Development of Hand Gesture Command Using Leap Motion for Floorplanner App

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Innovations in architectural simulation applications have evolved from traditional mouse-based interfaces to more immersive methods such as gestures and limb movements. Leap Motion is a device that recognizes hand gestures and is gaining popularity due to its interactive approach. However, despite advances, his use of Leap Motion in 3D architectural design simulations lacks innovation. The authors addressed this gap by designing a hand gesture command system for an architectural design app that was tested in Floorplanner simulation. Users from a variety of backgrounds rated the system on a usability scale, resulting in a score of 59.167 out of 100. This means that it works "barely acceptable", although it does require some knowledge of the device.

***Key words*: Gesture Command, 3D Simulation, Architecture Design, Leap Motion, System Usability Scale.**

I. INTRODUCTION

Architecture is part of the art of life and is most successful when it seems to give expression to the life that inhabits it. Our feelings can be influenced by the shape of a building – whether or not it looks beautiful, appropriate, or attractive – whether it looks solid and reliable or ostentatious and insincere [1]. Architecture cannot be away from technology's influence in professional field or even education about the architecture field [2].Architecture in the current era has developed a lot so that many applications can be used to train or try to design your own houses, cafes, or other types of buildings that you want, both inside and outside, such as AutoCAD, Rhino 3D, SketchUp, and so on.

Applications such as AutoCAD are highly complex computer-based design (CAD) software [3]. Another architecture app is Rhino 3D with most commonly used due to its capability of creating free-form curves and surfaces which facilitates the creation of complex and intricate designs in a workable aspect [4]. Also SketchUp, this application is one of the most familiar and popular 3D modeling programs out there, enables users to create 2D and 3D models for use in a variety of fields including mechanical engineering, architecture even gaming, and still has many other complex features [5]. However, that popular and usual apps are too complex. In addition to applications that have been widely used by those who have jobs or are studying the field of architectural design with simple interfaces and features, there are several applications that simulate design images in a more real and interesting way to use but simpler than the usual app, such as Floorplanner. The utilization of Floorplanner is warranted due to its status as a simulation application that proves highly advantageous for individuals seeking to engage in the design process of a building and its components, encompassing a 3D visual representation and an intuitive user interface. Further, Unity is an app that is already integrated with virtual devices, 3D simulation app assets and the system built in Unity also can be used for other app that didn't from Unity Assets.

However, even though there are so many apps that can be used for and in other fields than architecture that already starts using virtual media like a simulation on the body's part, there is still no one in architecture design app using virtual media. Many virtual devices or media already exist to control virtual 3D simulation applications such as mouse, Augmented Reality (AR) tools, Virtual Reality (VR) tools, touch screens, and Leap Motion. The use of mouse interaction media is very common to use and the simplest compared to other media, but it is starting to be less attractive to users in an era where devices are more natural and entering the virtual world and require additional space to be able to use them comfortably. Then for AR tools interaction media, many have started to use them and are popular in games and applications that make the virtual world closer so that it appears to interact directly, this media is very interesting to use but requires a smartphone device in addition to interacting with the desired object and sometimes still looks less real or does not match the quality it should be [6]. Furthermore, media VR tools such as VR headsets and HTC Vive devices, There is one journal about architecture design application that using VR tools for replace of mouse and keyboard with the results of it are helpful and effective for using virtual devices to architecture design application [7]. VR Tools is the media that are most closely related to the virtual world where users can feel directly in the virtual world, even with complete tools, they can feel almost all of the senses that humans have, but VR tools can burden the user's mind due to the side effects of being connected to the virtual world directly so that it can be difficult to distinguish between the real world and the virtual world and the devices used by users are sometimes uncomfortable for some users [8]. Then the Leap Motion interaction media, Leap Motion has a light device load, is practical to use only by plug-and-play, does not burden the user's mind, is comfortable and attractive to use, virtual displays can still be felt without any reduction in visual quality so that this media very suitable for use in simulation applications related to architectural design in an era that has a lot to do with virtual without reducing the virtual impression it gives.

In connection with Leap Motion, there is one study that has used Leap Motion, namely "Design Review of CAD Models using a NUI Leap Motion Sensor". In this study, using the Leap Motion device as a motion detection sensor to replace commands for other devices such as a mouse proves that using Leap Motion in simulation software can make it more interactive and intuitive [9]. Also, there is a paper proving that hand gesture is preferred over using mouse and keyboard for the design interface. User test results on the paper verify that system using leap motion hand gestures is more natural and intuitive than using mouse and keyboard in architectural design [10].

Based on this, the use of the mouse requires additional space to be used, it is less attractive to use for virtual 3D simulation applications in the era of media devices that have approached the virtual world such as AR, VR, and Leap Motion and are still less interactive than virtual media devices. Furthermore, human gesture recognition as an interaction technique to provide more natural interpretation and communication with computers. The purpose of this study is to find out the possibility of using leap motion, the effectiveness of the Leap Motion controller in recognizing hand gestures. So that the interaction can be more interesting, and interactive, able to use the application even with insufficient space to use the mouse and comfortable to use in the Floorplanner architectural design simulation application, this research will develop hand gesture commands using Leap Motion to Floorplanner is suitable and comfortable for users to use. To be able to determine the most suitable and comfortable hand gesture according to the user, a survey will be conducted on the examiners with several hand gesture options provided. In the process of developing this system, the Unity application will be used because it supports 3D application display, has been integrated with Leap Motion, and the system that built in Unity can be used for application assets in Unity and outside of Unity. It is hoped that the results of this research can be used by the general public, teachers, students, and architect itself to create a more real architectural design that is more interactive, comfortable, and interesting to use.

II. Literature Review and Basic Theory

A. Related Research

Research on the development of hand gesture commands in Floorplanner simulation applications using Leap Motion has not been found when this research is conducted. However, there are several studies related to the application of 3D architecture that can be used as a reference in this study.

Research conducted by Florin G. et al developed a design review method for CAD models using the NUI Leap Motion sensor as a controller. The study contains a CAD model design display that can be controlled using hand movements with the help of Leap Motion such as zoom, pan, and rotate [9].

Furthermore, research conducted by Aron S. et al integrates speech recognition and hand gesture control for interaction with Augmented Reality (AR) design practice. The research uses hardware, one of which is Leap Motion and Unity software with Visual Studio to be able to integrate hand gesture control as an interaction with AR from a design [11].

Then research conducted by Hsu et al built a Design and Initial Evaluation of a VR based Immersive and Interactive Architectural Design Discussion System. In this study, VR tools is used to design and discuss virtually in Rhino 3D architecture design application. The features as results is helpful and effective for designing and discussion [7].

These three studies show that 3D architectural design simulation applications such as Floorplanner will become more interactive and attract the interest of users of architectural simulation applications and enthusiasts who want to try to design their own virtual 3D house and interior using hand gestures and Leap Motion. One of these studies has used Leap Motion as a tool for user interaction with the 3D VR world and there is also using Unity to build applications that will be connected to the 3D VR world.

Research conducted by Johanna et al builds gesture-based interaction features in video games using a leap motion controller. In making these interaction features, the Unity application is also used to connect the interaction features of Leap Motion with video games. The results of this study are the interaction features of hand gestures using Leap Motion can make the experience of doing it more interesting, interactive, and can be used for rehabilitation or therapy on the hands [12].

Research conducted by Binbin Yang et al. developed a flight simulation system using Leap Motion. In the development of the system, hand gesture interaction is used in the process to control flight action and the results obtained are that the accuracy developed has increased significantly [13].

Furthermore, research conducted by Elfrida Riani Tsani reviewed the literature regarding the use of VR and Leap Motion as physical therapy for post-stroke patients. The results of searching and sorting the research literature concluded that the use of VR and Leap Motion is useful as physical therapy in post-stroke patients [14].

Based on the collection of research that has been done, it can be seen that Leap Motion can work well in simulation applications that require interaction with hand movements and become an alternative to the mouse.

B. Supporting Theory

B.1. Architecture

Architecture is part of the art of life and is most successful when it seems to give expression to the life that inhabits it. Our feelings can be influenced by the shape of a building - whether it looks beautiful or not, or appropriate, or attractive - whether it seems solid and reliable or flashy and insincere [1]. On the other hand, in addition to architecture as an art that is felt to be enjoyed and displayed only, the design of architecture can also affect the health and safety of its residents. Environmental architectural design in the future will focus more on developing more human-centered designs in architecture and urban design. This is done to protect the residents as a permanent design strategy to avoid epidemics in the future [15].

B.2. Input Device

Input device is any hardware device that sends data to a computer, allowing you to interact with and control it [16]. There are many type of input device, some of the input device are mouse, keyboard and Leap Motion.

B.2.1. Mouse

Mouse is a pointing device that reflects a hand's 2D movement on a flat surface through the form of a pointer on a computer screen. The first created computer mouse is since 1960s and called mice. Computer mouse is started become popular since 1984 [17].

B.2.2. Keyboard

Keyboard is a typewriter for computer’s input device. The first typewriter was introduced in 1860 and The Sholes & Glidden company established the QWERTY layout in 1874. The keyboard has been the basic input device for computers for many decades now, and this will probably remain unchanged for years to come [17].

B.2.3. Leap Motion

Leap motion is an interactive hardware that has the main target of detecting hand gestures and the position of fingers and palms. This device has 3 infrared (IR) light emitters and 2 cameras to receive IR light. One of the interactions that can be done using leap motion is hand gesture recognition [18]. Leap Motion software was began to developed since 2008 [19].

Fig. 1. Leap Motion device

B.2.3.1. Gesture Recognition

Gestures are a natural part of human communication and are central to AR/VR interactions. Hand gesture recognition can be done by detecting and tracking the position of the fingers and palms. Hand gesture recognition is divided into 2 types, namely static by forming hand gestures only, and dynamic by forming hand gestures and then moving [20].

B.3. Unity3D

Unity or commonly known as Unity3D is a game engine and integrated development environment (IDE) for creating interactive media such as video games. Unity application is a tool with technology that can run graphics, audio, physics, interaction, and networking. Unity supports several programming languages, one of which is C# [21].

B.4. System Usability Scale (SUS)

The System Usability Scale (SUS) is one of the most popular usability testing tools among the general public [22]. The System Usability Scale (SUS) is also a reliable and cost-effective usability testing tool that can be used for a global assessment of system usability [23]. The SUS test itself is carried out by conducting a questionnaire or survey that will provide 10 questions that have 5 short answer choices.

III. RESEARCH METHODOLOGY

A. Tools and Materials

In this research, the tools and materials needed are in the form of software, hardware, as well as supporting data and information during the research.

A.1. Tools

The tools needed in developing hand gesture commands using Leap Motion for Floorplanner Applications are as follows:

- Laptop Lenovo Ideapad 3 15ARH05 AMD Radeon 5 4600H 3.00 GHz RAM 16GB, as a device of conducting research and system development.
- Operating System Windows 10 64-bit, as the main operating system used by researchers in conducting research and system development.
- Visual Studio 2019 and Unity, as a tool for building applications.
- Programming Language C#, as a Programming Language used to build applications.
- Leap motion, as a tool to detect and track the position of the fingers and palms.

A.2. Materials

The materials needed in developing hand gesture commands using Leap Motion for Floorplanner Applications are 2D & 3D Floorplanner website Application, as a simulation application that is used with hand gesture recognition and the Ultraleap Unity Plugin Leap Motion as a Unity package that connects Leap Motion with assets of simulation app built on Unity.

B. Research Flow

The research flowchart from literature study to report generation can be seen in Figure 2.

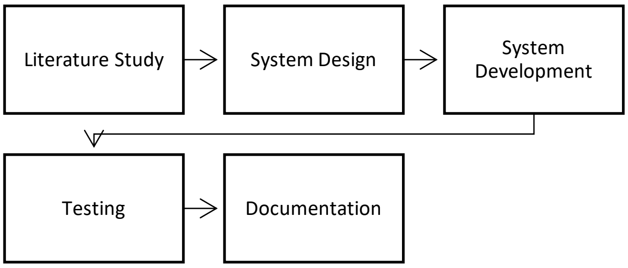


Fig. 2. Flow Diagram

Based on Figure 2 The stages carried out in the implementation of this research are Literature Study, System Design, System Development, System Testing, and Documentation. In the first stage of the literature study, sources related to the issues raised are studied and then used as a basis for conducting research. Then the second stage is system design, namely determining features, and making designs and storyboards from the simulation that will be done. The third stage is system development, namely making simulations based on storyboards, making features in the application, and connecting simulations with hand motion detection along with hand gesture detection which will be a mouse replacement interaction tool using Leap Motion. At this stage of system development, the Extreme Programming method is used. Then the fourth stage is system testing, where the user tests the system using the System Usability Scale to determine whether the system is acceptable and feasible to use. Then in the last stage, the fifth stage is making reports as documentation to be used as learning in future research.

C. System Design

System design is carried out to be able to determine all important decisions such as features and design so that when system development has started everything runs smoothly and efficiently.

C.1. System Architecture

The system architecture serves to describe how this application system works in outline.

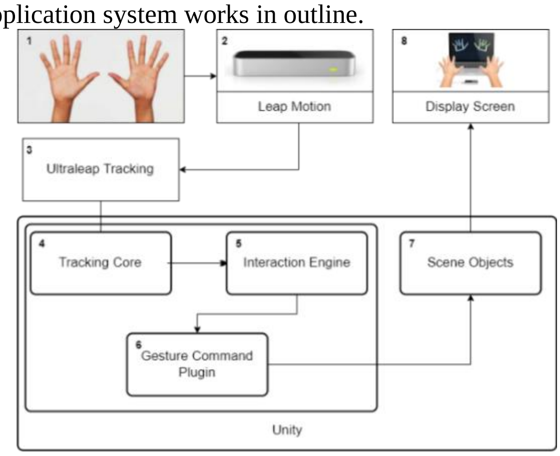


Fig. 3. System Architecture

The first step of this system is the projection of infrared light and Leap Motion will record the user's hand movements which produce data in the form of video. The second step is that the data obtained will be sent via a USB cable to a device such as a laptop/computer and processed by Ultraleap Tracking software to track and detect the position of the recorded fingers. The third step is the processing results from the previous step are sent to Unity which is processed by the Tracking Core assets so that the recorded hand structure data can be built in the Unity virtual world. Step number 4 displays a live virtual animation of the hand structure on the screen. Step number 5 the position of the fingers is sent to the Interaction Engine to be processed as to what type of interaction is carried out. Step number 6 checks between the types of hand gesture interactions carried out with commands that will occur according to the type of hand gestures so that in step 7, the hand object can interact with objects and interfaces that are in the simulation scene, such as hand interaction with the UI of the application. to press buttons or hand interaction by moving objects. Step number 8 displays the objects and scenes in the simulation on the screen according to the hand gesture interaction data obtained previously. All these steps run in real-time during the practical simulation.

Leap Motion as a hand movement recording device is mounted on a table facing upwards so that it is straight with the user's hand position which is in a straight forward position. Illustration of system installation can be seen in Figure 4.

Fig. 4. Leap Motion usage illustration

C.2. Pre-design of hand gesture command

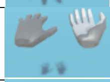
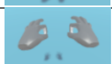
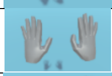
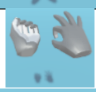
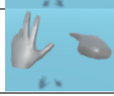
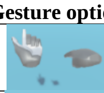
The pre-design of hand gesture commands serves to describe how the hand gestures used for each command can be carried out in outline. Each command is selected from the mouse and keyboard interaction control that is required on the Floorplanner Application. Every command that is needed to control movement in using Floorplanner are :

- Moving the cursor to move the direction of pointing on UI or any features in the Floorplanner interface;
- Left-click the mouse to make further interactions like opening features in Floorplanner, pressing the button, showing options in any objects in the design (furniture, wall, floor, etc), or drag and drop the objects;

- Right-click the mouse to complete all features using a mouse that usually opens pop-up windows with some features corresponding to the interface area in the Floorplanner like inspect, copy or save image, back, forward, reload, or even print the browser page;
- Zooming screen to enlarge or reduce the display size of the design in the Floorplanner App;
- Scrolling vertically to scroll on the list of every item listed in the Floorplanner App such as furniture, all kinds of windows, all kinds of doors or even colors;
- Scrolling horizontally to complete the other kind of scrolling feature in the Floorplanner App that might be used;
- Switching app windows (Alt + Tab button) to switch to other apps running in the background;

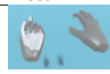
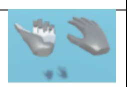
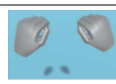
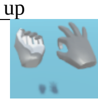
Every gesture that used for Floorplanner App is set by every fingers on hand when it is extended or not and both hand's palm is facing up, front or down. Every gesture used for Floorplanner App is set by every finger on the hand when it is extended or not and both hand's palm is facing up, front, or down. As the Black Box of every 3 gesture used on each command activity in this research that successfully documented can be seen in Table I.

TABLE I. PREDESIGN OF HAND GESTURES WORKING STATUS BLACK BOX

No	Command Activity	Gesture option	Status
1	Moving the cursor		✓
2			✓
3			✓
4	Doing a right-click mouse		✓
5			✓
6			✓
7	Doing left-click mouse		✓
8			✓
9			✓
10	Zooming in and zooming out		✓
11			✓
12			✓
13	Switching Application Windows (Alt + Tab)		✓
14			✓
15			✓
16	Scrolling Vertical		✓
17			✓
18			✓
19	Scrolling Horizontal		✓
20			✓
21			✓

The survey will be given to examiners with backgrounds in architecture and outside the field of architecture by providing a choice of hand gestures for each type of command required. The pre-design that was chosen as the hand gesture can be seen in Table II.

TABLE II. PREDESIGN OF HAND GESTURE THAT WILL BE USED AS INTERCATION COMMANDS

No	Command	Alternative Gesture 1	Alternative Gesture 2	Alternative Gesture 2
1	Moving the cursor	 The index finger and thumb of the right hand meet	 Only the index finger and middle finger of the right hand appear and meet	 Only the thumb and index finger of the right hand appear
2	Doing a right-click mouse	 Left palm facing up	 Only the index finger of the left hand appears facing up	 Right palm facing up
3	Doing left-click mouse	 The index finger and thumb of the left hand meet	 Left hand holding facing down	 The thumb of the left hand appears with the palm facing up
4	Zooming in and zooming out	 Left palm facing forward and right palm facing forward and moving right and left	 Left palm holding facing forward and right palm holding facing forward	 The palm of the left hand grips facing up and the index finger and thumb of the right

No	Command	Alternative Gesture 1	Alternative Gesture 2	Alternative Gesture 2
			moving right and left	hand meet moving up and down
5	Switching Application Windows (Alt + Tab)	 Only the index finger of the left hand appears with the palm facing down and the right palm facing down moving downwards	 Only the thumb, index finger and middle finger of the left hand appear with the palm facing forward and only the index finger of the right hand that appears facing down moves downwards	 Only the thumb and index finger of the left hand appear with the palm facing up and only the index finger of the right hand that appears facing down move downwards
6	Scrolling Vertical	 Left hand holding facing down and right palm facing down moving up and down	 The left hand grips facing down and the thumb and index finger of the right hand meet moving up and down	 Only the thumb and index finger of the left hand appear with the palm facing down and the right palm facing down moving up and down
7	Scrolling Horizontal	 Left hand holding facing down and right hand holding facing down moving right and left	 All fingers other than the thumb of the left hand that appear facing down and the index finger and thumb of the right hand meet moving left and right	 Only the thumb and index finger of the left hand appear with the palm facing down and the right palm clasped facing down moving left and right

C.3. Use Case Diagram

Use Case Diagram is a diagram display that has the aim of providing an overview of the features that can be done by users of the system that has been built.

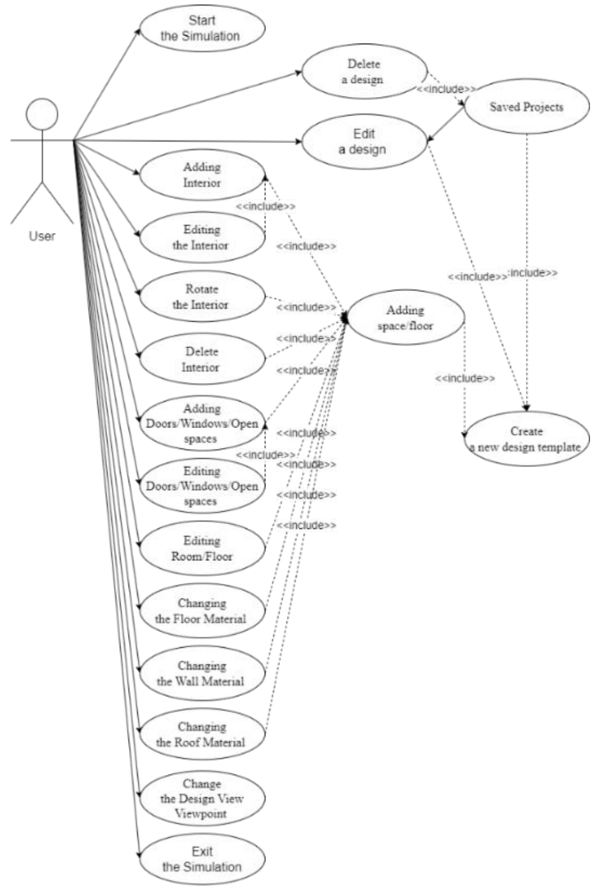


Fig. 5. Use Case Diagram

It can be seen in Figure 5, users can perform activities that come from the Floorplanner, namely:

- Start the Simulation to start the 3D Floorplanner simulation in virtual reality,
- Create a new design template to create a room or floor as a design basis, either automatically provided in L and square shapes or custom through the create room/floor feature,
- Saved Projects is automatic saving data from the designs that have been made in the simulation,
- Delete a design to delete the design data that has been saved,
- Edit the design to manage the changes you want to make to the saved design data,
- Adding space/floor to add space/floor which automatically adds walls and roofs following the shape and size of the side of the floor in order to be able to lay the interior,
- Adding Interior to add interior and putting it on the floor foundation in the desired space,
- Editing the Interior to manage the changes that will be made to the interior both the name, variant, and location of placement,
- Rotate the Interior to rotate the interior direction,
- Delete Interior to delete the interior that has been placed,

- Adding Doors/Windows/Open spaces to create doors/windows/open spaces from the part of the wall that has been created,
- Editing Doors/Windows/Open spaces to manage any changes you wish to make to the doors/windows/open spaces that have been added to the wall such as the size of the holes.
- Editing Room/Floor to manage changes you want to make to the space/floor that has been made such as size, shape, etc.
- Changing the Floor Material to change the appearance of the material used on the floor,
- Changing the Wall Material to change the appearance of the material used on the wall,
- Changing the Roof Material to change the appearance of the material used on the roof,
- Change the Design View Viewpoint to zoom-in and zoom-out on the design view.
- Exit the Simulation to close the application and stop the simulation.

C.4. Mockup user interface

User interface mockup of developing hand gesture commands using Leap Motion for Floorplanner Applications consists of the Floorplanner Welcome screen, Floorplanner main menu, and Floorplanner features.

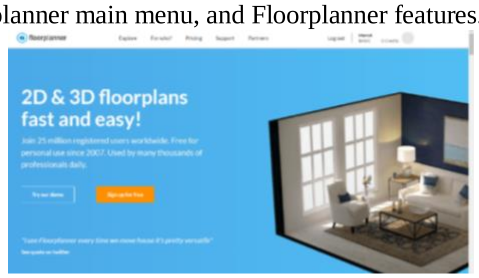


Fig. 6. Welcome screen of Floorplanner web app

In Figure 6 there is a Welcome screen display from the Floorplanner with the description of Floorplanner to welcome users and giving a choice to trying the demo and sign up for free for the free version. Then, sign in to use the Web App.

In Figure 7 the main menu or dashboard will be displayed with an option to create a new project (new design) or open a previous saved projects that has been created. In the main menu there are also several features on the left such as account setting, total projects, total exported projects and credits on the account.

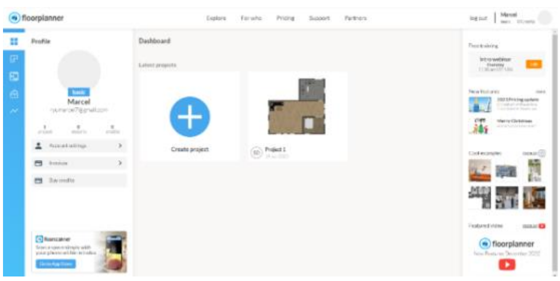


Fig. 7. Dashboard

Fig. 8. Build menu

In Figure 8 there is a menu display when you want to build the design with draw the room, the wall and the surface or place the doors, the windows and the structural and also setting the background. In the build menu there are also several features on the right of top such as color view mode, general setting on build, view mode 2D or 3D and on the bottom left there are measure unit (meter/feet), measure distances ruler, lock construction, lock labels and lines and lock furnitures.

C.5. Testing

After the system is completed, the next step is system testing to determine whether the system is acceptable and suitable for use by end-users. Testing of the system is done by giving the testers the opportunity to use the application, then the System Usability Scale questionnaire is given to the examiners to be filled in according to their experience using the application. Testing of the application system in this study was carried out by users with different backgrounds from architectural and layman backgrounds. In addition to using SUS, open input is also included to accommodate more specific criticism or suggestions from examiners with architectural and informatics backgrounds for further development. Also, there will be testing on comparing using mouse and leap motion by made a same design of floor mapping and interior placement with the same application.

After the SUS questionnaire has been successfully collected, the average of the SUS scores will be calculated by adding up the total SUS scores and then dividing by the number of examiners. A system is declared in the "Acceptable" category with an average score above 70, in the "Marginally Acceptable" category with an average score from 50 to 70, and in the "Unacceptable" category with an average score below 50.

IV. Results and Discussion

The first survey involved respondents testing the system for the first time by feeling themselves against the Leap Motion device and testing the hand gestures provided through the pre-design of hand gestures, which would then select the movement that felt most comfortable and suitable for the user. This survey results is purposed to know the most suitable and comfortable gesture of hand command for users from the given option with each question have 3 option differently each other for all question and option. The survey is taken from a total of 21 respondents 15 of them related to architecture and the rest of them are from outside of the architecture field. From the survey we got results as shown in Table III.

TABLE III. PRE-DESIGN OF HAND GESTURE RESULTS

No	Command Activity	Gesture option	SUS Score
1	Moving the cursor	Alternative Gesture 1	11
2		Alternative Gesture 2	4
3		Alternative Gesture 3	6
4	Doing a right-click mouse	Alternative Gesture 1	11
5		Alternative Gesture 2	8
6		Alternative Gesture 3	2
7	Doing left-click mouse	Alternative Gesture 1	7
8		Alternative Gesture 2	2
9		Alternative Gesture 3	12
10	Zooming in and zooming out	Alternative Gesture 1	13
11		Alternative Gesture 2	5
12		Alternative Gesture 3	3
13	Switching Application Windows	Alternative Gesture 1	10
14		Alternative Gesture 2	9
15		Alternative Gesture 3	2
16	Scrolling Vertical	Alternative Gesture 1	13
17		Alternative Gesture 2	7
18		Alternative Gesture 3	1
19	Scrolling Horizontal	Alternative Gesture 1	10
20		Alternative Gesture 2	9
21		Alternative Gesture 3	2

SUS survey is a survey phase 2 after the gesture is fixed and already try the system before to know if the system is acceptable or not. The survey is taken from a total of 21 respondents 15 of them related to architecture and the rest of them are from outside of the architecture field. Each question SUS score from the survey results can be seen in Table IV and from each respondent in Table V.

TABLE IV. SUS SCORE BASED ON EACH QUESTION

No	Question	SUS Score
1	I think I will use this system again	62
2	I found the system to be complicated to use	49
3	I found the system easy to use	60
4	I need assistance from other people or technicians in using this system	32
5	I feel the features of this system are working properly	68
6	I feel there are a lot of inconsistent (mismatched in this system)	54
7	I have a feeling other people will understand how to use the system quickly	57
8	I found the system to be confusing	56
9	I feel that there are no obstacles in using this system	51
10	I need to get used to it first before using this system	8

From each question SUS score, the highest score from the SUS survey is the fifth question with 68 and the lowest score is the last question with 8. From the highest score can be concluded that most respondents feel the features in the application is working properly. And from the lowest score can be concluded that most respondents agree that the system needs to get used first by the respondents because there are not many people get to know or even try the leap motion device before.

TABLE V. SUS SSCORE BASED ON EACH RESPONDENT

No	Question	SUS Score
1	ST. Zaitun Nasifa	57.5
2	Ida Ayu Angelia Septiana	57.5
3	I Dewa Gede Dirgayusa Wicaksana	40
4	Indah Apriati Ningsih	57.5
5	Sisnadya Kus Andriana	45
6	Dhia Mukti Hanifah	50
7	Detrizikrana gading maula	42.5
8	Rizqanul Khair	65
9	Ayu Rahmatin Puspita Sari	40
10	Maidatun Izzati	72.5
11	Fathurahman	67.5
12	Husna Muthia Labibah	70
13	Agil Al Habsyi	57.5
14	Dika Adrian Farazi	80
15	Siti yuhana	80
16	Sharah Almira Najati	62.5
17	Susmita smarla	62.5
18	Robby Igfirly	72.5
19	Alif Zidan Zikri	40
20	Ande Rizky Riefnaldi	55
21	David Arizaldi Muhammad	67.5

From each respondent's SUS score that can be seen in Table IV, the highest score from the SUS survey got 80, the lowest score the SUS survey got is 40 and the average score from a total of 21 respondents is 59.167 out of scale from 0 to 100. With the average score is above 50, the system can be confirmed that the system is **Marginally Acceptable** which means it is still accepted by users and the usability of the system is working properly and for the Black Box of this research successful documented every gesture that chosen based on all scenario of using mouse and keyboard that reserved and required for the Floorplanner App.

V. CONCLUSION AND SUGGESTION

Based on the results and discussion that has been described previously, It can be concluded that the system was built properly according to the users, as proven by all the survey/test cases that produced the expected results. In addition, the overall usability of the application built is considered marginally acceptable with a System Usability Score of 59,167 out of scale from 0 to 100. While the hand gesture command system is validated to be interesting, suitable and comfortable for the user.

However further development is still needed to improve the usability of the application, such as adding manual instructions in UI of the application, more feature so can be used for other than simple architecture application like Floorplanner and mode option for different user preference. Also, further research is needed to determine the most optimal setup of the Leap Motion device for more accurate recording and more responsive level of detecting the hand gesture for system.

For further research, the use of 3D hand movements and Leap Motion is not only limited to replacing the mouse and keyboard in the simple architectural design application Floorplanner, but can be used in other applications such as Sketchup, AutoCAD, Photoshop, etc. furthermore, we need to trying some combination of hand gestures to find out which is the best and comfortable gestures to use in architectural applications.

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