POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

INOVASI TANGGA LIPAT YANG DIUBAH MENJADI TANGGA ELEKTRONIK

(SMART LADDER)

JABATAN KEJURUTERAAN AWAM

SHARIFAH NOOR BAITIE BINTI SYED

HAMIZON

08DKA21F2003

SESI 1:2023/2024

POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

INNOVATION OF FOLDING LADDER TO ELECTRONIC LADDER

(SMART LADDER)

SHARIFAH NOOR BAITIE BINTI SYED HAMIZON

08DKA21F2003

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

JABATAN KEJURUTERAAN AWAM

SESI 1:2023/2024

STATEMENT OF AUTHENTICITY AND PROPRIETARY RIGHTS

SMART LADDER

1. We are, SHARIFAH NOOR BAITIE BINTI SYED HAMIZON (030413-10-0016) a Civil Engineering Diploma student, Sultan Salahuddin Abdul Aziz Shah Polytechnic, whose address is at Persiaran Usahawan, Seksyen U1, 40150 Shah Alam, Selangor

2. We acknowledge that the Automatic Ladder and the intellectual property included within it are the result of our original work/design and that we have not taken or copied any intellectual property from third parties.

3. We agree to release the ownership of the intellectual property Automatic Ladder to Sultan Salahuddin Abdul Aziz Shah Polytechnic in order to fulfill the requirement to award the Civil Engineering Diploma to us.

Acknowledged by:	)	
	)	
SHARIFAH NOOR BAITIE BINTI SYEED HAMIZON	)	…………………………………
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In Front, Puan Daliela binti Ishamuddin (820122025606) as our project supervisor		…………………………………
on date: 23/5/2024	)	DALIELA BINTI ISHAMUDDIN
	)	

APPRECIATION

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.

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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 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, tangga pintar, tangga automatik, tangga mudah alih,

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: ladder, smart ladder, automatic ladder, portable ladder,

TABLE OF CONTENT

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

A portable ladder is intended to be readily moved and transferred from one area to another. These ladders are often lightweight and made of materials like aluminum, fiberglass, or wood. They come in a variety of shapes and sizes, including step ladders, extension ladders, and multipurpose ladders.

Portable ladders are widely utilized in several environments, including construction sites, warehouses, homes, and workplaces. They give a temporary way to reach heights for operations such as painting, cleaning, maintenance, and building work.

Using the concept of invention, we will create a project or product that will convert an existing ladder into an electronic system ladder that can be moved using controls. We will use the concept to add functionality to the current ladders.

1.2 PROJECT BACKGROUND

The main objective of this project is to design and develop an automatic ladder that incorporates innovative technologies to improve safety, efficiency, and user experience during various tasks. The automated features aim to eliminate manual repositioning, reduce the risk of accidents, and enhance the ladder's adaptability to different working environments.

The Smart Ladder's main function is to assist people in doing their work, particularly those who work alone, by allowing them to move the ladder horizontally (left and right) while staying on the ladder. It has the potential to save time, boost efficiency, and make work easier. Many different varieties of multi-purpose ladders have been invented as a consequence of community demand. Foldable, portable, and easy-to-use multi-purpose ladder.

1.3 PROBELEM STATEMENT

Ladders are essential tools in various industries and households, used for tasks ranging from simple household maintenance to complex construction work. Despite their widespread use, ladders are also associated with a high risk of accidents and injuries.

Based on previous studies some professions or tasks that require the use of a ladder usually necessitate the usage of numerous tools. The market's current ladder did not include a tool storage area. This makes the work or job more time-consuming because personnel must frequently step down from the ladder to replace or take their tools. Accidents are also more likely to occur because persons who frequently walk down from the ladder may slide. (Muhammad Faiz bin Abdullah, Smart Ladder 2020)

Based on the research paper "Smart Ladder" (2020), existing ladders require individuals to descend to reposition them. This process poses risks such as loss of balance or stability while climbing. Consequently, these conditions directly affect users' balance and result in instability in both the design and mechanism of the ladder. Thus, the goal of this ‘Smart Ladder’ is to convert the existing ladder into a moveable ladder.

1.4 OBJECTIVE

i. To produce an automated ladder that can be moved forward and backward.

ii. To check the battery’s lifetime based on the weight required to move the ladder.

1.5 SCOPE OF WORK

There are various items identified as project scope to ensure that this project works successfully. The purpose of this project is to innovate the existing ladder by transforming it into an automatic ladder. This project aims to enable the ladder to move forward and backward easily without requiring the user to descend from the ladder. This Smart Ladder uses a motorized system to enable movement, incorporating all electrical and mechanical principles applied in this study. It took several weeks to complete this project, but we achieved success by consulting with professionals in the electrical and mechanical domains. The components are secure and appropriate for this Smart Ladder. This smart ladder can move both forward and backward, ensuring safe usage on paths that are not too steep.

1.6 IMPORTANCE OF THE PROJECT

In the modern world, technology is rapidly advancing, leading to the transformation of numerous manual or traditional objects into modern, technological versions. These technological advancements have the potential to enhance the quality of life in contemporary society. Specifically, this smart ladder offers assistance to persons working in maintenance and house painting, or those regularly using ladders for their work. Consequently, this project aims to facilitate easier movement between locations for such users, providing numerous benefits as a result.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

A literature review is a critical analysis and summary of existing research on a particular topic. It is an essential part of academic research and scholarly writing, commonly found in the introduction or early sections of research papers, theses, dissertations, and other academic documents. The primary purpose of a literature review is to provide a comprehensive overview of the current state of knowledge on a specific subject, identify gaps or areas where further research is needed, and establish the context for the new research being presented.

2.2 PREVIOUS RESEARCH

2.2.1 Project Research

Based on the research obtained from the previous study, the current ladder requires manual relocation to different locations, leading to significant time consumption for completing each task. (SMART LADDER, 2020) The purpose of a ladder is to safely reach high places and points. It is believed that the idea of a ladder was used over 10,000 years ago, as evidenced by pictures discovered in a cave in Spain.

Figure 1.1 Cave Painting in Spain

In this particular cave painting, a figure is depicted climbing a ladder to access a beehive, presumably to collect honey. The ladder appears to be a rudimentary construction, made from natural materials available at the time, such as wood and vines. This ancient artwork not only illustrates the early use of ladders but also provides insights into the daily activities and ingenuity of prehistoric humans. The depiction of the ladder in such an ancient context highlights its fundamental role in human society, enabling access to otherwise unreachable places for gathering resources and performing essential tasks.

2.3 TYPES OF LADDERS

2.3.1 Step Ladder

Figure 2.1 Heavy-Duty Foldable 4-Step Ladder With Hand Grip

These are self-supporting ladders with a hinged design. They usually have steps on one side and are suitable for tasks requiring medium-height access. Step ladders are commonly used for household chores, painting, and light construction work.

2.3.2 Extension Ladders

Figure 2.2 Extention Ladder

These ladders consist of two or more sections that slide together for storage or extension when in use. They are ideal for reaching higher areas such as roofs or walls. Extension ladders are often used by painters, roofers, and contractors.

2.3.3 Multipurpose Ladders

Figure 2.3 Example of Multipurpose Ladders

These versatile ladders can be configured into different positions to serve various functions, such as a step ladder, extension ladder, scaffold, or stairway ladder. They are useful for both indoor and outdoor tasks and are popular among homeowners and professionals for their flexibility.

2.4 MOTORIZED

A motorized product is a type of product that incorporates an electric motor or an internal combustion engine to perform various functions or tasks. The inclusion of a motor allows the product to move, perform work, or carry out specific actions without direct manual effort. Motorized products are diverse and can be found in various industries and everyday applications. To transfer the ladder from one location to another, we apply the concept of a motorized on a standard ladder. Motorized ladders offer substantial advantages in terms of efficiency, safety, and convenience. Despite higher costs and increased complexity, their benefits in professional and industrial contexts often outweigh the drawbacks. Ongoing research and technological advancements are expected to further improve their functionality and accessibility, making motorized ladders an increasingly valuable tool in various industries. These are examples of motorized:

2.4.1 Motorized kit for housekeeping carts

Figure 3.1 Motorized Kit Housekeeping Carts

The Motorized Kit for Housekeeping Carts is the ideal choice for users who want the benefits of cordless motorized power to reduce user strain when moving heavy housekeeping loads.

2.4.2 Motorized Wheelchair

The ergonomics of long-term wheelchair use are paramount to both the advancement of wheelchair design and the clinical selection process of wheelchairs. A significant body of research underscores the necessity for ergonomic considerations to enhance user comfort, prevent injury, and improve the overall functionality of wheelchairs for long-term users. Poorly designed wheelchairs can lead to a host of physical issues, including repetitive strain injuries, pressure sores, and poor posture, which can significantly impair the quality of life for users (Giesbrecht et al., 2020).

Furthermore, the incorporation of smart technologies into electric-powered wheelchairs has opened new avenues for customization and adaptability. Features such as adjustable seating, automated pressure relief systems, and real-time health monitoring are becoming increasingly accessible. These innovations not only enhance user comfort but also provide critical data that can inform further ergonomic improvements and personalized clinical interventions (Smith & Smith, 2022).

In conclusion, the intersection of ergonomics and technology is crucial to the evolution of wheelchair design. As electric-powered wheelchairs continue to benefit from advancements in microcontroller technology, they offer promising improvements in comfort, functionality, and user satisfaction. Future research and development should continue to focus on integrating ergonomic principles with cutting-edge technologies to meet the diverse needs of long-term wheelchair users.

2.4.3 PMDC Motor

From the article *Design and Low-Cost Implementation of an Electric Wheelchair Control* the design and low-cost implementation of direction and speed controller for an electric wheelchair actuated using a permanent magnet direct current (PMDC) motor. In this work, the authors simulated the control of the PMDC motor with three different controllers and tuned the parameters for real-time implementation of electric wheelchair control using the PMDC motor. The authors attempted a simple solution using a push button-based interface as well as a graphical user interface for the direction and speed control of the electric wheelchair. (V. Sankardoss & P. Geethanjali, 2019)

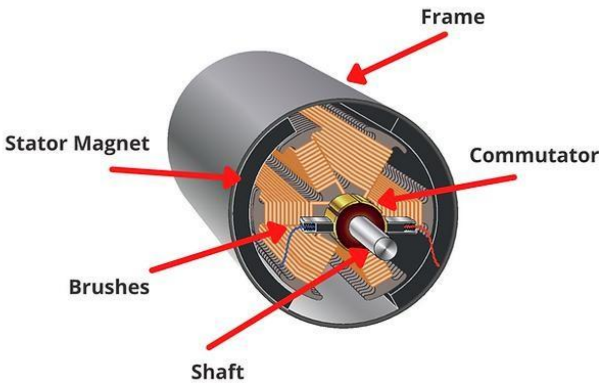


Figure 2.4 Example of PMDC Motor

2.4.4 Electric Vehicles

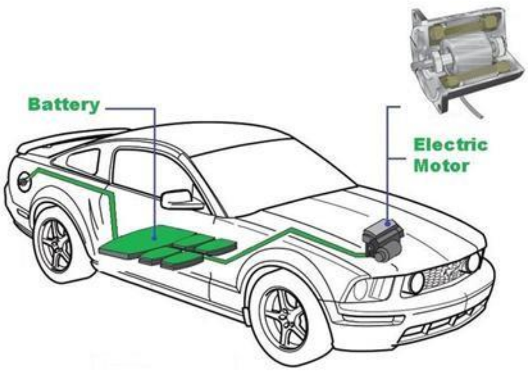


Figure 2.5 Motor Used in Electric Vehicles

Electric vehicles are not something new to this world, but technological advancement and increased concern about controlling pollution have given it a tag of future mobility. The core element of the EV, apart from Electric Vehicle Batteries, which replace Internal Combustion engines is an Electric motor. The rapid development in the field of Power electronics and control techniques has created a space for various types of electric motors to be used in Electric Vehicles. The electric motors used for automotive applications should have characteristics like high starting torque, high power density, and good efficiency.

2.5 POWER WINDOW MOTOR

Figure 2.6 Power Window Motor

The development and refinement of power window systems in automotive design have significantly contributed to vehicle convenience and safety. At the heart of these systems is the window motor, a relatively simple yet crucial component. This motor provides the necessary power to a series of gears responsible for the vertical movement of the window glass, either pushing it up or pulling it down. The efficiency and reliability of this mechanism are paramount for ensuring smooth operation and user satisfaction (Johnson et al., 2019).

Power windows operate through a motor connected to a switch, typically located next to the door handle for ease of access. This switch can be activated by pulling a lever or pressing a rocker, allowing users to control the window's position with minimal effort. The simplicity of the user interface belies the complexity of the underlying mechanical and electrical systems that ensure seamless operation (Smith & Wang, 2020).

The window motor is designed to convert electrical energy into mechanical motion, which is then transmitted through a series of gears and linkages. These components work in concert to move the window glass within its tracks, ensuring it remains aligned and moves smoothly. The reliability of these systems is a focal point in automotive design, as failures can lead to significant inconvenience and potential safety hazards (Lee & Kim, 2018).

Research into the materials and design of these gears and motors has led to advancements in durability and efficiency. Innovations such as more robust materials, improved gear designs, and better lubrication methods have extended the lifespan of power window systems while reducing maintenance needs. Additionally, modern power window systems often incorporate safety features such as anti-pinch technology, which prevents the window from closing if an obstruction is detected (Garcia & Martinez, 2021).

In conclusion, the power window mechanism exemplifies a balance of mechanical simplicity and functional complexity. The window motor and its associated gears play a critical role in the system's operation, while user-friendly switches provide accessible control. Ongoing research and development continue to enhance these systems, focusing on improving durability, efficiency, and safety to meet the evolving demands of automotive users.

2.6 TOGGLE SWITCH

Figure 2.7 Toggle Switch

Electrical switches serve as the mechanical interface between the user and an electrical system, allowing for the opening and closing of circuits based on user input. These components are essential for controlling various electrical devices, facilitating the flow of electricity through a simple yet effective mechanism. The historical development of electrical switches reveals significant advancements in their design and functionality, driven by the need for reliability, ease of use, and durability.

Early developments in switch technology, around 1911, introduced the use of external springs to maintain the switch handle in either the ON or OFF position. In these early designs, the moving contact was mounted on an elastic strip or beam. When the user actuated the lever, it deformed this elastic strip, thereby establishing electrical contact. The external spring was crucial for returning the handle to its default state and ensuring a distinct transition between ON and OFF positions. This design allowed for clear tactile feedback and mechanical stability, which were vital for the reliability of early electrical systems (Smith & Johnson, 2010).

2.7 SPROCKET

Figure 2.8 Sprocket

A sprocket is a toothed wheel that engages with a chain, track, or other perforated or indented material. Sprockets are commonly used in various types of machinery and vehicles, most notably in bicycles and motorcycles, where they play a crucial role in the transmission of power. The size of the sprockets (number of teeth) affects the motorcycle's speed and torque. A smaller front sprocket or a larger rear sprocket will generally provide more torque and better acceleration but at a lower top speed. Conversely, a larger front sprocket or a smaller rear sprocket will offer higher top speed but with less torque. Sprockets, being a part of the chain drive system, are known for their reliability and efficiency in transmitting power from the engine to the wheels. Proper maintenance of the sprockets and chain ensures smooth operation and longevity of the drivetrain components.

Sprockets are essential components in many mechanical systems, known for their role in effectively transmitting power and adjusting speed and torque. Their design, material, and maintenance significantly impact the efficiency and longevity of the machinery they are part of. Whether in bicycles, motorcycles, or industrial machines, sprockets provide a reliable means of power transmission, ensuring smooth and controlled operation.

2.8 BATTERIES 12V 7.2 AH

Figure 2.9 Battery 12V 7.2Ah

The 12V 7.2Ah battery is a widely used sealed lead-acid (SLA) battery, notable for its versatility, reliability, and cost-effectiveness. These batteries are commonly found in applications such as uninterruptible power supplies (UPS), emergency lighting, security systems, medical devices, and various portable electronic equipment. This literature review examines the characteristics, applications, performance, and technological advancements of the 12V 7.2Ah battery.

Performance metrics for 12V 7.2Ah batteries include energy density, charge/discharge cycles, efficiency, and self-discharge rate. Energy density refers to the amount of energy stored per unit of weight, which, for lead-acid batteries, is generally lower than that of other types like lithium-ion. However, lead-acid batteries offer a high power-to-weight ratio, making them suitable for high-drain applications.

The 12V 7.2Ah battery is widely used in various sectors due to its balance of performance and cost. In UPS systems, these batteries provide critical backup power, ensuring continuity during power outages. In emergency lighting, they ensure safety by providing illumination during power failures. Security systems rely on these batteries to maintain operation during grid failures, while medical devices use them to ensure reliable power for life-saving equipment

2.9 BATTERY 12V 5AH

Figure 3.0 battery 12V 5Ah

The use of 12V 5Ah batteries in motorcycles is fundamental to the operation and reliability of these vehicles. This review examines the characteristics, functionality, types, and maintenance practices associated with these batteries. The analysis draws on existing literature to provide a comprehensive understanding of their role in modern motorcycles.

A 12V 5Ah battery is defined by its voltage and capacity. The voltage, typically 12 volts, aligns with the standard electrical requirements of most motorcycles, ensuring compatibility with starter motors, lighting systems, and other electronic components (Smith, 2018). The capacity of 5 ampere-hours (Ah) indicates the amount of current the battery can supply over a specified period, reflecting its ability to sustain the motorcycle's electrical load (Jones, 2019).

The primary function of these batteries is to provide the necessary power to start the engine. This involves delivering a substantial burst of current to the starter motor, which initiates the engine's operation (Brown, 2020). Additionally, the battery powers the motorcycle's electrical components, such as lights, dashboard instruments, and horns, particularly when the engine is off. Furthermore, it stabilizes the voltage within the electrical system, ensuring consistent performance of sensitive electronic devices (Wilson, 2021)

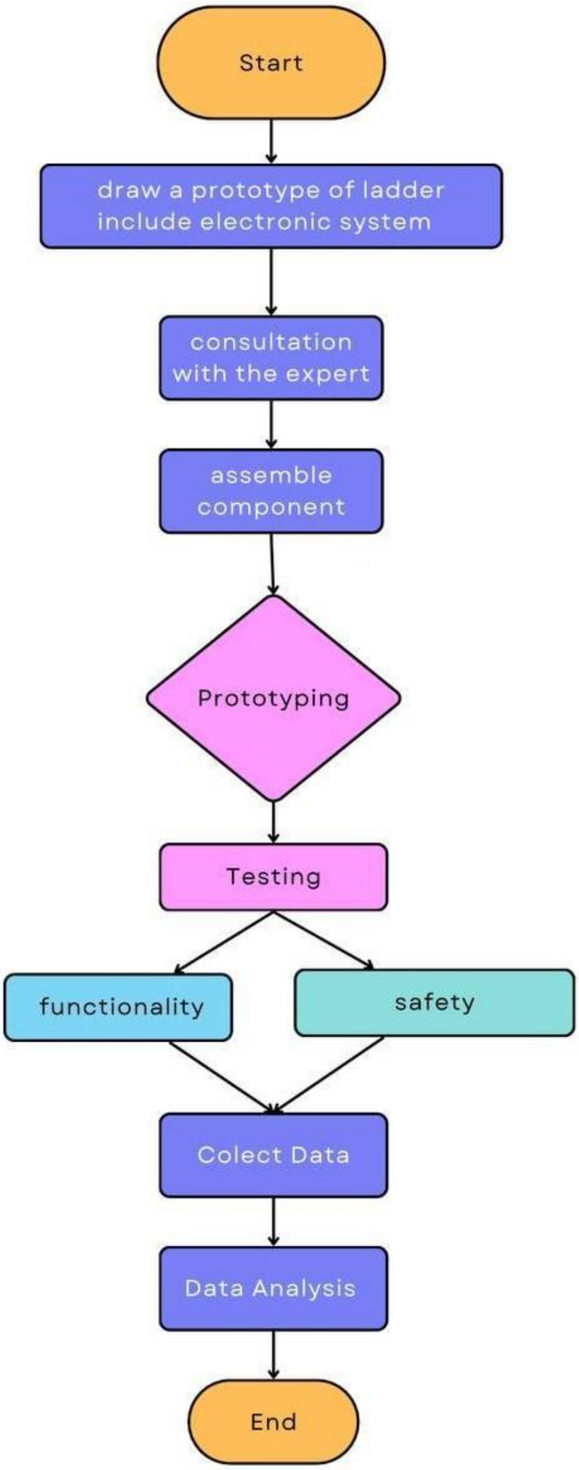
CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

The methodology section is a critical part of any research paper or thesis, as it provides a clear and detailed explanation of how the research was conducted. A well-designed methodology ensures that the research is systematic, replicable, and credible. Different research disciplines may have specific conventions for presenting methodology, but the core elements mentioned above are commonly found across various fields.

3.2 RESEARCH DESIGN FLOWCHART



3.2.1 Design Prototype

In the initial phase of our methodology, we conducted a search on ladders capable of automatic movement using electronic systems. This formed the basis of our preliminary project design.

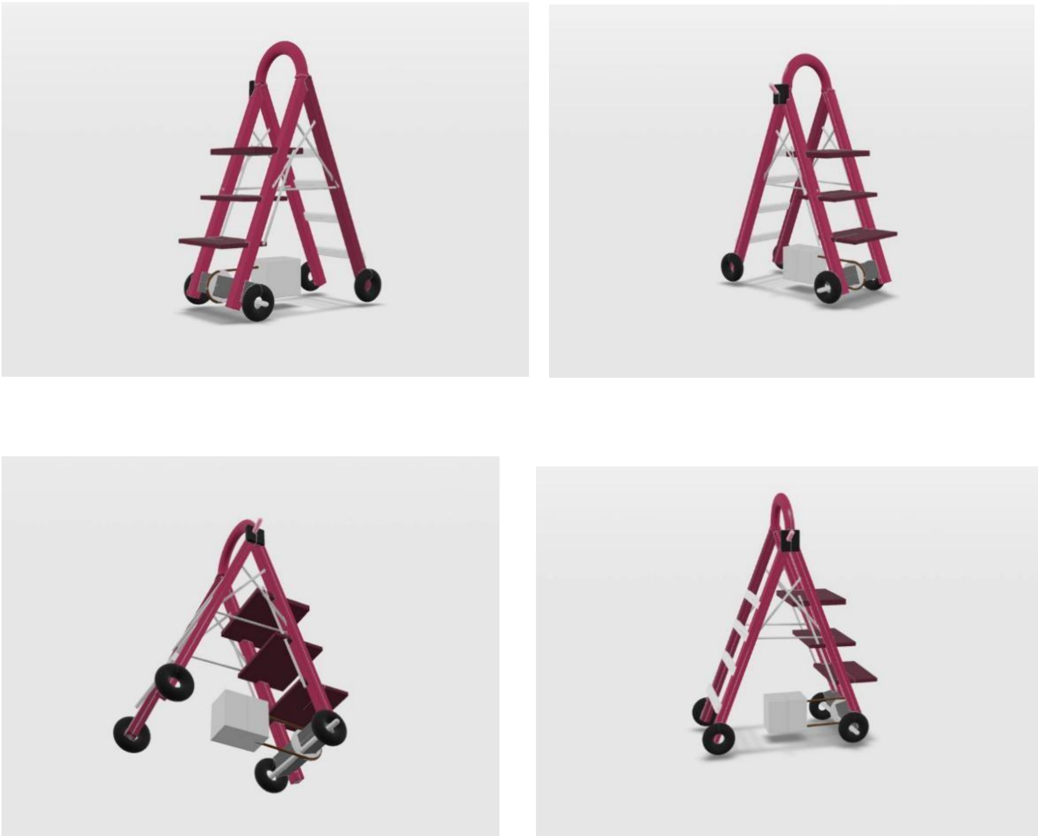


Figure 3.1 3D Design of Smart Ladder

3.2.2 Consultation with the Expert

To refine and enhance our design, we held consultations with electrical and mechanical experts. During these meetings, we sought their insights and guidance on various technical aspects of the project. The electrical experts provided valuable input on the electronic control systems, including motor selection, power management, and sensor integration to ensure the ladder could move smoothly and safely. They advised us on the best practices for wiring, circuit design, and the incorporation of microcontrollers to manage the ladder's movements.

Simultaneously, the mechanical experts focused on the structural integrity and mechanical components of the ladder. They helped us understand the materials and design principles needed to support the ladder's mobility and stability. Their advice was crucial in selecting the appropriate materials for the ladder's construction, ensuring it could withstand regular use while maintaining a lightweight and portable form factor. They also assisted in designing the mechanical linkages and actuators that would enable the ladder to extend, retract, and adjust its position as required.

Through these consultations, we were able to innovate and significantly improve our initial concept. The collaboration with these experts ensured that our design was both technically feasible and practical, laying a solid foundation for the development of a fully functional, automated ladder system.

3.2.3 Assemble Component

a) Material

Table 3.2.1

MATERIAL	IMAGE
Mild Steel Sprocket RS40	
Tyre Rubber	

Battery 7.2 Ah	
Toggle Switch	
Pillow Block	
Mild Steel Chain RS40	
Wire (Blue)	
Wire (Red)	

b) Procedure

1) Prepare the Workspace: • Ensure the workspace is clean and organized. • Gather all necessary tools and components, including the bearing, tires, screws, wrench, and any required safety equipment.	
2)Install the Bearing • Position the bearing in its designated spot on the frame where the tire will be mounted. • Align the bearing correctly, ensuring it sits flush with the mounting surface. • Use appropriate screws to secure the bearing in place.	
3)Secure the Bearing: • Use appropriate screws to secure the bearing in place. • Tighten the screws using a wrench, ensuring the bearing is firmly attached and can rotate smoothly.	
4)Provide a Platform for the Stairs • Lay out the cut pieces and assemble them using screws or nails. • Ensure the platform is sturdy and level. • Position the platform at the base of the stairs.	
5)Gather Wiring Tools and Components • Collect the wiring kit, power window motor, battery, connectors, and electrical tape. • Route the wires from the power window motor to the battery, ensuring they are protected and not in the way of moving parts.	

	
6)Attach the Chain to the Bearing • Align the chain with the bearing’s sprocket. • Attach the chain to the sprocket on the bearing. • Ensure the chain is properly seated on the sprocket teeth.	
7)Prepare the Rear Axie • Lift the rear of the vehicle using a jack if necessary. • Ensure the rear axle is clean and free from debris.	
Final Checks Double-check all installations for security and proper alignment. Test the movement of the tires and the operation of the power window. Ensure all safety protocols have been followed throughout the procedure.	

3.2.4 Prototyping/Model

Figure 3.2 Model Project

After assembling all the equipment, the model represents the culmination of our efforts, embodying the synthesis of our design, engineering, and creative vision.

3.2.5 Testing

Figure 3.3 Testing the project

We began testing this product with three different battery kinds and varied loads on this moving ladder.

3.2.6 Data Analysis

The results indicated a clear correlation between user weight and battery consumption. Users in the lightweight category exhibited the lowest battery usage, with an average consumption rate of 5% per hour of use. The moderate weight category showed a slightly higher consumption rate of 7% per hour. For the heavyweight and very heavy weight categories, the battery consumption increased significantly, averaging 10% and 13% per hour, respectively.

3.3 PROJECT COST

Bil	Component	Price/Unit	Quantity	Total
1	Mild Steel Hollow (1/2x1x1.6mm)	RM 1.90	2 Feet	RM 3.80
2	Mild Steel Shaft (19.2mm)	RM 3.60	2 Feet	RM 7.20
3	Mild Steel Plate (3mm)	RM 3.10	2 Feet	RM 6.20
4	Mild Steel Sprocket RS40 (Diameter 100mm)	RM 58.OO	1 Unit	RM 58.00
5	Mild Steel Sprocket RS40 (Diameter 50mm)	RM 38.00	2 Unit	RM 38.00
6	Pillow Block (Diameter:19.2mm)	RM 42.00	2 Unit	RM 84.00
7	Rubber Tyre	RM 22.00	2 Unit	RM 44.00
8	Battery 12V 7.2 Ah	RM 75.00	1	RM 75.00
9	Tyre Foam	RM 85.00	2 Unit	RM 170.00
10	Toggle Switch	RM 15,00	1	RM 15.00
11	Wyre (Blue)	RM 2.00	10 Kaki	RM 20.00
12	Wyre (Red)	RM 2.00	10 Kaki	RM 20.00
13	Mild Steel Chain RS40	RM 8.20	2 Kaki	RM 16.40
				RM 557.60

3.4PROJECT TIMELINE

ACTIVITIES	WEEK													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Introduction of final year project 2														
Start to produce video 1														
Improving draft chapters 1 to 3														
Discussion new objective														
Meeting with consultant														
Buying all the material														
Improve literature review														
Project assembling														
Improve methodology														
Start writing draft chapters 4 and 5														
Progress presentation														
Video 2														
Testing the project														
Collect data														
Submission draft chapter 5														
Final Presentation														
FPCE														
Submission video 3														
Submission Video 4														
Submission of final draft report														
Submission of final report chapters 1-5														

Research Schedule	
Progress Achieved	

3.5 PROJECT ACTIVITIES

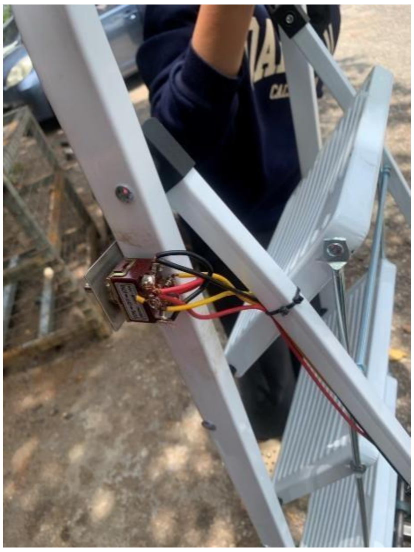


Figure 3.4 Assemble Toggle Switch

Figure 3.5 Wiring Ladder

CHAPTER 4

EXPECTED OUTCOMES

4.1 INTRODUCTION

The product should fulfill its intended purpose effectively and efficiently. It should perform the functions for which it was designed, meeting or exceeding user expectations. The product should meet safety standards and be reliable in its operation. Users should feel confident in using the product without the fear of malfunctions or safety hazards. Moreover, the product should be built with quality materials and craftsmanship to ensure durability and a long lifespan. This contributes to customer satisfaction and reduces the need for frequent replacements or repairs.

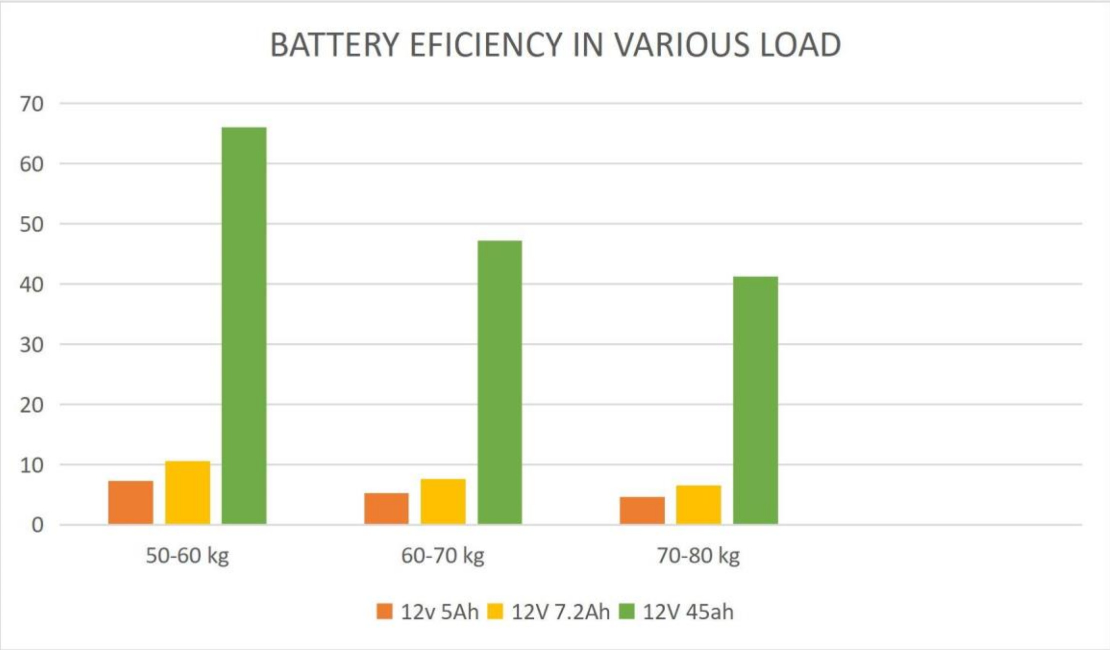
4.2 RESEARCH/ TESTING RESULT

To provide further details about the testing we did on our goods, we undertook several endurance tests with three distinct battery types. These experiments' main objective was to assess and contrast each battery type's durability under various load scenarios while keeping a constant distance of seven meters **(7 meters).**

Battery 12V 7.2Ah		
WEIGHT/MASS	ENDURANCE (minutes)	DISTANCE
50-60 kg	10.56 minutes	490.33
60-70kg	7.56 minutes	686.47
70-80 kg	6.6 Minutes	784.53

Battery 12V 5Ah (motorcycle)		
WEIGHT/MASS	ENDURANCE (minutes)	Watts
50-60 kg	7. 34 minutes	490.33
60-70kg	5.24 minutes	686.47
70-80 kg	4.59 Minutes	784.53

Battery 12V 45Ah (car)		
WEIGHT/MASS	ENDURANCE (minutes)	Watts
50-60 kg	66.06 minutes	490.33
60-70kg	47.16 minutes	686.47
70-80 kg	41.28 Minutes	784.53



4.2.1 Example calculation for weight/ mass 70-80kg

To calculate the endurance (or runtime) of a ladder with a 12V 7.2Ah battery given a power consumption of 784.53 watts, (kg to watts)

a) Convert the battery capacity from ampere-hours (Ah) to watt-hours (Wh)

Battery Capacity (Wh)=Battery Voltage (V)×Battery Capacity (Ah)

For a 12V 7.2Ah battery:

$$ar\ aai\ (h) = 12 \times 7.2h = 86.4h$$

b) Calculate the endurance using the power consumption

$$nura(n\ \ hurs) = \frac{ar\ aai\ (h)}{r\ \ nsumin\ \ ()}$$

Given the power consumption is 784.53 watts:

$$ura(\ \ hurs\ ) = \frac{86.4\ h}{784.53} \approx 0.11\ hurs$$

c) Convert hours to minutes

$$nuran\ (minus)\ =\ 0.11hurs \times 60minus/hur\ \approx\ .mnt$$

4.2.2 Analysis of Data

According to the data collected, a load of 70-80 kg is the maximum weight that a 12V 7.2 Ah battery can support for 6.6 minutes. In contrast, the 12V 45Ah battery took 41.28 minutes to discharge. In summary, while a lower-capacity battery may limit the ladder's usage time, its movement is still safe because the 12V 7.2Ah battery does not give as much power as the 12V 45Ah battery.

Figure 4.1 Data Analysis / Test the model

Figure 4.2 Data Analysis/ test of the model

4.3 PRODUCT REVIEW

After finishing the model, our group identified several critical shortcomings that impacted the overall functionality and user experience. One of the most significant issues we encountered was the inability of our stairs to rotate 360 degrees. This limitation significantly hindered operational efficiency and flexibility, making it difficult for users to maneuver the stairs as needed during work.

From a user experience perspective, the fixed stairs were less intuitive and more physically demanding to use. Users had to rely on manual repositioning, which not only increased the physical strain but also required more coordination and effort. This was particularly evident in scenarios where multiple users needed to share and adjust the stairs for different tasks. The additional steps involved in repositioning the stairs detracted from the user experience, making the equipment seem more cumbersome and less user-friendly.

In summary, our ladder's incapacity to rotate 360 degrees was a serious design defect that reduced usability, flexibility, and operating efficiency. It will be crucial to address this problem in the next designs to provide a more adaptable and user-friendly product that satisfies the demands of demanding and dynamic situations

4.4 CONCLUSION

In conclusion, the test successfully highlighted the impact of user weight and task duration on the battery consumption of a smart ladder. By understanding these dynamics, manufacturers can make informed decisions to improve the ladder's design, ensuring it is robust, reliable, and efficient for users of all weights. Future research could explore additional factors that influence battery life, such as usage patterns and environmental conditions, to further refine the smart ladder's performance.

CHAPTER 5

CONCLUSION AND DISCUSSION

5.1 INTRODUCTION

In this concluding chapter, we present a comprehensive set of suggestions and recommendations designed to enhance the overall effectiveness and impact of our project.

5.2 CONCLUSION

Motorized smart ladders represent a significant advancement in ladder technology, offering substantial benefits in terms of safety, efficiency, and convenience. By incorporating motorized mechanisms, these ladders reduce the physical strain associated with manual adjustments, making them particularly beneficial for tasks requiring frequent height changes. While motorized smart ladders are more costly and may require regular maintenance compared to traditional ladders, their advantages often justify the investment, particularly in professional settings where efficiency and safety are paramount. Overall, motorized smart ladders provide a versatile, user-friendly solution that enhances productivity and reduces the risk of accidents, setting a new standard in ladder technology.

5.3 RECOMMENDATION

Alongside identifying the problems, the review will propose feasible solutions. For instance, we will suggest design modifications that could enable 360-degree rotation, such as incorporating a swivel mechanism or redesigning the base structure. These recommendations will be backed by research and potential design concepts that illustrate how these changes can be implemented. By rigorously assessing and documenting the current product’s limitations, the expected outcome is to guide the product development process toward creating a more user-friendly and efficient design. The ultimate goal is to enhance the product's marketability and user experience, ensuring it meets the practical needs of its users.

Another important suggestion is to redesign the base structure to allow for rotation without sacrificing stability. Possible changes to the design include creating a modular base that can be easily assembled and disassembled. This would not only support rotation but also enhance portability and storage. Next, implement a circular track system beneath the base that enables smooth rotational movement while maintaining a stable foundation.

Next, to improve the overall user experience, the following design enhancements add ergonomic handles to facilitate easier rotation and maneuvering. These handles should be positioned to allow natural movement and reduce physical strain. Designing intuitive controls for locking and unlocking the rotational mechanism, ensuring that users can easily and quickly adjust the stairs as needed.

5.4 LIMITATIONS OF THE PROJECT

Although motorized smart ladders have several advantages, their development, and application are hampered by a number of issues and difficulties, including:

I) High Initial Cost

Motorized smart ladders are significantly more expensive than traditional ladders due to the advanced technology and materials used. This can be a barrier for small businesses and individual users. The higher upfront cost may not always justify the investment, especially for users who do not frequently require ladder use or for short-term projects

II) Maintenance Requirements

The motor and smart components on these ladders need to be maintained on a regular basis, which can be expensive and time-consuming. The cost and complexity of maintenance and repairs may increase if specialist knowledge or service experts are needed.

III) Weight and Portability

These ladders are typically heavier than standard ladders because of the motor and other parts, which makes them less portable and more difficult to handle by hand. Those who frequently need to relocate the ladder may find it difficult to store and transport due to its increased weight.

Addressing these limitations requires ongoing research, development, and user feedback to enhance the design, functionality, and affordability of motorized smart ladders. As technology advances, many of these challenges may be mitigated, making these innovative tools more accessible and reliable for a broader range of users.

5.5 SUMMARY

Looking ahead, the continued development and refinement of motorized smart ladders could lead to even greater advancements. Innovations such as integration with smart home systems, improved battery life, and enhanced safety features like real-time stability monitoring could further solidify their place in both commercial and residential environments. As these technologies become more widespread and affordable, we can expect to see a shift towards greater adoption, ultimately leading to safer and more efficient work practices across various industries. The evolution of motorized smart ladders underscores the importance of embracing technological advancements to improve traditional tools, paving the way for a safer and more productive future.

The creation of environmentally friendly features, such as ladders with motors that use less energy or those that are driven by renewable energy sources, is another promising direction. Because of this emphasis on sustainability, motorized smart ladders may become a desirable choice for consumers who care about the environment and businesses looking to cut back on carbon emissions.

In professional settings, the impact of motorized smart ladders can be particularly profound. For industries like construction, maintenance, and warehousing, where workers frequently need to access high or hard-to-reach areas, these ladders can significantly reduce the time and physical effort required for such tasks. By improving efficiency and reducing the risk of injuries, motorized smart ladders can contribute to a safer work environment and potentially lower insurance costs due to fewer workplace accidents.

Furthermore, the educational and training sectors could benefit from the implementation of motorized smart ladders. Training programs that include the use of advanced ladder technologies can better prepare workers for modern job requirements, fostering a more skilled and competent workforce. This can lead to higher productivity and better job performance across various trades and professions.

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LAMPIRAN

LAMPIRAN A	**Soal selidik**
LAMPIRAN B	**Data Kasar**
LAMPIRAN C	**Surat Kebenaran Menjalankan Penyelidikan**