

DESIGN AND FABRICATION OF A MULTI TOUCHSCREEN  
DESKTOP FOR MULTI PURPOSE USAGE

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### **SUPERVISOR'S DECLARATION**

We hereby declare that we have checked this project and in our opinion this project is satisfactory in term of scope and quality for the award of the degree of Diploma o Mechanical Engineering.

Signature :

Name of Supervisor :

Position :

Date :

### **AUTHOR'S DECLARATION**

I hereby declare that the work of this project is my own except for quotation and summaries which have been duly acknowledged. The project has not been accepted for any award or prize-winning competition and is not concurrently submitted for other purpose of acknowledgement.

Signature :

Name :

ID number :

Date :

To my family and all that involved

## **ACKNOWLEDGEMENTS**

I would like to return my gratitude and courtesy to all personnel who involve in this project and especially to those who assisted and encourage me in completing this whole project. Special thanks to my supervisor Mr. Muhammad Ammar Bin Nik Mu'tasim for the whole guidance for 14 weeks during the making of this project. Thanks also to other lecturer and instructor engineer in the lab for their assistance while using the tool and equipment in the laboratory.

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Not forget my family, to all my peers who should be recognized for their support during the testing period. All the comment, suggestion and tips were useful to make this project run smoothly and minimized the flaws. Lastly, this project is to bring the good and to ensure the future life to be more comfortable.

## ABSTRACT

This thesis is regarding the final year project for a diploma student in Universiti Malaysia Pahang (UMP). The title is building Multi Touchscreen Desktop. The student needs to design and fabricate a Multi Touchscreen Desktop for multipurpose usage. It is to overcome the problems that arise when using normal computer which use too many space in a room. Normal computer also cannot receive too many input at a time which make it time consuming. The student needs to use various fabrication processes in the making of this project. All the skill had been taught in previous lab courses in UMP. Firstly, the work must be plan well so the work can be finished in time. A gantt chart is constructed in order to show the date and time for the specific work to be done. Moreover, a flow chart is also constructed to visualize the step-by-step process of making this project. Literature review is done early to give better understanding about what is multi touch screen. Lots of research is done whether using internet or other media. Then the student makes the sketches of the multi touch screen desktop. All the sketches undergo screening process and only 4 that pass the screening. The 4 sketches are then refined before final concept is selected using scoring process. The final concept is then turned into 3D drawing. The 3D drawings are generated using computer software. After the detail of the drawing is finished, the project is fabricated. All the process is mainly done in the fabrication lab of UMP. Starting from the measuring and marking process until the assembly process is done using the tools and equipment in the lab. Next the product is checked for any defect that comes from the fabrication process. Lastly the project is tested to make sure the multi touch screen desktop can function well. Therefore the project can be used although with some flaw that could not being resisted.

## ABSTRAK

Tesis ini berkenaan dengan projek tahun akhir untuk pelajar diploma di Universiti Malaysia Pahang. Projek tersebut bertajuk pembinaan sebuah komputer skrin sesentuh. Pelajar perlu mereka dan membina sebuah komputer skrin sesentuh untuk pelbagai guna. Ia adalah untuk menangani masalah yang timbul apabila sebuah komputer menggunakan terlalu banyak ruang dalam sesebuah bilik. Komputer biasa juga tidak boleh menerima terlalu banyak input pada satu-satu masa lalu menyebabkan pembaziran masa. Pelajar perlu menggunakan pelbagai cara pembuatan yang telah dipelajari dalam kursus lain di UMP. Pertama sekali, kerja-kerja harus dirancang dengan teliti, oleh itu carta gantt telah ditubuhkan. Kemudian carta aliran juga diadakan untuk menggambarkan langkah-langkah kerja dilakukan. Kajian awal telah dilakukan untuk mendapatkan lebih maklumat berkenaan dengan skrin sesentuh. Banyak kajian telah dilakukan melalui sumber internet dan media lain. Kemudian pelajar memulakan lakaran awal idea skrin sesentuh yang ingin dihasilkan. Kesemua lakaran melaluin proses penapisan sehingga empat lakaran melepasi proses penapisan tersebut. Selepas itu, lakaran tersebut diperhalusi dan melalui proses pemarkahan untuk menentukan konsep terakhir. Konsep terakhir tersebut akhirnya ditukar kepada lukisan 3D melalui perisian komputer. Selepas lukisan yang teliti telah disiapkan, kerja-kerja membuat skrin sesentuh dilakukan. Segala kerja dilakukan di dalam makmal fakulti. Kemudian produk diperiksa untuk mengenalpasti sebarang cacat cela yang terhasil dari kerja- kerja pembuatan. Akhir sekali skrin sesentuh tersebut di cuba untuk memastikan ia berfungsi dengan baik. Projek tersebut telah berjaya dengan sedikit masalah yang tidak dapat dielakkan.

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## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 Background**

Multi touch screen desktop (MTD) is a generation of computer we used nowadays. As we all know, normal computer used mouse and keyboard as their input, but with MTD we can interact with the computer by the touch of our finger. The moment we touch the screen, the computer will interact with them to produce input to our computer. Moreover, with MTD the users can have multiple touches or inputs on the same computer. It will make it easier for the user to have a conversation and interacting with the computer on the same time.

MTD can be in many different sizes but it must be in suitable to fit a LCD projector and an IR webcam. For some of the products, MTD is built in standard sizes to make the user easier to use it also as a table. The size is an important factor when building MTD because it will save some space in the room.

The mechanism to construct the touch screen is by reflecting the IR light to the webcam at the bottom of the table. The Frustrated Total Internal Reflection (FTIR) is used. FTIR happens when the IR light is trapped into the acrylic and it only reflects in the acrylic. When someone touches the acrylic, the light will bounce back to the IR webcam below the acrylic.

## **1.2 Problem Statement**

Nowadays many people find it hard using mouse and the keyboard while using the computer at the same time. It also limits the user to interact with the computer by one click at a time. Some computers maybe consume too much space for it.

## **1.3 Project Objective**

To design and fabricate Multi Touch Screen Desktop (MTD) for multipurpose usage.

## **1.4 Scope**

- To test the software for multi touches.
- To fabricate (MTD) using various manufacturing process.
- To compare ideas with past developers and products.

## **CHAPTER 2**

### **REVIEW OF LITERATURE**

#### **2.1 Introduction**

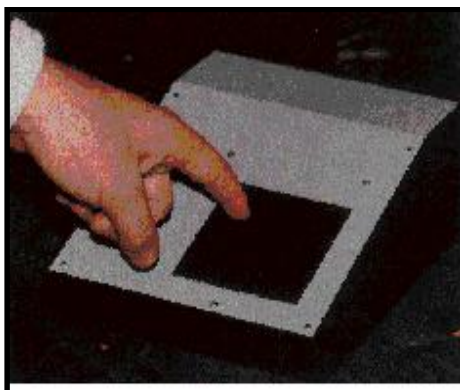
Lots of effort had been done to maximize our hand usage to control digital objects. The results we can see now are touch pad, ATM machines, and as the latest, tablet PC and Smartphone. Many revolutions had happen since 1985, when the first multi touch tablets were proposed by Lee, Buxton and Smith. Since that time, many people continue to develop the technology of multi touch screen and the design of this product. The types of input to this multi touch display are various, whether it is a direct input, gestural input, symbolic or hand measurement to specify the input or command. Nowadays, lot of multi touch gadgets use lot of effort and very complex design, thus it will increase the cost of making the device.

#### **2.2 Early Edition of Multi Touch Screen**

##### **2.2.1 Touchpad**

Touch tablets that can sense more than a single point of contact was first propose by Lee, Buxton, and Smith in 1985. They used digitizer as their main component at the touchpad. The proposal was made at University of Toronto the place where they are doing their work.





**Figure 2.1:** First touch pad.

The purpose of their proposal is to search the method for multi touch can be done in the same time at the same thing. Their digitizer is composed of an array of capacitive proximity sensors where the finger and the sensor act as two plates of capacitors. Since capacitance is inversely proportional to the distance between the plates, robust contact detection can be accomplished by simply selecting an appropriate threshold.

The resolution of the digitizer can be enhanced beyond the physical resolution of the sensor matrix by interpolating data from neighboring groups of sensors, the touchpad also approximate pressure sensing by monitoring the increase in capacitance as the fingertip flattens against its surfaces.

This proposal made the breaking point for the revolution of the multi touch screen. Since then, many type of touch pad had been commercialized. For example, TouchStream and iGesture touchpads by FingerWorks

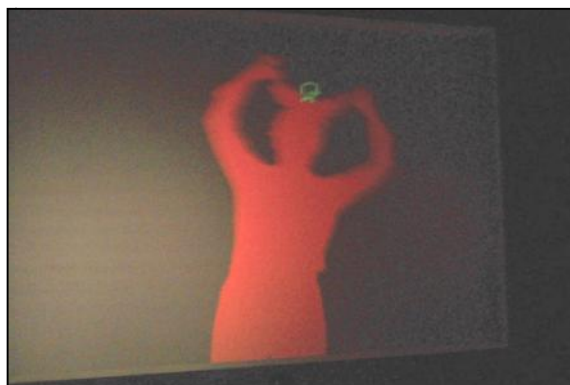
### **2.2.2 Vision-Based System**

Vision based can be roughly classified as “direct” system, where the camera are aimed at the users hand, and “indirect” system, where the cameras are aimed at a touch-surface that produces a change in the image when touched by a finger or object.

One of the earliest direct vision based system for whole hand interaction is Krueger's Videoplace. Myron Krueger who is a computer genius has started the research of from 1969 until 1974. The system captures an image of the users, who stand in front of a plain background. It segments the image and displays it as a silhouette in real time. The moving silhouette can then be used to interact with digital objects and animated characters.



**Figure 2.2:** Input from the user.



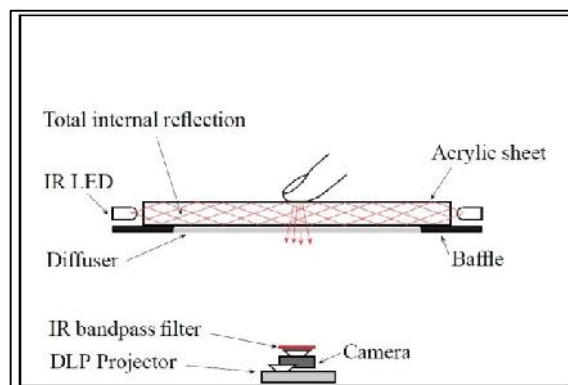
**Figure 1.3:** Digital image produce.

## 2.3 Technology

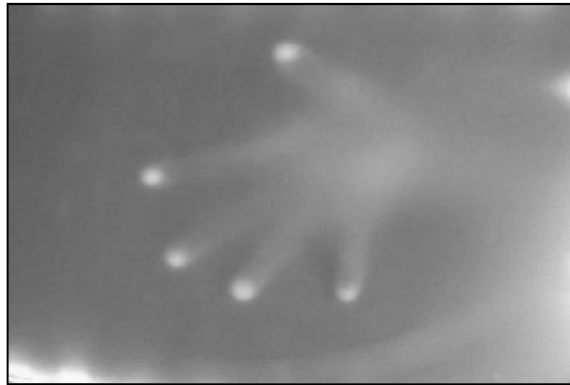
### 2.3.1 Frustrated Total Internal Reflection (FTIR)

FTIR is a name used by the multi touch community to describe an optical multi-touch methodology developed by Jeff Han ( Han 2005). The phrase actually refers to the well known underlying optical phenomenon underlying Han's method. Total Internal Reflection describes a condition present in certain material when light enters one material from another material with high refractive index, at an angle of incidence greater than the specific angle. The specific angle at which this occurs depends on the refractive indexes of both materials, and is known as the critical angle, which can be calculated mathematically using Snell's Law.

When this happens, no refraction occurs in the material, and the light beam is totally reflected. Han's method uses this to great effect, flooding the inside of a piece of acrylic with infrared light by trapping the light rays within the acrylic using the principle of Total Internal Reflection. When the user comes into contact with the surface, the light rays are said to be frustrated, since they can now pass through into the contact material (usually skin), and the reflection is no longer total at that point. This frustrated light is scattered downwards towards an infrared webcam, capable of picking these blobs up and relaying them to the tracking software.



**Figure 2.4:** FTIR mechanisms.



**Figure 2.5:** Blobs from fingers.

## 2.4 Types of Multi Touch Screen



**Figure 2.6** Multi touch Screen.

### 2.4.1 Bend Desk

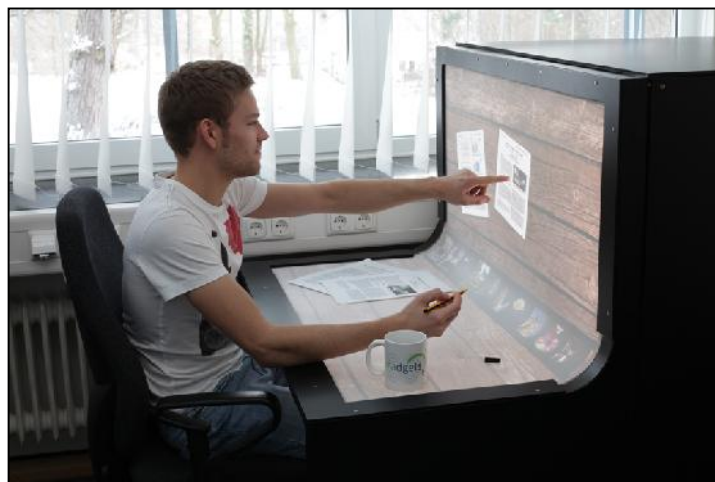
Bend desk is a prototype interactive display that takes the digital workspace from the screen to the desktop by the media computing group at RWTH Aachen University. While a typical work setup combines a flat desktop with a vertical computer screen, bend desk combines the two into one single unit. Bend desk is a vision for a future workspace that allows continuous interaction between both areas. This workspace can be used to display digital content and interact with it directly using multi-touch gestures and manipulation.

#### Advantages

- Very large working surface.
- Ergonomic for the user.
- Can be used as table.

#### Disadvantages

- Cannot move freely.
- Limited to small number of person.
- Large space consumption.



**Figure 2.7:** Bend Desk

### 2.4.2 Multi Touch Television

Similar to other multi touch product but has wider screen. The projector and the computer were located in the box of the multi touch. The project use FTIR technology. Then it combined with speaker and can work as normal computer.

#### Advantages

- Large wide screen.
- Build in speakers.
- Nice and clean design.

#### Disadvantages

- Cannot move freely.
- The design is not suitable for long usage.
- Can consume too much space.



**Figure 2.8:** 56inch Multi touch Television

### 2.4.3 Multi touch Mini

A Multitouch Mini, MTmini for short, is a cheap, small, portable multitouch pad. It can be used for all different purposes including: drawing, OS navigation, multitouch operation, games, entertainment, experimentation, and more. I created the Multitouch Mini to show people how something that seems complicated or 'magical' can be made simply and at low cost. The MTmini uses the "Front Diffused Illumination" multitouch technique, with normal ambient light (infrared not required or needed) and a normal off-the-shelf webcam (IR filter can still be in place).

#### Advantages

- Can be portable.
- Very light weight.
- Less space consumption.

#### Disadvantage

- Too small to fit the image.
- Less aesthetic value.
- Limited user.



**Figure 2.9:** MT Mini

## 2.5 Material Selection

### a) Acrylic

The acrylic is used as the surface of the MTD. The acrylic is better use than glass because of its clearness. Acrylic is clearer than glass. Besides, it is also easy to handle because it is less fragile. For this project, 7mm acrylic is used. It should be thicker to make the infrared light bounces inside the acrylic.

### b) Aluminum alloy.

This material is chooses to make the frame of the MTD. Because of its strength, it can withstand the pressure from the surface and human touch. The aluminum alloy used is in L-shaped.

### c) Plywood

Plywood is also used in this project. Because of its strength and aesthetic value, plywood is a very good choice for the project. The plywood is 10mm thick and is used as in the drawing of the project.



## **CHAPTER 3**

### **METHODOLOGY**

#### **3.1 Methodology**

In designing and fabricating of this Multi touch screen, a flow of methods were used in completing the project. First of all, a project planning was constructed and were charted out. These chart will function as the guideline to be followed so that, the final model meets the requirement and time.

#### **3.2 Flowchart**

The flow chart starts with the introduction. This is where the first plan of work is constructed. The supervisor explains the scope of the project and requested for understanding of the project and makes some finding about the project. Student makes project synopsis, objective, scopes, problem statement and work planning. Then the problem statement is following down the steps. Here problem are generated by the observing and research on the project.

Next the literature review of the project is done thoroughly to get the better understanding of this project. The literature review covered all the aspects regarding the build of MTD. Student gets the information via internet and books. Additional information comes from lecturer and other student.

After the literature review was done, few raw sketching were done to fulfill the objective and the problem statement of the project. Four sketches were made with

3-dimensional and clear understanding. Sketching is done to make a clear view for designing process after this.

After all the sketches are prepared, a comparison among the sketches is made to give the advantage and this advantage for the sketches. This is to make sure the best sketches will be produced.

Pugh analysis is made to get the scoring between the sketches. By using this method, the student can see more easily and clearly compared to comparison. Every criterion will be given a weight and the scoring is made based on the criteria. The score is then multiplied by the weight of the criteria to get the score. The best is chose among the highest total score.

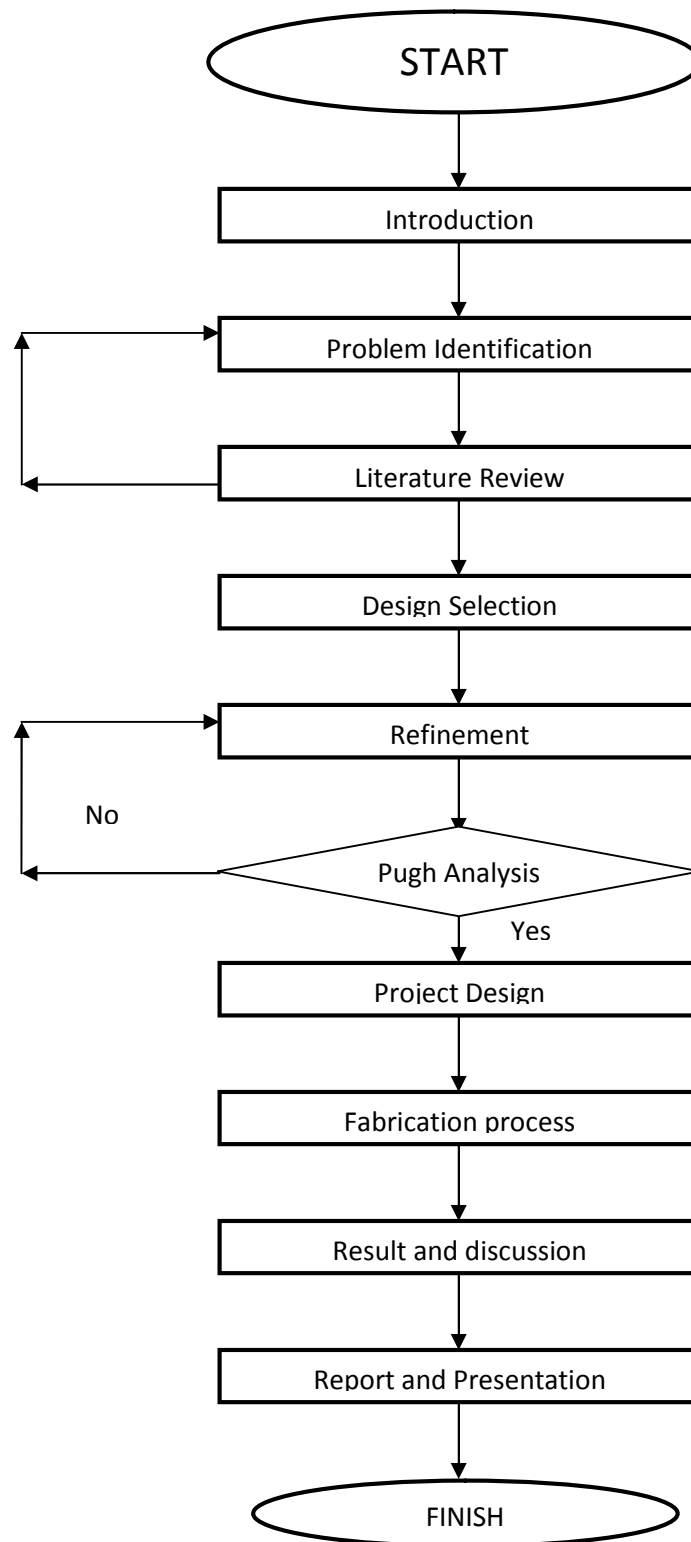
Then the actual project design is made based on the chosen sketches. The design is made by using SolidWorks 2010 software. The design is made part by part and is assembled by using the same software. Then 2D drawing is made with dimension and scale.

The next step is fabrication process. All the fabricating works are made in the lab and utilize all the tool and equipment in the lab. The first step is getting the material from the FKM store. Aluminum L-bar is used as the main frame of the model. Then, the aluminum is cut into various lengths according to the drawing. After that plywood is used as the based and the level of the model. The joining process of the product is using rivet, bolt and nut, so drilling process is needed before the joining process is made.

As all the parts had been joined together, it comes to the result and discussion section. In this section, the report and the product are shown and tested. The draft report and the entire related article are handed over to the supervisor for checking.

For the conclusion, all the recommendations are stated to get the best quality product. The project and the report is also checked to make sure no mistake and flaw in the end report.

Lastly, when the report and the project are approved by the supervisor, the project will be finally published and handed over to the supervisor, the coordinator and the Faculty of Mechanical Engineering. All presentation slides were also made and ready to be presented.



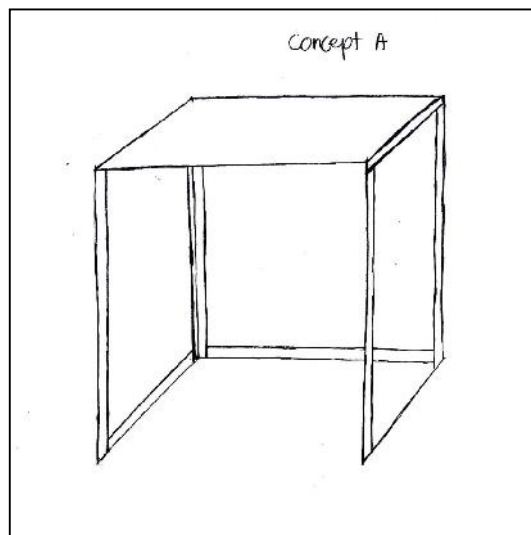
**Figure 3.1:** Flowchart

### 3.3 Sketching

There were 6 sketches including a reference. The entire concepts are screened and after the screening process, 4 sketches were made based on the ideal concept and as followed:

#### 3.3.1 Concept 1

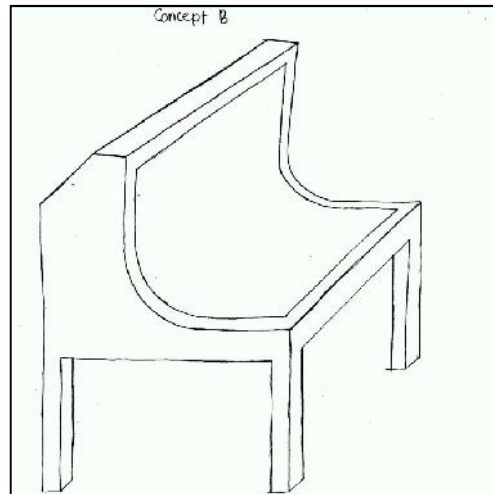
This is the basic design of multi touch screen. The top of the table is the main screen and consist of 4 legs.



**Figure 2.2:** Concept 1

#### 3.3.2 Concept 2

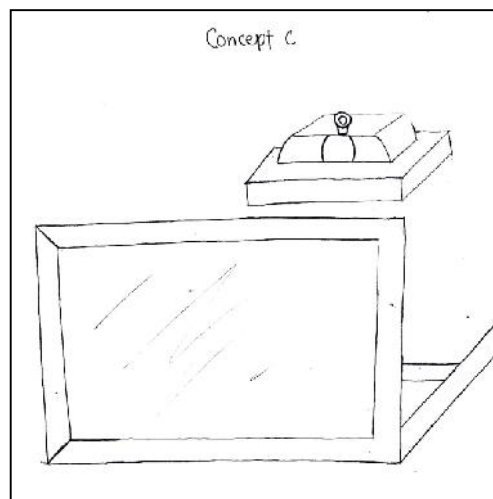
This concept is larger than the first concept. Can be made as an table. The bend part is also the screen for multi touch.



**Figure 3.3:** Concept 2

### 3.3.3 Concept 3

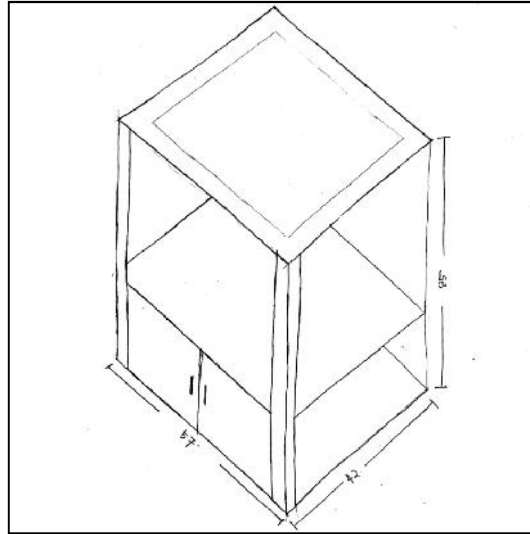
The third concept only consists of the screen. It has larger screen and stand on the back part of the concepts.



**Figure 3.4:** Concept 3

### 3.3.4 Concept 4

The last concept of this project is made for more use other than multi touch screen. It can be more useful than other concepts.



**Figure 3.5:** Concept 4

### 3.4 Concept Selection and Comparison

Concept selection and comparison are made to select the best concept among the entire concepts given. The concepts are compared by using screening and scoring process. The comparison is based on reasonable criteria all as called as matrix.

The four given concept is the best among all the concept generated and pass the screening process.

**Table 3.1:** Concept 4,2,3,1 passes the Screening process

<b>Matrix\Concepts</b>	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Concept 6 (reference)
Comfort	+	o	+	+	+	o
Durability	o	+	+	+	o	o
Easy to Use	+	o	+	+	+	o
Production Cost	+	+	o	o	-	o
Portable	+	+	+	+	+	o
User limit	o	-	0	o	o	o

Easy to fabricate	o	+	0	+	+	o
Simplicity of design	+	-	o	+	-	o
Strength	o	+	-	o	o	o
Total (+)	5	5	4	6	4	o
Total (-)	0	2	1	0	2	o
Total Score	5	3	3	6	2	0
Rank	2	3	4	1	5	0

### 3.5 Pugh Analysis

Pugh analysis is made after the screening process to select the concept as the best concept. The method is same as the screening process but this time the criteria is weighted and total score are calculated in the end.

**Table 3.2:** Concept 4 made the final concept.

<b>Matrix\Concepts</b>	<b>Weight (%)</b>	<b>Concept 1</b>	<b>Concept 2</b>	<b>Concept 3</b>	<b>Concept 4</b>
Comfort	10	1	3	2	4
Durability	10	2	4	1	3
Easy to Use	10	1	1	2	3
Production Cost	10	4	2	1	3
Portable	15	2	3	3	4
User limit	20	1	3	3	2
Easy to fabricate	10	2	1	1	4
Simplicity of design	5	4	2	2	3
Strength	20	2	2	3	2
Total score (%)	110	210	265	245	325

Rank		4	2	3	1

1 = Okay

2 = Good

3 = Very Good

4 = Excellent

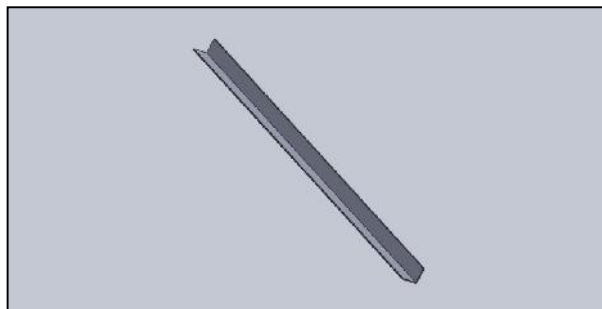
### 3.6 Solidworks Design

the sketch of concept 4 is converted into 3D drawing by using SolidWorks 2010 software. The design is made part by part and by using this software. Then a 2D sketch is generated to get the clearer view of the model.

#### 3.6.1 Part by Part View

##### a) Part 1

This part is the main part of the frame.

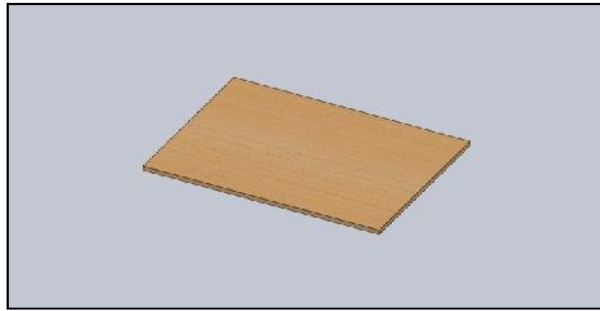


**Figure 3.6:** Table Frame

##### b) Part 2

This part is the base part of body frame. It is made from plywood.

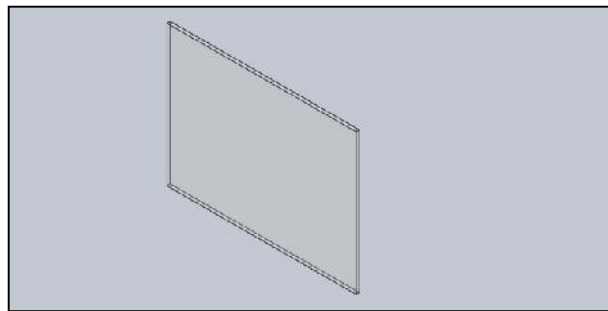




**Figure 3.7:** Plywood

c) Part 3

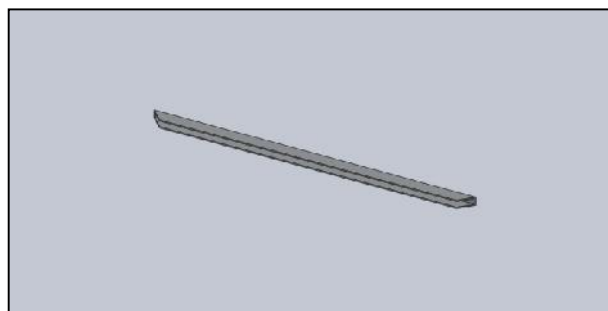
The top part of the table is made from acrylic.



**Figure 3.8:** Acrylic

d) Part 4

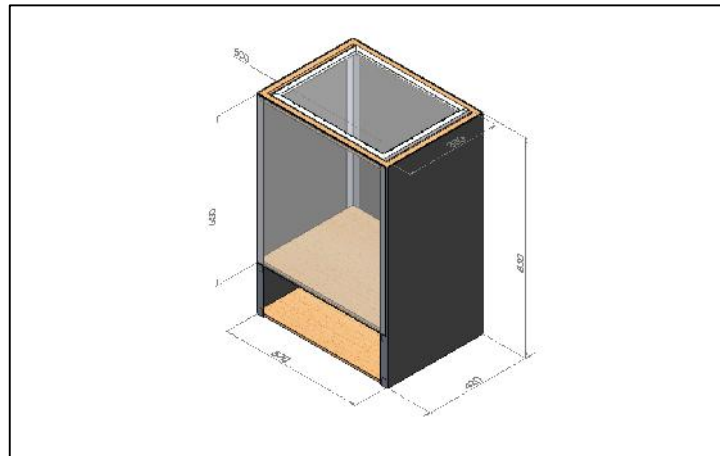
This part is to hold the IR LED along the acrylic.



**Figure 3.9:** Aluminum frame

### 3.6.2 Assembly View

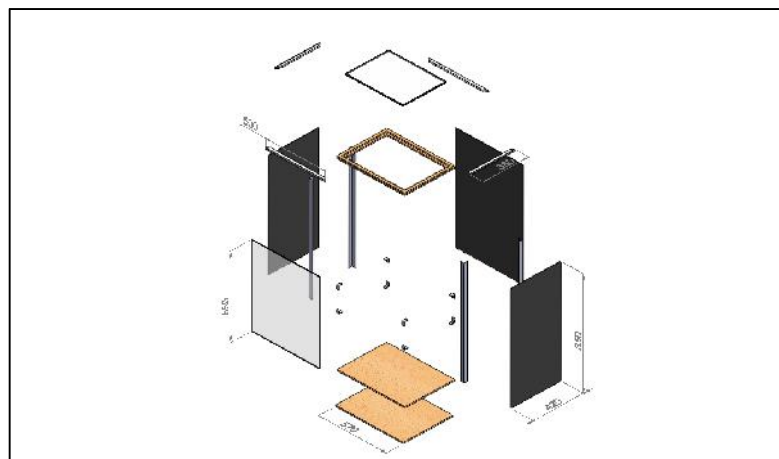
This is the final assembly of the project which shown the last product of this project.



**Figure 3.10:** Assembly view

### 3.6.3 Exploded View

This is the final assembly by using exploded view.



**Figure 3.11:** Exploded View

### 3.7 Bill of Material

In this section, the list of material and its size are shown for reference. The material can be found in the FKM store or in hardware.

**Table 3.3:** Bill of Material

No	Description	Quantity	Estimated Cost (RM)
1	Acrylic ( 480mm x360mm x 80mm)*	1 Sheet	65
3	Aliminum L-shaped bar	12 m	*
4	Brasso (metal polish)	1 Bottle	13
5	Silicon rubber	1 Bottle	12
6	Tracing paper	1 Sheet	5
7	Plywood	1 Sheet	25
8	IR LED	30 Pieces	60
9	Resistor	10 Pieces	10
10	12V DC adapter	1 Set	12
11	Webcam	1 Set	25

\* = material already in the lab.

### 3.8 Fabrication Process

In this section, all the fabrication process will be explain thoroughly. The fabrication processes are made in one of the lab in FKM. All the materials selected in section 3.6 of this report are used to make this project. The project is fabricated based on the design made earlier and using various fabricating methods. The method used to fabricate the product such as, cutting, grinding, drilling and more other methods.

### 3.9 Process involve

In order to make the project to be finished and tested, the process of fabricating must be used. The fabrication processes start with dimensioning and end with assembly process. The process involve in this project are as followed.

#### a) Collecting material

Firstly, the material used is collected at FKM store. There are various types of materials there and the aluminum L-bar is collected there. The other materials were bought from hardware nearby.



**Figure 3.12:** Collecting material

#### b) Measuring and marking

Next, all the materials are measured and marked according to the dimension from the design earlier. Measuring tape is used to measure the correct measurement according to the dimensions specified in final drawing.

#### c) Cutting

After the materials are measure and marked, the cutting process will be done. The material is cut based on the mark on the material earlier. Many tool were used in this process such as hand saw, and floor cutting disk.

#### d) Drilling

Then the drilling process is done in order to join the parts of the product using nut and bolt. The drill point is mark before using center punch and drilled using hand drill and table drill.



**Figure 3.13:** Drilling

#### e) Grinding and finishing

This process is to remove the bur and unnecessary part from the material. Hand grinder and file is use in this process.



**Figure 3.14: Grinding****f) Joining**

This process where the frame of the product is joined together using nut and bolt. The wrench is used to tighten the screw.

**g) Wiring**

This is the process when the IR LED is put into the acrylic frame used. The LED is connected using solder metal. 30 LEDs is connected using 12V power supply.

**h) Final assembly**

When all the parts are done, the whole project is assembled and finishing process is done lastly.

**3.10 Summary**

This chapter is done to discuss the step by step procedure to start the work till the end. All the flow of this project is based on the flow chart prepared early. Throughout the project, student can be more understand how to manage to work properly. The design starts with the work planning then continue to sketch the draft of the project. All the details about the concept selection and concept generation were also covered in this chapter. The drawing and the fabrication process were also being thoroughly briefed.

## **CHAPTER 4**

### **RESULT AND DISCUSSION**

#### **4.1 Introduction**

This chapter is to show the final product that has been made. Then product is then compared whether is it met the target or not. If the final product doesn't met the real target then it means there are problem faced in the production period. The entire problem also will be discussed in this chapter. If the product meet the objective of this project, so it will be tested and all the testing process will be discussed in this chapter. Lastly the discussion is about the way to overcome the problem faced in the making of the project.

#### **4.2 Final Product**

The final product is finished after undergoing the entire fabrication process. The final product is then tested if it works perfectly or not. All the processes are again being reviewed to check if there is any flaw in the process of making the product.

#### 4.2.1 Product View



**Figure 4.1:** Front view



**Figure 4.2:** Side view

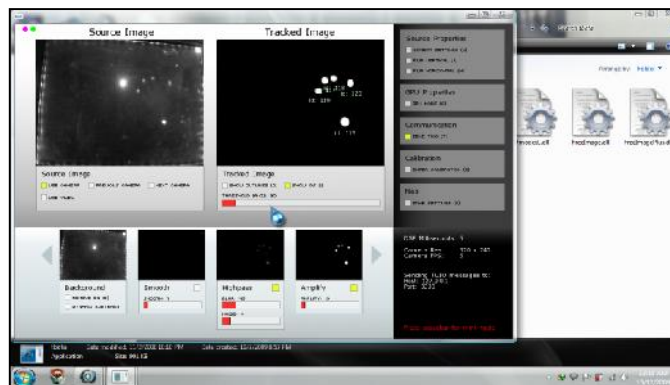




**Figure 4.3:** Back view

### 4.3 Testing

When people touch the surface of the MTD, blobs are produced when the infrared light is reflected towards the webcam. In order to track fingers or objects, tbeta first needs to be configured. The goal is to have a final tracked image that has white blobs coming from fingers or objects placed on the touch surface (with no background noise or false blobs visible or tracked). In order to reach this goal, various image filter sliders are adjusted.



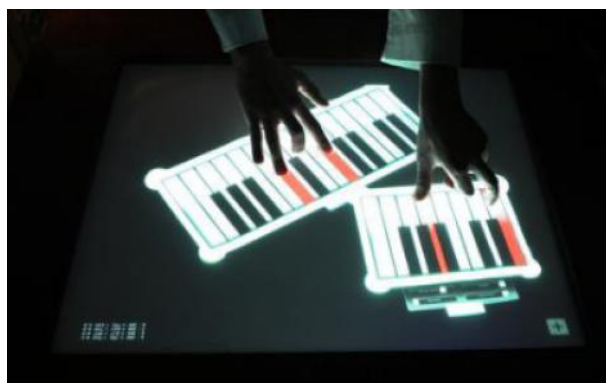
**Figure 4.4:** Blob detection

In order to calibrate tbeta for the camera and projector, student need to run the calibration process. Calibrating allows touch points to line up with the elements on screen. This way, when touching something displayed on screen, the touch is registered in the correct place. In order to do this, tbeta has to translate camera space into screen space; this is done by touching individual calibration points.



**Figure 4.5:** Calibration

Lastly, to test it out, some flash applications such as MultiKey.exe, Photos.exe and mma-pro.exe were open.



**Figure 4.6:** Flash application

#### 4.4 Defect

In the making of the project, there are many defects can happen while the fabrication process is done. There are few flaws that have been detected at the end of this project. The defect can happen because of the human error or machine and tool

error. All flaws that had been detected can be the guide to overcome the problem on next production. It also can be the way to prevent any wastage of cost and production in next time production.



**Figure 4.7: Gap**

## **4.5 Problem Progress**

There progress of making the product also faces some problems during its time. The problems can occur because of the limited number tools or time and more.

### **4.5.1 Material problem**

The problem happen when the material that early suggested, needs to be changed. It is because the material needed for the project is not located in faculty store. So the material is change to the suitable material which is in the store. But not all the materials are in the lab, so student has to find the store nearby Pekan for the exact material.

### **4.5.2 Design problem**

There are also a few problems in this part. Because of the limited machine and tool in UMP, some of the materials need to be changed to match the limit of the tools in UMP faculty lab. It is also be a problem when the student does not have

enough experience to handle designing software such as SolidWorks. The student has to learn the skill of using the software from the student that can help.

#### **4.5.3 Fabrication Problem**

There are also problem that occur in fabrication process. The problem may be caused by the limitation of the tool, type of tool in the lab and how to use the machine. At the beginning of this project. Student must know how to use all the machines involve in this project. The problems occur when student is hard to find the person in charge of the lab. Some of the student doesn't know where the PIC for the lab while doing their work.

## **CHAPTER 5**

### **CONCLUSION**

#### **5.1 Introduction**

In this section, the summary of the whole project will be made in order to show the things that had been done in the entire process. This chapter also includes recommendation for the product to enhance the usage and the esthetic value of the product.

#### **5.2 Conclusion**

Therefore, the project has accomplished the objective successfully. The project is done in 14 weeks time. The entire process of making this project is follows such as literature review, design, sketching and fabrication. The flow chart and gant chart is also followed successfully.

The project of the Multi Touch screen Desktop is finished with some characteristics that we can easily see. The MTD can fit into a small space and because of its rectangular shape, it can save lot of space that normal computer cannot. It also can be easily moved because of the wheel that had been installed below the table. The MTD show that, with some technology and research, lot of things can be saved and help the human to do work more conveniently. With a lot of technology that being invented now, MTD can stand out together with the other new gadget if the project improved a bit more in design and the fabrication process.

### **5.3 Recommendation**

The project must use more suitable material such as large aluminum alloy in order to make the table stronger. The size of the aluminum alloys of the frame should be 3x3 inches. Then the acrylic used must be more than 7 mm thick to make the thing more efficient.

Even though the MTD did not perform perfectly, but some adjustment will make the project better. High end webcam which can be costly can help to improve the detection of the blob from the acrylic. Besides, multiple layers of silicon plus xylene will help to multiply the sizes of the blob coming from the touching of fingers.

Lastly, the lab should provide more functioning machine for the student to make the work easier and faster. Student should start their work earlier to make the work finish on the time.

#### **5.3.1 Future work**

For future improvement, the table should undergo more detail planning. Many things or functions can be added besides using the MTD as a computer. Continuous improvement should be made if the project is commercialized.

Some adjustment can improve the MTD into a fingerprint scanner if done. It only needs the software and some high definition of tracking device to make the improvement complete.

## REFERENCES

This thesis is prepared based on the following references

Giancoli, D. (2008). *Physics: Principles with Applications*. Addison Wesley

Marsal, K. (2008, September 4). *Apple looks to take multi-touch the touch screen*. Retrieved August 4, 2009, from AppleInsider: [http://www.appleinsider.com/articles/08/09/04/apple\\_looks\\_to\\_take\\_multi\\_touch\\_beyond\\_the\\_touch\\_screen.html](http://www.appleinsider.com/articles/08/09/04/apple_looks_to_take_multi_touch_beyond_the_touch_screen.html)

Mathema, C. (2009, July 29). *Multi-Touch All-Point Touchscreens: The future of User Interface Design*.

*Total Internal Reflection*. (2003). Retrieved August 4, 2009, from University of Virginia Physics Department: <http://galileo.phys.virginia.edu/education/outreach/8thgradesol/InternalReflectionForm.htm>

Weisstein, E. (n.d.). *Frustrated Total Internal Reflection*. Retrieved August 6, 2009, from [scienceworld.wolfram.com: http://scienceworld.wolfram.com/physics/FrustratedTotalInternalReflection.html](http://scienceworld.wolfram.com/physics/FrustratedTotalInternalReflection.html)

## APPENDIX A1

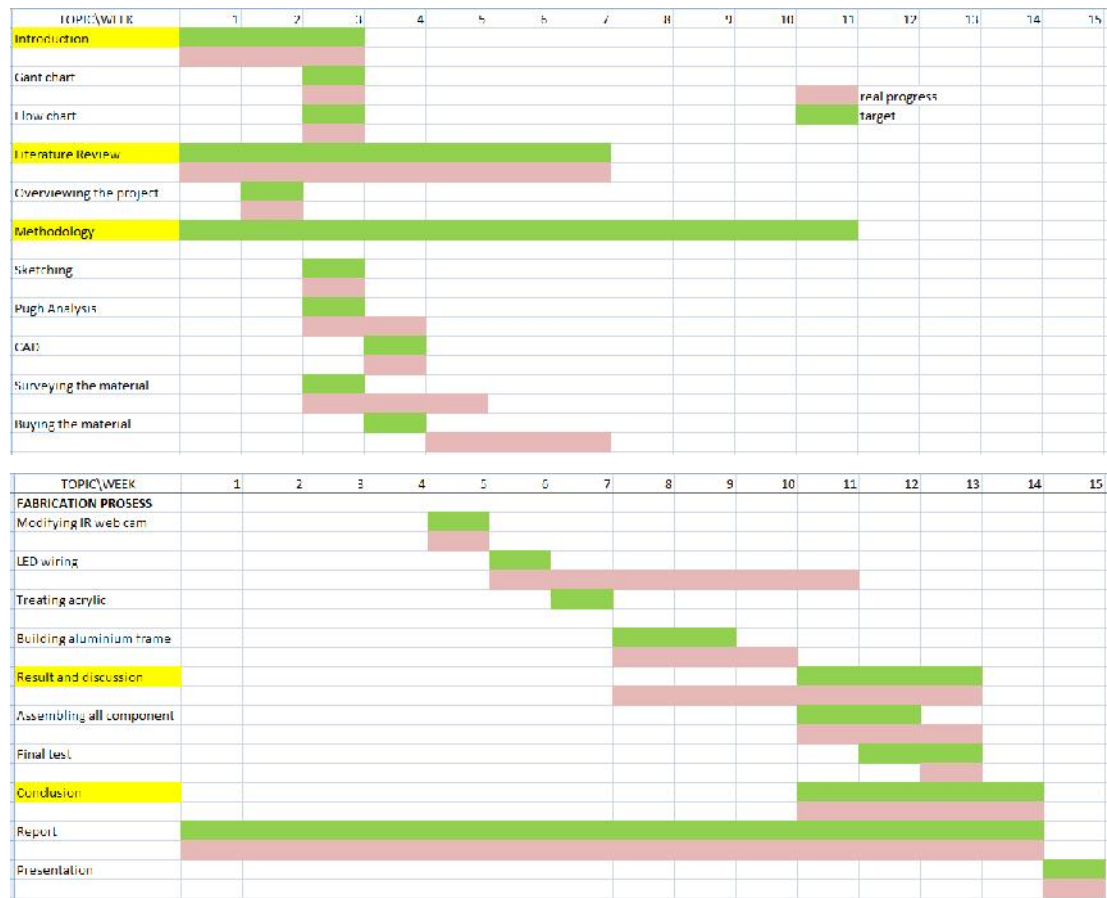
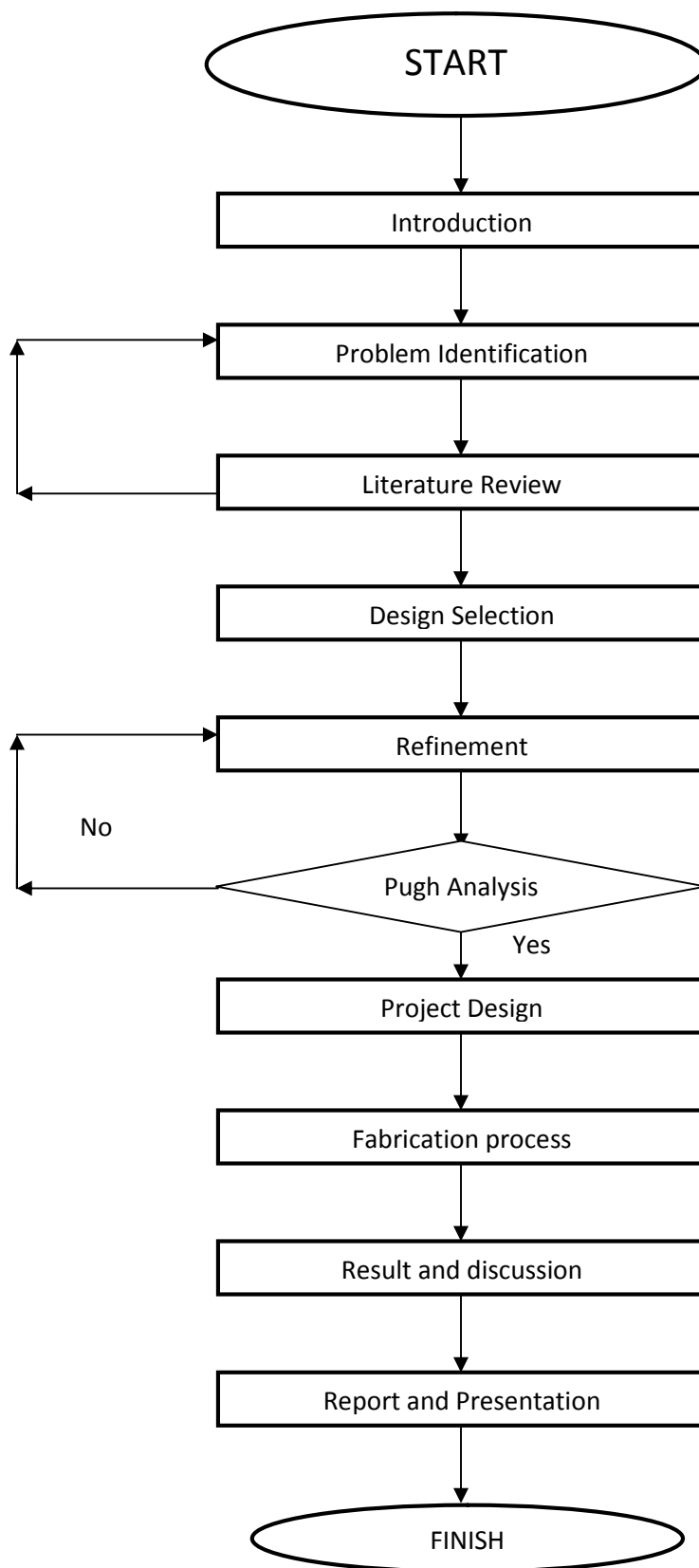


Figure 6.1: Gantt chart.



## APPENDIX A2

**Figures 6.2:** Flow chart.



## APPENDIX B1

**Table 6.1:** Concept Screening.

<b>Matrix\Concepts</b>	<b>Concept 1</b>	<b>Concept 2</b>	<b>Concept 3</b>	<b>Concept 4</b>	<b>Concept 5</b>	<b>Concept 6 (reference)</b>
Comfort	+	o	+	+	+	o
Durability	o	+	+	+	o	o
Easy to Use	+	o	+	+	+	o
Production Cost	+	+	o	o	-	o
Portable	+	+	+	+	+	o
User limit	o	-	0	o	o	o
Easy to fabricate	o	+	0	+	+	o
Simplicity of design	+	-	o	+	-	o
Strength	o	+	-	o	o	o
Total (+)	5	5	4	6	4	o
Total (-)	0	2	1	0	2	o
Total Score	5	3	3	6	2	0
Rank	2	3	4	1	5	0

## APPENDIX B2

**Table 6.2:** Concept Scoring.

<b>Matrix\Concepts</b>	<b>Weight (%)</b>	<b>Concept 1</b>	<b>Concept 2</b>	<b>Concept 3</b>	<b>Concept 4</b>
Comfort	10	1	3	2	4
Durability	10	2	4	1	3
Easy to Use	10	1	1	2	3
Production Cost	10	4	2	1	3
Portable	15	2	3	3	4
User limit	20	1	3	3	2
Easy to fabricate	10	2	1	1	4
Simplicity of design	5	4	2	2	3
Strength	20	2	2	3	2
Total score (%)	110	210	265	245	325
Rank		4	2	3	1

1 = Okay

2 = Good

3 = Very Good

4 = Excellent

## APPENDIX C1

**Figure 6.3:** 3<sup>rd</sup> Angle view of the final project.

## APPENDIX C2

**Figure 6.4:** 3rd Angle view of the aluminum frame.

### APPENDIX C3

**Figure 6.5:** 3rd Angle view of Acrylic.

## APPENDIX C4

**Figure 6.5:** IR led orientation.



DESIGN AND FABRICATION OF A MULTI TOUCHSCREEN DESKTOP FOR MULTI  
PURPOSE USAGE

MOHD SALLEH BIN MAT SAHAT

Report submitted in partial fulfilment of the requirements  
for the award of Diploma in Mechanical Engineering

Faculty of Mechanical Engineering  
UNIVERSITI MALAYSIA PAHANG

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