POLITEKNIK MALAYSIA

SULTAN SALAHUDDIN ABDUL AZIZ SHAH

JABATAN KEJURUTERAAN MEKANIKAL

SMART TOOLBOX

SUPERVISOR:

DR. NORASIAH BINTI MUHAMMAD

TEAM MEMBERS	MATRIC NUMBER
AUSTIN YONG MUAN	08DKM18F1049
KELVIN HO MING KANG	08DKM18F1060
DARREN MAING ANAK ABITT	08DKM18F1058

SESI JUN 2020

POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

SMART TOOLBOX

NAMA	NO. PENDAFTARAN
KELVIN HO MING KANG	08DKM18F1060
AUSTIN YONG MUAN	08DKM18F1049
DARREN MAING ANAK ABITT	08DKM18F1058

DEPARTMENT OF MECHANICAL ENGINEERING

DECLARATION OF ORIGINALITY

TITLE : SMART TOOLBOX

SESSION : JUN 2020

1. **AUSTIN YONG MUAN** **08DKM18F1049**
2. **DARREN MAING ANAK ABITT** **08DKM18F1058**
3. **KELVIN HO MING KANG** **08DKM18F1060**

Are students of fifth semester of Diploma of Mechanical Engineering at Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor.

1. We acknowledge that the project is above, and the intellectual property therein are our original works / innovations without taking or imitating any property of other parties.
2. We also concur to relinquish copyright ownership of the project to any purpose of Polytechnic in order to meet the requirements for the Diploma of Mechanical Engineering.

MyIPO Application number:

LY20200005260

ACKNOWLEDGEMENT

In this section, we would like to take the opportunity to express our gratitude and appreciation to everyone who involve directly or indirectly in helping us to embody and realizing our project from the early stage of proposing idea to the success of our finished product.

Firstly, we would like to express our appreciation towards Madam Dr. Norasiah Binti Muhammad, supervisor of our project who supervised us by providing valuable advice, guidance, and support as well as motivation from the very beginning until the completing of the research. Without her insightful suggestion and her dedication in guiding us, this project would not have the expected outcome and we might not be able to finish the project on time as she was the one who constantly highlighting our project's flaw and the way to improve them.

Secondly, we would like to thank Politeknik Sultan Salahuddin Abdul Aziz Shah by giving us the opportunity to conduct this research and conclude our Diploma studies. We had finally obtained a lot of experience and understanding on how to conduct research, analyzing data that absolutely will benefit us for or further studies precisely. It is important as we had gained a lot of knowledge that will be useful and beneficial for our future.

Thirdly, we would like to extend our earnest gratitude to Mr. Mohd Ariffin Zulkifli from MYINVENT TECHNOLOGIES SDN BHD, an IOT Consultant who constantly giving us advice and useful information about the Arduino software as our group has no solid understanding about the software. Fortunately, with his determination in advising and guidance, we were able to comprehend a little by little of the software until we managed to make a programming that suit our toolbox specifications. Plus, thanked to him we were able to gain extra knowledge and experience outside our course studied that we believe it can bring a lot of benefit for us in the future.

Finally, hear felt appreciation is expressed towards each member of this group as each of us has given all our efforts and time to complete and present this project as best as we could. This project would not complete and work functionally without the cooperation and coordination from each member that finally led us into the RICE top 10 mechanical department project 2020.

ABSTRACT

Variety kind of tools that has a various kind of function was undeniably has help its user to ease their daily work. Hence, the toolbox was invented to carry, protect and the organizing the tools inside it. Although, there a lot of innovation and improvement on the existing toolbox, yet the missing tool was still being one of the biggest issues for the toolbox owner. There is no one to blame as forgetfulness was one of the biggest factors that contributed to the problem. Research has been done also state that in 1990 American Demographics report that we spend 16 minutes per day looking for lost items. Other estimates range as high as 31-55 minutes per day. As to fulfil the vision of Industrial Revolution 4.0, the idea was triggered to innovate and redesign the existing toolbox into a smart toolbox. The smart toolbox will be able to detect the absence of the tools inside it and display it through an LCD screen so that the user will be noticed to not to forget their tools. By the creation of this smart toolbox, the missing tool of toolbox owner can be preventing from happen more frequent in the future and the user can enjoy using the smart and efficient toolbox to improve their daily working life. Plus, the Arduino software also will be more acknowledge by the public and specifically the toolbox's owner since this smart toolbox was programmed using Arduino software.

CONTENT

CHAPTER 3 METHODOLOGY

CHAPTER 4 RESULTS AND ANALYSIS

CHAPTER 5 CONCLUSION

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1

INTRODUCTION

1.1RESEARCH BACKGROUND

Nowadays, there are still many employment sectors out there that are still using and utilizing hand tools in their day-to-day work despite the rapidly increasing technological advances. The tool itself refers to an object used to extend the ability of an individual to modify features of the surrounding environment. Hence, a toolbox was invented to protect, organized and carry the tool inside it. Although, there a lot of innovation and improvement on the existing toolbox, yet the missing tool was still being one of the biggest issues for the toolbox owner. Not to mention that if the owner wouldn't be able to find their tool, then not only they can't proceed they work but they also must buy the new one. Plus, the missing tool can be hazardous for those who didn't aware of the present of the missing tool. Moreover, it is a part of human nature to naturally forget something. Forgetfulness is part of adult life for many reasons, including being preoccupied, under stress, fatigue or possibly health issues like depression, hypothyroidism or worse, dementia.

However, throughout this project the existing toolbox can be improve to the smart, efficient and convenience toolbox that can be apply from various user and different kind of industrial field. Besides, the smart toolbox also is able to detect the absence of each tool inside it. One of the main components that make this concept to work effectively is LDR sensor. A photo resistor or light-dependent resistor LDR is an active component that decreases resistance with respect to receiving luminosity (light) on the component's sensitive surface. The resistance of a photo resistor decreases with increase in incident light intensity, in other words, it exhibits photoconductivity [Photo resistor-light dependant resistor LDR,(19 April 2018), resistor guide, retrieved from https://en.wikipedia.org/wiki/Photoresistor]. There are many applications of LDR sensor such as camera light meters, outdoor clocks, and solar road studs. Besides, the smart toolbox applying an Arduino software into its system to make it as relevance as the Industrial Revolution 4.0 where **smart connectivity** is the important part of the revolution.

1.2PROBLEM STATEMENT

The existing toolbox undoubtedly has helped its owner in variety aspect such in organizing, carrying and protect the owner tools .Unfortunately, as good as its helped its owner in various way, yet the existing toolbox was still not being able to detect the tools inside them if one of the tool gone missing .This not only will slow down the pace of work of the toolbox owner but the owner also need to find a new tool that is missing in order to continue their job properly. Not to mention that instead of spending of so much time looking for the missing tool, a toolbox's owner can use that valuable time to be more focused toward their work and become more productive, effective and creative throughout their performance at workplace or anywhere else. 1990 American Demographics report that we spend 16 minutes per day looking for lost items. Other estimates range as high as 31-55 minutes per day (based on surveys in the UK and Boston, respectively) [virtual lost and found,(n.d), computer science zone, retrieved from https://www.computersciencezone.org/virtual-lost-found/] .There is no one to blame as carelessness and forgetfulness is a part of human nature and none of us could avoid it. However, through our project we could at least prevent this type of issue to happen more frequent in the future. In addition, the missing tools also could be hazardous for those who didn't aware of its present.

Next, the design and the function of the existing toolbox is quite old school and not compatible with Industrial Revolution 4.0 era where **smart connectivity** play a crucial role to the revolution.

1.3RESEARCH OBJECTIVES

The objectives to this research are:

i. To detect the absence of the tools inside the toolbox.
ii. To create a smart, convenience and efficient toolbox.
iii. To help the user to identify which tool is missing through LCD screen that been install on the project.

1.4RESEARCH QUESTIONS

This study will answer those following question:

i. How to detect the absence of the tools inside the toolbox?
ii. Is it possible to create a smart, convenience and efficient toolbox?
iii. How can user know which tool is missing?

1.5SCOPE OF RESEARCH

The scopes and limits to this research are:

i. Could last a long time with a good care.
ii. The toolbox can't detect the person who took the tool.
iii. This product has LDR sensor
iv. This product can sense an absence of it tool using LDR sensor
v. This product need 9v battery and power bank to operate.
vi. The LED inside the toolbox allow its user to use it in the dim places (night).
vii. This product has LCD screen display on it.

1.6 SIGNIFICANCE OF RESEARCH

The existing toolbox has improved over the year from the various aspect such as the design, the quality and the material of the toolbox to fulfil the user need and no matter how much the price was the manual toolbox is, still the most preferred toolbox by the users. However, the existing toolbox was not much improved on it function and can't help so much in finding the tool that is missing or misplace from the toolbox. Hence, the finding of this study will bring a lot of benefit not only to the industrial sector but also to the toolbox's owner so that they will always have their tool available with them. Plus, this study will not only contribute to the toolbox user's performance but also the company of toolbox manufacturer as well.

1.7DEFINITION OF OPERATIONAL TERM

Table 1.1 below is showing the definition of operational term of the project.

	DEFINITION
LDR SENSOR	A component that has a (variable) resistance that changes with the light intensity that falls upon it. This allows them to be used in light sensing circuits.
ARDUINO	An open-source electronics platform based on easy-to-use hardware and software.
EFFICIENT	A system or machine achieving maximum productivity with minimum wasted effort or expense.

Table 1.1

1.8 CHAPTER SUMMARY

In this chapter, the studies were explained about its origin of ideas and inspirations based on Industrial Revolution 4.0. All the objectives were made out of all the problem statements. The objective of this project along with the Arduino and LDR sensor usage and their application that will not only enhance the overall performance of the toolbox' users, but also can comprehend the carelessness of some user that randomly misplace the tool as well from end up harming other people. Thus, with a good care this smart toolbox can run its function perfectly and at the same it can achieve the purposes of its creation.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, will be shown about the innovation of the existing toolbox to the smart and convenient toolbox. Before continue to further in this topic, a toolbox also called toolkit, tool chest or workbox is a box to organize, carry, and protect the owner's tools. They could be used for trade, a hobby or DIY, and their contents vary with the craft of the owner. A toolbox could refer to several types of storage to hold tools. It could mean a small portable box that can carry a few tools to a project location or a large storage system set on casters.

Early in mankind, people would find objects that they could use to do other things. For example, one might find a rock with a nice flat spot on it to use as a hammer. As these early tools were being found and made, people needed some place to store them. People utilized cloth bags, stone, or clay jars to hold their tools. Once wood became more available, people started making wooden toolboxes. As wood became more available for homes and tools were created to work wood, toolboxes were created from wood. Wood was the material of choice for toolboxes-built beginning in the early 19th century (*Unique Truck Accessories,2015*).

Overtime as building designs change, tools and toolboxes must evolve. People who worked in construction, repair, and general labours. Oftentimes need to carry their tools to the work site with them. Portable toolboxes were typically made from wood, steel, and plastic. Steel toolboxes are known to be stronger, withstand abuse, and support the weight of many tools. Steel toolboxes tend to rust. Plastic toolboxes are known to be lightweight. Plastic toolboxes loaded with tools can oftentimes be just as heavy as an empty steel toolbox. Modern toolboxes are predominantly metal or plastic.

Toolboxes can be mainly divided as 5 types, they are:

1) Plastic
2) Steel
3) Aluminium
4) Waterproof
5) Cantilever

The pictures underneath are the various types of the toolbox that usually used as shown in Figure2.1-Figure2.5.

Figure 2.1: Moulded Toolbox

Figure 2.2: Fastener Storage Toolbox

Figure 2.3: Hand Carry Toolbox

Figure 2.4: Wooden Toolbox

Figure 2.5: Cantilever Toolbox

2.2 RESEARCH OF THE TOOLBOX

A toolbox is a box to organize, carry and protect the owner's tools. This existing toolbox come in many shapes and have their own design which is in the form of boxes, cantilever toolbox, simple wooden toolbox, portable toolbox and moulded toolbox. However, it has been a common behaviour to human being, to not be able to remember to place back tools that been used, to its own correct position. Thus, in order to prevent this happens, there are come out with several ideas to improve the existing toolbox become more convenient and comfortable to use.

Besides, the existing toolbox cannot detect the presence of the tools inside while the toolbox is carried by the users to the workplace or the toolbox stored in its original place. Therefore, in terms of the research being made, the toolbox will detect the presence of the tools itself with LDR sensor. Hereby, the owner or user can be ready early to know the all the tools inside the toolbox are presence. This is to prevent all carelessness occur before the user start working or using the tools that needed.

Furthermore, in future planning, adhesive RFID tag is one of the systems to make sure the tools in safe condition which mean the tools will not be steal by other people or missing after used. In this adhesive RFID tag where each ID is registered using programming to know their identity, it will have its own tools name or ID in the system. After that, this adhesive RFID tag will attach on the tools body. Therefore, the function of this adhesive RFID tag is to detect the lost or forgotten tools to return it to its original place. Next, the RFID antenna will be installed in the workshop exit area to detect if the toolbox or tools have been taken out. But since there is a slight budget limitation, this RFID systems cannot be done at this moment.

2.3 MATERIAL SELECTION

2.3.1 Light Dependent Resistor (LDR) Sensor

The figures below are one of the LDR sensor that has been selected to make it more convenient for toolbox owner.

Figure 2.6: LDR Sensor

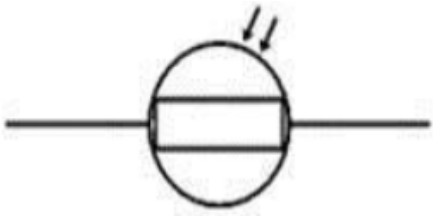


Figure 2.7: LDR Circuit Symbol

The idea of Photoresistor developed when photoconductivity in Selenium was discovered by Willoughby Smith in 1873. Many variants of the photoconductive devices were then made.

An LDR or light dependent resistor is also known as photo resistor, photocell, photoconductor. It is a one type of resistor whose resistance varies depending on the amount of light falling on its surface. When the light falls on the resistor, then the resistance changes. These resistors are often used in many circuits where it is required to sense the presence of light. These resistors have a variety of functions and resistance. For instance, when the LDR is in darkness, then it can be used to turn ON a light or to turn OFF a light when it is in the light. A typical light dependent resistor has a resistance in the darkness of 1MOhm, and in the brightness a resistance of a couple of KOhm (*WatElectronics.com*).

This resistor works on the principle of photo conductivity. It is nothing but, when the light falls on its surface, then the material conductivity reduces and also the electrons in the valence band of the device are excited to the conduction band. These photons in the incident light must have energy greater than the band gap of the semiconductor material. This makes the electrons to jump from the valence band to conduction.

The Figure 2.8 below is showing about the light falls on the LDR then the resistance decreases, and increases in the dark.

Figure 2.8: Situation that light falls on the LDR

These devices depend on the light, when light falls on the LDR then the resistance decreases, and increases in the dark. When an LDR is kept in the dark place, its resistance is high and, when the LDR is kept in the light its resistance will decrease (*WatElectronics.com*).

The Figure 2.9 below is showing about the Variation of LDR Resistance with Variation in Light Intensity.

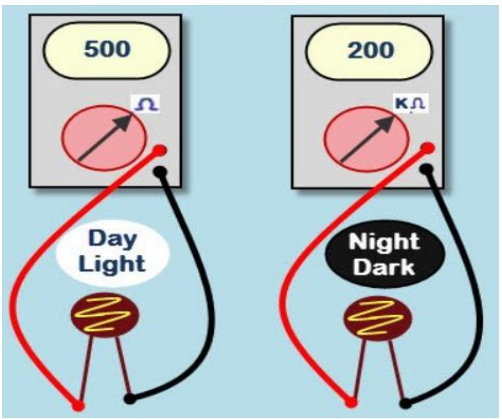


Figure 2.9

The Figure 2.10 below is showing about the Light intensity vs LDR intensity.

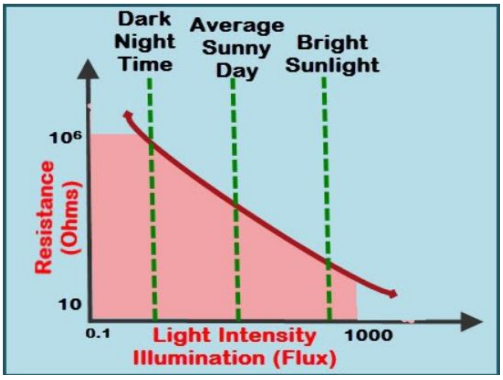


Figure 2.10

This LDR sensor will be install in the toolbox. The purpose is to detect the presence of the tools inside while the toolbox is carried by the users to the workplace or the toolbox stored in its original place. Thus, the user can prevent the carelessness such as the missing tools or incomplete tool kit.

2.3.2 Arduino Software

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board often referred to as a microcontroller and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware called a programmer in order to load new code onto the board, you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Next, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package (*Electronics Weekly. 2018-05-18*).

Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing, and embedded environments. All Arduino boards are completely open-source, empowering users to build them independently and eventually adapt them to their particular needs. It is growing through the contributions of users worldwide (*seeedstudio,2019*).

The Figure 2.11 below shows about several type of Arduino boards.

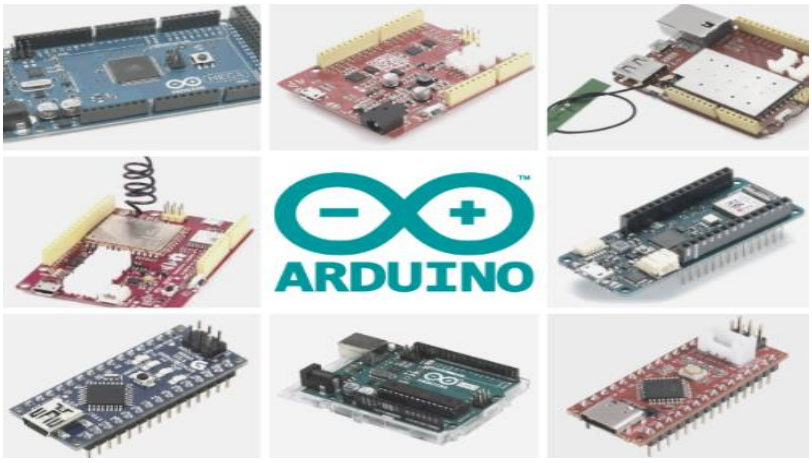


Figure 2.11

The Arduino software is easy-to-use for beginners, yet flexible enough for advanced users. It runs on Mac, Windows, and Linux. Teachers and students use it to build low cost scientific instruments, to prove chemistry and physics principles, or to get started with programming and robotics. Designers and architects build interactive prototypes, musicians and artists use it for installations and to experiment with new musical instruments. Makers, of course, use it to build many of the projects exhibited at the Maker Faire, for example. Arduino is a key tool to learn new things. Anyone - children, hobbyists, artists, programmers - can start tinkering just following the step by step instructions of a kit, or sharing ideas online with other members of the Arduino community (*seeedstudio*,*2019*).

The Figure 2.12 below is showing about the installed circuit diagram of LDR sensor and Arduino UNO.

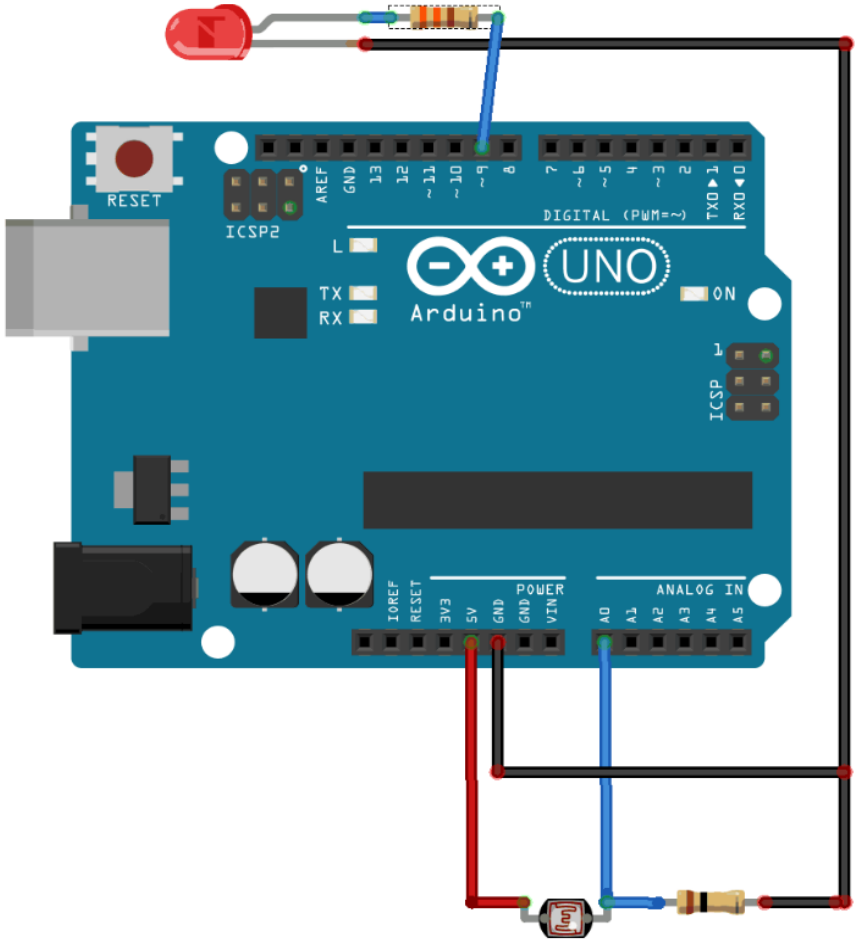


Figure 2.12

As per the circuit diagram, voltage divider circuit using LDR and 100k resistor have been made. The voltage divider output is feed to the analog pin of the Arduino. The analog Pin senses the voltage and gives some analog value to Arduino. The analog value changes according to the resistance of LDR. So, as the light falls on the LDR the resistance of it get decreased and hence the voltage value increase (*circuitdigest,2018*).

Intensity of light ↓ - Resistance ↑ - Voltage at analog pin ↓ - Tools detected which mean present.

By using this LDR sensor and Arduino, the working principle of the smart toolbox is when the analog value falls below 700 it will consider as dark and the tool will be detected. This is when the smart toolbox is closed and the tools are in the correct position. If the value comes above 700 it will consider as bright and that tool is still using by the user or lost. This is when the smart toolbox is opened and the tool is taken by user so the LDR sensor can detect the presence of the tools.

2.4 COMPARISON OF CRITERIA

The Table 2.1 below shows a comparison of criteria for the existing toolbox and smart toolbox.

Table 2.1: Comparison of criteria for the existing toolbox and smart toolbox.

	Existing Toolbox	Smart Toolbox
Can detect the misplace tool	No	Yes
Can detect the availability of the tools	No	Yes
Can read on LCD display about the presence of the tools	No	Yes
Durable and Hardness	Yes	Yes
Using Arduino Software	No	Yes
Using battery	No	Yes
Can operate at night and dim places	No	Yes

2.5 CONCLUSION

As to conclude this chapter, literature review is important to showcase all the studies of materials and concept of the smart toolbox to enhance the knowledge on this project. Besides, in term of the investigation being made, this smart toolbox will become more convenient for the users while working also hoping that this smart toolbox will make it easier for humans. Obviously, due to the advanced technology nowadays, many things today use more sophisticated tools to make it accessible for people to work. This means that the toolbox is also capable of being innovative and become better for all users.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

What is Methodology? Methodology is the study of how research is done, how we find out about things, and how knowledge is gained. In other words, methodology is about the principles that guide our research practices. Plus, it is a system of method that used in a particular area of study or activity.

In this chapter, there will be a lot information of the process and journey through out the making of our final project. There will be flow chart showing the process of material selection and material purchase, installation circuit and sensor, project assembling & development, project testing, analysis data and report writing. (Figure 3.1 shows the flow chart of the project). Moreover, there will be an explanation of each of the processes in the flow chart. Next, is the Gantt Chart, which will show the actual and planning throughout all the 15 weeks of our final year project journey.

3.2 FLOW CHART

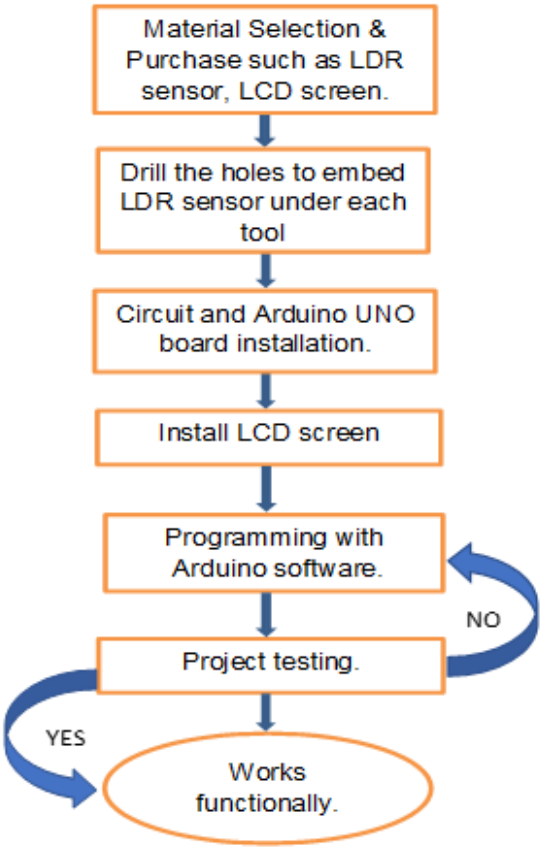


Figure 3.1 – Flow Chart

3.3 FLOW CHART EXPLANATION

- **Material Selection & Purchase**

The process of material selection is one of the most important process in this final year project. The main factor of material selection is to discuss and finalized which materials that will be use in the project in order to avoid wasting of money and time. The material selection needs to be done precisely so that the best outcome can be made. Figure 3.2 below is showing about the LDR Sensor.

1. LDR sensor

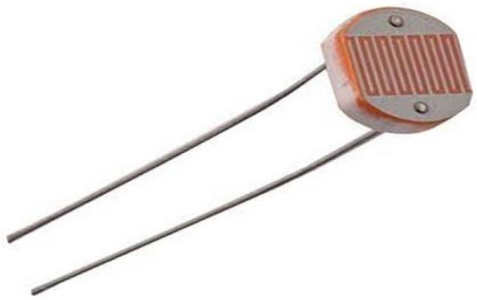


Figure 3.2

It was widely applied on street light, light failure alarm circuits and camera shutter control. The working principle of an LDR is photoconductivity, that is nothing but an optical phenomenon. When the light is absorbed by the material then the conductivity of the material reduces. When the light falls on the LDR, then the electrons in the valence band of the material are eager to the conduction band. But, the photons in the incident light must have energy superior than the bandgap of the material to make the electrons jump from one band to another band (valance to conduction).Hence, when light having ample energy, more electrons are excited to the conduction band which grades in a large number of charge carriers. When the effect of this process and the flow of the current starts flowing more, the resistance of the device decreases. The ability to detect small intensity of light make this sensor must be apply on the smart toolbox.

2. LCD screen display

Figure 3.3 below is showing about the LCD screen display.

Figure 3.3

LCD screen have a large and varying set of use including smartphones, televisions, computer monitors and instrument panels. LCD screen is available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and seven-segment displays, as in a digital clock. They use the same basic technology, except that arbitrary images are made from a matrix of small pixels, while other displays have larger elements. LCD screen can either be normally on (positive) or off (negative), depending on the polarizer arrangement. The display on the LCD screen will allow the users to identify which tool that are available on the toolbox.

3. HJ-C02B Toolbox
   Figure 3.4 shows the toolbox that will be redesign.

Figure 3.4

For this project, HJ-C02B toolbox are used to be redesign from the manual toolbox to a smart toolbox. This type of toolbox consists 9 pieces of tools, measuring tape and duct tape. Besides, it also has a firm outer toolbox frame which mean it was not too soft nor too hard for the embedment of the LDR sensor. Overall, it was an affordable and compatible toolbox to be redesign.

4. Arduino jumper wire

Figure 3.5

As shown in figure 3.5 above Arduino jumper wires are used for making connections between items on the breadboard and Arduino's header pins. Although jumper wires come in a variety of colours, each colour does not represent anything. This

means that a red jumper wire is technically the same as a black one. But the colours can be used to our advantage in order to differentiate between types of connections.

5. 9V battery

Figure 3.6

Figure 3.6 above show the 9V battery. For this project, Energizer 9v battery was required to act as a power source to the smart toolbox component.

6. 9V battery holder

Figure 3.7

Figure 3.7 show the battery holder for 9v battery. Act as a holder to the battery as well as to transfer the power sources to the circuit.

7. Arduino UNO

Figure 3.8

Figure 3.8 above shows the Arduino UNO board. The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller. The function of the board in this project was to channel the programmed input from the software into the circuit. The micro-USB also included with this Arduino Uno Board.

8. Prototyping Board

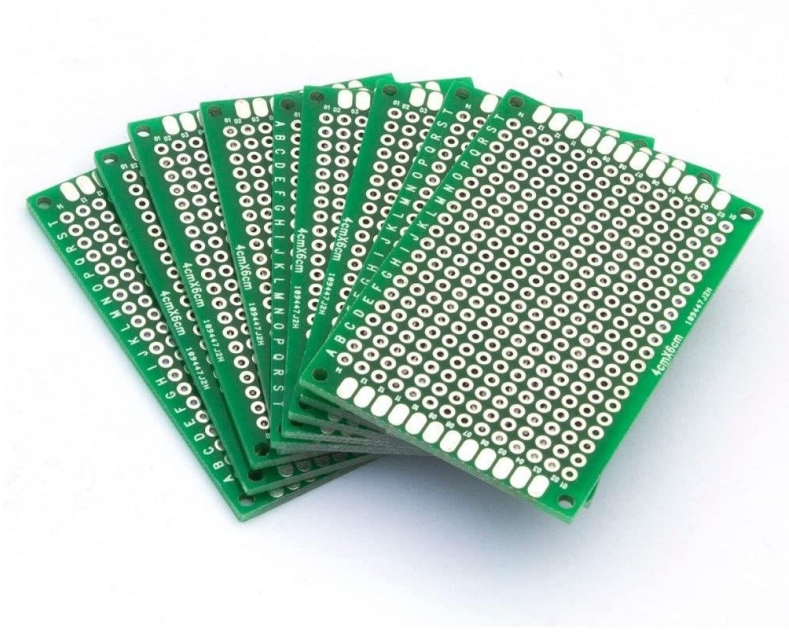


Figure 3.9

Figure 3.9 above shows the prototyping boards. The function of this board is it have holes to which you affix electronic components to build your desired circuit. These components can be attached with or without solder depending on the type of board.

9. Resistor

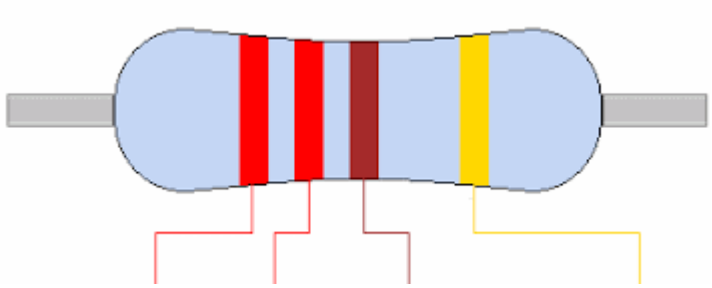


Figure 3.10

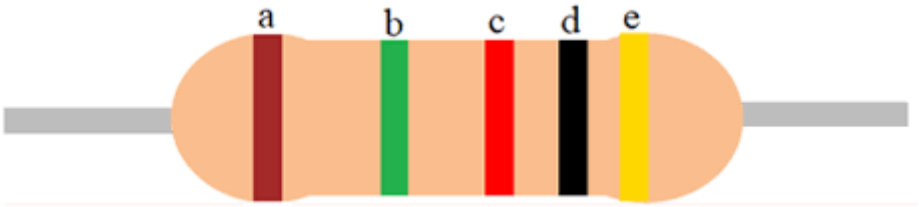


Figure 3.11

Figure 3.10 above shows 220 Ohm 4 Band Colour Resistor and Figure 3.11 above shows 10 K Ohm 5 Band Colour Resistor. The function of resistor is a passive electrical component with the primary function to limit the flow of electric current.

10. Rocker Switch

Figure 3.12

Figure 3.12 above shows Rocker Switch which is on/off switch that rocks when pressed, which means one side of the switch is raised while the other side is depressed much like a rocking horse rocks back and forth.

11. LED Super Bright

Figure 3.13

Figure 3.13 above shows LED Super Bright, a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons.

12. EVA Foam

Figure 3.14

Figure 3.14 above shows EVA Foam. The material has high durability and sturdiness even at extremely low temperatures. Ability to withstand stress without obtaining cracks or breaking. UV-resistant properties. Water-resistant attributes.

13. Power Bank (Cylinder)

Figure 3.15

Figure 3.15 above shows cylinder power bank use to supply energy and rechargeable power supply device.

➢ Installation of main circuit and programming

The hole was made first on the bottom side of each tool before starting the installation of the circuit.

The hole under each tool was made with the exact the diameter of the LDR sensor. This will allow the LDR sensor to be embedded fit and firmly under each tool in the toolbox.

The reason for every tool must have the LDR sensor underneath them is to ensure each tool can be detected once it being taken out by the user.

Installation process:

1. Embedded the LDR sensor firmly under each tool in the toolbox through the hole that was made earlier. The figure 3.16 shows where the LDR sensor embedded. Next, figure 3.17 also showing on each LDR sensor that embedded in each hole.

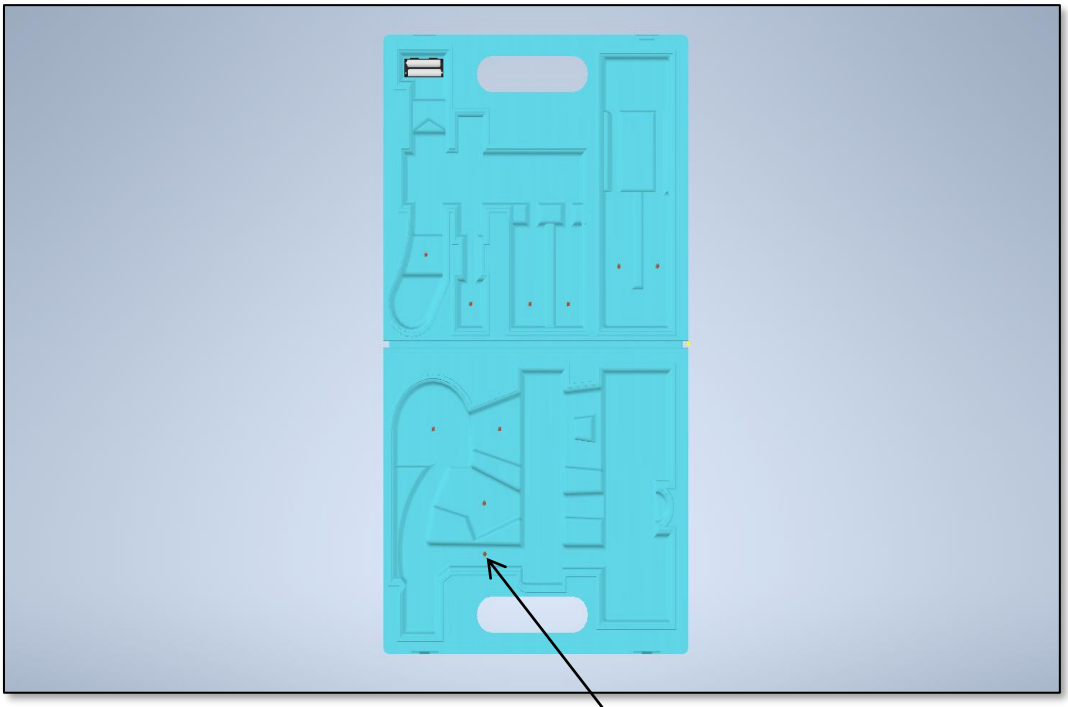


Figure 3.16

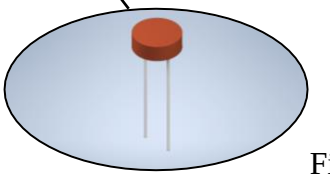


Figure 3.17

2. Connected every tool's sensor with jumper wire into the proto board.
3. Then, the other component that will be used also need to be connect into the proto board such as the LCD screen display, LED light, Rocker switch, Battery and Arduino UNO board as well.
4. Then, the smart toolbox will run it function properly once the programming is done using the Arduino software.

LED installation:

The 4 LDR sensor was firmly embedded under each tool in the toolbox through the hole that was made just like the embedment of the LDR sensor earlier. The LED light installation purposely was to provide the light source inside the smart toolbox when the toolbox was closed and allow the LDR sensor to receive the data(light) and submit it to the UNO board.

Smart toolbox working principle:

The LDR sensor play a crucial role in order to ensure the effectiveness of this project as it was able to detect a very small light intensity with the sensor's sensitive surface.

Hence, the LDR sensor in this project will transfer the input of the availability of the tool into the Arduino UNO when the sensor was still covered under the tools. There is no light intensity that can be detect by the sensor once it was covered with the tools. Hence, LED play a crucial part in providing extra light source inside the toolbox when it was closed.

If the tool was uncovered or being took by the users, the sensor will detect the intensity of the light and directly send an input of the unavailability of the tools to the Arduino UNO board.

The input that have been gathered will appear on the LCD screen that have been installed on the smart toolbox where it will display and remind the users which tools that missing from the toolbox. The figure 3.18 below shows where the LCD screen display the information of the tools.

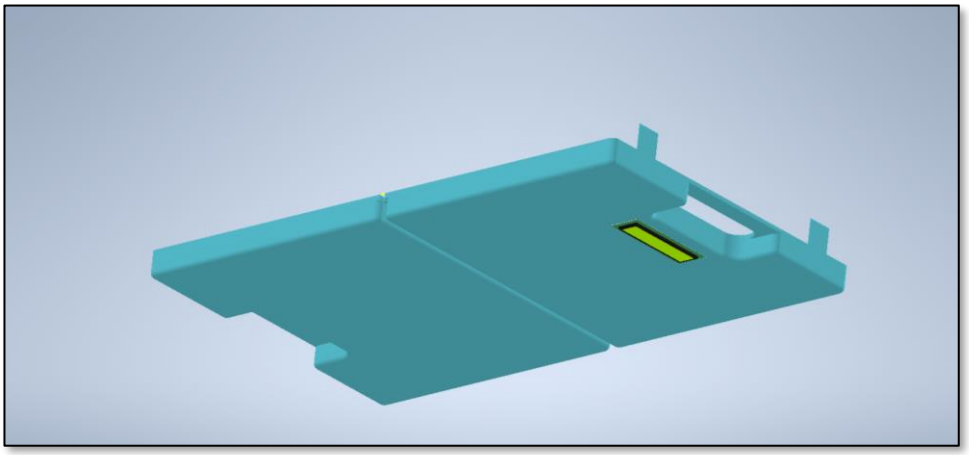


Figure 3.18

3.4 INTERVIEW & RESEARCH

In this section, the first step taken was to do the feasibility study and research which is intending to be a preliminary review of the facts to see if it is worthy of proceeding to the analysis phase. It is because the feasibility analysis is the primary tool for recommending whether to proceed to the next phase or to discontinue the project.

The aims of the smart toolbox are:

i. It will solve the 'forget' issues among user.

ii. To be user friendly and safe to use,

iii. Convenience for the consumer.

Next, the second step in designing the project is by answering the question of 4W1H (What, Who, Where, Why and How) question. Table 3.1 below provided the question and answer based on method of project.

No.	Question and Answer
1.	Q: What is smart toolbox? A: A toolbox that will be able to detect the absence of the tools inside.
2.	Q: Who will use this smart toolbox? A: Mechanics, people at home, factory worker and engineers.
3.	Q: Where is this product most needed? A: In the mechanical industry such as workshop, small factory, home and more.
4.	Q: Why does this project important? A: To avoid the missing tools, ease the work as well as to enhance the performance of its user.

Table 3.1

3.5 PRODUCT DESIGN

Figure 3.19 shows the Project's top view

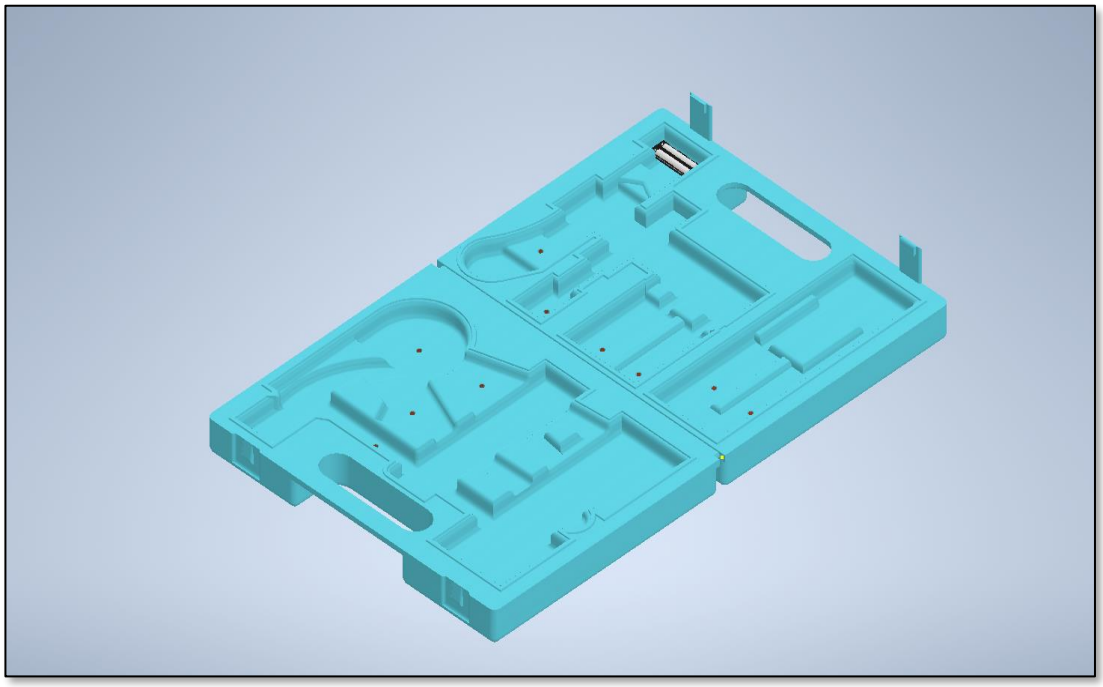


Figure 3.19

Figure 3.20 shows the Project's bottom view

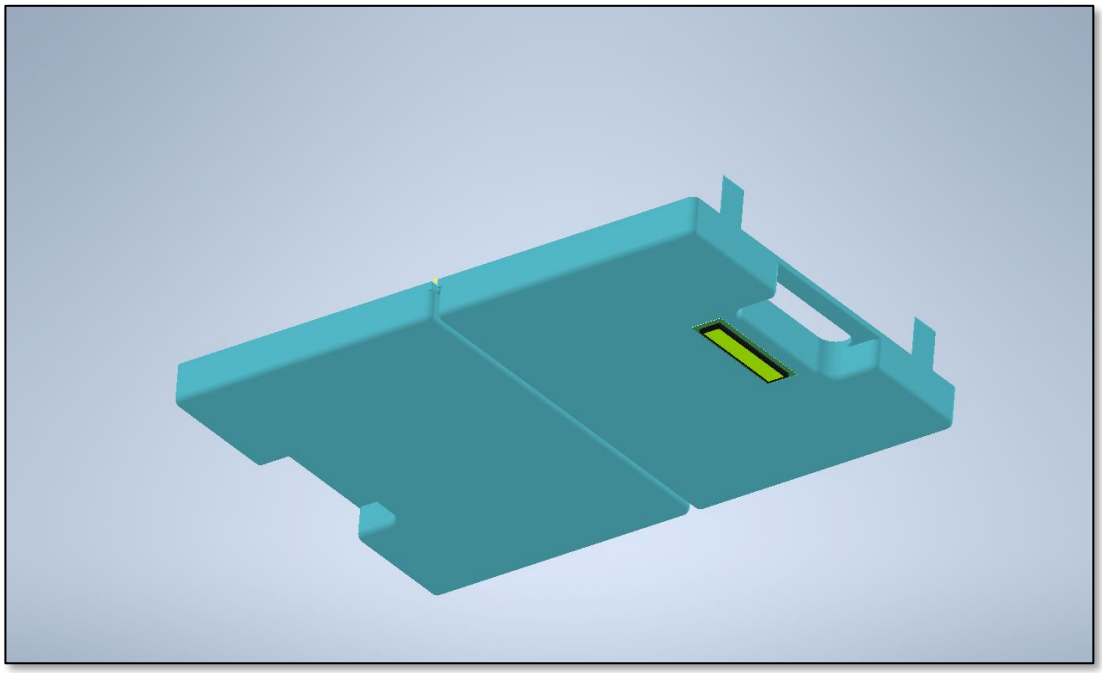


Figure 3.20

Figure 3.21 shows the Project's exploded drawing and parts list.

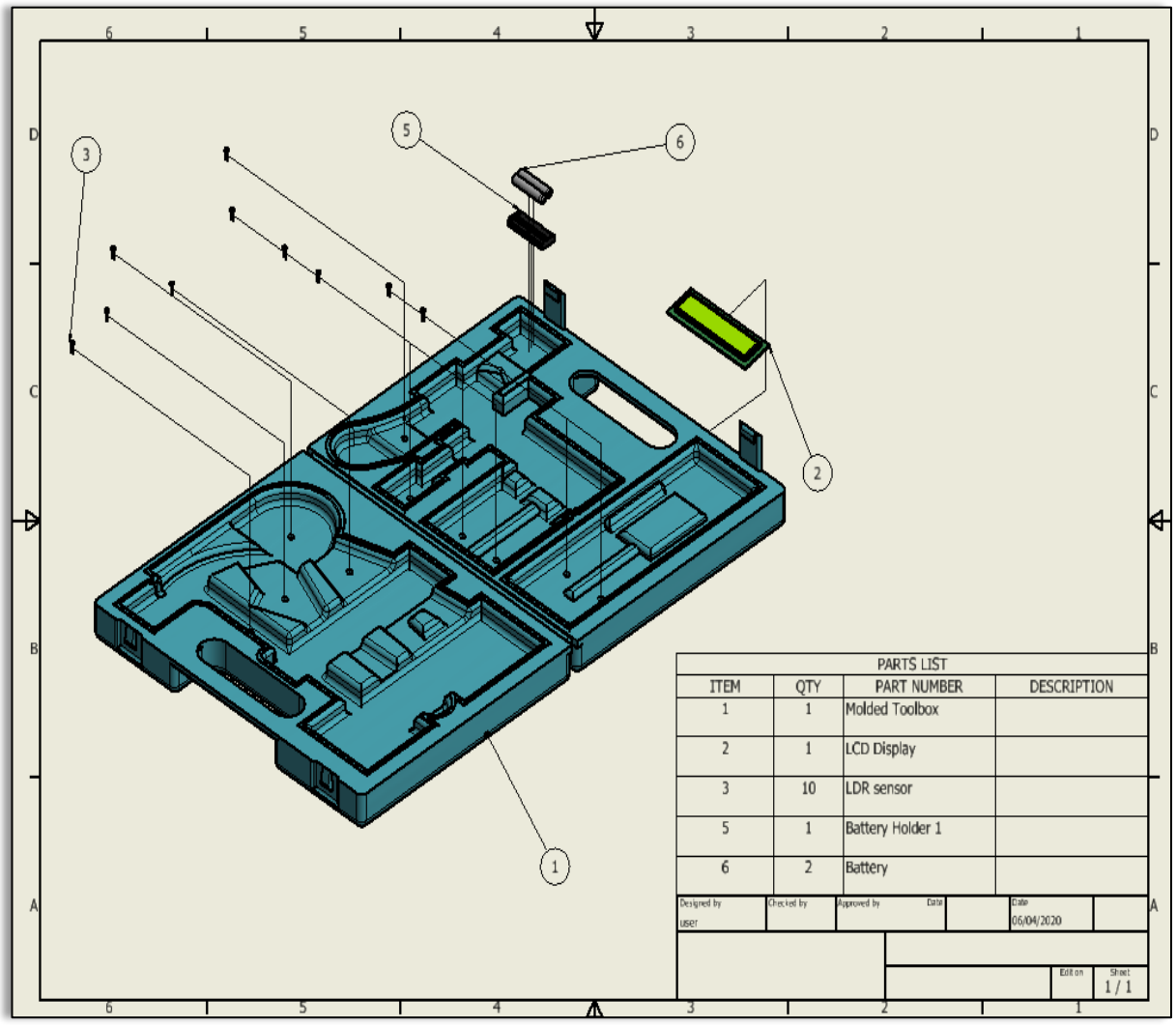
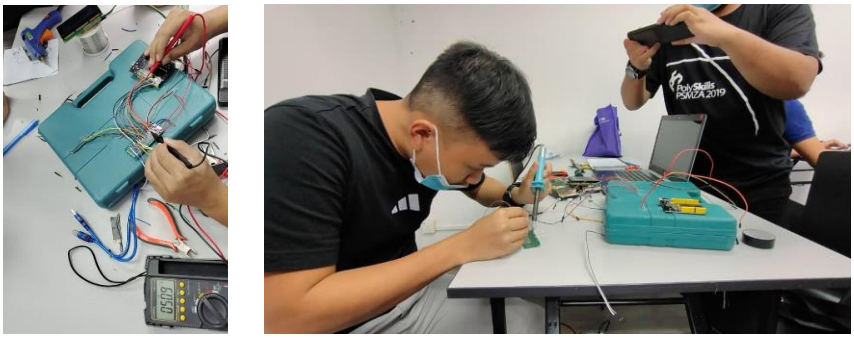


Figure 3.21

3.6 Operational Methodology

Embedding LDR Sensor



Main Circuit Installation/Soldering

Arduino Programming **LED Installation/Soldering**

Figure 3.22 Operational Methodology

- **Embedding LDR sensor**

  This proses were carried out by drilling a few holes on the toolbox using driller. Then, all of the LDR were embed and glued firmly in the holes. The purpose of this LDR sensor is to receive the information(light) from the LED.

- **Main Circuit Installation/Soldering**

  This main circuit installation was carried out by choosing the type of circuit that suits for our project. That is parallel circuit. First, the LDR sensor were connected to Donut board and Uno Board with Dupont wire. Resistor also added to the circuit in order to control and limit the flow of electric current. Then, the circuit were connected to power bank (10 000 mah) to gain power supply.

- **Arduino Programming**

  This Arduino programming were carried out by using our Arduino IDE software in our computer. The purpose of this Arduino programming was to read/detect the absence of the tool in our toolbox.

- **LED circuit Installation**

  This LED installation proses is crucial because this is where the product begin to work. LED installation was separate from the main circuit installation in order to ease the maintenance of the circuit if one of the LED damaged. A few holes also made on the toolbox in order to embed the LED. The type of circuit was used in this installation also parallel circuit. The purpose of this installation is to send the information(light) to the LDR sensor.

3.7 METHODOLOGY PHASE

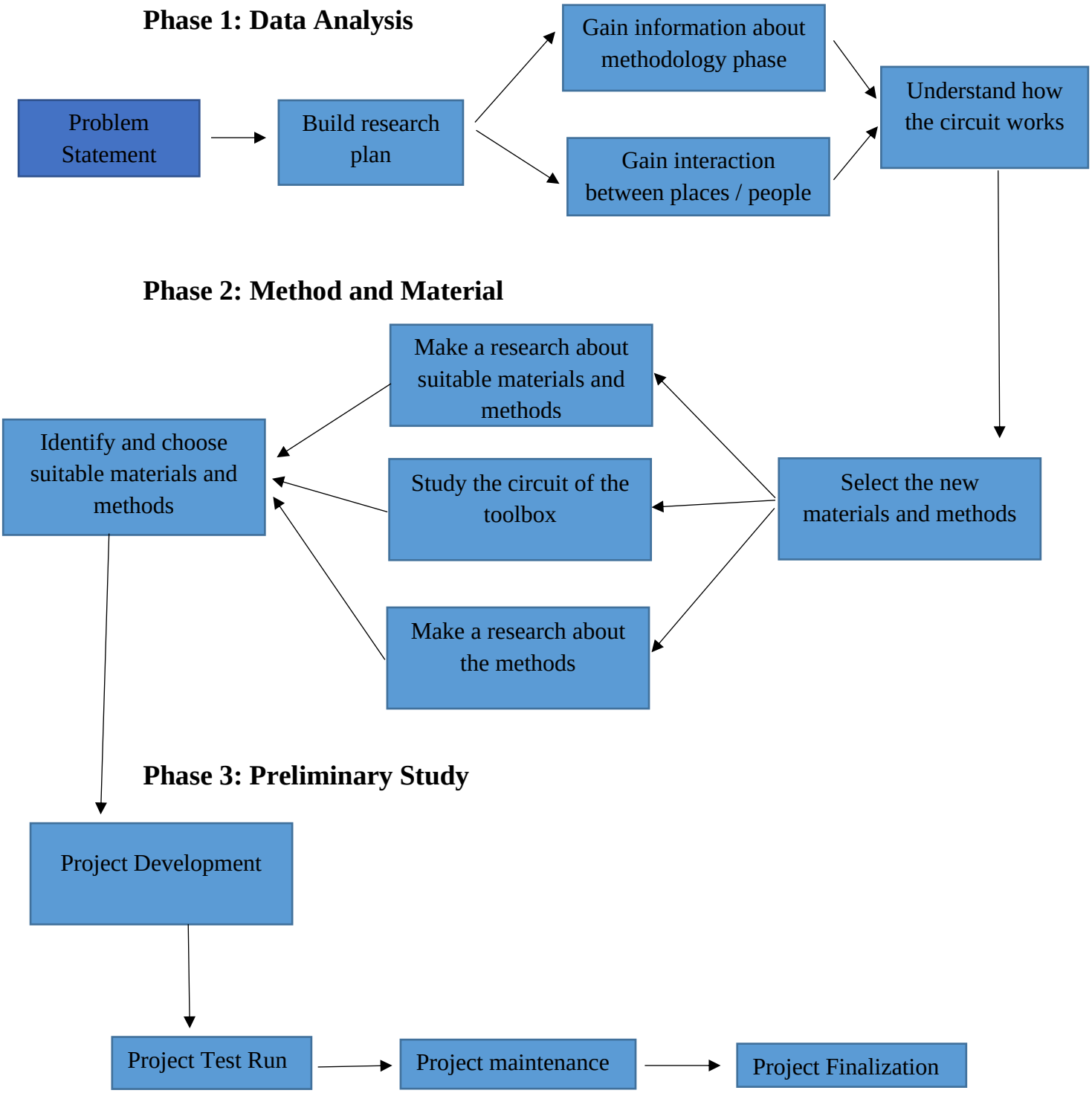


Figure 3.23 is showing the methodology phase.

3.8 BUDGET CALCULATION

Table 3.2 below shows the budget calculation of smart toolbox.

No	Materials / Equipment	Amount	Price
1.	Toolbox	1 unit	RM19
2.	LDR sensor	12 unit	RM24
3.	LCD screen display	1 unit	RM29
4.	Prototyping Board	2 unit	RM10
5.	Dupont jumper wire	1 unit (40 pieces)	RM5.50
6.	9V battery	1unit	RM6.20
7.	9V battery holder	1unit	RM3.00
8.	Arduino UNO board (including USB Cable)	1unit	RM35
9.	Rocker Switch	1 unit	RM4
10.	Resistor (2 Type)	16 unit	RM1.60
11.	Cylinder Power Bank (including Micro USB Cable)	1 unit	RM19
12.	LED Superbright	4 unit	RM2
13.	EVA Foam (Green)	1 unit	RM4.20
14.	Binding Tape	1 unit	RM3.90
15.	Glue Gun (including glue stick)	1 unit	RM20
Total			RM186.40

Table 3.2

3.9 PROJECT ACTIVITY (GANTT CHART)

Table 3.3 below shows the Gantt Chart of smart toolbox progress.

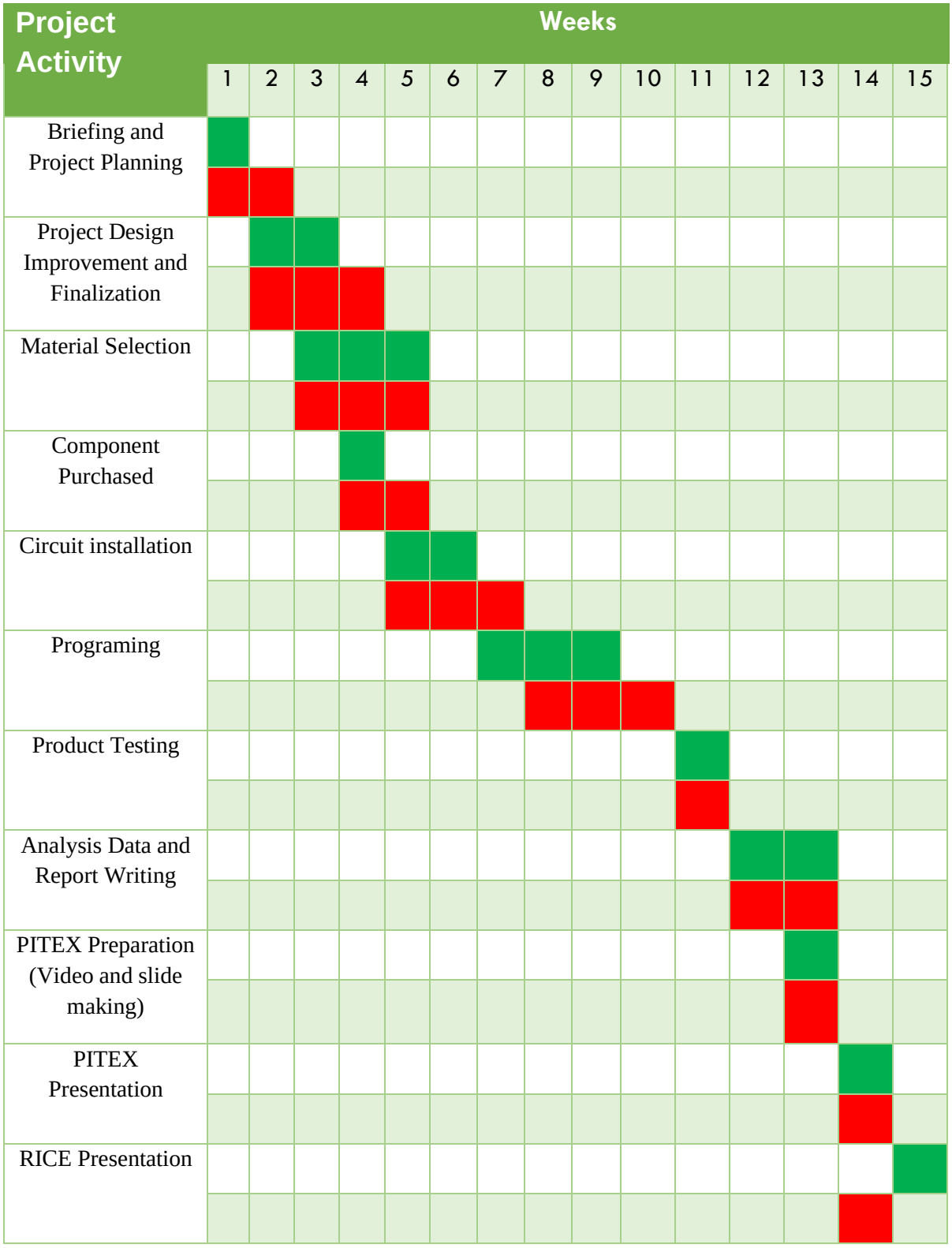


Table 3.3

3.10 SUMMARY

As a conclusion, the methods implemented in this project are very crucial and important to complete the project. Thus, as stated in the interview, this project is agreed and accepted by Mr. Mohd Ariffin Zulkifli from MYINVENT TECHNOLOGIES SDN BHD, an IOT Consultant who has been making electrical innovation more than five years. The type of electrical system used in the project will create an easy, safe and very efficient smart toolbox and yet very cheap, hence this project is very convenient to the user. However, this method will affect the result totally if one of the methods is change.

CHAPTER 4

RESULTS AND ANALYSIS

4.1 INTRODUCTION

This chapter will include the impact of our product, its advantages, and disadvantages, as well as the challenges throughout the process of developing the product and finally product testing. This data and analysis are very important for this project to achieve the objectives and scope of the project. This data indicates the successful results of the materials testing. After getting all of this data, we analyze every single possible to make it perfect.

4.2 IMPACT

There are various of impact that been brought by our project such as detecting and alarmed its user about the absence of the tool inside the toolbox. The absence tools can delay the toolbox user to do their work and not to mention that they also need to buy a new tool if the missing tool was never been found. Hence, this efficient, convenient and smart toolbox, was significantly ensure the tools for its user whenever they need them.

4.3 ADVANTAGES AND DISADVANTAGES (SMART TOOLBOX)

ADVANTAGES	DISADVANTAGES
• Detect the absence of the tool inside the toolbox by displaying the data on the LCD screen.	• Can't detect the exact location of the tool that went missing from the toolbox.
• Can be use in the dim places as the smart toolbox have the LED light inside it.	• The user must switch off the smart toolbox when not in used to avoid extra power consumption.
• Rechargeable	

Table 4.1

4.4 CHALLENGES

1) Problem with soldering iron

The soldering iron is crucial to perform a soldering on jumper wire into the circuit board. Unfortunately, our soldering iron is not functional well as the tip of the soldering iron can generate enough heat to solder the jumper wire. Our group bought another 2-soldering iron, and finally the last one was good enough to perform the soldering process.

2) Type of circuit for LED sensor

Before start with the embedment of the LDR sensor beneath the smart toolbox, we struggle to find the type of circuit arrangement to make the system work successfully.

3) The placement of LED light

Since our power can only supply up to 4 LED light in a time, we must figure out where the exact place we can put the LED light where it can light the entire toolbox when the toolbox was closed as shown in figured 4.1.

Figure 4.1

4) Programming process

Since all of us has no solid background for programming, we must start from scratch and refer from as many sources as we can find and most of that source are from the Internet and YouTube.

4.5 PRODUCT TESTING

Figure 4.2 shows LCD screen display all the tools inside the toolbox are complete.

Figure 4.2

Figure 4.3 shows all tool being took out and the LED light switched on.

Figure 4.3

Figure 4.4 manifest that the toolbox detects all the tools that went missing and display it through LCD screen.

Figure 4.4

As conclusion, the product testing went smoothly as our product was able to fulfil its main objective which is an efficient and smart toolbox that can detect the absence of the missing tools inside them.

CHAPTER 5

CONCLUSION

The Smart Toolbox was designed to innovate the existing toolbox to be more efficient, convenient, and smart toolbox as we lived in the era of Industrial Revolution 4.0 where smart connectivity was the main point of the revolution idea. This project will help to detect the absence of the tools inside the smart toolbox by notifying its user through the LCD screen that been installed on the toolbox. It will display the exact tool that when missing and then alert its user. Next, the Arduino software play the big role to embody the IR 4.O revolution vision on this smart toolbox project. Arduino software was use in this project to receive the data from the LDR sensor and delivered them to the UNO board and then display it through the LCD screen. For the additional features, the smart toolbox has the LED light that can be switched on and off when the user wants to use it for night work or in the dim places. Overall, this project has exceeded its existing purpose to be a multipurpose device that can benefit its user a various way.

SUMMARY

After the completion of the report and a test run of the project, this project guaranteed a plethora of benefit it can bring to its user. Through this project, it can develop creativity in creating, modify and innovate the existing project to be attractive and useful. This product was designed with the assist of Autodesk Inventor 2019. It went through many steps on the software to get the full design of the project as well as the challenges to bring out the detail of the project especially the molded design inside the toolbox. Next, the material was chosen and the type of circuit for the system decided. There two separate circuit that been operating inside the smart toolbox. One that connecting the LDR sensor to proto board and UNO board as well the power supply (power bank 10000 mah). The other one the LED light circuit which connect the LED light directed to the 9V battery and Switch ON OFF Rockers. Then, the programming process was on the ARDUINO IDE software where all the data (absence of the tools) was received from the LDR sensor and transfer back to the LCD screen to notify the

smart toolbox's user. The LED light inside the toolbox was act like a light source to the LDR sensor so that it can detect the absentees of the tools inside the toolbox when the toolbox was closed. Besides, the LED light can assist its user when they want to perform a work at the night or even in the dim places.

Finally, this project can be concluded that the stated objectives have been achieved and implemented effectively.

REFERENCES

1) Computer science zone, [31 OCTOBER 2014], virtual lost and found , retrieved from https://www.computersciencezone.org/virtual-lost-found/
2) Maker.pro , [21 MARCH 2018], How to Use an LDR Sensor with Arduino, retrieved from https://maker.pro/arduino/tutorial/how-to-use-an-ldr-sensor-with-arduino
3) Electronic-notes, [n.d.],Light Dependent Resistor LDR: Photoresistor , retrieved from https://www.electronicsnotes.com/articles/ electronic_componen/ resistors/light-dependent-resistor-ldr.php
4) Home Stratosphere, [n.d], 11 Different Types of Toolboxes, retrieved from https://www.homestratosphere.com/types-of-toolboxes/
5) Watelectronics.com, [24 SEPTEMBER 2019], Arduino Uno Board with Real-Time Application Projects, retrieved from https://www.watelectronics.com/ arduino-uno-board-tutorial-and-its-applications/
6) Component101.com, [28 FEBRUARY 2018], Arduino UNO, retrieved from https://components101.com/microcontrollers/arduino-uno
7) Irbnet.de, [n.d], Tools and Equipment – Their role in accident causality, retrieved from https://www.irbnet.de/daten/iconda/CIB1502.pdf
8) Kitronik, [14 Jan 2014], How an LDR (Light Dependent Resistor) Works, retrieved from https://kitronik.co.uk/blogs/resources/how-an-ldr-light-dependent-resistor-works
9) Spotlightmetal.com, [n.d.], IoT Basics: What Does Industry 4.0 Mean?, retrieved from https://www.spotlightmetal.com/iot-basics-what-does-industry-40meana842216/?cmp=gotaarttrfSLM_DSA20180820&gclid=CjwKCAjw8MD7BRArEiwAGZsrBVZu7JTdwUsteYQGx8cjsH73euLlgYRSTiiMole61alqDycvAwkyhoCCAkQAvD_BwE
10) By (author) Erik Oberg , Franklin Jones , Holbrook Horton , Henry Ryffel [10 SEPTEMBER 2020], Machinery's Handbook (Toolbox edition),

APPENDIX

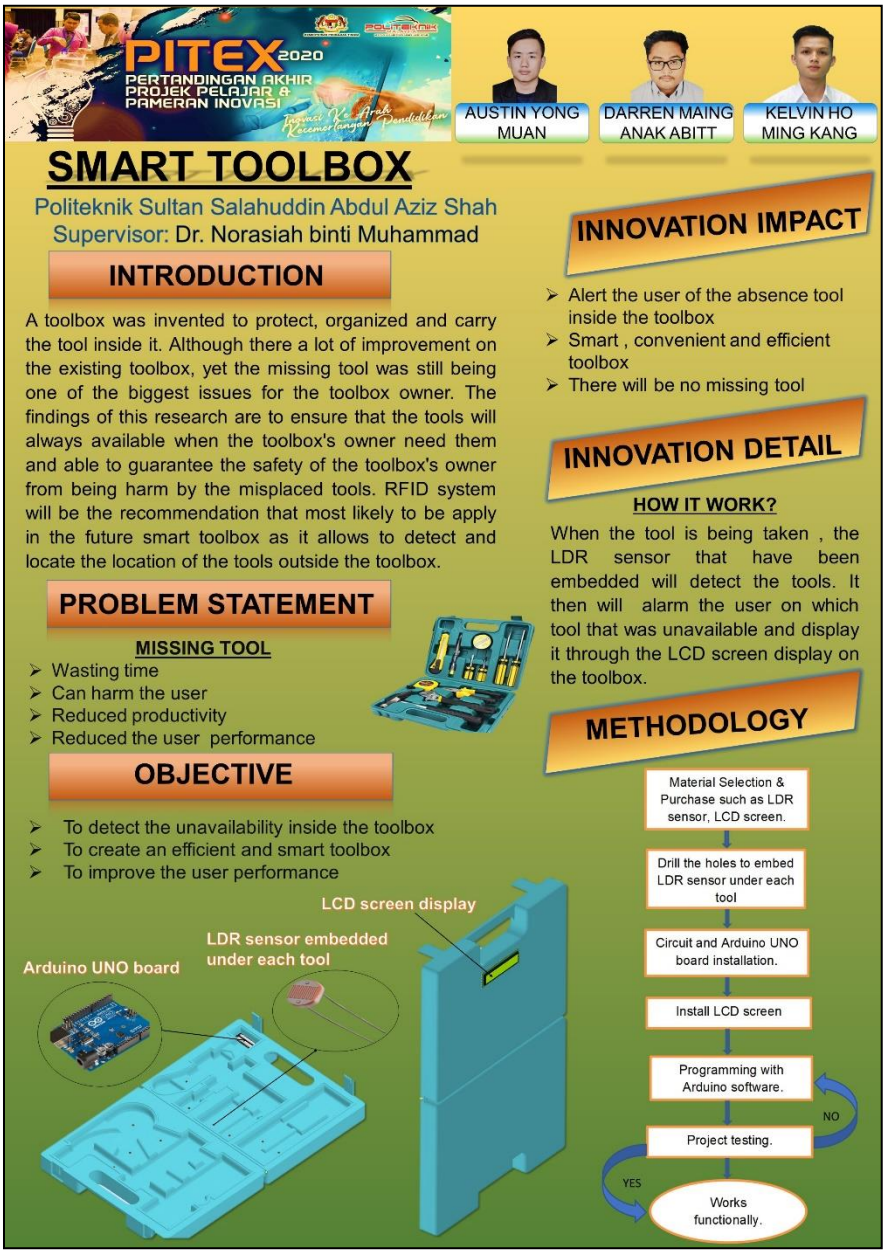
APENDIX A SMART TOOLBOX POSTER

APENDIX B SMART TOOLBOOX ACHIEVEMENT

APENDIX C PROJECT RELATED PICTURES

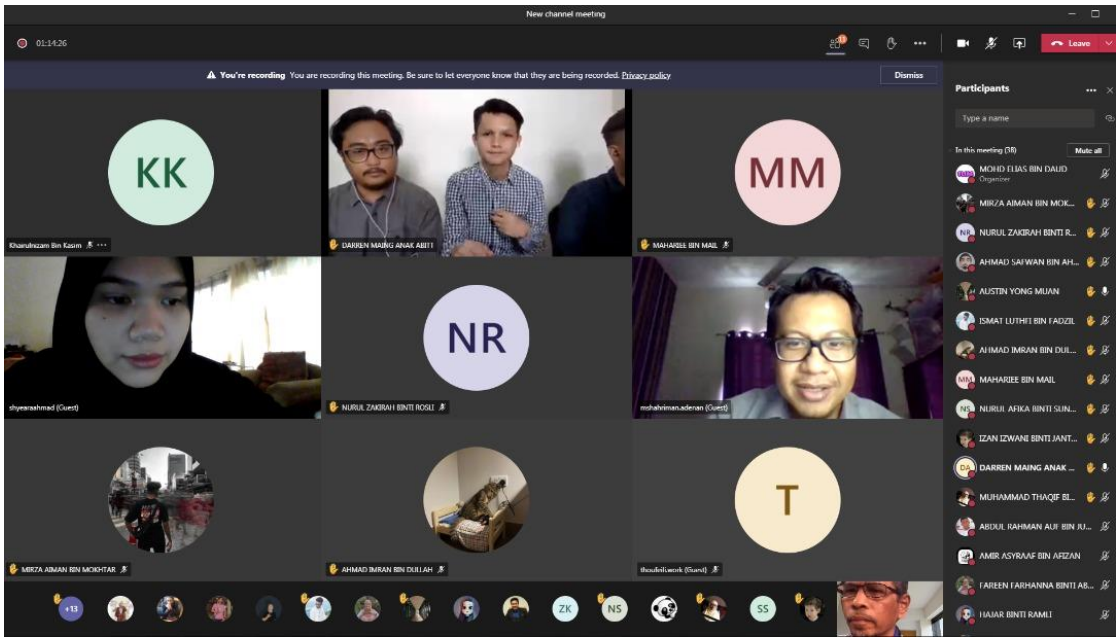
APENDIX D MyIPO REGISTRATION SOFTCOPY

SMART TOOLBOX POSTER



APPENDIX B

RICE TOP 10 MECHANICAL PROJECT
EVALUATION



AWARDED WITH GOLD IN PITEX 2020

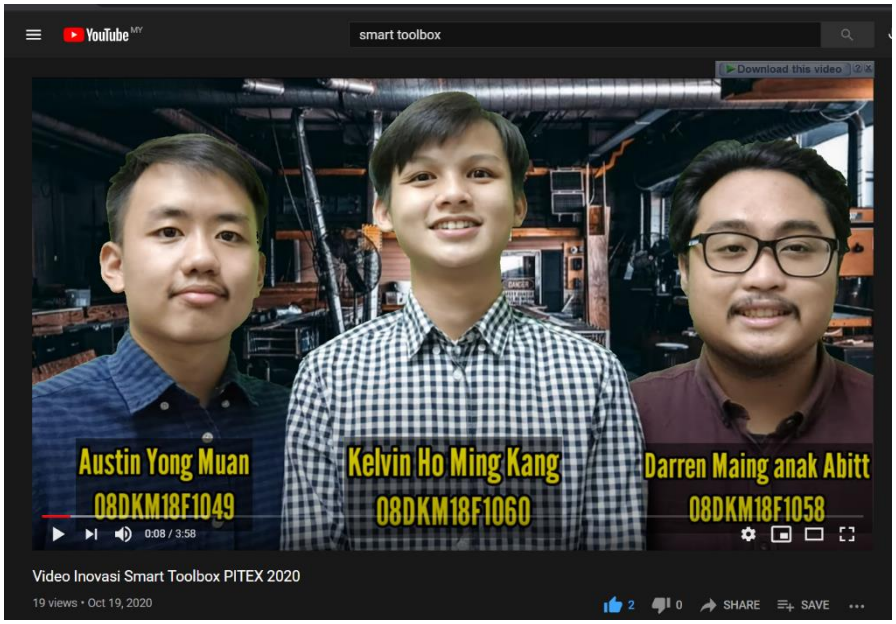
		PROJECT TITLE:	PROJECT SUPERVISOR:	CLASS:	MEDAL	TOTAL MARKS (40)
2	2	SMART TOOLBOX	DR NORASIAH	DKM5B	GOLD	

POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH
INVENTORI PROJEK 2 - SESI JUN 2020

SESI	JUN 2020	**TAJUK PROJEK**	**JENIS DAN KLUSTER**	**MERENTASI BIDANG**	**PENYELIA PROJEK**	MEDAL
KELAS	DKM5B					
KURSUS	DJJ6143-PROJEK 2					
PENYELIA						
NO MATRIKS	**NAMA PELAJAR**					
08DKM18F1078	LAU WEI ZHE	RFID Grocery Cart	MECHANICAL	MECHANICAL/MARKETING	DR.NORASIAH BINTI MUHAMMAD	GOLD
08DKM18F1079	ATHANAIUS MCKENNZY DUAT ANAK POLYCARP DANSON					
08DKM18F1080	JEROME GIOVANIE ANAK ASAP					
08DKM18F1049	AUSTIN YONG MUAN	Smart Toolbox	MECHANICAL	MECHANICAL/MARKETING		GOLD
08DKM18F1058	DARREN MAING ANAK ABITT					
08DKM18F1060	KELVIN HO MING KANG					
08DKM18F1055	NUR LIYANA AMEERA BINTI AHMAD FAIRUZ	Automatic Whiteboard Cleaner	MECHANICAL	MECHANICAL/MARKETING		SILVER
08DKM18F1062	NUR BATRISYIA IWANI BINTI SYAMSUL FAHRIZAL					
08DKM18F1083	NORASIKIN BINTI NAALI					
08DKM18F1048	MOHAMMAD HAFEKIE BIN ZULKEFLEE	WELDING ANGLE DETECTOR	MECHANICAL	MECHANICAL/MARKETING		SILVER
08DKM18F1069	BAMBANG ADLIEY BIN BAMBANG SUMANTERI					
08DKM18F1081	MUHAMMAD FAUZI BIN SHAMSUL BAHARI					
08DKM18F1046	MOHAMMAD FARHAN BIN SAJALI	MOTORCYCLE SAFETY STAND	MECHANICAL	MECHANICAL/MARKETING		SILVER
08DKM18F1059	MUHAMMAD IMAN NURHANIF					
08DKM18F1061	AHMAD TAUFIK BIN AMIN					

APPENDIX C

PROJECT RELATED PICTURES

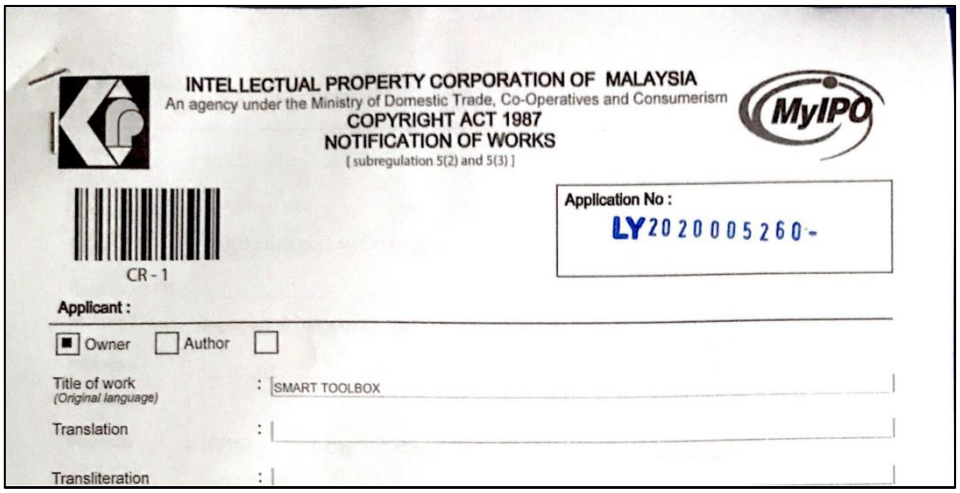


PITEX Smart Toolbox Innovation Video

Finished Product of Smart Toolbox

APPENDIX D

MyIPO REGISTRATION SOFTCOPY



INTELLECTUAL PROPERTY CORPORATION OF MALAYSIA
An agency under the Ministry of Domestic Trade, Co-Operatives and Consumerism
COPYRIGHT ACT 1987
NOTIFICATION OF WORKS
[subregulation 5(2) and 5(3)]

MyIPO

CR - 1

Application No : LY2020005260-

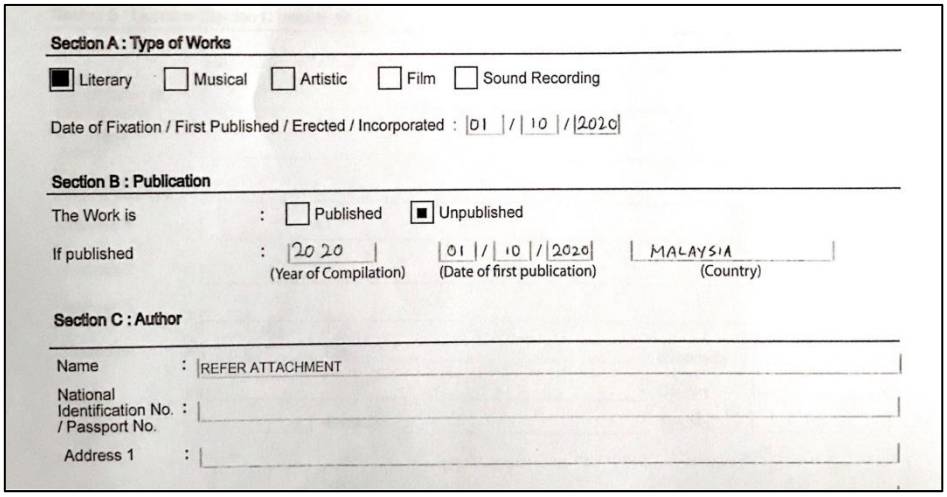
Applicant :

☑ Owner ☐ Author ☐

Title of work (Original language) : SMART TOOLBOX

Translation :

Transliteration :



Section A : Type of Works

☑ Literary ☐ Musical ☐ Artistic ☐ Film ☐ Sound Recording

Date of Fixation / First Published / Erected / Incorporated : 01 / 10 / 2020

Section B : Publication

The Work is : ☐ Published ☑ Unpublished

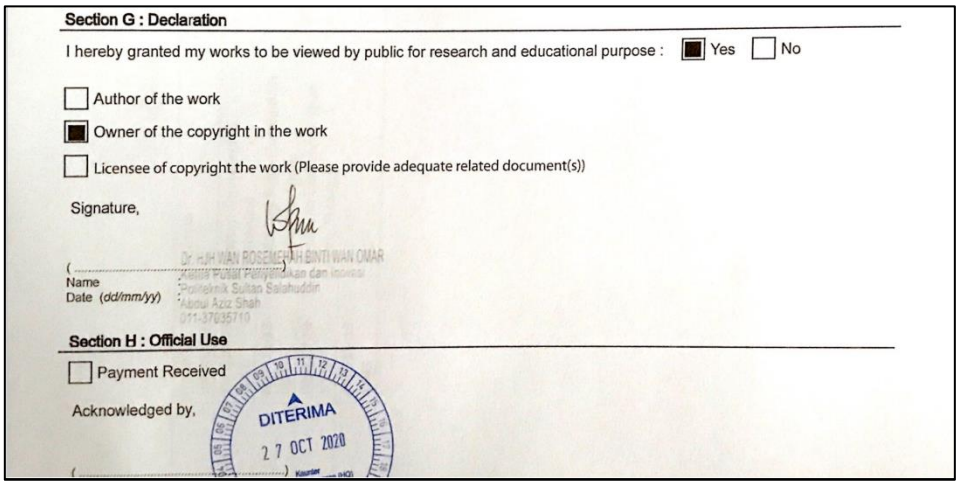
If published : 2020 (Year of Compilation) 01 / 10 / 2020 (Date of first publication) MALAYSIA (Country)

Section C : Author

Name : REFER ATTACHMENT

National Identification No. / Passport No. :

Address 1 :



Section G : Declaration

I hereby granted my works to be viewed by public for research and educational purpose : ☑ Yes ☐ No

☐ Author of the work

☑ Owner of the copyright in the work

☐ Licensee of copyright the work (Please provide adequate related document(s))

Signature,

(Dr. HJH WAN ROSEMIZAH BINTI WAN OMAR
Pengarah Pusat Penyelidikan dan Inovasi
Politeknik Sultan Salahuddin
Abdul Aziz Shah
011-37035710)

Name
Date (dd/mm/yy)

Section H : Official Use

☐ Payment Received

Acknowledged by,

DITERIMA
27 OCT 2020

( ) Kaunter