

**3D UTAR Interactive Virtual Tour (Basic)**

**BY**

**CHENG WEI JING**

**A REPORT**

**SUBMITTED TO**

**Universiti Tunku Abdul Rahman**

**in partial fulfillment of the requirements**

**for the degree of**

**BACHELOR OF INFORMATION SYSTEM (HONS)**

**Faculty of Information and Communication Technology**

**(Perak Campus)**

**MAY 2016**

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## DECLARATION OF ORIGINALITY

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I would like to express my thanks to my supervisor, Ms. Saw S.H. who has given me an opportunity to engage in an interactive virtual tour project, providing suggestion and guidance throughout the project.

I must also thanks to my parents and family for their caring and support throughout the course, all these wouldn't be possible without them.

## **Abstract**

Virtual tour, has an increasing amount of usage as the world's technology getting more advance. With virtual tour, people can have a view of the actual place like they are actually there through devices like computer or phone, without having to travel to that specific location. Thus, it is considered as a convenient alternative to the actual tour.

UTAR could possibly attract more students to enrol in it by having a virtual tour platform for the campus. It is achievable through the usage of a more interesting and advanced way of interaction instead of the traditional mouse and keyboard. The goal of this project is to ease the hassle of actual campus touring, as the tourist might face problem like long travel time, bad weather, and etc. during the process of campus tour. Other than that, UTAR can also be one of the few university in Malaysia that have a virtual campus tour software.

The methodology used in this project is the prototyping methodology. This methodology is chosen as it allows responsive feedback and changes to be made with minimum cost, together with a shorter development process since requirement is clear. A virtual tour platform which contains the details about UTAR's library is expected to be produced as the end product, and the software should be able to be navigated by using leap motion.

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## **List of Abbreviation**

UTAR	University Tunku Abdul Rahman
3D	3-Dimensional
2D	2-Dimensional
HD	High Definition
GIS	Geographic Information System
LMC	Leap motion Controller
ER	Error Rate
UE4	Unreal Engine 4
UI	User Interface
FYP	Final Year Project
USB	Universal Serial Bus

## **Chapter 1: Introduction**

### **1.1 Background**

Virtual tour is a term that is used to describe the simulation of an actual location that exists on Earth. The initial use of this term is actually from the year 1994, where a museum interpretation is provided with a 'walk-through' of a 3D reconstruction of Dudley Castle in England as it was in 1550. Since then, virtual tours have started to spread among the people and are used as a way to show a certain area, building and etc. The most common industries that use the virtual tour feature are the academic field, famous attractions of a country and the real estate industry.

Virtual tours are used by colleges and universities to provide a walking tour experience around the campus. So, potential students can just use the virtual tour platform to look around the campus and its environment. By comparison, the experience of a virtual tour will definitely not be as good as being at the campus in person. But, it has the advantage of letting the user have access to the virtual campus anytime, without having to concern about the opening hours, the weather, and the status of the campus. Provided the user has access to a PC or phone, they can just get online and grab the application or go to the webpage and start the tour, which not only provides the user the ease of having a tour but also saves their time of travelling to the campus when it's located far from their existing location.

As for the real estate industry, it is having almost similar advantages with the campus virtual tour. The industry uses the virtual tour to provide a preview of the building to its customer. This allows them to exhibit the building even if the building intended to be shown to the potential customer is not done, or even before the construction activity is carried out. This is able to solve the common problem shared by all the tours, which is the condition of the place. The management of the place won't have to worry about the presentability of the area, e.g. to keep the place clean, repaint parts of the building, or carry out maintenance and etc., which are all prevented by using virtual tours.

## **1.2 Problem Statement**

- Exhausting to have a full campus tour
  - Comparing to the Sungai Long campus, UTAR campus at Kampar is bigger in size, providing more space for future expansion program. However, the problem occurs when those potential students are there for the Open Day. Those students are usually with their parents and some even with their grandparents. The size of the campus will be exhausting for them to fully explore it.
  
- Lack of tour guide
  - When visitors came for a campus tours, they expect to have someone who is familiar with the campus to guide them throughout the tour. During the normal days, UTAR doesn't provide a tour guidance to those who came for a campus tour. Thus, visitors will have to tour on their own, or visiting the UTAR open day, where resources will be allocated for tour guidance.
  
- Uncommon campus location
  - Campus visits can be very expensive for students and their families. Moreover, depending on how many schools the student want to look at, and where they are looking, the cost can be thousands of dollars. (Pilloni 2011) said "I had to travel six hours for my visits since I wanted to go to school in Boston, Massachusetts; and I needed a hotel room, gas money, and of course, a new outfit for my interview. If you need to fly to visit your school, or if you want to visit several in different areas, you can imagine how much money that could cost!"
  - UTAR Kampar campus is located at Perak, Kampar. The location of the campus is not strategic, as the nearest city, Ipoh will still need at least 30 minutes of car trip to reach Kampar. Therefore, those who are not staying in Ipoh have to spend hours to get to Kampar, not to mention the petrol fees.

- Unpredictable weather
  - Although Malaysia don't have four seasons, it tends to rain unexpectedly, and for those time it is not raining, it will most likely have a scorching sun for the day. Due to the problem stated above, those who planned to have a tour in Kampar campus will definitely concern of the weather when they reach Kampar. If it starts raining the moment they reach Kampar, they won't be able to start the tour and have to wait until it stops raining. This might cause them to hesitate whether to have a tour to campus or not and make the decision not to join UTAR Kampar.
  
- New student not familiar with the campus
  - As UTAR Kampar campus is huge in size, the common issue among the new student is to find out where their class is located at. It usually takes them few weeks to familiarize themselves with the campus. This is often the main culprit of why they are late for their class.
  
- Boring interaction with the available virtual tour
  - There are tons of virtual tour application out on the internet, and majority of them are still using the standard input of mouse and keyboard. While they are the standard input device that is used daily, it is just plain and boring to use them to experience a virtual tour. With the technology getting better day by day, there are a lot of new input device that have the potential to replace the mouse and keyboard combination.



### **1.3 Motivation**

- With the technology getting more developed day by day, it is important for us to catch up with it and integrate it with our daily activity, which includes having a tour to a campus. As UTAR Kampar currently doesn't have any existing 3D Interactive Virtual Tour software yet, it will be good to kick-start an application for it. What's more is the application is not controlled using mouse and keyboard.
- Although it has been a long time since mouse and keyboard are invented, both of it are still the common and widely used among people to provide input. With the invention of leap motion, oculus rift, and etc. there exist the need to bring the human-computer interaction into the next level. Instead of pointing or typing physically through the device, there are now ways to interact with computer naturally using just hands, which can possibly change the standard of the future of human-computer interaction.
- To showcase the beautiful environment of UTAR Kampar and Kampar itself and help promote it. Both UTAR and Kampar have some of the best view of the surrounding that's breath-taking, most of the students and residents will have a grasp of it.

## **1.4 Objectives**

- To provide convenience to the people
  - Due to the problem of huge campus size, location of campus, and also bad weather, it's inconvenient for most of the people who want to have a campus tour. So by having a campus tour virtually, those who want to have a tour don't have to travel to Kampar, they can just get the access to the virtual tour and having a campus tour at their home. By using this way, they can save their time and also energy.
  
- To help new student in familiarising with the campus
  - Since UTAR Kampar campus is huge, it is pretty common for those newcomers to have problem on getting to the right destination. Through virtual tour, those newcomers can familiarise themselves with the 3D replica of UTAR Kampar's building and route. Hence, it helps them in faster and better understanding of the campus.
  
- To provide an interesting way to interact with the virtual tour
  - By using leap motion, a device that senses the hand and finger motions and uses them as the input to interact with application, it is possible to fully replace the mouse and keyboard to provide the input to the application. Inputting in this way will attract and maintain the user's interest throughout the whole process.

### **1.5 Impact, Significant and Contribution**

- In Malaysia, most of the universities or colleges have yet to obtain a virtual tour application, only a small number of them have a campus virtual tour and it is using the photo-stitching method, which doesn't allow much interaction in comparison to a 3D virtual campus platform. With this application, prospective or current UTAR stakeholder will be able to have or provide a campus tour in a much efficient way, which will provide a numbers of benefits to them. Besides that, this application is using one of the latest input technologies, the Leap Motion. With Leap Motion, it will give the user a fresh experience of providing input and controlling the virtual tour, which will attract them and gives them an unforgettable tour, while providing useful campus information.

### **1.6 Project Scope**

The aim of this project is to produce a 3D interactive UTAR Virtual Tour to solve the problems previously stated. A few main outcomes that are going to be produced are:

- 3D Building Model for the interior of library
  - 3D model of the UTAR Kampar Library will be created as this project focuses on the interior of the library. The 3D model will have the same texture and layout with the actual one, thus user is able to feel like they are actually there.
- Integration of 3D model into a platform
  - After the modelling of library is done, it will be imported and integrated into a platform in order to implement the 3D model to work together with the functions like navigating inside the 3D library model, interaction of user to do some task, a guided tour and etc.

- Use leap motion as the main input device
  - The norms of providing input to interact with an application is the usage of mouse and keyboard. Thus, by using leap motion as the main input device, will increase the interaction between the user and the application, to be more lively and interesting. User will have to control what they want to do such as to walk, to change the direction, to open the door, to select options and etc. through leap motion device. The standard way to input will be enabled too in case the device is not available.
- Different point-of-view of the building (3D Doll House & floor plan)
  - Other than able to navigate inside the 3D model of library, user can also choose to have a 3D Doll House view or floor plan view in order to get a better or preferred point of view. 3D Doll House view will be a scene where the user will be shown to the whole library building from the outside, while the floor plan view can be changed when this feature is enabled. This will allow user to understand the building in depth.
- Interesting sound effect and background music
  - Any brilliant application won't be as good as they are if sound is not present. Sound effects can help an ordinary application to become a better one. Sound effects and music will be in the virtual tour to enhance the user experience, e.g. opening a door, sound of footsteps, and etc.

## **Chapter 2: Literature Review**

### **2.1 Application Review**

There are already a number of virtual tour applications available on the internet which people are using it for the purpose stated above:

#### **2.1.1 Library of Alexandria – 3D Virtual Tour (Web Application)**

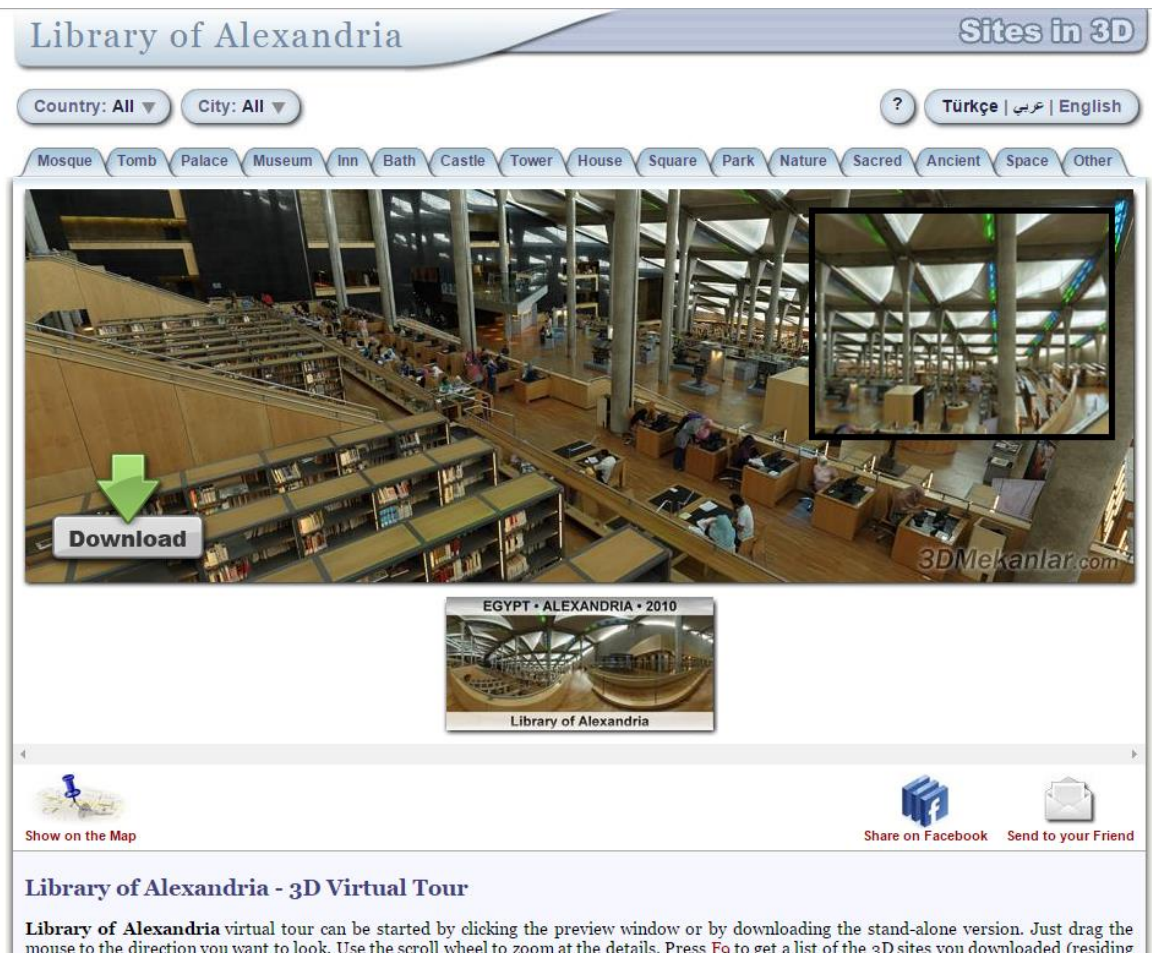


Figure 2-1-1 F1 Library of Alexandria – 3D Virtual Tour (Library of Alexandria - 3D Virtual Tour n.d.)

The Library of Alexandria – 3D Virtual Tour is a web application created using the method of photograph stitching. It features a 360° panoramic virtual tour experience by using HD photo for the application, and users are not able to navigate in the library. After the application is loaded, the user still need to wait for the photos to fully loaded before they can have a clear view of the library. This is only a part of the full application that if accessible only through the provided executable file. When it is started through the file, there will be a list of location available to be selected to start the virtual tour, including the Library of Alexandria. It contains the ability to set the virtual tour as the

screensaver, and when screensavers starts, a random site will be chosen and shown around automatically.

### Strength

- High quality photos, allows user to zoom and still get an acceptable level of detail
- Virtual tour can be set as screensaver

### Weakness

- Only have one spot for the view, no navigation around the place
- Both the web version and .exe version requires internet connection in order to work

## 2.1.2 All in One Interactive Virtual Tour (Web Application)



Figure 2-1-2 F1 All in One Interactive Virtual Tour (Virtual Reality 3D Tours n.d.)

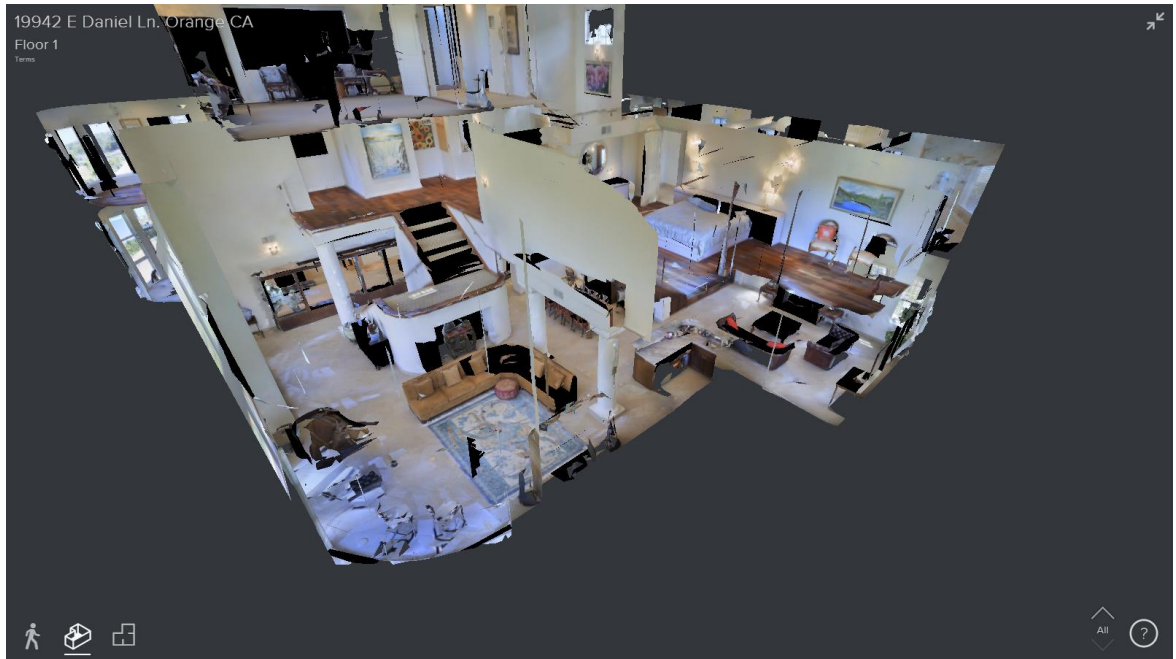


Figure 2-1-2 F2 All in One Interactive Virtual Tour (3D Doll House view) (Virtual Reality 3D Tours n.d.)

This All in One Interactive Virtual Tour is also a web application. It is also using the photograph stitching method. It features 360° panoramic virtual tour experience using HD photos. There is an instruction that will be shown to the user when they first enter the application. The user is allowed to navigate around the area by providing input using the mouse or keyboard. After the application is loaded, the view for the specific spot is loaded only when the user choose to navigate to the specific spot. There are 3 viewing mode available for the application, other than the panoramic view as mentioned above, it also contains 3D Doll House view and also 2D floor plan view. In the 3D Doll House view, user is able to have a view of the whole house in 3D, and able to zoom/move/rotate using mouse or keyboard. While for the 2D floor plan view, user will have a top view of the house and also able to zoom/move/rotate the model. It also provides the function to move between floors.

### Strength

- High quality photos and 3D model, which create attractive product
- Able to navigate around a number of fixed spots to have a better view of the building

- Different viewpoint available (panorama, 3D doll house, floor plan)
- Clear instruction on how to use the application is provided

#### Weakness

- Requires internet connection to load the application
- Restricted to only a number of fixed spots to have a view of the building

### 2.1.3 TomBraining The Gallery (Computer Application)

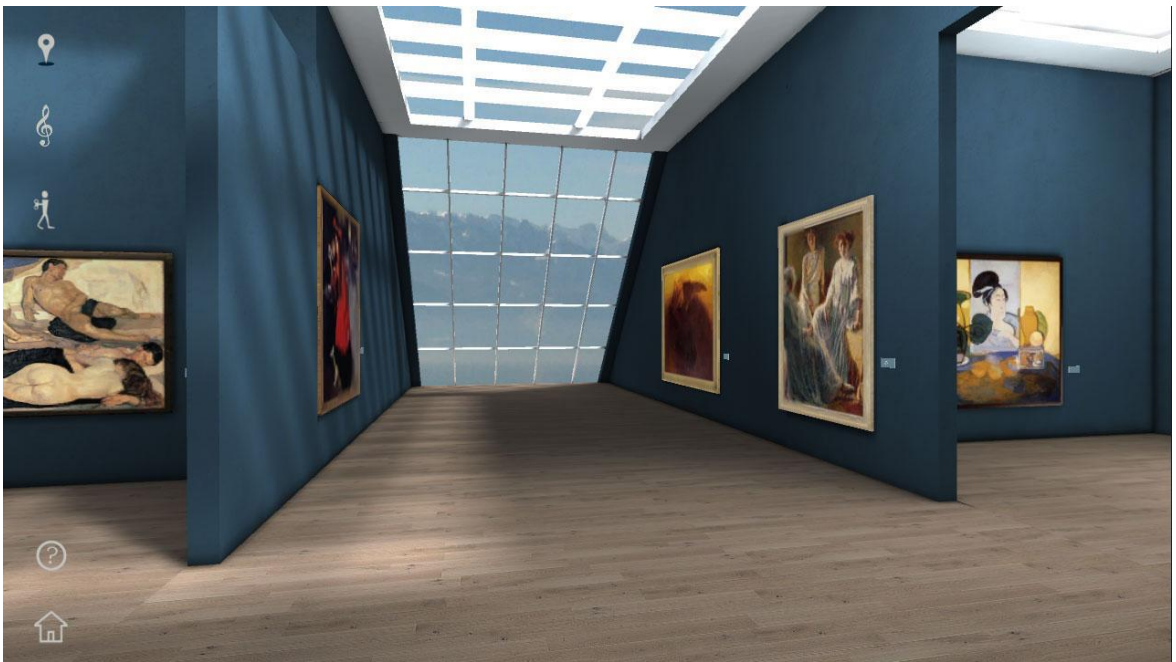


Figure 2-1-3 F1 TomBraining The Gallery (TomBraining The Gallery Trial n.d.)

TomBraining The Gallery is a desktop application. It is a 3D virtual art gallery with multiple exhibition rooms that aims to expand the user's cultural knowledge through more than 250 masterpieces of art and music. By using leap motion device, the user is able to walk around the virtual 3D gallery using hand gestures, and admire the great paintings accompanied with classical music. While the user is looking at the painting, detailed description about the painting is shown beside. Each painting also having a specially commissioned text by the celebrated art historian, and is narrated by Brian Protheroe, which brings the paintings to life. It also have a game mode that allows the user to measure their knowledge of art and test their memory on what they have seen, heard and understood.



**Strength**

- Attractive graphics and arts used which attracts people to use it
- Able to navigate through the whole area freely
- Have an interactive game mode to test user’s knowledge
- Detailed description of the content it is showing
- Support the use of leap motion
- A map indicating the location of the paintings
- High quality sound effects that suit the application

**Weakness**

- Navigate using the mouse is troublesome

**2.1.4 Comparison between Reviewed Applications and Proposed System**

Features	Library of Alexandria - 3D Virtual Tour	All in One Interactive Virtual Tour	Tom Braining The Gallery	3D Interactive UTAR Virtual Tour (Proposed project)
High Quality Photo/3D Model	Yes	Yes	Yes	Yes
Free to navigate inside the area	-	Yes(Partially)	Yes	Yes
Multiple viewpoint/ map of the area	-	Yes	Yes(Map)	Yes
Interactive activity other than to navigation	-	-	Yes	Yes
Instruction to use the application	-	Yes	Yes	Yes

Good quality/suitable sound effects	-	-	Yes	Yes
Works without internet connection	-	-	Yes	Yes
Support leap motion	-	-	Yes	Yes

Table 2-1-4 T1 Comparison between Reviewed Application and Proposed System

## **2.2 Campus Tour and Virtual Tour**

Campus tour is a tour to visit a university or college's campus. Prospective students, often accompanied by their family members together with other visitors, have a campus tour to learn in detail of the information about the college or university such as the facilities, the culture, academics, and much more. These tours normally will last around an hour of walking around the campus, and will either have someone to explain and introduce the place or building, or is a self-guided tour.

Having a campus tour is inevitable before any further consideration of enrolling in the university or college is taken. However, to have a campus tour, the visitor needs to be there physically, and this is where the problems are. First the campus might locate at a place that is far and is inconvenient for the visitor to travel to there. Other than that, the campus size might be huge and exhausting for the elders of the family to walk and explore the whole campus. The unpredictable weather is also a factor that causes a problem to the campus tour. Lastly, the campus will not be in its perfect condition 24/7, which might cause the visitors to have a bad impression.

According to (Duncan & Roth 2001) :

Because of the confusing physical layout of the library (with its collections spread out on four levels due to the building's unique architecture), some kind of orientation for first-time patrons is almost a necessity. Providing tours to users on a drop-in basis is not always practical or feasible for library staff, especially during the evenings or weekends when staffing is at a minimum. The Web-based virtual tour allows staff members to offer an alternative to the time-

consuming physical tours when an on-the-spot tour is not practical, while providing users with an easy and enjoyable way to learn about the library.

Based on the information above, providing a virtual tour will help to ease the staff's task when a physical tour is not practical. The staff can focus on doing their job instead of stopping halfway to serve and guide the visitors, which improves their overall work performance.

Referring to (Duncan & Roth 2001), the virtual tour is also beneficial for distance education students, who may be on campus only a few times each semester. The time these students are able to spend in the library is very limited, so the students' ability to tour the library in advance and familiarise themselves with the services offered can be a timesaver.

Since new students don't know much about the campus layout and tend to lose their direction, by using the virtual tour, they are able to familiarise with the environment of the virtual tour, which in this case, the library. It allows new student to understand the physical layout of the library and the whole campus much faster and easier. However, the use of photo stitching virtual tour, which is the one used in this library has a few limitations, and it will be discussed at the later part.

### **2.3 3D Virtual Tour Development Method**

There are a few methods for the creation of 3D virtual tours, and one of the widely used methods is the photograph stitching method. Although there are a few ways to stitch the photo, they all serve the same purpose. This method basically stitches high quality photographs together to form a 360 degree photo that can be viewed from any angle. After repeating the previous step for multiple spots for the area, it will create a scene that allows the user to have an experience of virtual tour since it acts like walking to a different spot in the real world.

Another method of creating 3D virtual tour is by the construction of 3D virtual platform. This is the more advanced way as it will require to create an actual 3D model that is identical to the real one. Other than that, it will require more designing and programming skills than the previous method as this method, instead of using photos,

it is to create and integrate the 3D model into a software to create a 3D-replica of the area/building and interaction features.

According to (Qiang 2013), the advantage of tourist attraction virtual reality technology can turn potential tourists into ones with a knowledge of tourist attractions from ones with no knowledge of tourist attractions, and can turn them into ones whose desire to buy tourist attraction products are aroused from ones who have a knowledge of tourist attractions.

A recent study by (Qiang 2013) also stated that most of the tourism websites only use the photo-stitching method of virtual tour. And although it is less expensive and interesting, it is not detailed enough, the information providing about the destinations is incomplete through the lack of remote sensing and real-time monitoring of tourist attraction, leaving them unable to perceive their landscape. The article also stated that the introduction of tourist scenic spots includes those 3D imaging simulation technology, man-machine dialogue technology and Geographic Information System (GIS) technology to create a lifelike scene area which tourist can ramble freely and select freely their own tour paths, and show independently and interactively with the scene from anywhere and from any angle, together with interactive effects, will inspire tourist with a strong wish to pay personal visits to the sites.

Refer to (Phillips 2010), 360 degree panorama software gives a good sense of being in a space and being able to seamlessly pan around that space. Its downfall is pixilation when user zooms in close to something.

Based on the study, the strength and weaknesses of both methods is clearly stated, photo-stitching method is less expensive and easier to be developed, but not detail enough and photo will be pixelated when zoomed in, while the 3D virtual platform requires much more work and effort to be created and provide a much better platform that gives the user to freely navigate. However, the 3D virtual platform method will allows the user to have much more control of the application which leads to a better experience and will leave them with a good impression on the tour sites and inspire to have a further activity with it, e.g. prospective student decide to join UTAR after the virtual tour.

## **2.4 Leap Motion and Mouse**

While most of the existing virtual tour applications are using mouse and keyboard to provide input and interact with the system, there are several new technologies that allow the user to have a more interesting way to interact with the system, e.g. Leap Motion, Oculus Rift, and etc. The leap motion, for instance, is able to replace mouse and keyboard as an input device, which allows the user to input by only using their hand or finger motion, which is much more effective at carrying out some task comparing to using mouse and keyboard. Just connect the leap motion device with the USB port and it is ready to use.

A recent study by (Bachmann et al. 2014) shows that by studying the test result of pointing tasks between Leap Motion Controller and mouse, LMC is having an overall error rate of 7.2%, which is 3 times higher than standard mouse device. The ER of LMC movements increase more steeply with index of difficulty than mouse movements. Mean movement time was significantly lower with mouse too (565ms against 945ms of LMC). In sum, LMC has more degrees of freedom, but then requires more advanced motor and coordination skills, and it is suitable for specialised adapted interaction task. However, that study has at least 2 limitations, which are the degree of familiarity of both device, and even though LMC provides similar gesture for pointing, the requirements of motor system differ considerably.

With the above study, although the test shown that leap motion is the weaker performer, the lack of experience in using LMC might be the factor of the poor result. It's believed that with more training given to the user, the user can perform specific task using LMC just as well as using mouse, or maybe better since LMC allows a more complex input through different gestures.

According to (Nowicki et al. 2014):

Nowadays, human-computer interaction is mainly based on the pointing or typewriter-style devices. This kind of interaction can limit the natural ways of manipulation using the hands, which may result in a complication of simple tasks. One of the overcomplicated control examples is rotating a three-dimensional object. Using a computer mouse, a user needs to grab the object

and rotate it using the mouse, which can only operate in a two-dimensional space. The rotation operation represented by the mouse's movement is unintuitive for humans and users need a few attempts to understand how it works. In the real world, however, the rotation task is natural thus it is simple how to move hands to rotate the object in a desired way.

Therefore, although the previous study proved the leap motion as a weaker performer compared to mouse, the above study shows that using mouse to interact with computer is limited because it is operating in 2D space. Even with the technology getting better in such fast pace, there will hardly be any huge improvement in the mouse as no matter what, it will still be limited by the 2D operating space. Leap motion, in the other hand, would be a better performer as it is operating in 3D space by using hand through a series of hand gestures, which allows a more natural task manipulation.

## **Chapter 3: Methodology**

### **3.1 Methodology**

There are a huge number of software methodologies available and every single one of them is unique in terms of the aspect that they excel in. After analysing all the methodologies pros and cons, prototype method is the selected methodology to be used in this project.

The reason prototyping methodology is chosen is because this methodology allows users to actively involve in the process of development. With the users involving in the development, quicker feedback is available and it might provide some solutions and help with identifying the confusion functions. Other than that, errors occurred can also be detected earlier as any changes or additions will be examined and reviewed before moving on to other enhancement. The time and cost required for the development process will also be reduced as what the user wants to implement can be determined in the early stage of the development, resulting in a faster and less expensive development process. Evolutionary prototyping is the chosen type as it allows the basis requirement to be first built and then only follow up with those advanced requirements.

So, by applying the methodology on the project, the involvement of user will ease the process of development as the virtual tour application focuses on the human computer interaction. This model includes a total of 4 phases:

- Identification of basic requirements
  - The basic requirement of the project is first identified, leaving the detailed requirement in the later stages. The basic requirements of a virtual tour application is determined, for example the area/buildings to be included, the level of detail, the basic function of a virtual tour like the ability to navigate, a guided tour function, explanation and etc.
- Develop Initial Prototype
  - The first working version of the application is developed. Core requirement such as the 3D models of library will be produced and implement into the virtual tour application. Together with other stated basic requirements, it is developed with the purpose to let the users to

evaluate by actually trying the prototype. A virtual tour software with 3D models of the library together with the basic controls, which is the best if it is controlled by leap motion, are expected to be produced. The 3D models or the functions (controls, actions) in this prototype might not represent the one used in the final software, but it's there to show how it will work, which is then only refined in the further iteration.

- Verification of prototype (Iterate)
  - A stage where users examine the prototype and giving their opinion and providing feedback on changes and addition of modules. The virtual tour application will be examined by the user to check whether the addition/changes are the correct one, and the satisfactory of the features is also tested e.g. the presentation of information about UTAR, the ease of using the software to have a campus tour, the quality of the models, and etc. After those implemented contents is tested and checked, feedback or the opinion from the user will be taken into consideration, which will affect the next phase's action
  - .
- Changes for the prototype (Iterate)
  - Based on the user's feedback, changes or addition will be made when the prototype is found to be insufficient or unsatisfactory. For the first time of this iteration, most of the time only the prototype with the base function is produced, and is deciding for further iteration. Further iteration of the verification and changes phases will take places to add on features like the different viewpoint, advanced way of leap motion input, and etc. The iteration will not stop until the application is perfect or user is satisfied with the application.



### 3.2 Timeline

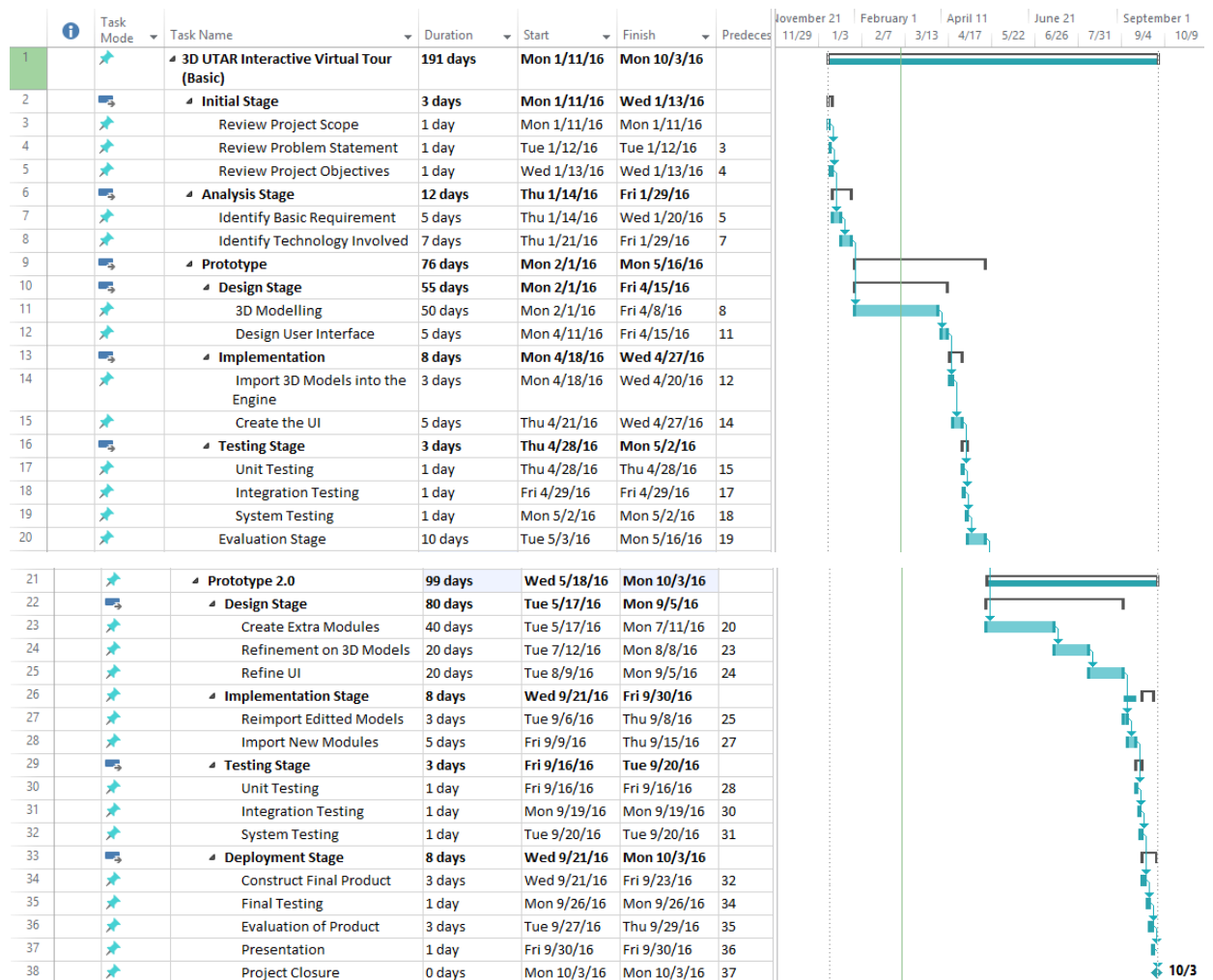


Figure 3-2 F1 Gantt Chart

This project starts by reviewing the previous work and follow up by identifying the basic requirement of the project and also the technology involved. The work for the first prototype begins with the 3D modelling job of the UTAR’s library, and at the end of the semester, the prototype is expected to have the models integrated into the engine and is able to navigate around the environment. The 3D models are possibly just a placeholder before a fully completed model is created, and minimal UI is expected.

The second prototype will start after the evaluation stage, where feedback is obtained and the work will be focused more on the UI and features instead of the modelling part.

## Chapter 4: System Design

### 4.1 System Flowchart

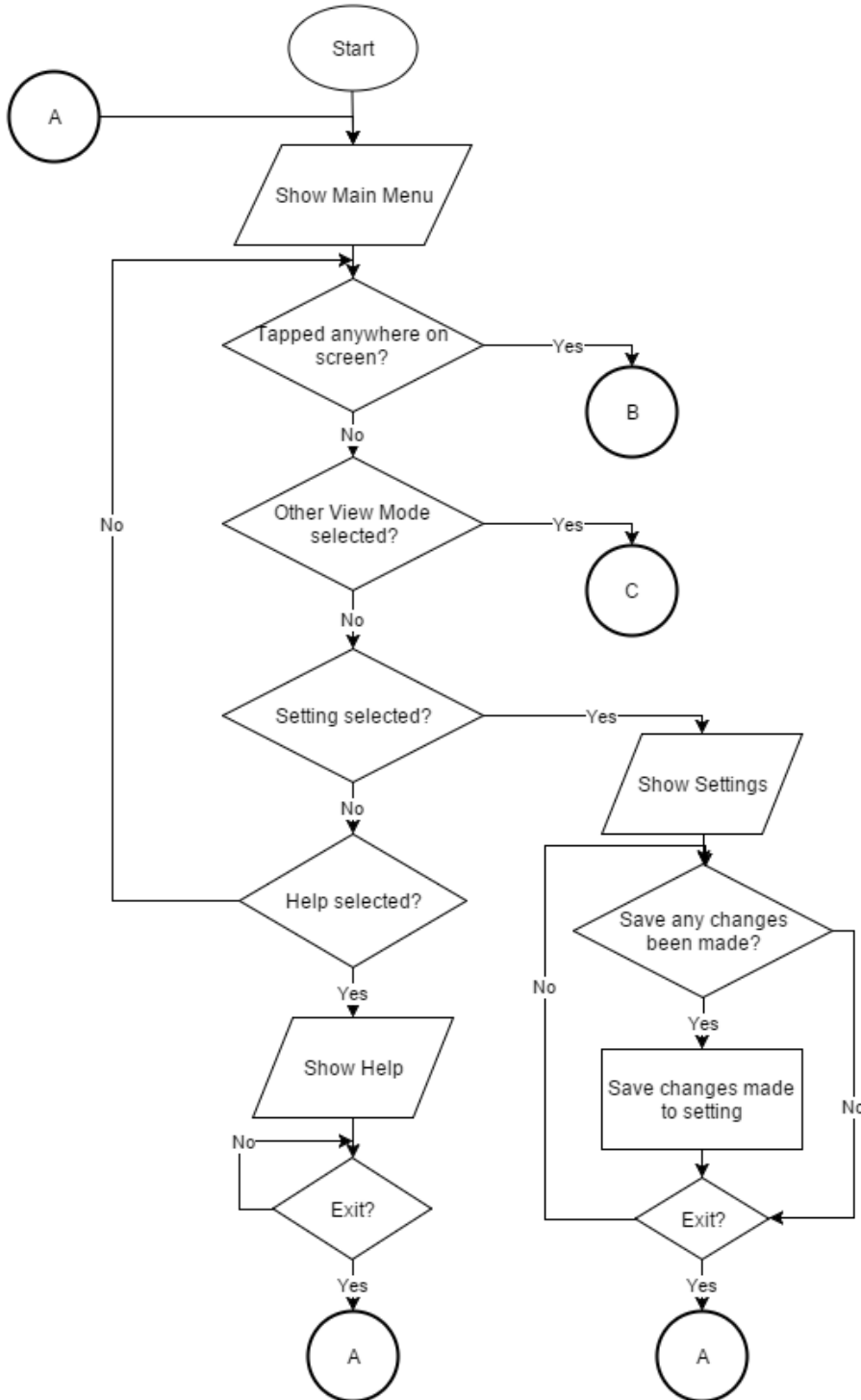


Figure 4-1 F1 Flowchart 1

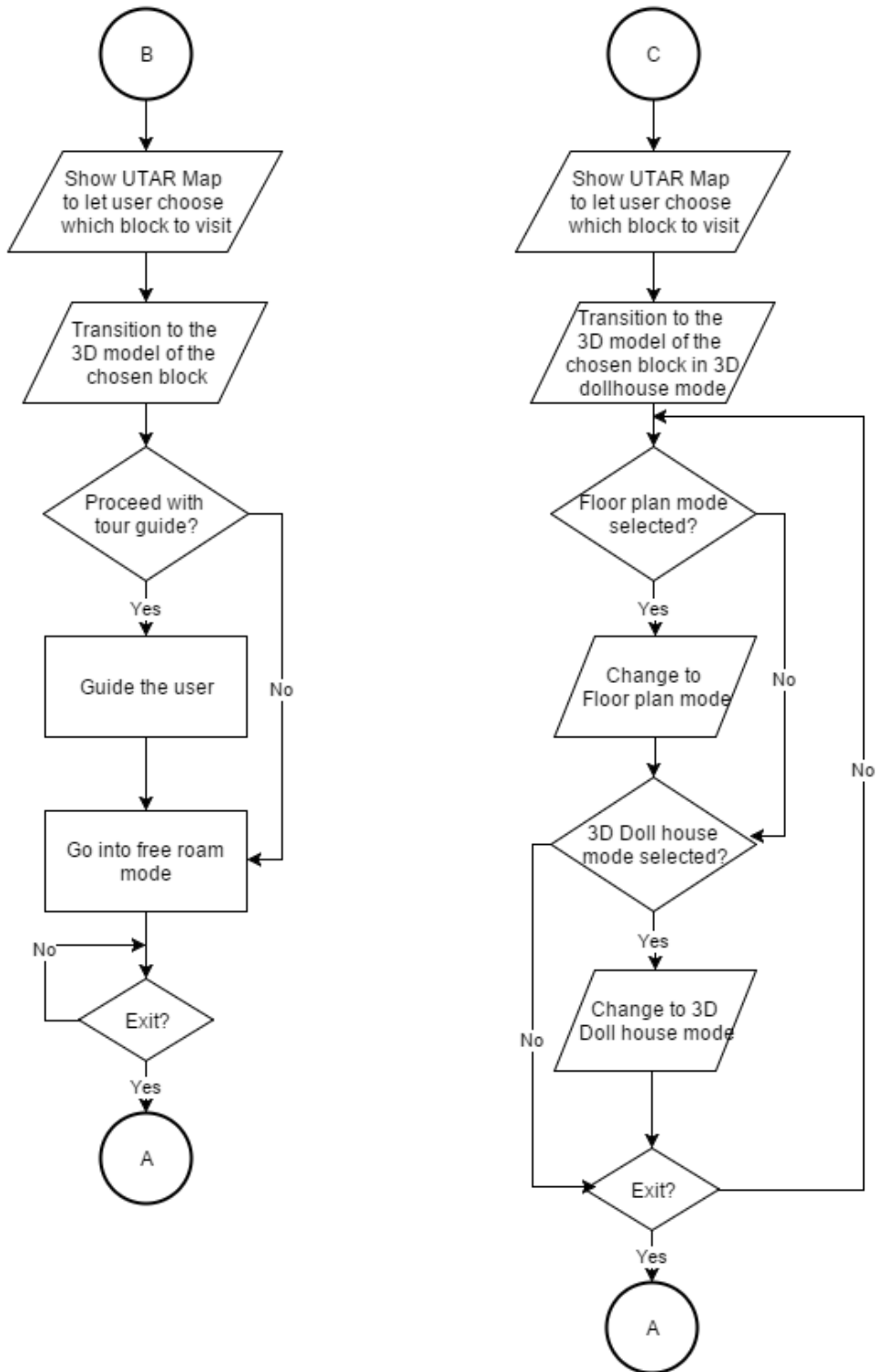


Figure 4-1 F2 Flowchart 2

**4.2 Storyboard**

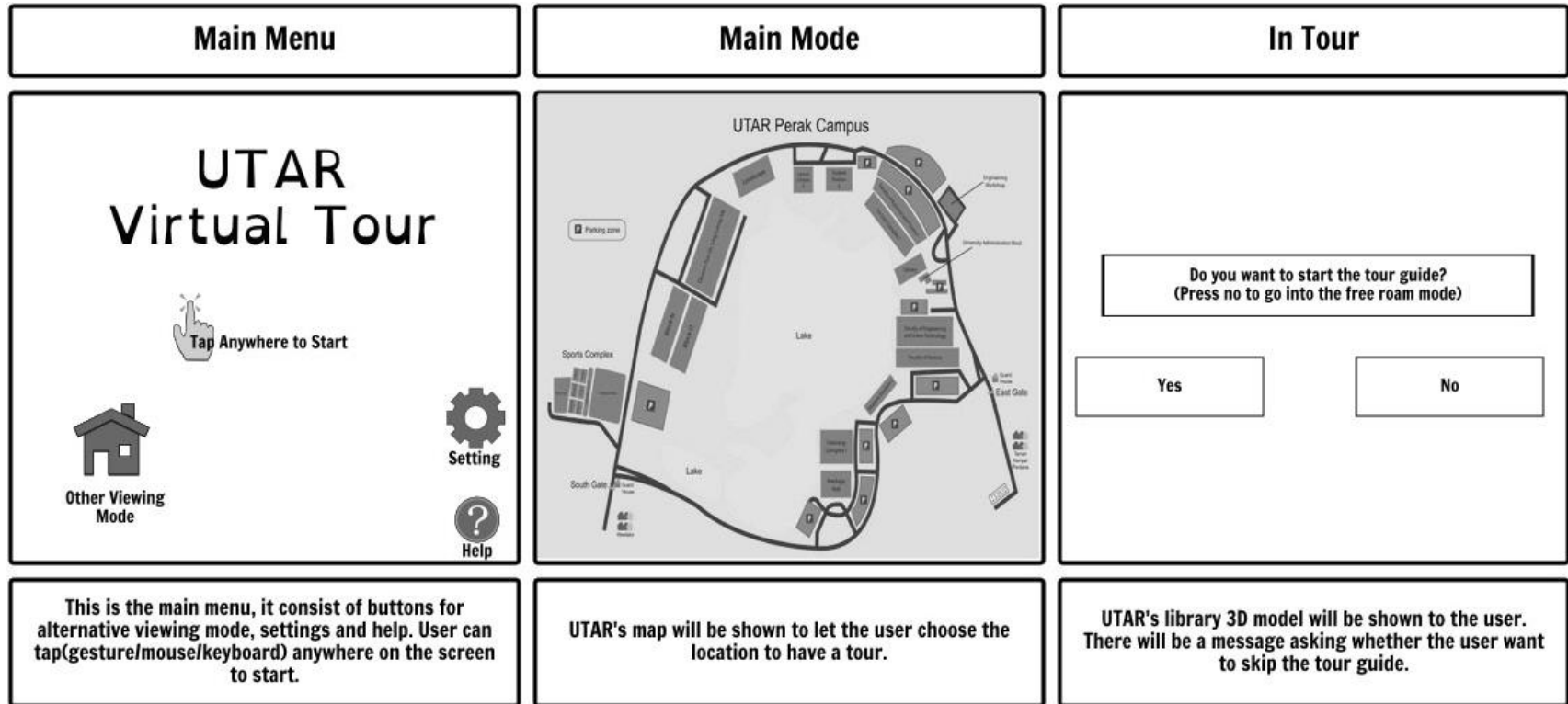


Figure 4-2 F1 Storyboard 1

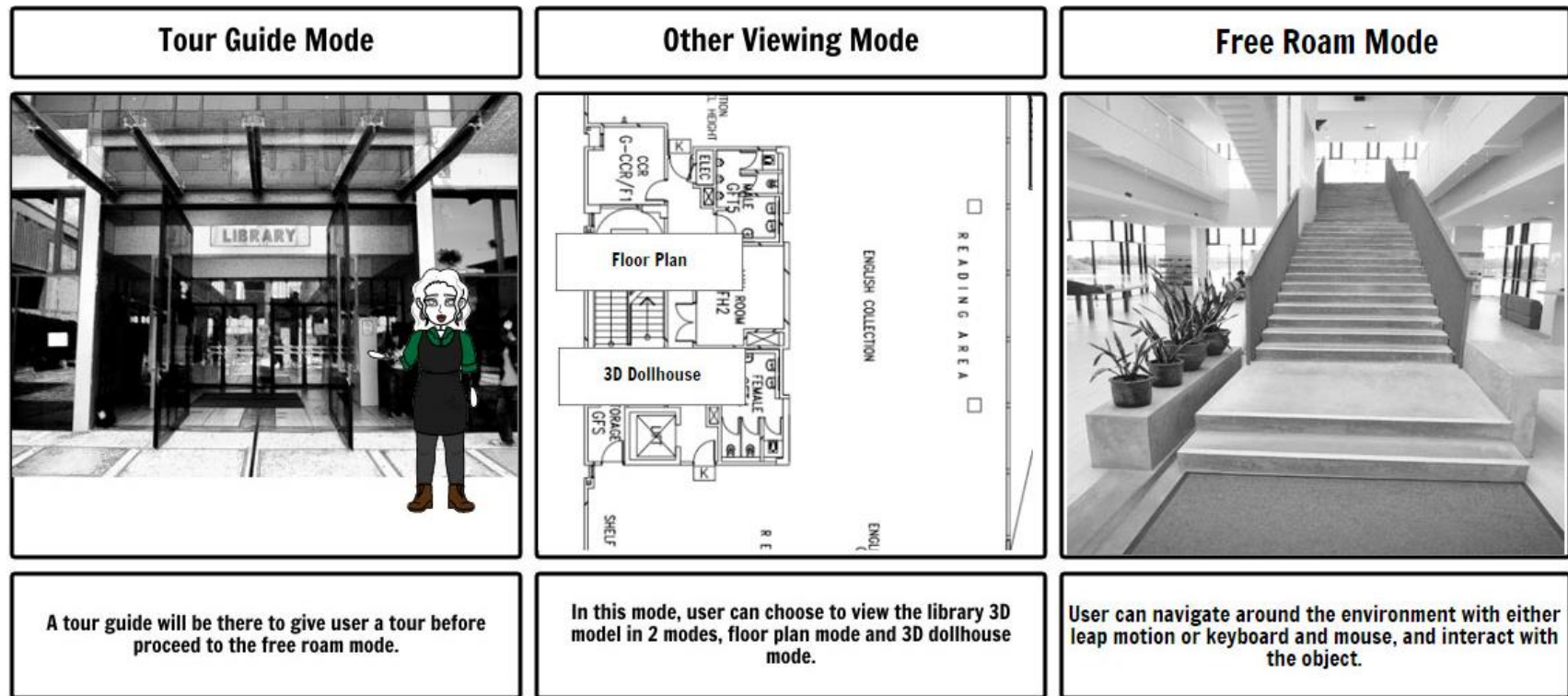


Figure 4-2 F2 Storyboard 2

## **Chapter 5: Implementation and Testing**

### **5.1 Software Used**

#### **5.1.1 Autodesk AutoCAD**



Figure 5-1-1 F1 Autodesk AutoCAD

##### **5.1.1.1 Description**

AutoCAD is a software used by architects, engineers, graphic designers and others to create drawings of 2D and 3D designs. It is used in this project as the 3d models required for this virtual tour software includes the UTAR's library, which is a building. AutoCAD is able to create a high accuracy drawings of those design, which is necessary in order to generate a realistic 3D model of the building that have the main purpose of letting the users to navigate around the 3D model just like the actual building.

##### **5.1.1.2 Installation Steps**

1. Go to the link <http://www.autodesk.com/education/free-software/autocad> to download the latest version of 3ds max required for your PC.
2. Enter your email address that is used to create an Autodesk account and sign in.
3. After login into the website, choose the preferred version, language and OS of AutoCAD. A 3-years student license is given to you and proceed to download the setup by clicking "Install Now".
4. After the download is done, execute the setup file.
5. Click install.
6. Select your country or region, accept to the license and services agreement and click on next.

7. Select the product language, license-type and enter the product key that's given previously and click next.
8. Click install to start the installation and wait until its finish.

### 5.1.2 Autodesk 3DS Max



Figure 5-1-2 F1 Autodesk 3DS Max

#### 5.1.2.1 Description

In the other hand, Autodesk 3DS Max is used when the accuracy/reading is not the main concern. Although there are also some programs like Autodesk Maya, 3DS Max is chosen since it is more user-friendly of the two, together with a huge library of modifiers, is able to import files form AutoCAD, and the advance animation of Maya don't actually come in useful since it is overkill for the project. Thus, most of the 3D modelling aside from the building part uses 3DS Max.

#### 5.1.2.2 Installation Step

1. Go to the link <http://www.autodesk.com/education/free-software/3ds-max> to download the latest version of 3ds max required for your PC.
2. Enter your email address that is used to create an Autodesk account and sign in.
3. After login into the website, choose the preferred version, language and OS of 3DS Max. A 3-years student license is given to you and proceed to download the setup by clicking "Install Now".
4. After the download is done, execute the setup file.
5. Click install.
6. Select your country or region, accept to the license and services agreement and click on next.

7. Select the license-type and enter the product key that's given previously and click next.
8. Click install to start the installation and wait until its finish.

### 5.1.3 Unreal Engine 4



Figure 5-1-3 F1 Unreal Engine 4

#### 5.1.3.1 Description

Frankly speaking, a 3D interactive virtual tour that is made of 3D models are basically a game application without the game part but instead having functions and features that allows user to navigate around the place and learn the information about it.

After some research, the scope of looking for an engine is being reduced down to the two most popular game engines that are available to the public, Unreal Engine 4 (UE4) and Unity.

After some comparison work is done, it's found that the biggest difference being these two engines is its scripting language, and Unreal Engine 4 seems to be a better choice. By comparison, the community size of Unity is much bigger, which makes solving problems easier as there are more people to discuss the solution. Aside from that, it is also having a wider range of library assets. However, the free version of Unity is not having the full features, which might cause the development process to be hindered by it. Other than that, UE4 will be easier to learn and at the same time, it is using C++ as its scripting language. Together with the help of Blueprint system, UE4 would be the preferred engine to be used as the development engine due to the time constraint of FYP.



### 5.1.3.2 Installation Step

1. Create an account for Epic Games.
2. With a valid Epic Games account, proceed to download the installer for Epic Games Launcher.
3. Install the Epic Games Launcher.
4. Execute and sign in into the Epic Games Launcher.
5. Now that the sign in process is complete, click on the Unreal Engine tab inside the Epic Games launcher.
6. Click the Install Engine button to download and install the latest version of Unreal Engine.
7. Read the Unreal Engine End User License Agreement and click the Accept button.
8. Unreal Engine is now downloading, once the download is complete, it will automatically starts the installation and it is ready to be used.

### 5.1.4 Visual Studio 2015



Figure 5-1-4 F1 Visual Studio

#### 5.1.4.1 Description

The game engine used for this project is Unreal Engine 4, it contains the function to use either the blueprint function or C++ language to program for the software. Blueprint function is handy when the feature is simple, but for advance function C++ is preferred. Thus Visual Studio is needed in order to have some advance feature in the project.

#### 5.1.4.2 Installation Step

1. Go to <https://www.visualstudio.com/en-us/downloads/download-visual-studio-vs.aspx> and download the Visual Studio Community.
2. Run the .exe file that is downloaded.
3. Choose the installation location, select custom and click next.
4. Make sure the Visual C++ feature is ticked, click next.
5. Click install.
6. Visual Studio Community is now be downloading and installing.

#### 5.1.5 Adobe Photoshop



Figure 5-1-5 F1 Adobe Photoshop

##### 5.1.5.1 Description

In the process of creating 3D models, the textures of those 3D models are one of the main factors of creating a high quality 3D model. The texture file is mostly created using image editing software and then map onto the 3D model. Among those huge amounts of software available on the internet, Adobe Photoshop is the most preferred choice by most. It is a powerful application that is used by the professionals for image editing, touching up photos, creating high-quality graphics and etc. It consists of tools like the pen tools, advance selection tools (cropping, slicing, moving etc.), colour replacement tools, and much more. With the help of this software, high quality textures will be able to be produced and used in the 3D models to achieve a realistic look.

### 5.1.5.2 Installation Step

1. Execute the Adobe Photoshop setup .exe.
2. Accept the license agreement.
3. Enter a serial number for Adobe Photoshop and click next.
4. Click install.

## 5.2 Hardware Used

### 5.2.1 Leap Motion



Figure 5-2-1 F1 Leap Motion

#### 5.2.1.1 Description

Leap motion is a USB peripheral device that is designed to be used on its own, or be mounted onto a virtual reality headset. It tracks the user's hand and finger motions as input without the need of touching anything. It is tracked using infrared camera and infrared light-emitting diode to observe a hemispherical area with distance around 1 meter. It is capable of generating almost 200 frames of data per second and send it to the host computer to be analysed by the software.

#### 5.2.1.2 Installation Step

1. Go to <https://www.leapmotion.com/setup> and download the setup.
2. Execute the setup.
3. Click next and it will start the installation.

## 5.2.2 Personal Computer



Figure 5-2-2 F1 Personal Computer

### 5.2.2.1 Description

Personal Computer is a device that can is able to carry out sets of logical or arithmetic operations when programmed to do so. It is designed to be a single-user system and is capable of linked up through a network. Most of the user use it to play games and surf the web. Aside from that, it is also used for business purpose like word processing, running database management application, and etc.

## **5.3 Graphical User Interface (GUI)**

### **5.3.1 Main Menu**



Figure 5-3-1 F1 Main menu

This UI will be the first scene shown to the user as they starts the application. User can then scroll through the menu by moving their right hand's position to the same height as the option, and select the option from the menu by pinching their right hand.

1. Start Tour – Navigate to Map Selection
2. Other View – Navigate to Map selection
3. Settings – Navigate to Settings
4. Exit – Exit the application

### 5.3.2 Map Selection

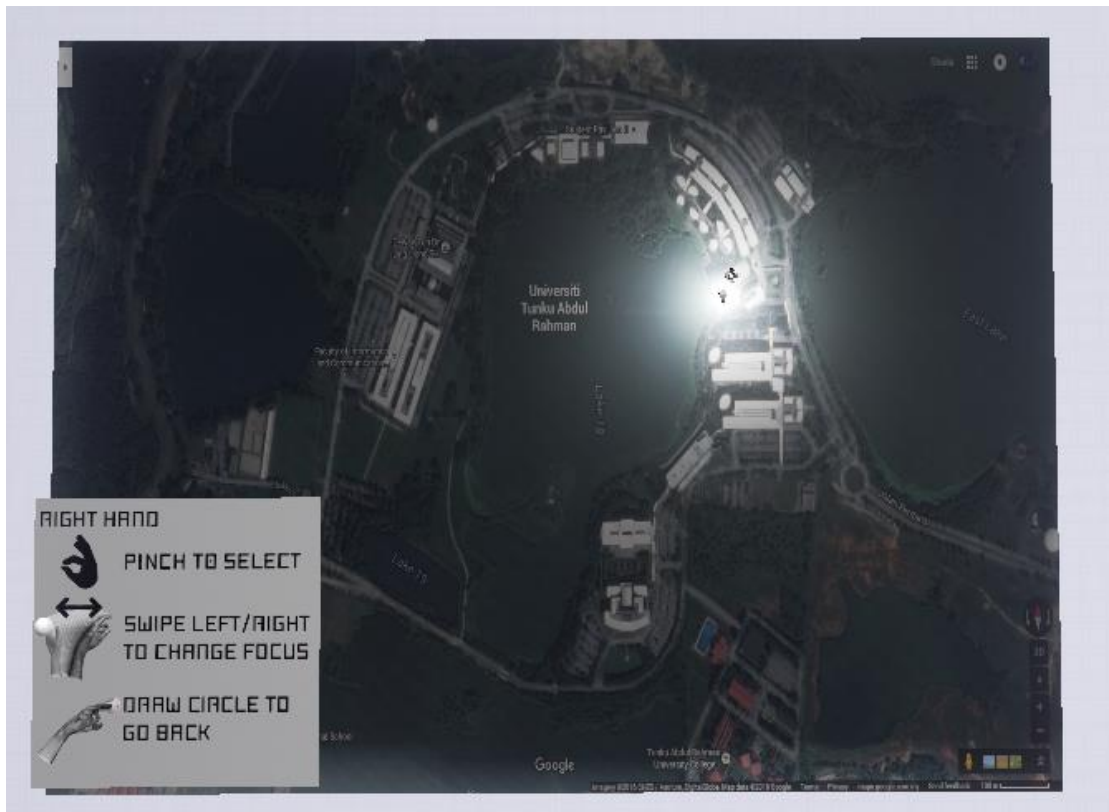


Figure 5-3-2 F1 Map Selection

This will be shown once the user choose the “Start Tour” or “Other View” option. User is required to select 1 of the building available to start the tour. User can then swipe their hand left or right to scroll through the available options, or draw circle gesture to go back to main menu.

1. Library – Open the Library’s level in Start Tour or Other View mode based on previous selection

### 5.3.3 Pre-Tour Guide

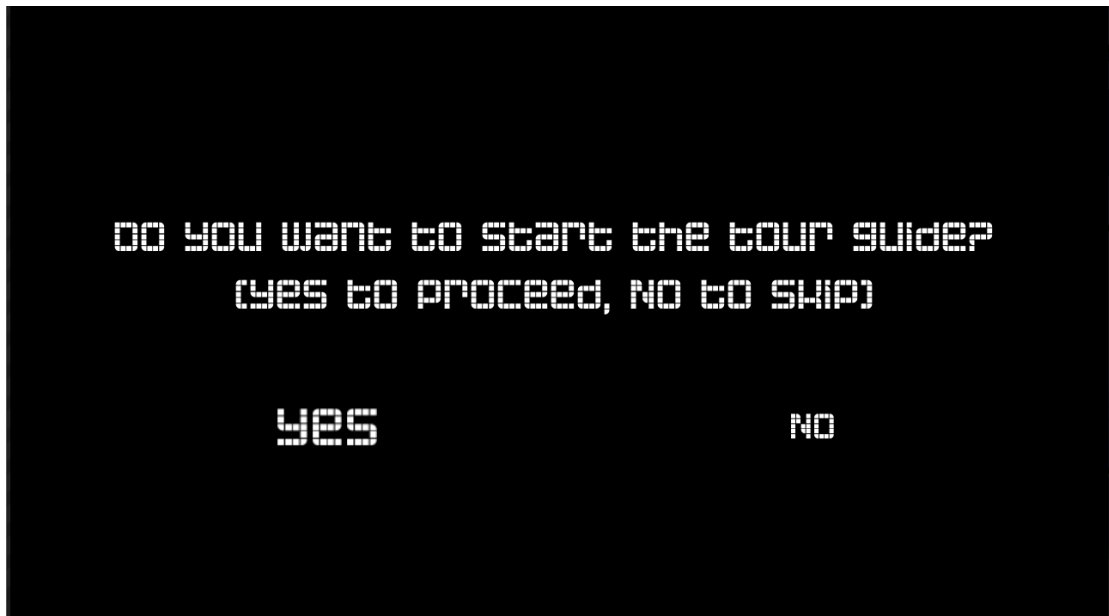


Figure 5-3-3 F1 Pre-Tour Guide

User will be prompted whether they want to have a tour guide. They can select “Yes” to start a tour guide, or they can select “No” to go straight into the free roam mode. User can position their right hand at left or right to browse the option and pinch to select the option.

1. Yes – Goes into Tour Guide Mode
2. No – Goes into Free Roam

### 5.3.4 Tour Guide (Instruction)

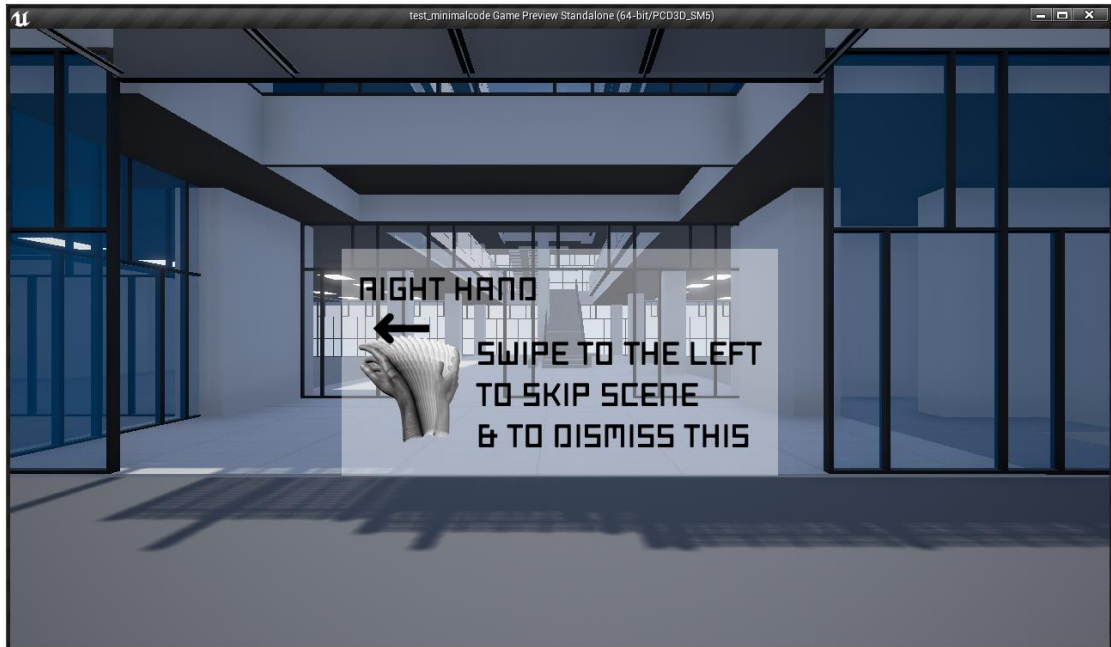


Figure 5-3-4 F1 Tour Guide (Instruction)

An instruction will be shown to inform the user on the currently applicable gesture, which in this scene, is swipe their right hand to the left to skip the current tour scene. User can then swipe their right hand to the left to remove the instruction and starts the tour.



### 5.3.5 Tour Guide



Figure 5-3-5 F1 Tour Guide

User will be guided through the building. User can swipe their right hand to the left to skip the current tour scene. After all the guiding ends, the user will proceed to Free Roam mode.

### 5.3.6 Free Roam (Instruction)

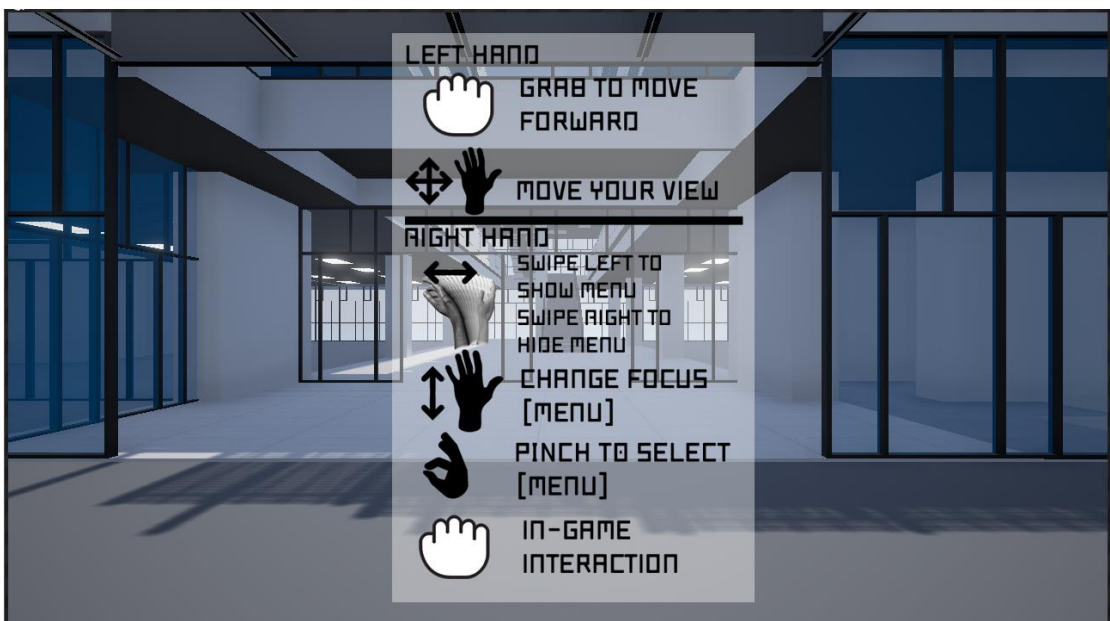


Figure 5-3-6 F1 Free Roam (Instruction)

Before Free Roam starts, an instruction is shown to the user to tell them about how to control their input during the free roam period. User can then swipe their right hand to the left to dismiss the instruction and proceed to Free Roam.

### 5.3.7 Free Roam



Figure 5-3-7 F1 Free Roam

In here, user are allowed to move freely inside the 3D replica of UTAR campus. User can move their viewing camera as they move their left hand naturally to control the head of the character. User can also make the character move forward by grabbing their left hand.

### 5.3.8 Free Roam (Menu)



Figure 5-3-8 F1 Free Roam (Menu)

While in the free roam mode, user can show the menu by swiping their right hand to the left, and proceed to go through the options by moving their right hand up and down. User can then choose the selected option by pinching their right hand or dismiss the menu by swiping their right hand to the right.

1. Resume
2. Other View
3. Settings
4. Exit

### 5.3.9 Other View Mode

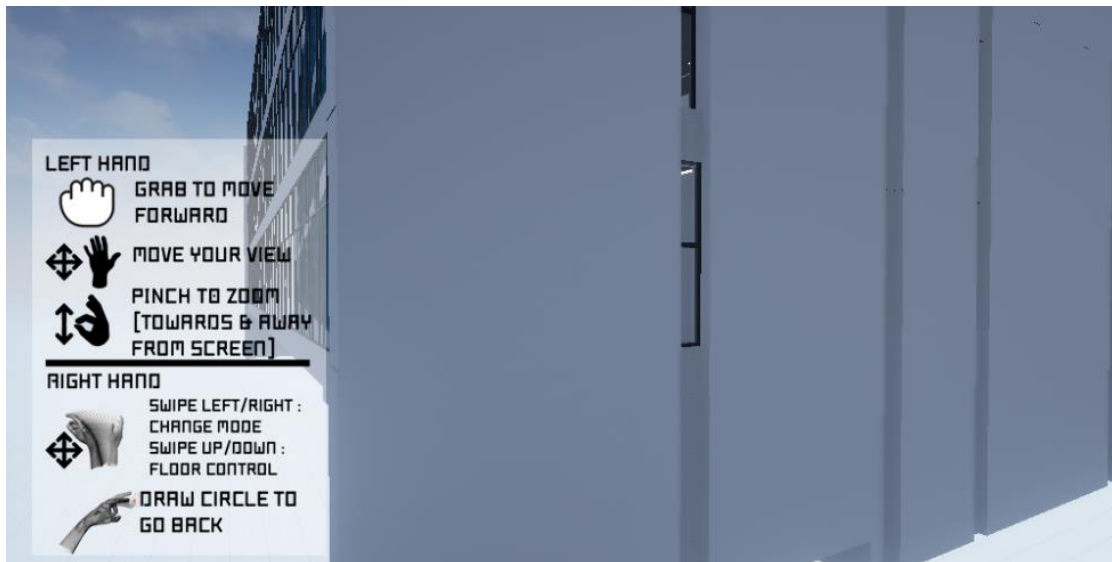


Figure 5-3-9 F1 Other View Mode

In this mode, users are able to view the selected building as a whole, and with 2 choices of point-of-view. By moving left hand around, user are able to change the view to the building naturally. Other than that, user can swipe their right hand to left or right to change to different point-of-view. User can also swipe their right hand up or down to show or hide the building's floor. Instruction will be shown at the side of the screen. User can then draw a circle gesture to go back to main menu.

### 5.3.10 Settings



Figure 5-3-10 F1 Settings

In here, users are allowed to change the application's resolution setting to suit their hardware performance.

1. 1366x768
2. 1600x900
3. 1920x1080
4. Back

## 5.4 Testing

### 5.4.1 Survey and Questionnaire

A survey had been done among the students to get their feedback on the application after using it.

Do you have any experience of using a virtual tour application? (30 responses)

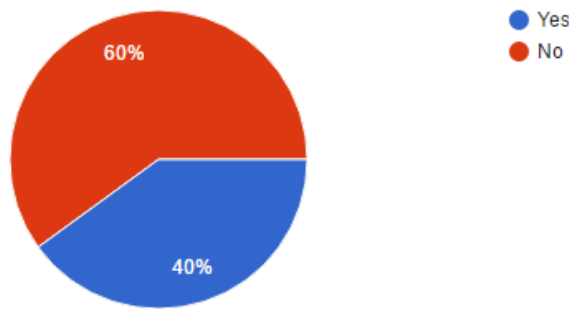


Figure 5-4-1 F1 Question 1

(If Have Experience) On what device do you use the virtual tour application?  
(12 responses)

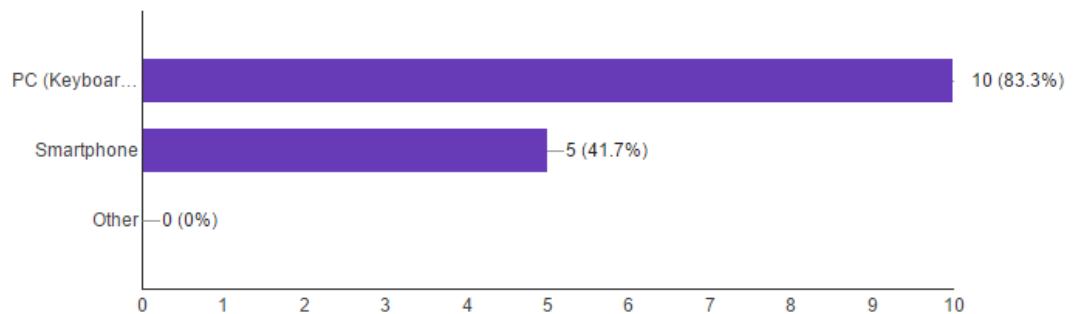


Figure 5-4-1 F2 Question 2

What do you think about virtual tour? (30 responses)

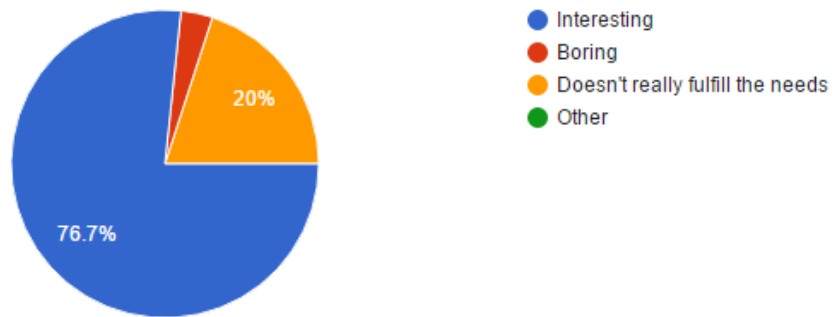


Figure 5-4-1 F3 Question 3

Through the above questions, it shows that 60% of the students don't have an experience on using a virtual tour application, but having the thought that it will be interesting to use one.

Do you think having a virtual tour through this application is convenient by comparing to going for an actual tour? (30 responses)

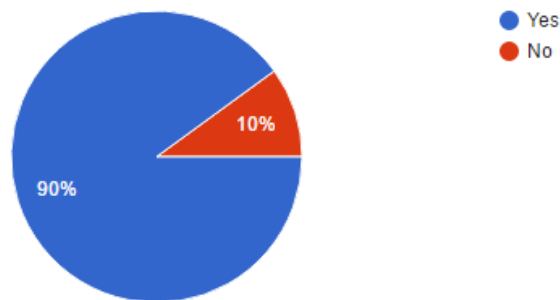


Figure 5-4-1 F4 Question 4

90% of the students think it is convenient to have a campus tour through the use of virtual tour instead of actually going to one.

As a student, how often did you lost your way in campus when you are still new to it?

(30 responses)

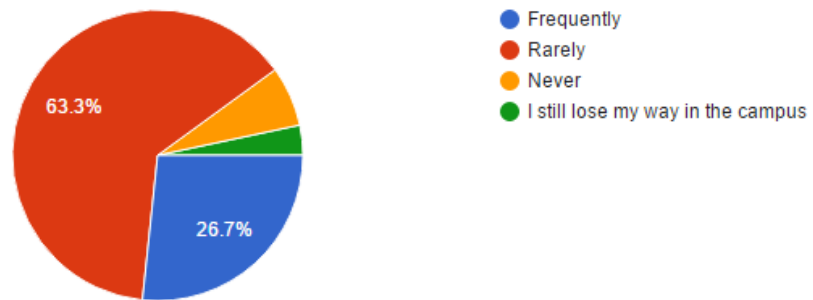


Figure 5-4-1 F5 Question 5

Do you think that this application can help people to familiarize with the campus?

(30 responses)

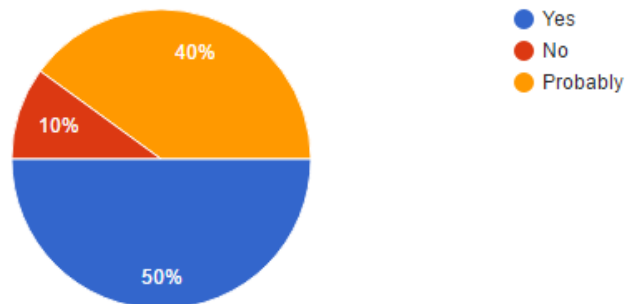


Figure 5-4-1 F6 Question 6

Through these questions, only 10% of the students think that this application is not going to have any use on helping people to familiarize with the campus.



What do you think about the application? (30 responses)

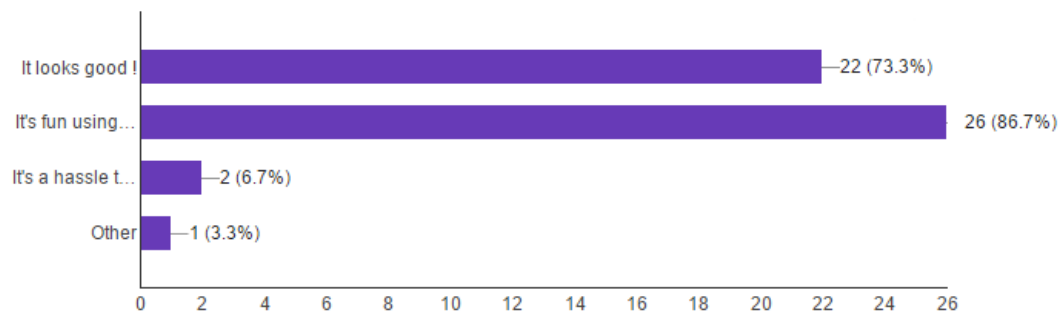


Figure 5-4-1 F7 Question 7

What kind of improvement you wish to see in the future? (30 responses)

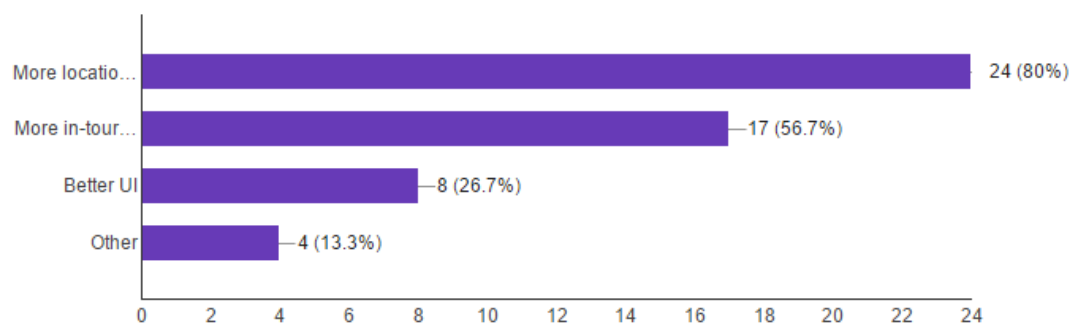


Figure 5-4-1 F8 Question 8

Lastly, through the above questions, it shows that 86.7% of the people have a good time using the leap motion to navigate through the virtual tour. They also hope that in the future, this virtual tour application can include more location option and more ways of interaction inside the tour.

## **Chapter 6: Conclusion**

### **6.1 Conclusion**

With the technology getting better, a lot of work that is previously unachievable is now possible to be done, which include an advance way of providing input to the computer. To conclude things up, developing a virtual tour software for UTAR is going to be beneficial in a few ways. As the traditional way of having a campus tour is to travel physically to the location and staying there for some time, probably exposing themselves to the unfavorable condition of the environment, and forced to go through the whole touring process. The whole process of traveling and touring will most probably takes a long time.

With that being said, and some motivation as support, a UTAR virtual tour is decided to be developed. It will definitely provide a way to conveniently touring the campus, as it will be accessible as long as there is a computer, which will help attract and motivate potential student to join in. It will help new students to familiarize with the campus environment as they can easily view the campus through the software.

The current result of the project consist of having the UTAR Kampar's library as an option for the virtual tour location. It consist of modules like tour guide mode, free roaming mode, dollhouse view mode and floor plan mode. It currently have some interesting sound effects and uses leap motion for full navigation throughout the whole process.

### **6.2 Discussion**

Through reviewing a several amount of others application, it is found that the common attribute that shared among all the application is the quality of those application. All of them are using high quality of photos or models, which creates a realistic environment, and that is also what this project is aiming to achieve. As for the navigation aspect, only 1 of it allows free navigation, and others are either partially or is unable to navigate through the area. Majority of the system allows multiple viewpoint, which is also an essential features for virtual tours.

Aside from that, interactivity seems to be a less adapted aspect for most systems, which probably might bore the user after some extended usage. As for the input part, majority of the system are still using the keyboard and mouse, which means if a newly developed system uses a more unique and advance way of input, it will definitely catches the attention of the user compared to the others.

Based on the article reviewed, it is found that the staff's believes and appreciate that virtual tour is able to ease on their task. A number of new students also tend to lose their direction, and this is where virtual tour comes handy. 3D virtual environment platform is chosen instead of photo-stitching method as it allows the user to navigate freely in the area, which the latter method don't. Last but not least, leap motion is chosen as the primary input device as there are more room of improvement for it, since it is operating in 3D space instead of 2D space like the mouse, which provide a more natural way of manipulation in 3D space.

### **6.3 Future Work**

Since this system aims to provide a virtual tour for the users, it will be essential to have the whole campus included in it. The current idea is to create the 3D environment for each section individually, which mean the user can only select 1 specific block and navigate only in that area. Assume that in the future when all block have its own module completed, a compilation work can be made to combine all the blocks model into 1 single environment, which means the user can walk directly, in the 3D environment, to the others block. Which means users can even have a view of the road in between each blocks, taking the realisticness to the next level.

Other than that, it might be possible to even integrate the currently used system into the virtual tour. For instance, it can be connected to the internet and adapt the library system to handle the book leasing, getting the information of the student's timetable and show its location precisely and etc. Together with a kind of GPS system inside the UTAR that will guide a student to go from a place to another in different mode like map view or first person view in detail, and showing the time taken, distance, the path and etc.

There are a lot of possibility for this system and if it is all achieved, it will definitely bring a lot of benefit to the UTAR staffs and students.

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## Appendix A : Survey Form

# FYP Survey

\*Required

Do you have any experience of using a virtual tour application? \*

Yes

No

(If Have Experience) On what device do you use the virtual tour application?

PC (Keyboard and Mouse)

Smartphone

Other: \_\_\_\_\_

What do you think about virtual tour? \*

Interesting

Boring

Doesn't really fulfill the needs

Other: \_\_\_\_\_

Do you think having a virtual tour through this application is convenient by comparing to going for an actual tour? \*

Yes

No

As a student, how often did you lost your way in campus when you are still new to it? \*

- Frequently
- Rarely
- Never
- I still lose my way in the campus

Do you think that this application can help people to familiarize with the campus? \*

- Yes
- No
- Probably

What do your think about the application? \*

- It looks good !
- It's fun using the leap motion to have a virtual tour.
- It's a hassle to use leap motion to have a virtual tour.
- Other: \_\_\_\_\_

What kind of improvement you wish to see in the future? \*

- More location included as the tour option
- More in-tour interaction
- Better UI
- Other: \_\_\_\_\_

**SUBMIT**

## Turnitin Result

### FYP 2 Report

#### ORIGINALITY REPORT

% **7**

SIMILARITY INDEX

% **6**

INTERNET SOURCES

% **1**

PUBLICATIONS

% **4**

STUDENT PAPERS

#### PRIMARY SOURCES

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