POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

SMART LADDER

JABATAN KEJURUTERAAN AWAM

MUHAMMAD KHAIRUL HIRZAME BIN HIRMAN

(08DKA20F1045)

SESI II:2023/2024

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Laporan ini dikemukakan kepada Jabatan Kejuruteraan Awam sebagai memenuhi sebahagian syarat penganugerahan Diploma Kejuruteraan Awam

JABATAN KEJURUTERAAN AWAM

SESI II:2023/2024

STATEMENT OF AUTHENTICITY AND PROPRIETARY RIGHTS

SMART LADDER

1. I, Muhammad Khairul Hirzame Bin Hirman (030116-10-0087) am a Civil Engineering Diploma student, Sultan Salahuddin Abdul Aziz Shah Polytechnic, whose address is Persiaran Usahawan, Seksyen U1, 40150 Shah Alam, Selangor

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0087), Bin Hirman
)
In front of me, Puan Daliela Binti Ishamuddin) ……
(820122025606) as project supervisor on)date : Puan Daliela Binti
23/5/2024 Ishamuddin

PENGHARGAAN

Bismillahirrahmanirrahim,

Alhamdulillah, Bersyukur ke hadrat Ilahi yang maha pengasih lagi maha penyayang, dengan izin-Nya memberi peluang kepada kami untuk menyiapkan Projek Tahun Akhir ini. Projek ini hanya dapat dicapai kerana bantuan dan sokongan ramai orang. Saya ingin mengambil kesempatan ini untuk mengucapkan terima kasih kepada semua orang atas bantuan mereka.

Puan Daliela Binti Ishamuddin, yang menyelia pengajian dan penyelidikan kami, adalah orang pertama yang kami ingin ucapkan terima kasih atas segala bantuan dan sokongan beliau. Kami berterima kasih atas masa dan usaha beliau dalam membantu kami untuk menyiapkan projek ini, terutamanya semasa fasa penyelidikan dan penulisan laporan. Sepanjang projek ini, kesabaran dan sokongan beliau amat dihargai.

Di samping itu, , penyelaras projek tahun akhir, dan semua pensyarah dipuji atas segala usaha memberikan penerangan dan syarahan mengenai projek tersebut.

Akhir kata, kepada ibu bapa, saudara mara dan rakan-rakan terdekat, kami ingin merakamkan ucapan terima kasih di atas sokongan yang tidak berbelah bahagi sepanjang kajian ini dijalankan. Tanpa sokongan dan dorongan berterusan mereka, projek kami tidak akan berjaya

ABSTRAK

Memperkenalkan Tangga Pintar, teknologi elektronik terobosan yang menukar tangga standard kepada alat yang boleh disesuaikan dan boleh dikendalikan. Dengan menggabungkan teknologi canggih, peranti unik ini meningkatkan keselamatan dan kecekapan tempat kerja. Kajian ini menyokong keperluan untuk pekerja rumah atau penyelenggaraan yang kebanyakannya bekerja bersendirian. Tangga Pintar mempunyai kawalan mesra pengguna menggunakan suis togol untuk pengendalian yang mudah. Dengan butang atas dan bawah, pengguna boleh melaraskan tangga secara mendatar dengan mudah, membolehkan mereka mencapai kawasan yang berbeza tanpa perlu menurunkan atau meletakkan semula kedudukan secara manual. Ciri ini amat berguna untuk orang yang bekerja bersendirian kerana ia mengurangkan kesulitan dan risiko yang berkaitan dengan pengendalian tangga tradisional. Selain keupayaan pergerakan mendatar, Smart Ladder menyertakan ciri keselamatan yang dipertingkatkan untuk memastikan pengguna selamat daripada kemalangan dan kecederaan. Seterusnya, Tangga Pintar ini akan berhenti secara automatik jika suis tidak ditolak ke atas atau ke bawah. Keputusan menunjukkan bahawa berat maksimum tangga boleh bergerak dari satu tempat ke tempat lain ialah 90kg. Ujian ini melibatkan 4 individu dengan berat yang berbeza. Hasil kajian ini, melaksanakan tangga bermotor dengan langkah keselamatan yang kukuh membolehkan individu menggunakan tangga dengan lebih selamat. Penemuan ini bukan sahaja mengesahkan objektif penyelidikan tetapi juga menyerlahkan skop yang besar untuk aplikasi masa hadapan

Kata kunci: tangga pintar, tangga automatik dan tangga bermotor.

ABSTRACT

Introducing the Smart Ladder, a breakthrough electronic technology that converts standard ladders into adaptable and maneuverable tools. By incorporating cutting-edge technology, this unique device improves workplace safety and efficiency. This study supports the necessity for household or maintenance workers who predominantly work alone. The Smart Ladder has a user-friendly control using a toggle switch for easy operation. With an up and down button, users may easily adjust the ladder horizontally, allowing them to reach different regions without having to dismount or reposition manually. This feature is especially useful for persons working alone because it reduces the inconvenience and risk associated with traditional ladder handling. In addition to horizontal movement capabilities, the Smart Ladder includes enhanced safety features to keep users safe from accidents and injuries. Next, this Smart Ladder will automatically stop if the switch is not pushed up or down. The results show that the maximum weight the ladder can move from one place to another is 90kg. The testing involved 4 individuals with different weights. The outcome of this study, implementing a motorized ladder with strong safety measures enables individuals to use the ladder more safely. These findings not only validate the research objectives but also highlight the enormous scope for future applications.

Keywords: Smart ladder, automatic ladder and motorized ladder.

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CHAPTER 1

IDENTIFICATION

1.1 INTRODUCTION

A staircase is a simple vertical or inclined construction consisting of two long side sections (called stiles) connected by several horizontal steps or steps. Ladders are used to reach great heights and gain access to hard-to-reach areas. Depending on the intended application and the climate in which it is used, it is usually manufactured from various materials such as wood, aluminum, fiberglass and steel.

In the fields of engineering and industrial automation, the concept of "ladder" carries diverse connotations, from the physical structures used to climb to the sophisticated programming logic used in control systems. As a ubiquitous symbol across multiple disciplines, the notion of a ladder intersects with themes of functionality, progress and efficiency. Understanding and harnessing the potential of stairs, whether in the context of product design, career advancement or educational pathways, has significant implications for innovation, security and human progress.

Using the concept of innovating, we will redesign a project or product that will convert an existing ladder into an electronic folding ladder that can be moved using a toggle switch. We will add functionality to the current ladder, adding functionality that can help workers or maintainers while doing work. We will add wiring, toggle switches, wheels and other components to move the ladder. Therefore, the ladder can move in two directions, forward and backward.

1.2 PROJECT/STUDY BACKGROUND

The main goal of this project is to design and develop an automated ladder that incorporates advanced technology to improve safety, efficiency and user experience while performing multiple tasks. The automatic feature aims to eliminate manual repositioning, reducing the risk of accidents and increasing the ladder's adaptability to various work environments.

The main function of the Smart Ladder is to help people in carrying out their tasks, especially those who work alone such as maintenance workers or someone who wants to maintain their own house, by allowing them to move the ladder forwards and backwards while on it using toggle switches and materials other. It has the potential to save time, increase efficiency, and make work easier. Community demand has resulted in the development of various types of multi-purpose ladders. Ladders can be folded, transported, and used for many purposes. It is also available in various sizes and designs, allowing customers to choose the one that suits them best.

Traditional ladders, although necessary for many tasks, often pose safety risks, especially when used by individuals working alone. The need for solutions to these challenges drove the development of the Smart Ladder. This ladder incorporates toggle switches, wiring, batteries and other components. enables automatic movement, making it a versatile tool for a variety of applications.

1.3 PROBLEM STATEMENT

According to the Article I referenced in scholar ship, Assessment of injury patterns and accident modalities in ladder-related injuries, only considered accidents involving ladders. Stairs are often associated with cracks; execution errors do not fall with strain or sprain; and a pinch is a wound. This study found that when using a ladder in a non-occupational environment, crash modes were associated with injury patterns. Elizabeth A. Rapp van Roden (2021).

In addition, the article mentions crash mode. According to Elizabeth A. Rapp van Roden, the most common crash mode is falling (91%), followed by failure to fall in performing the intended kinematics (4%), and pinching (1%). Elizabeth A. Rapp van Roden (2021).

Finally, according to previous research I conducted, the author of the article stated that some professions or tasks that require the use of ladders often require the use of various tools. Current ladders on the market do not have tool storage space. This increases the time it takes to complete a job or work because workers must frequently descend stairs to replace or retrieve their tools. Accidents also happen more often because people who often go down stairs are more likely to slip. Muhammad Faiz bin Abdullah. Smart Stairs 2020. To move the stairs, people must go down them. According to Muhammad Faiz Bin Abdullah. Currently, all stairs require users to climb them. People may lose their footing or stability when climbing stairs, especially if they are carrying equipment or materials. This condition will disturb the user's balance, making the design and mechanism of the ladder unstable and dangerous. (Muhammad Faiz bin Abdullah; Tangga Pintar 2020).

1.4 OBJECTIVE

The objective of the study is to solve or provide a solution to the Smart Ladder problem.
Here are the objectives of the project:

i. To produce ladder that move automatically forward and backward.

ii. To determine the effectiveness of battery usage and user weight.

1.5 SCOPE OF WORK

The scope of the project for this Smart Ladder requires the installation of wiring and other components, thus, this ladder can help the user move forward and backward while the user is doing work (maintenance, etc). Further, the scope of our project needs to meet the set objectives, and our product (Smart Ladder) can be used to help users in Polytechnic Sultan Salahuddin Aziz Shah or small buildings.

1.6 THE IMPORTANCE OF STUDY

In my opinion, the significance of this project/study stems from its potential to provide valuable insights and contributions to addressing existing building maintenance challenges. As a result, it broadens the range of brainstorming methods available to ladder users when completing maintenance work, increasing their ability to tackle difficult tasks effectively. Furthermore, this project will serve as a reference material for future innovations in automatic ladder products, providing a foundation for further advancements in building maintenance technology.

CHAPTER 2

LITERATURE REVIEW

2.1 CHAPTER INTRODUCTION

The literature review is the initial stage of this research by reviewing a series of related reviews. All relevant materials including journals, books, British Standards, technical papers, bulletins and handbooks will provide the necessary information and also to gain knowledge about the research. All these items are used to support the product/project being carried out. In addition, previous literature studies were also used as a comparison.

2.2 HISTORY OF LADDER

A ladder is a common object that we use to make certain tasks easier. The simple design serves its purpose and has not changed since stairs were first used several thousand years ago. No one knows where or when the first stairs were built and used, but one of the earliest records of stairs can be found in rock paintings from the Mesolithic era in Valencia, Spain, which date back to about 10,000 years ago.

Mesolithic rock paintings of stairs found in the Spider Cave in Valencia. The painting depicts or shows two people using a long ladder made of plant fibers to reach wild beehives and harvest honey. The ladder painted on the paint was found to be a flexible ladder made of different types of grass. The paint is estimated to be 10,000 years old. The Spider Cave in Valencia contains the first depiction of a staircase. Estimated to be 10,000 years old. Although it is the earliest evidence of ladder use, most researchers believe it is older than that. However, by studying ancient Egyptian and Hebrew cultures, researchers have discovered the roots of the functional design of stairs. Both civilizations invented and designed the perfect staircase. Mesolithic rock paintings show that ladders were an important way to get food or raw materials to survive. Furthermore, ladders have become household necessities and common daily items.

It is not difficult to imagine that some ladders were first developed for harvesting honey in the Mesolithic era, as this was still practiced by isolated tribes. Humans are used to reaching high places by themselves, but the use of climbing tools such as poles and branches will make the task easier. The ladder may be designed to provide access in situations where there are no climbing aids to reach high places. Ladders have been designed and manufactured for a variety of purposes, including fiberglass ladders for electricity, telescopic ladders for portability and cat ladders for safe roof climbing.

However, some older ladders are made of rope. This type of ladder still exists in certain countries. There is also a sturdy wooden ladder that can hold a heavy load or a person. Also, during World War II, this type of ladder was used.

Ladders now come in a variety of shapes, sizes, and applications. To fully comprehend the history of the ladder, it's important to understand its origins prior to the invention of the step ladder. Important specifications to consider include height, size, and safety features.

2.2.1 PREHISTORIC ERA

The existence of prehistoric humans is very different from the way humans live now, and the surrounding conditions have changed significantly. There may not be tall buildings, or there is little need to climb and reach high places independently or with their own abilities (i.e. without using natural materials such as trees, roots, and others), so stairs as a development will change people's way of life. With their new ability to climb heights and access high places that were previously out of reach, humans can access caves in high rock faces. Scale cliffs to create more homes or practical environments. The modern ladder is thought to have been invented in the Middle East and North Africa by the Hebrews and Egyptians, and was likely used in the construction of the pyramids and other Egyptian structures

Figure 2.1: Ancient Egyptian

Figure 2.2: Painting in cave

2.3 PORTABLE LADDER

2.3.1 TYPE OF LADDERS

Referring to the website I studied, a ladder is a must-have tool in every home for maintenance work. In addition, what I found is that all the ladders on the market are shaped like "A" and are made of different types of materials. For example, aluminum, iron or fiberglass.

. Some ladders are small and portable, while others are large and require time to construct. These ladders are classified as either rigid or flexible.

Flexible ladders are typically made from ropes, cables, grass, or other flexible materials. They're easier to transport and handle. Of course, they are not particularly easy to scale. When you add weight to a flexible ladder, it flexes and bends, making it difficult to climb without practice. However, they are frequently used in combat situations and can be extremely useful in an emergency.Rigid ladders, as opposed to flexible ladders, feel more secure underfoot and are much easier to use. They are, however, very difficult to relocate. Small ladders are lightweight and portable. Large stairs, on the other hand, necessitate specialized transportation and assistance. Rigid stairs are available in a variety of styles, including.

Single Pole Ladders

Single pole ladders are single ladders whose shape and length are fixed and cannot be changed. Its use is usually leaned against the wall, but some are also equipped with hooks. Single pole ladders usually have a maximum height of 9 meters.

Figure 2.3: Single Pole Ladder.

ii. Extension Ladder

Extension ladders are ladders that can be extended and raised. Extension ladders have a maximum height of 15 meters and should be supported on the wall. There are sliding extension and telescopic types. The advantage of a telescopic ladder is that its dimensions can be simplified, making it easier to transport and save storage space.

Figure 2.4: Extension Ladder.

iii. Step Ladder

Step ladders are folding ladders that can support themselves. Some are shaped like the letter A and can be climbed from both sides, while others resemble a right-angled triangle and can only be climbed from one side.

A ladder with 2-3 steps is commonly used as a foothold to reach a tall bookshelf or cupboard. Meanwhile, step ladders typically reach a maximum height of 6.1 metres.

Figure 2.5: Step Ladder.

iv. Platform Ladders

Platform ladders are ladders that can stand on their own (do not need to be supported) with the top footing in the form of a podium / wide platform. Platform ladders are often the best choice for repair or renovation jobs with a height above 3 meters due to their stability.

Figure 2.6: Platform Ladders.

2.4 MATERIALS

Referring to our wiring diagram, the materials used for wiring are wire (red and blue), toggle switch, bearing, sprocket, rubber tire (4pcs) and battery. Along with that, we also added Mild steel hollow (1/2"x 1"x 1.6mm), Mild Steel shaft (19.2mm), Mild Steel plate (3mm) and pillow block (19.2mm).

2.4.1 BATTERY

Choosing the right battery is very important, that is choosing the right battery to use on the product. There are several characteristics to choose a battery in terms of capacity, weight/size, and voltage.

In addition, the selection of the battery also affects how long the battery lasts when worn or installed in the product. Determine whether the battery to be used is rechargeable. If we use a battery that has a high power, the cost of the battery also becomes more expensive. Therefore, for the project we used only one battery (12V 7 2Ah).

Figure2.7: Battery

2.4.2 SPROCKET

A sprocket is a mechanical wheel that has teeth or spikes that are intended to move the wheel and rotate it with a chain or belt. The teeth or spikes engage with the belt and rotate with the belt in a synchronized manner. To function efficiently it is very important that the sprocket and belt have the same thickness.

The basic design of the sprocket is almost the same all over the world and it is widely used in some specific industries such as cars, bicycles, motorcycles, and other types of machinery for multi-functional mechanics and applications.

Figure 2.8: Sprocket

2.4.3 WIRE (BLUE AND RED)

I. WIRE (BLUE)

The Blue Wire is the Neutral wire In an AC (alternating current) electrical system. The neutral wire serves to close the circuit and carry current back to the power source. This is important to complete the circuit and ensure that the electrical current flows properly. In addition, it also becomes a Negative Marker or Signal Return In DC (direct current) systems or electronic circuits, the blue wire is often used as a negative marker or signal return. It can be a marker for the part of the circuit connected to the negative of the battery or power sour

II. WIRE (RED)

Red Wire is Phase (Live/Active) In AC electrical system. This is the wire that carries current from the power source to the load (such as a lamp or electrical appliance). It is the part of the circuit that carries the active voltage. Therefore, it also becomes a Positive Marker In DC systems, the red wire is often used as a positive marker. It marks the part of the circuit that is connected to the positive of the battery or power source.

These wires will be used in Electrical or Electronic Projects the use of blue and red colors makes it easier to identify connections in the circuit. This helps in maintenance and troubleshooting. Using standard colors helps in avoiding connection errors that can cause short circuits or electrical hazards. Finally Facilitates installation in an orderly and efficient manner, as well as ensuring that each component is connected correctly.

Figure 2.9: Wire red and blue

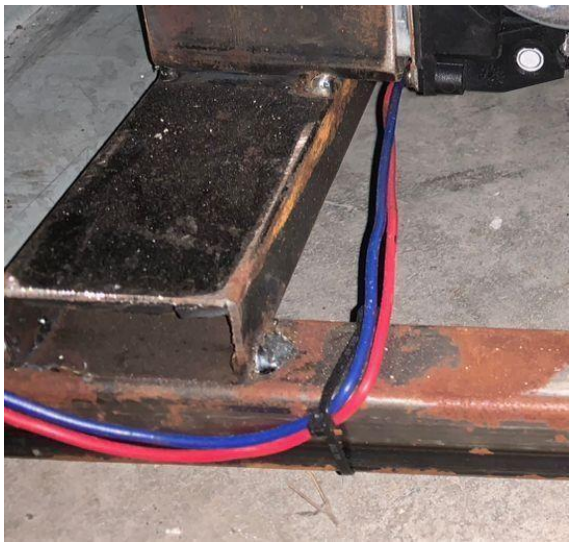


Figure 2.10: Wire at our product

2.4.4 TOGGLE SWITCH

A toggle switch is a type of electrical switch that is manually operated by a mechanical lever, handle, or rocking mechanism. It is commonly used in a variety of electronic and electrical applications due to its simplicity, reliability, and ease of use. Here's a comprehensive explanation of toggle switches that you can include in your final year report:

Overview of Toggle Switches

Toggled between two or more positions.

Construction:

1. Lever/Actuator: The part that the user manipulates to change the switch position.

2. Housing: Encases the internal components and provides mounting options.

3. Contacts: Metal pieces inside the switch that open or close the electrical circuit.

4. Terminals: Connectors that interface with the external circuit.

Working Principle

When the lever of the toggle switch is moved, it changes the position of the internal contacts. This action either completes the electrical circuit, allowing current to flow (on position), or breaks the circuit, stopping the current flow (off position). In multi-position switches, the lever movement can redirect the current to different circuit paths.

Applications

1. **Electronics:** Used in electronic devices for power control and mode selection.

2. **Automotive:** Commonly found in cars for controlling lights, indicators, and other accessories.

3. **Industrial:** Used in machinery and control panels to operate equipment.

4. **Home Appliances:** Found in household items like fans, lights, and other electrical devices.

Advantages

1. Simplicity
2. Easy to operate with a straightforward on/off mechanism.
3. Reliability durable and can handle frequent use.
4. Versatility available in various configurations to suit different applications.
5. Cost-Effective generally inexpensive and widely available.

Disadvantages

1. Manual Operation: Requires physical actuation, which may not be suitable for automated systems.
2. Wear and Tear: Mechanical parts can wear out over time with extensive use.
3. Limited to Binary Control: Typically offers simple on/off control without finer adjustments.

Selecting a Toggle Switch

When selecting a toggle switch for a project, consider the following factors:

1. Electrical Ratings: Ensure the switch can handle the voltage and current requirements of your application.
2. Number of Poles and Throws: Choose the correct configuration (SPST, SPDT, DPST, DPDT) based on the control needs.
3. Mounting Style: Consider the physical mounting requirements (panel mount, PCB mount, etc.).
4. Durability: Look for switches rated for the environmental conditions they will face (e.g., waterproof for outdoor use).

Conclusion

Toggle switches are integral components in many electrical and electronic systems due to their simplicity, reliability, and versatility. Understanding the types, working principles, and applications of toggle switches can help in selecting the right switch for specific needs, ensuring effective and efficient control in various projects.

This detailed explanation provides a comprehensive understanding of toggle switches, which can be beneficial for your final year report. Ensure to include diagrams or images to visually represent different types of toggle switches and their configurations for better clarity.

Figure 2.11: Toggle Switch

2.5 SUMMARY

This chapter concludes with a literature review highlighting studies on ladders and electronic parts to enhance understanding of the project. Our Smart Ladder function similarly to regular stairs, making them ideal for reaching high objects that are out of reach for most people.The Smart Stairs have been completed, but they still need to be tested for quality and strength to meet user expectations.

The study of stairs inspired the design of Smart Stairs, which included a few additional characteristics. In addition, it is important to know the functions and characteristics of the stairs step ladder throughout the year because we can make improvements and specifications to previously created ladders for build a Smart Ladder.

CHAPTER 4

METHODOLOGY

3.1 INTRODUCTION

Methodology is a comprehensive and rational approach to research projects. Studying field methods and their underlying theories helps develop an approach that aligns with planned objectives.

In addition, methods are specific tools or procedures for data collection and analysis. The overall goal of methodology is to standardize, structure, and organise work processes. This helps to focus all projects in the same way and allows us to iterate on successful aspects while learning from mistakes, resulting in a continuous improvement cycle.

The methodology provides benefits such as organizing project time, managing risk, and developing team skills. Smart Ladder has been completed based on the methodology which has been planned and prepared like the chart we have done.

3.2 FLOWCHART

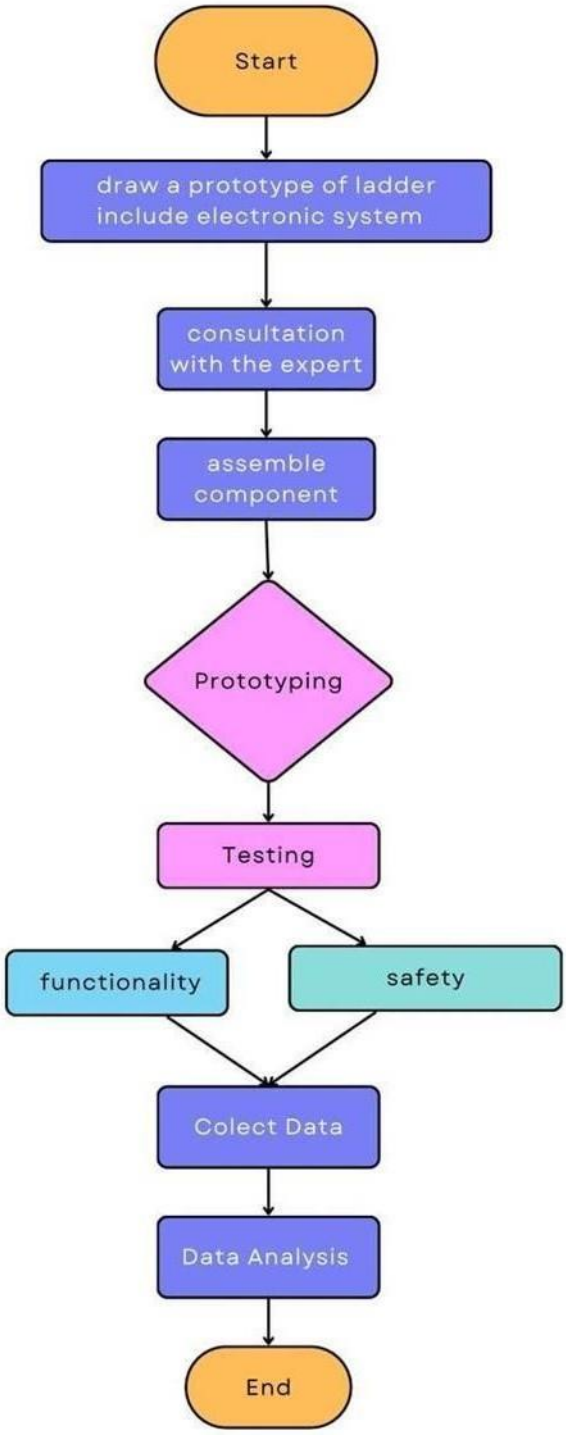


Figure 3.1: Flow Chart for Smart Ladder

3.2.1 SKETCHING/DESIGNING THE PRODUCT

1. Make a study regarding the design and size of stairs that are suitable to be used as a prototype.
2. Identify the materials and tools to be used with the help of the consultant 'Zul Design'..
3. Make a preliminary design of the product shape to illustrate the stable characteristics and be able to provide information in more detail.

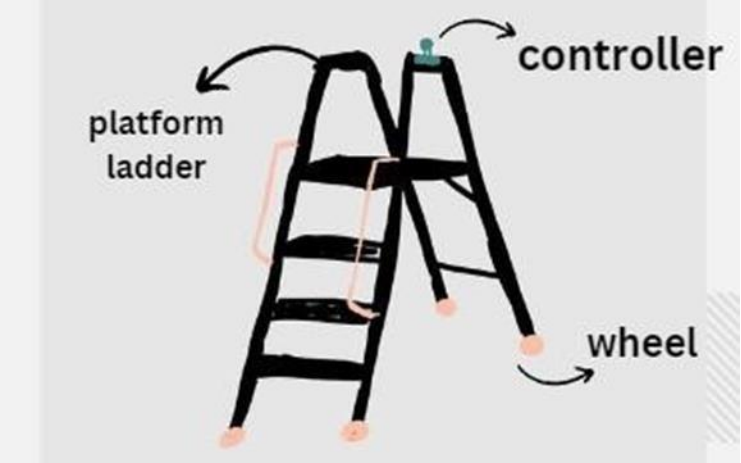


Figure 3.2: The first sketch produced.

After us, ask the consultant, we have changed the shape/redesign of the sketch for the new "Smart Ladder".

Figure 3.3: New sketch for the “Smart Ladder”.

3.3 MEETING WITH CONSULTANS

We have conducted a survey and sought information about reliable parties in the field of electronics and mechanics to guide us in preparing our "Smart Ladder" product. After that, someone suggested a party that specializes in electronics and mechanics. We collected information and found that the party "Zul Design" has guided many students to complete their Final Year Project (FYP). We have made a decision to consult with "Zul Design".

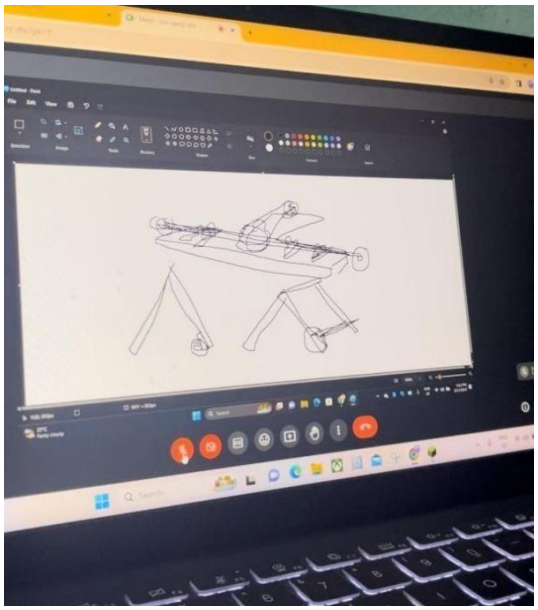


Figure 3.4: Online Meeting.

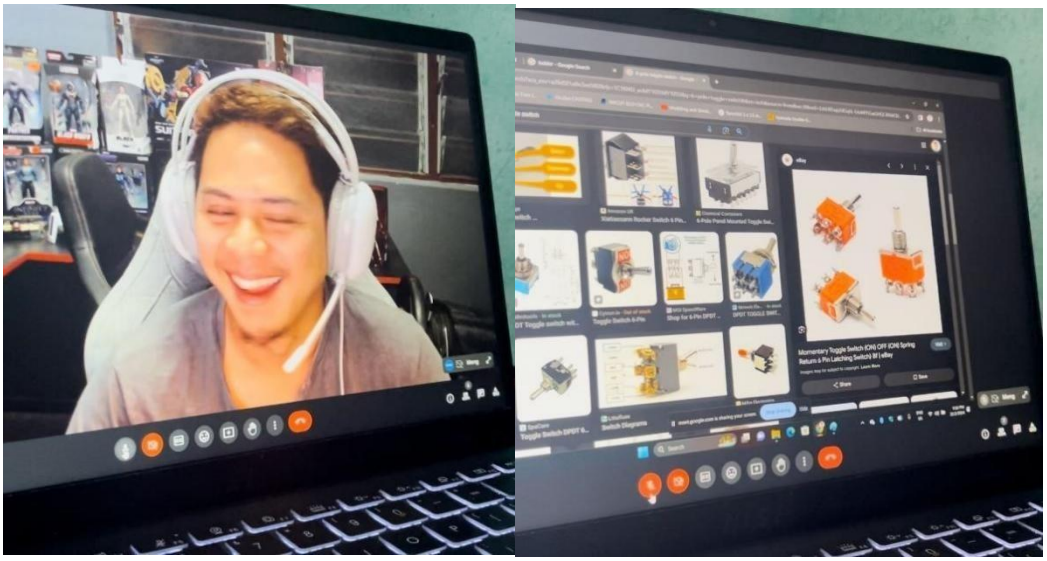
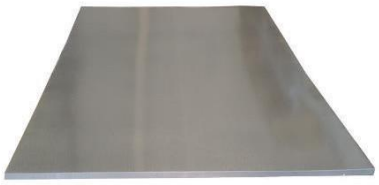


Figure 3.5: Online Meeting with our consultant.

During the online meeting, we got a little bit of data and ideas to use in our "Smart Ladder" product.

3.4 LIST OF MATERIALS AND EQUIPMENTS

Here is table 3.1 which shows the materials for use in designing the "Smart Ladder".

NO.	MATERIALS	Quantity
1	Mild Steel Hollow (1/2”x 1” x 1.6mm)	
2.	Mild Steel Shaft (19.2mm)	
3.	Mild Steel Plate (3mm)	

4.	Mild Steel Sprocket RS40 Size (Diameter 100mm and 50mm)	
5.	Pillow block (Diameter 19.2)	
6.	Tyre Foom 10”	
7.	Rubber Tyre 4”	
8.	Battery 7.2 Ah	

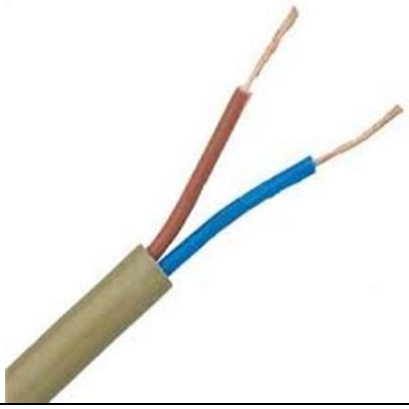
9.	Toggle Switch	
10.	Wire (Red and Blue)	
13.	Mild Steel Chain RS40	

Table 3.1: List of components

Picture from (Google)

3.4.1 COST

Bil	Perkara/Komponen	Harga/Unit	Kuantiti	Jumlah
1	Mild Steel Hollow (1/2"x 1" x 1.6mm)	RM 1.90	2 kaki	RM 3.80
2	Mild Steel Shaft (19.2mm)	RM 3.60	2 kaki	RM 7.20
3	Mild Steel Plate (3mm)	RM 3.10	2 kaki	RM 6.20
4	Mild Steel Spocket RS40 (Diameter 100mm)	RM 58.00	1 unit	RM 58.00
5	Mild Steel Spocket RS40 (Diameter 50mm)	RM 38.00	1	RM 38.00
6	Pillow Block (Diameter : 19.2mm)	RM 42.00	2 unit	RM 84.00
7	Tayar Foom 10"	RM 85.00	2 unit	RM 170.00
8	Rubber Tyre 4"	RM 22.00	2 unit	RM 44.00
9	Battery 7.2 Ah	RM 75.00	1	RM 75.00
10	Toggle Switch	RM 15.00	1	RM 15.00
11	Wayer (Biru)	RM 2.00	10 kaki	RM 20.00
12	Wayer (Merah)	RM 2.00	10 kaki	RM 20.00
13	Mild Steel Chain RS40	RM 8.20	2 kaki	RM 16.40
			Jumlah:	RM 557.60
			Servis	RM -
			Jumlah Keseluruhan:	RM 557.60

Table 3.2: Cost list of material/component types.

3.5 THE PROCESS OF INNOVATING THE ‘SMART LADDER’

According to the Gartt Chart that we have built and compiled. Here I will explain about the process or work we do when innovating a normal ladder to an electronic ladder that is "Smart Ladder". First, we identified the ladder we used for our project "Smart Ladder". Second, meet with the "Zul Design" consultant to understand more about the process and identify the materials or other components needed for the "Smart Ladder". Third, we started doing work such as punching iron, smoothing and cutting iron using a grinder and welding.

Next, connect the ladder and also other components such as wire, battery, sprocket and so on. Make a connecting wire to move the ladder. With that, the stairs can move according to our objective which is to be able to innovate ordinary stairs into moving stairs.

Finally, testing and adding safety features to the ladder, we have added a section at the bottom to prevent the user and the ladder from falling.

Figure 3.7: consultants teach using tools.

Figure 3.8: Grinder.

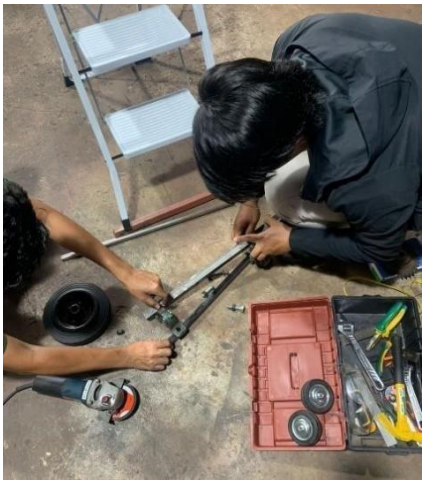


Figure 3.9: Connecting components.

Figure 3.10: finished connecting stairs and platform.

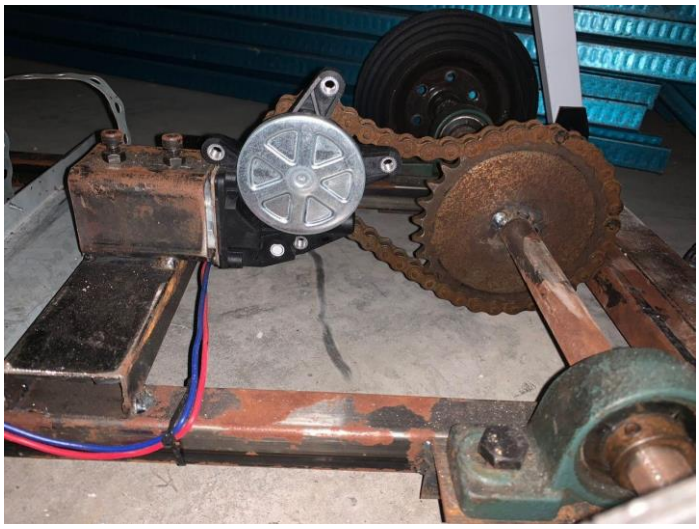


Figure 3.11: Components are mounted on the platform.

Figure 3.12: The part that has been added stabilize the ladder.

Figure 3.13: Ladder Movement Test.

3.6 WIRING

In electronics projects, wiring refers to the connections made between various electronic components such as resistors, capacitors, integrated circuits, actuators and power sources. Proper wiring is essential to ensure the circuit operates properly and safely. This can include soldering wires to circuit boards, using breadboards for prototyping, or even designing custom PCBs (printed circuit boards) with traces that connect components.

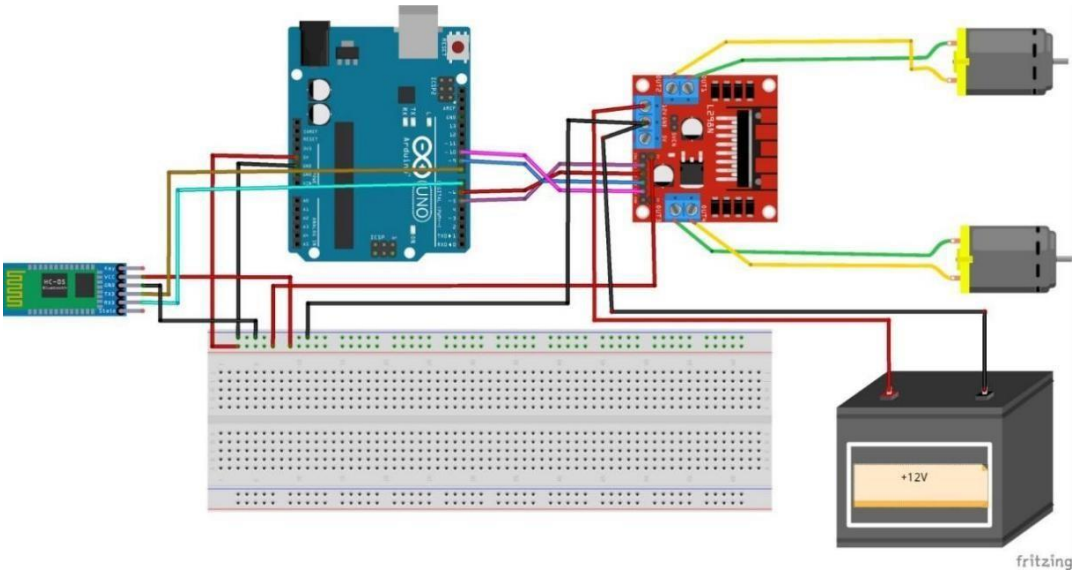


Figure 3.14: Diagram Wiring for Smart Ladder.

3.7 GANTT CHART

I have made a gantt chart for the activities throughout doing FYP 2. There is also a lot of new knowledge that we got while doing FYP 2. From gathering information until we were able to complete our "Smart Ladder" product.

Week / Activity	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Semester End
Briefing FYP 2	/														
Update and send the Draft report of chapter 1, 2, 3 to the supervisor		/	/												
Meeting with experts in the field of mechanics and electronics			/	/											
Preparation of materials/tools and start designing the project				/	/	/	/								
Improving products in terms of safety								/	/						
Start analyzing the data										/	/				
Final presentation to the panel											/				

Figure 3.15: Gantt Chart from week 1- 14

CHAPTER 4

ANALYSIS DATA

4.1 INTRODUCTION

This chapter summarises the data and comprehensive analysis used in the study. It includes the presentation of findings and overall analysis via tables, diagrams, and testing, which aids in the discovery of key insights. The structure of this chapter follows the hierarchy of research questions, ensuring that all objectives presented throughout the study are adequately addressed. A critical discussion of the findings further emphasises the study's scientific rigour, demonstrating its alignment with the needs and objectives of the project course and study programme.

4.2 DATA

The analysis data is based on the following:

1. Takes time to move the stairs from one place to another.
2. Compare the speed limit of each user using different user loads.

4.3 CALCULATION

Weight	Time taken to move ladder At the front	Time taken to move at back	Velocity
38kg	17.39 sec	17.76 sec	0.2 m/s
55kg	18.19 sec	18.77 sec	0.19 m/s
65kg	18.53 sec	19.10 sec	0.18 m/s
85kg	20.6 sec	21.19 sec	0.17 m/s

Table

Distance "Smart Ladder" moves = 7m

Formula of Velocity = V= Distance / time

Calculations

-Velocity for User weight 38kg

V= (17.39 + 17.76)/ 7

= 0.2 m/s

-Velocity for user weight 55kg

V= (18.19 + 18.77)/ 7

= 0.19 m/s

- Velocity for user weight 65kg

V= (18.53 + 19.10)/ 7

= 0.18 m/s

- Velocity for user weight 85kg

V= (20.6 + 21.19)/ 7

= 0.17 m/s

Figure 4.1: Line Graph.

4.4 SUMMARY

The more the user's weight increases, the less the 'Smart Ladder' movement speed limit from one distance to another.

user weight affects battery life, the heavier the user, the more energy needs to be used. Therefore, for long-term use, the battery power must be large.

Figure 4.2: User with weight 38kg.

Figure 4.3: User with weight 55kg.

Figure 4.4: User with weight 65kg.

Figure 4.5: User with weight 85kg.

In addition, we also test our product "Smart Ladder" moving in an area where the floor is inclined by 30 degrees and we also do testing to measure the work ability of our product.

Figure 4.6: Testing.

Figure 4.7: Testing work ability.

CHAPTER 5

CONCLUSION AND SUGGESTION

5.1 CONCLUSION

Through this project, it helps develop creativity in creating projects and modify existing projects to be more efficient and advanced. Project results accomplished with pointers on lessons to be learned from success and failure. When you make this ladder "Smart Ladder", all kinds of new things are made learning Making this ladder has also improved our skills in welding, drilling and cutting metal. Innovation in changing ladder to movable ladder has given the desired result of saving time and energy. Ability to move the ladder without the need for people to go down the ladder has proven that this ladder has fulfilled our first objective of being able to innovate the normal ladder to an electronic ladder. After several tests, the safety system on this crawler ladder has been proven to be effective by adding a section to the bottom of the platform to stabilize the ladder and the user.

In summary, the manufacturing process of the smart staircase project has been successful, demonstrating both forward and backward functionality. We also successfully achieved the project objectives. Furthermore, with the data we have collected, we can find out the maximum weight for our product "Smart Ladder". Its maximum weight is 90kg.

5.2 SUGGESTION

For students who want to continue our project, I have a suggestion to improve the 'Smart Ladder' product which is:

1. Motion Sensor

A tool used to detect and signal. Signals are given through sound and vibration or in the form of lights. In addition, the sensor can detect movement that will be around the stairs. It is programmed using Arduino software as one of its components is an Arduino Uno.

Figure 5.1: Arduino for sensor

2. Movement

Adds and allows the ladder to move 360 degrees. This, will please the user to move freely and not have to go down to change the direction of movement of the stairs.

3. Height

Increases the height of the ladder, so that users can reach or maintain high objects.

4. Holder

Safety is very important as a user, so by adding iron handles to the ladder, the user's safety will be more assured.

5. Tools box

place to store tools, tools box installed on the stairs so that users do not have to go back and forth to pick up craftsman's tools or users do not have to hang tools on the body.

Figure 5.2: Tools box

Finally, I sincerely hope that the 'Smart Ladder' product can be studied and developed further in terms of function, shape and also the materials used.

5.3 SUMMARY

In summary, the manufacturing process of the smart staircase project has been successful, demonstrating both forward and backward functionality. We also successfully achieved the project objectives. Furthermore, with the data we have collected, we can find out the maximum weight for our product "Smart Ladder". Its maximum weight is 90kg.

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LAMPIRAN

LAMPIRAN A **Soal Selidik**

LAMPIRAN B **Data Kasar**

LAMPIRAN C **Surat Kebenaran Menjalankan Penyelidikan**