storey such as floor plans on the floor plan stotey, 1st floor on the 1st floor, roof on the roof storey can also be

Accredited "Rank 4"(Sinta 4), DIKTI, No. 36/E/KPT/2019, December 13th 2019.

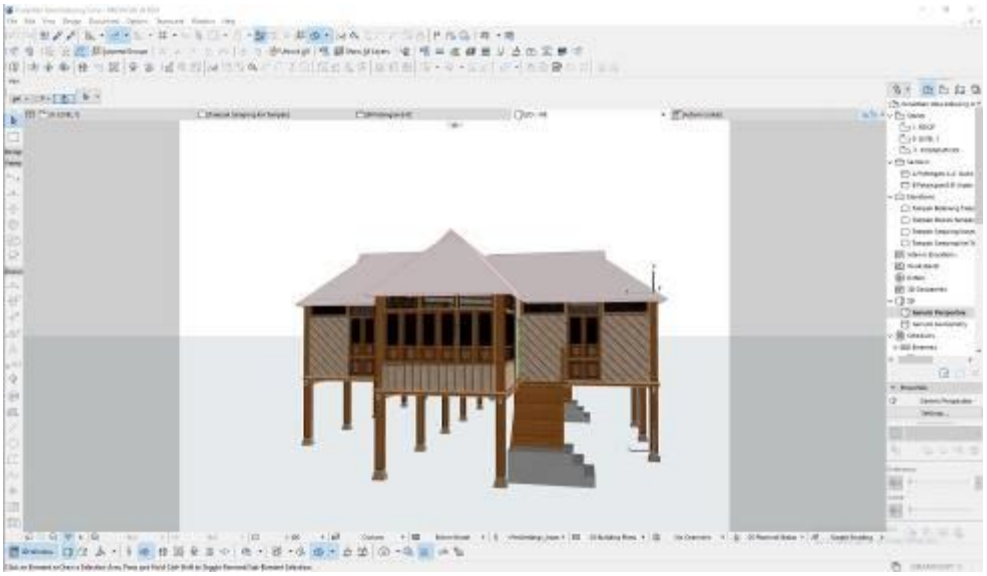

Figure 5. Interface Model View on Archicad Software

After the next model creation ensures that the information of each building element object has been inputted. The information will be read on BIMx mobile system in the form of data needed in restoration. The input process is performed on a 3D display in the BIM application. The stage of filling data is to select building objects in 3D. Next enter the settings dialog (control T) then will appear selection setting information box. In the selection setting box, there is data that must be filled in geometry and positioning, model, structural analytical parameters, and classification and properties according to building information Uma Kabuong Limo.

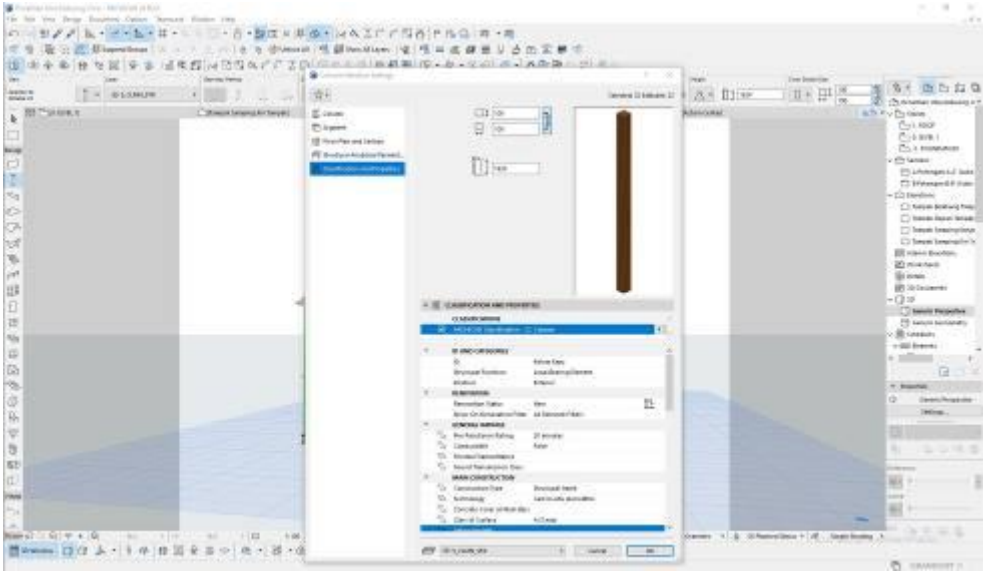

Figure 6. Input Information on 3D Models

The final stage is the process of publishing BIM data to BIMx data. BIMx uses the BIMx Hyper Model format. The hyper model format is a set of features that allows for easier integration of complex 2D and 3D models. This section at least performs some important steps, namely setting up the publisher shet folder on the organizer – publisher. The folder you have created must go through the process of setting up publishing properties to know the storage and format you want. Next, move the entire list of images and perspectives that will be brought to the hyper model by dragging from the project map or view map, or layout book into

Accredited "Rank 4"(Sinta 4), DIKTI, No. 36/E/KPT/2019, December 13th 2019.

the publisher sets folder. The final stage is to publish until all confirmed data can be included with the appearance of a checklist mark. The hyper BIMx model file is moved to the mobile device.

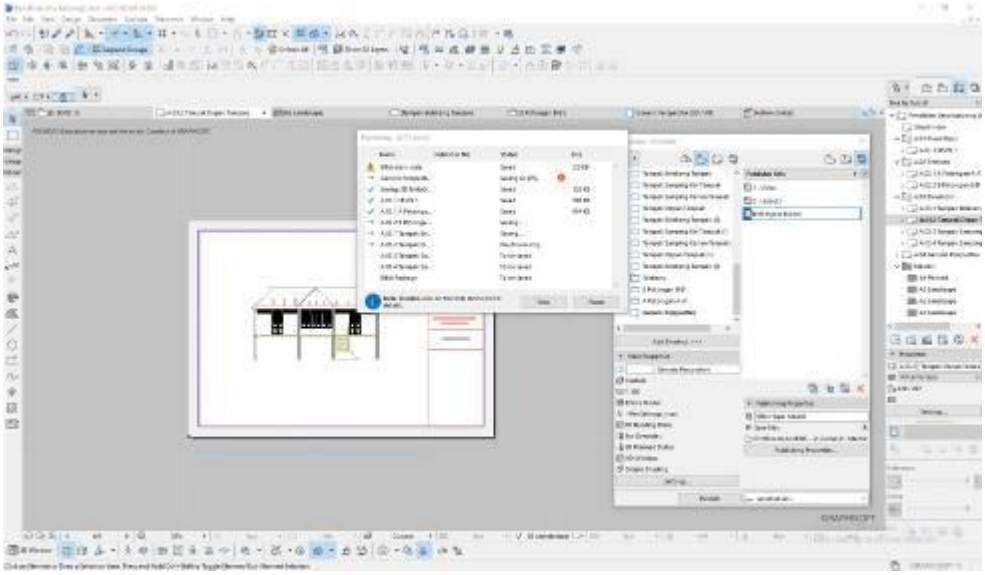

Figure 7. BIMx Hyper Model Publish Process

4.3 Implementation of Mobile BIMx System in Uma Kabuong Limo

This section of data has been entered on mobile devices both Android system and IOS systems. The left image is a BIMx view on a mobile device that displays a list of projects that have been entered. In this research, the project included is a file named research Uma Kabuong Limo number 2. The right image shows a list view of the images in this research file such as floor plan images, viewable images, crop images, and perspectives.

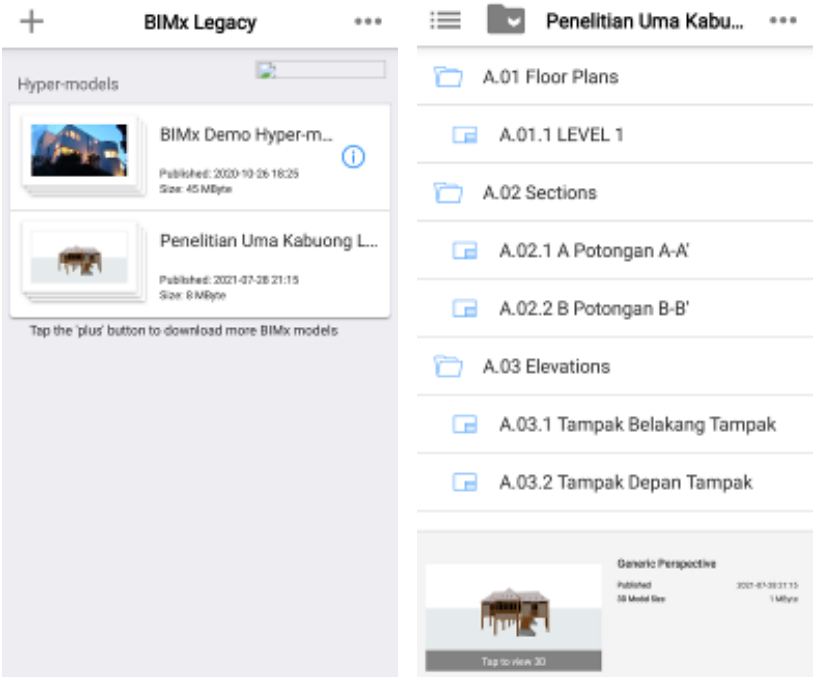

Figure. 8. (Left) Initial View of Hyper Model Format Has Been Inputted. Figure. 9. (Right) Hyper Model Data File Vie

Accredited "Rank 4"(Sinta 4), DIKTI, No. 36/E/KPT/2019, December 13th 2019.

Figure. 10. (Left) 2D. Figure Plan Image View. 11. (Right) 2D integration image view and 3D Floor plan

BIMx can integrate 2D and 3D floor plan views. This integration is done with superimposing technique so that restoration researcher Uma Kabuong Limo understands the position and shape of building elements in precision and detail. The 3D view will be truncated so that it can show the inside of the floor plan openly. The position of the intersection height can be moved up or down so that the user can determine the desired information on the floor plan.

Figure. 12. (Left) 2D Cut-Out Image Display. Figure. 13. (Right) 2D integration image display and 3D Crop

Accredited "Rank 4"(Sinta 4), DIKTI, No. 36/E/KPT/2019, December 13th 2019.

Uma Kabuong Limo building has a complexity of structural and architectural elements that require an easier way of presenting images. The cut image is an important part of a working image on restoration. Restoration researcher Uma Kabuong Limo has always had difficulty drawing pieces if they are only presented in 2D pieces because they have diverse information. BIMx provides ease in presenting the integration of section images in 2D and 3D, making it easier to understand the image of the building pieces. In this BIMx mobile data, users can perform image detailing and crop transfer quickly.

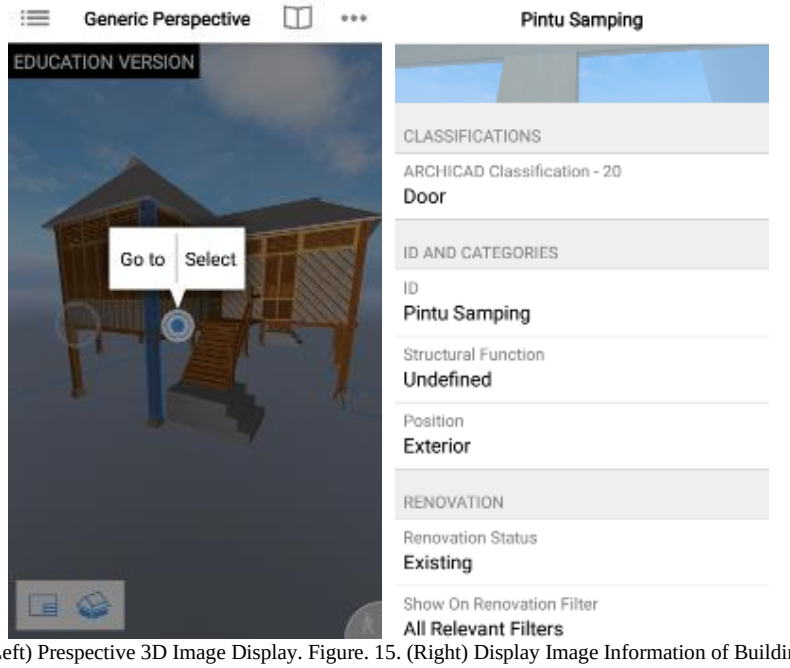

Figure. 14. (Left) Prespective 3D Image Display. Figure. 15. (Right) Display Image Information of Building Elements

One of the important things in this restoration process is the presentation of the building information as a whole. This restoration research file includes a perspective image of the building. This perspective image shows the building as close as possible to the original information of the building such as material, color, shade, size, position, and so on. This makes it easy for researchers to check the building elements of Uma Kabuong Limo. In addition, the perspective image has been equipped with information on each component of the building element. Researchers select the object to see the information by pressing the infobox. After that, you will see a box of information on building elements such as classification information, ID and category, material, renovation status, and so on (figure 15).

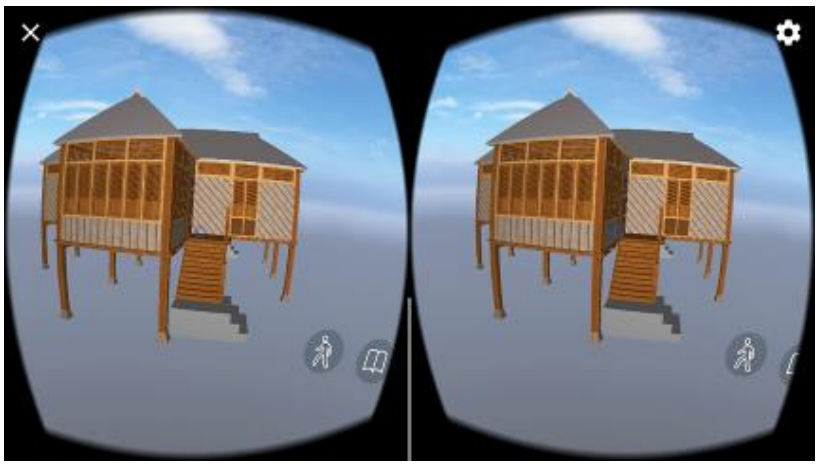

Figure. 16. Cardboard Virtual Reality Display

Accredited "Rank 4"(Sinta 4), DIKTI, No. 36/E/KPT/2019, December 13th 2019.

Uma Kabuong Limo is a cultural heritage object that has a high stamp of damage to buildings so it is necessary to be careful in any restoration actions. To achieve prudence it requires comprehensive understanding even to feel as close to the restoration object as possible. One of the advantages that BIMx mobile system has is the cardboard virtual reality feature. Virtual reality is a serving of technological information that allows users to interact with the environment in the virtual world simulated through a device /system. Researchers can not only watch or see images but can also feel the tour in 360 degrees so it will be easier to understand. This application can present a virtual reality view of the Uma Kabuong Limo building. This virtual reality helps make it easier for restoration actors to understand and feel the character of Uma Kabuong Limo in detail such as shape, motif, scale, building elements.

5. Conclusions

Restoration is one of the architectural conservation activities that demands thoroughness in the implementation of actions. Such thoroughness can be achieved by mastering the ever-evolving architectural technology. The BIMx application is very helpful in the restoration process of heritage buildings. The use of BIMx application has been implemented in the restoration of the Uma Kabuong Limo building to avoid misinformation of architectural elements. The advantage of using BIMx is that it can integrate 2D and 3D data buildings so that data is easy to understand, data is presented in mobile technology so that it is easy to carry anywhere, a relatively sustainable approach due to the little possible use of paper, and gaining visual experience through virtual reality. The implementation of this BIMx application results in the development of restoration methods from conventional to technology-based methods, especially virtual to produce a specific model simulation.

Acknowledgments

The author would like to thank the Institute for Research and Community Service, University for the research funding with contract number 590 / UM.19.5.1.3 / PT.01.03 / 2021. This research fund is used as operational funding and model making of the Malay House Uma Kabuong Limo, so that the research runs well.

References

[1] M. A. Al Husaini, *Prinsip Arsitektur Tropis Pada Rumah Tradisional Melayu Uma Kabuong Limo Dengan Pemodelan Metode Building Information Modelling (BIM)*, 1st ed. Pekanbaru: UR Press, 2020.

[2] M. A. Al Husaini, "Morphological Characteristic of Pulau Belimbing Village in Riau Province , Indonesia," vol. 4, no. 4, pp. 483–492, 2016.

[3] P. Indonesia, "Undang-Undang Republik Indonesia Nomor 11 Tahun 2010 Tentang Cagar Budaya." p. 9, 2010.

[4] ICOMOS, "Charter for the Conservation of Places of Cultural Significance," Australia, 1982.

[5] M. A. Al Husaini and I. Kuswoyo, "Analisis Penggunaan Renovation Tools BIM Dalam Proyek Dalam Proyek Konstruksi Di Kabupaten Kampar," vol. 1, no. 1, pp. 22–27, 2021.

[6] Bani Noor Muchamad and Ira Mentayani, "Model Pelestarian Arsitektur Berbasis Teknologi Informasi Studi Kasus: Arsitektur Tradisional Suku Banjar," *Dimens. (Jurnal Tek. Arsitektur)*, vol. 32, no. 2, pp. 95–101, 2004, [Online]. Available: http://puslit2.petra.ac.id/ejournal/index.php/ars/article/view/16180.

[7] M. A. Furqon, G. Faisal, and N. F. Najwa, "Graph Database Modelling on Malay Architecture IFC Data," no. May, pp. 50–55, 2021, doi: 10.38027/iccaua2021139n7.

[8] I. Soeharto, *Manajemen Proyek dari konseptual sampai operasional*, 1st ed. Jakarta: Erlangga, 1995.

[9] M. A. Al Husaini, "Analisa Pemahaman Mahasiswa Arsitektur Tentang Metode Building Information Modelling (BIM) Untuk Mendukung Revolusi Industri 4.0 Bidang Konstruksi di Provinsi Riau," *Pros. Semin. Nas. Teknoprenuer 1 UPP*, vol. 266–270, 2018.

[10] R. Miettinen and S. Paavalo, "Beyond the BIM utopia : Approaches to the development and implemetation of building information modelling," *Autom. Constuction*, vol. 43, pp. 84–91, 2014, doi: https://doi.org/10.1016/j.autcon.2014.03.009.

[11] B. Sucar, "Building information modelling framework: A research and delivery foundation for industry stakeholders," *Autom. Constuction*, vol. 18, pp. 357–375, 2009, doi: https://doi.org/10.1016/j.autcon.2008.10.003.
[12] R. Volk, J. Stengel, and Frank Schultmann, "Building Information Modeling (BIM) for existing buildings — Literature review and future needs," *Autom. Constuction*, vol. 38, pp. 109–127, 2014, doi: https://doi.org/10.1016/j.autcon.2013.10.023.
[13] C. Dore, M. Murphy, S. McCarthy, F. Brechin, C. Casidy, and E. Dirix, "Structural simulations and conservation analysis-historic building information model (HBIM)," *Int. Arch. Photogramm. Remote Sens. Spat. Inf. Sci. - ISPRS Arch.*, vol. 40, no. 5W4, pp. 351–357, 2015, doi: 10.5194/isprsarchives-XL-5-W4-351-2015.
[14] M. Murphy, E. Mcgovern, and S. Pavia, "Historic building information modelling (HBIM)," *Struct. Surv.*, vol. 27, no. 4, pp. 311–327, 2009, doi: https://doi.org/10.4018/978-1-4666-8379-2.ch007.
[15] Jim Buyens, *Web dabase Development. Elex Media Komputindo*, 1st ed. Jakarta: Graga Ilmu, 2001.
[16] S. Logothetis, A. Delinasiou, and E. Stylianidis, "Building information modelling for cultural heritage: A review," *ISPRS Ann. Photogramm. Remote Sens. Spat. Inf. Sci.*, vol. 2, no. 5W3, pp. 177–183, 2015, doi: 10.5194/isprsannals-II-5-W3-177-2015.
[17] ICOMOS, "The burra Charter," Australia, 1999.
[18] A. Risdyaningsih, Antariksa, and N. Suryasari, "Pelestarian Gedung Pertemuan Kompleks Asrama Inggrisan Kota Banyuwangi," *Arsit. e-Journal*, vol. 7, no. 2, pp. 115–128, 2014.
[19] ICOMOS, "New Zealand Charter," New Zealand, 2010.
[20] J. W. Creswell, *Research Design : Qualitative, Quantitative and Mixed Method Approches*, 4th ed. Singapura: SAGE Publishing, 2014.
[21] L. Groat and D. Wang, *Architectural Research Method*, 1st ed. Canada: J Wiley Inc, 2002.
[22] Endang Titi Sunarti Darjosanjoto, *Penelitian Arsitektur di Bidang Perumahan dan Permukiman*, 1st ed. Surabaya: ITS Press, 2012.