POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

INOVASI TANGGA LIPAT YANG DIUBAH MENJADI TANGGA ELEKTRONIK

(SMART LADDER)

JABATAN KEJURUTERAAN AWAM

MUHAMMAD EIZMIL HAZIQ BIN HAMIDI

08DKA21F2064

SESI 1:2023/2024

POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

INNOVATION OF FOLDING LADDER TO ELECTRONIC LADDER

(SMART LADDER)

MUHAMMAD EIZMIL HAZIQ BIN HAMIDI

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

JABATAN KEJURUTERAAN AWAM

SESI 1:2023/2024

AKUAN KEASLIAN DAN HAK MILIK

SMART LADDER

1. We are, MUHAMMAD EIZMIL HAZIQ BIN HAMIDI (031031-10-0525), SHARIFAH NOOR BAITIE BINTI SYED HAMIZON (030413-10-0016), and MUHAMMAD KHAIRUL HIRZAME BIN HIRMAN (030116-10-0087) 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:)
)
MUHAMMAD EIZMIL HAZIQ)
(031031-10-0525),)

In Front, Puan Daliela binti Ishamuddin
(820122025606) as our project supervisor on date:
23/5/2024)
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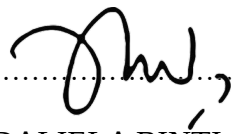
MUHAMMAD EIZMIL HAZIQ BIN HAMIDI



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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.

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 sistem elektronik revolusioner yang mengubah mana-mana tangga sedia ada menjadi alat yang serba boleh dan boleh dikendalikan. Dengan menyepadukan teknologi canggih, produk inovatif ini meningkatkan keselamatan dan produktiviti dalam pelbagai persekitaran kerja. Tangga Pintar menampilkan panel kawalan yang mesra pengguna dengan butang intuitif untuk operasi yang lancar. Dengan hanya menekan satu butang, pengguna boleh dengan mudah menggerakkan tangga secara mendatar, membolehkan mereka mencapai kawasan yang berbeza tanpa perlu menurunkan atau meletakkan semula secara manual. Fungsi ini amat bermanfaat untuk individu yang bekerja sendirian, kerana ia menghilangkan kerumitan dan risiko yang berkaitan dengan manuver tangga tradisional. Selain keupayaan pergerakan mendatarnya, Smart Ladder dilengkapi dengan ciri keselamatan termaju untuk melindungi pengguna daripada kemalangan dan kecederaan. Penderia bersepadu mengesan halangan dan menghentikan pergerakan secara automatik untuk mengelakkan perlanggaran, manakala pembinaan yang kukuh dan bahan tahan lama memastikan prestasi yang tahan lama dalam persekitaran yang mencabar. Dengan memanfaatkan kuasa ciptaan dan inovasi, Tangga Pintar merevolusikan cara orang bekerja pada ketinggian. Sama ada di tapak pembinaan, gudang, rumah atau tempat kerja, tangga sistem elektronik ini menetapkan standard baharu untuk kecekapan, keselamatan dan kemudahan. Alami masa depan teknologi tangga dengan Smart Ladder di mana produktiviti memenuhi ketepatan.

Kata kunci: tangga mudah alih, tangga elektrik, tangga pintar, tangga bermotor

ABSTRACT

Introducing the Smart Ladder a revolutionary electronic system that transforms any existing ladder into a versatile and maneuverable tool. By integrating cutting-edge technology, this innovative product enhances safety and productivity in various work environments. The Smart Ladder features a user-friendly control panel with intuitive buttons for seamless operation. With just a press of a button, users can effortlessly move the ladder horizontally, allowing them to reach different areas without the need to dismount or reposition manually. This functionality is particularly beneficial for individuals working alone, as it eliminates the hassle and risk associated with traditional ladder maneuvering. In addition to its horizontal movement capabilities, the Smart Ladder is equipped with advanced safety features to protect users from accidents and injuries. Integrated sensors detect obstacles and automatically halt movement to prevent collisions, while sturdy construction and durable materials ensure long-lasting performance in demanding environments. By harnessing the power of invention and innovation, the Smart Ladder revolutionizes the way people work at heights. Whether in construction sites, warehouses, homes, or workplaces, this electronic system ladder sets a new standard for efficiency, safety, and convenience. Experience the future of ladder technology with the Smart Ladder where productivity meets precision.

Keywords: : portable ladder, electric ladder, smart ladder, motorized ladder

SENARAI KANDUNGAN

SENARAI JADUAL

NO. JADUAL **TAJUK** **MUKASURAT**

SENARAI RAJAH

NO. RAJAH **TAJUK** **MUKASURAT**

SENARAI SIMBOL

SIMBOL

SENARAI SINGKATAN

PSA	Politeknik Sultan Salahuddin Abdul Aziz Shah
OPC	*Ordinary Portland Cement*

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

A ladder is a simple vertical or inclined structure composed of two long side sections (called stiles) connected by a series of horizontal steps or steps. Ladders are used to climb great heights and get access to inaccessible regions. Depending on the intended application and climate, they are often made of a variety of materials such as wood, aluminum, fiberglass, and steel.

Using the notion of invention, we will develop a project or product that will turn an existing staircase into an electronic staircase that can be manipulated with a control device such as a button. We will use this approach to add functionality to existing stairs in order to make it easier for workers and maintenance. We'll add wheels, motors, and other parts. We also provide storage space for handyman products or tools, allowing consumers to avoid going up and down stairs. When we climb stairs, we are usually unable to move them.

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 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. It also comes in a variety of sizes and designs, allowing customers to choose which one is best for them.

Traditional ladders, while essential for various tasks, often pose safety challenges, especially when used by individuals working alone. The need for a solution that addresses these challenges led to the conceptualization of an Smart Ladder. This ladder integrates sensors, motors, and control systems to enable automated movement, making it a valuable tool for a wide range of applications.

1.3 PROBELEM STATEMENT

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)

To move the ladder, people must descend it. Today, all ladders require the user to climb them. People may lose their footing or stability when mounting the ladder, particularly if they are carrying equipment or materials. This circumstance will affect the balancing of the users and cause the ladder's design and mechanism to be unstable and unsafe. (Muhammad Faiz bin Abdullah, Smart Ladder 2020)

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

The purpose of this research's scope is to guarantee that, by adhering to the previously described plan, the study can be completed without incident. There have

been discussions on several project study scope approaches. It also seeks to elucidate the criteria discovered in the planned investigation.

i) This study plans to produce a ladder product that can move in two directions, for example forward and backward automatically.

ii) This study employs ladders and suitable components to produce ladders that can move automatically.

iii) This study also uses battery energy to move the ladder product.

iv) This product's ability is to move automatically without the need to lift the ladder.

1.6 IMPORTANCE OF THE PROJECT

In today's modern age, the usage of ladder is essential for mobility and daily living. However, maintenance and painting workers, as well as ladder users, may find it difficult to utilize this ladder because they have to lift it to move from one location to another. Time to work is also slower, which causes work delays. Factors like this encourage maintenance workers and other stair users to use the stairs, which require energy and time to move from one location to another. Based on this problem, the design of this Smart ladder product will make it easier for maintenance workers, painting workers, and other users to complete daily work that involves ladders, as well as the creation

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

A literature review is a critical analysis and synthesis of existing research on a specific topic, serving as a foundational component of academic research and scholarly writing. Typically situated in the introduction or early sections of research papers, theses, dissertations, and other academic documents, a literature review provides a comprehensive overview of the current state of knowledge on a particular subject. Its primary purpose is to summarize and evaluate the existing body of research, identify gaps or areas where further investigation is warranted, and establish the context for the new research being introduced. By doing so, a literature review not only highlights the significance of the research topic but also situates the new study within the broader academic discourse, demonstrating its relevance and potential contributions to the field.

2.2 DEFINITION OF LADDER

A ladder is a step consisting of two parallel members connected by rungs; for climbing up or down. It has ascending stages by which the user can climb as well as shift heavy loads using the ladder. There are two basic types of ladder, rigid ladders and rope ladders, rigid ladders can be slandered against a vertical surface such as a wall while rope ladders are the ones that can be hung. The vertical members of a ladder are usually called beams or stiles. Rigid ladders are usually portable, but sometimes they are permanently fixed to buildings. (Nakum, M., Kansagara, R., Chovatiya, K., & Khan, A. 2016).

The concept of the ladder dates back to ancient times. One of the earliest known depictions of a ladder is found in a Mesolithic rock painting in the Spider Caves of Valencia, Spain, which is estimated to be around 10,000 years old. This painting shows two humans using a ladder to access a honeybee nest.

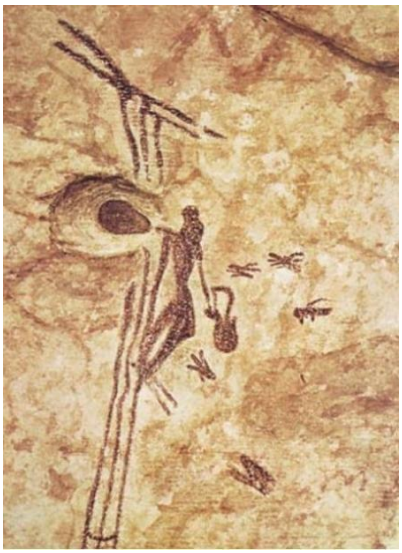


Figure 2.0 Cave Painting in Spain

During the medieval period, ladders were common in various forms for tasks such as castle sieges and construction work. They were usually made from wood and were simple in design. By the 17th century, the ladder's design began to see more innovation. The use of metal fittings improved the strength and durability of wooden ladders. In 1862, John H. Balsley of Dayton, Ohio, designed the modern stepladder. The first design by Balsley had a hinged mechanism that made the ladder collapsible and self-supporting. This invention greatly increased the ladder's versatility and made storing it while not in use easy.

2.3 FUNCTION OF LADDER

The primary function of a ladder is to provide a safe and stable means of reaching elevated areas that are otherwise inaccessible. Ladders serve as essential tools for vertical mobility, granting access to heights that would otherwise be unreachable. They provide a stable platform for various tasks requiring elevation, including construction, maintenance, painting, and cleaning. In buildings, ladders are crucial for emergency situations, offering a rapid escape route from upper floors during fires or other threats. Additionally, ladders facilitate access to higher levels of transportation vehicles, such as trucks, vans, and trailers, simplifying the processes of loading and unloading cargo. Beyond their functional uses, decorative ladders enhance the aesthetic appeal of indoor spaces by displaying items like blankets, towels, and plants.

2.4 TYPES OF LADDER

Ladders are essential tools used in various industries, construction sites, homes, and businesses for reaching heights safely. They come in various types, each designed for specific purposes. Here's an overview of common ladder types:

2.4.1 Platform Ladder

Platform ladder resemble steps, but the user can stand on the platform. To ensure safety, the rails connect to the platform and meet on it. Platform steps can vary in height from 4 to 16 feet.

Figure 2.1 Platform Ladder

2.4.2 Portable Ladder

The minimum distance between side rails on all portable ladders is 11.5 inches (29 cm). The ladder must be movable and coated with non-slip material to prevent slipping. The minimum width between side rails is 12 inches (30.48 cm) for ladders up to 10 feet (3.05 m) in height. The width between rails changes by at least 1/4 inch (0.64 cm) every 2 feet (0.61 m) of ladder length.

Figure 2.2 Portable Ladder

2.4.3 Extension Ladder

Some extension ladders (up to 60 feet) contain three pieces, although most have two. In the US and Canada, extension ladders are measured by their overall length. The 2-section ladder ranges from 16 feet (each 8 feet long) to 48 feet, with 4-foot increments in between.

Figure 2.3 Extention ladder

2.4.4 Step Ladder

The Step Ladder is the ladder that we opted to convert from a manual to an automatic. The Step Ladder is a self-supporting portable ladder that is non-adjustable in length, with a platform provided at the highest intended standing level. It has a hinged design for ease of storage and is intended for use by one person.

Figure 2.4

2.5 MATERIALS STUDY

Ladder materials influence the durability, weight, and usefulness of ladders for different uses. Here's a summary of the materials used in the Smart ladder:

2.6 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 product on a standard ladder.

Introducing the Smart Ladder, an innovative solution designed to enhance efficiency and safety in various tasks. Equipped with a powerful motor, this advanced

ladder can move automatically forward and backward, eliminating the need for manual repositioning. Whether you're painting, conducting maintenance, or reaching high shelves, the Smart Ladder's automated movement streamlines your workflow, allowing you to focus on the task at hand without the hassle of constantly adjusting your position. Experience a new level of convenience and productivity with the Smart Ladder, the future of work-at-height solutions.

Motorized technology encompasses a broad range of innovations that integrate motors into various applications, enhancing efficiency, performance, and user convenience. This technology spans from small-scale devices to large industrial machinery, transforming how tasks are performed across multiple sectors. Here are some specific examples and advancements in motorized technology:

2.6.1 Drone

Due to their motorized flight capabilities, drones, also known as unmanned aerial vehicles, or UAVs, have revolutionized several sectors. Accurate Farming Drones using cameras and sensors can manage pests, optimize irrigation, and keep an eye on crop health to increase agricultural productivity. Provision of Services Drone delivery systems are being tested by businesses like UPS and Amazon to improve logistics and speed up deliveries. Drones are used for mapping topography, taking aerial photos, and carrying out surveillance in difficult-to-reach places.

Figure 2.5 Drone

2.6.2 E-scooters and Bicycles

Scooters and electric bikes, also known as e-bikes, have gained popularity as urban transit options. Pedal-Assist Systems: By utilizing motorized assistance to facilitate pedaling, these e-bikes enable riders to cover greater distances with minimal exertion. Foldable bikes and e-scooters are more portable and convenient for commuters thanks to innovative designs. To improve convenience and security, a lot of electric bikes and scooters include smartphone apps for battery management, tracking, and locking.

Figure 2.6 Electric Scooter

2.6.3 Electric Wheelchair

A motorized wheelchair, powerchair, electric wheelchair, or electric-powered wheelchair (EPW) is a wheelchair that is pushed by an electric motor (often employing differential steering) rather than by manual power. Powerchair design can be classified according to the drive system/chassis, battery, controller, seat, and application. Because they are used as the principal mode of locomotion, they must be of the highest electrical and structural reliability and are classed as Durable medical equipment by Medicare in the United States.

Figure 2.7 Electric Wheelchair

2.6.4 Power Window Motor

Figure 3.2 Power Window Motor

The window motor is a relatively simple component that provides power to a series of gears, which are responsible for pushing the window glass up or pulling it down. They are connected to a switch, which is placed next to the door handle and can be activated by pulling a lever or pressing a rocker.

2.7 TOGGLE SWITCH

Figure 2.4 Toggle Switch

Electrical switches are mechanical interface to an electrical system which enables closing and opening of the circuit through the user input. Early developments

(in 1911) indicate use of an external spring to maintain the position of the handle in one of the two states, ON and OFF. The moving contact here was mounted on an elastic strip (beam) which was deformed by the actuation lever to establish contact. The switch (in 1952) uses the same type of contacts, but the elasticity of the elastic strip itself is used to maintain the ON and OFF states through the cam profile used in the operating lever.

2.8 BATTERY 12V 7.2AH

A 12V 7.2Ah battery is a type of rechargeable battery that finds widespread use in various applications, including emergency lighting, security systems, uninterruptible power supply (UPS) systems, portable electronics, and small-scale renewable energy setups. This essay will explain the significance of each part of the battery's specification and discuss its applications.

Firstly, the "12V" designation refers to the battery's voltage, which is 12 volts. Voltage is a measure of the electrical potential difference, indicating the force that drives electric current through a circuit. This potential difference is crucial for ensuring that the battery can provide sufficient power to operate various devices effectively.

Secondly, the "7.2Ah" rating stands for ampere-hour, a unit of electrical charge. This measurement indicates the battery's capacity to store electrical energy. Specifically, a 7.2Ah rating means that the battery can deliver a current of 7.2 amperes for one hour before it needs to be recharged. In practical terms, a higher ampere-hour rating generally implies that the battery can power devices for more extended periods, making it a critical factor in applications where longer battery life is essential.

When selecting a battery for a specific purpose, it is essential to consider not only the voltage and capacity but also other factors such as the type of battery, its chemistry, and the specific requirements of the application. Different battery chemistries, such as lead-acid, lithium-ion, and nickel-metal hydride, offer varying performance characteristics, life spans, and maintenance needs. For instance, lead-acid batteries are commonly used in UPS systems due to their reliability and cost-

effectiveness, while lithium-ion batteries are favored in portable electronics for their high energy density and lighter weight.

In conclusion, a 12V 7.2Ah battery is a versatile and widely used power source that provides a balance of voltage and capacity suitable for numerous applications. Understanding the specifications of such a battery helps in making informed decisions about its use, ensuring that it meets the power requirements and operational demands of various devices and systems.

Figure 2.5 Battery 7.2 Ah

2.9 BATTERY 12V 5AH

Voltage (12V): The nominal voltage of the battery is 12 volts. This represents the electrical potential difference the battery provides and is a standard voltage for many small-scale applications.

Capacity (5Ah): The battery has a capacity of 5 ampere-hours (Ah). This means the battery can deliver a current of 5 amperes for one hour, or it could deliver a lower current for a longer duration. For example, it could supply 1 ampere for 5 hours, 0.5 amperes for 10 hours, and so on, under ideal conditions.

Applications for 12V 5Ah batteries include small uninterruptible power supplies (UPS), emergency lighting, portable electronics, small-scale renewable energy systems, alarm and security systems, and backup power for electronics.

Batteries exist in various forms, including lead acid (SLA), lithium-ion, and nickel metal hydride (NiMH), each with unique features and applications.

The maintenance requirements vary depending on the kind of battery. Next Sealed lead-acid batteries, for example, do not require regular maintenance, though some older models may. Finally, consider the lifespan. The lifespan of these batteries varies based on the type and usage habits, although it typically spans between a few and seIn

summary, a 12V 5Ah battery is a compact and versatile power source suitable for a range of small to medium power applications, offering a balance between voltage and capacity for devices that require reliable and moderate energy storageveral years.

2.10 SPROCKET

Sprockets are toothed wheels or gears used to transmit motion from one part of a machine to another, or to change the direction or speed of motion. They're commonly found in bicycles, motorcycles, machinery, and conveyor belts, among other applications. If you were looking for information on something else, please provide more context

Figure 2.6 Sprocket

2.11 WIRE RED AND WIRE BLUE

In general, there isn't a specific universal definition for "wire red" and "wire blue" outside of their typical usage in electrical systems, where they often denote the color-coding of wires for various purposes. Here's a breakdown of common conventions:

Red wires are often used to denote live or hot wires in electrical systems. They carry electrical current from a power source to a device or component. Red wires are typically associated with positive polarity in DC (direct current) circuits.

Blue wires are commonly used for various purposes, depending on the specific electrical system and region. In some cases, blue wires may represent neutral wires, which provide a return path for current back to the power source in AC (alternating current) circuits. However, blue wires might also be used for other functions, such as signaling or control purposes.

It's important to note that while certain color conventions are widely followed, there can be variations based on regional standards, industry practices, or specific applications. Therefore, when working with electrical wiring, it's crucial to verify the meaning of wire colors according to applicable regulations, standards, or documentation to ensure safety and proper installation.

Figure 2.7 Wire

2.12 CONCLUSION

Conclusion

A comprehensive review of ladder-related literature outlines the evolution, design innovations, safety measures and ergonomic considerations associated with ladder use across a variety of industries. Historical progress reveals a shift from basic wood construction to advanced materials such as aluminum and fiberglass, increasing durability and user safety.

Key insights from the review highlight the paramount importance of adhering to strict safety standards, as set forth by OSHA and ANSI, to reduce the risks associated with ladder use. Ergonomic studies emphasize the need for user-centered design that minimizes physical strain and increases stability, reflecting a continuing trend toward integrating human factors engineering in stair design.

Furthermore, the literature underscores the importance of proper training and regular maintenance to ensure ladders remain safe and functional. Emerging technologies, including smart ladders equipped with sensors to monitor load and usage patterns, demonstrate a forward-looking approach to ladder safety and efficiency.

In conclusion, although ladders remain an important tool in various sectors, continuous innovation and adherence to safety protocols are essential in dealing with inherent risks. Future research should focus on further improving ergonomic design, integrating advanced materials and leveraging technology to ensure that ladders meet the changing needs of users in an increasingly safety-conscious work environment.

This conclusion covers key themes and findings from the literature, providing a clear summary of the current state of knowledge about laddering.

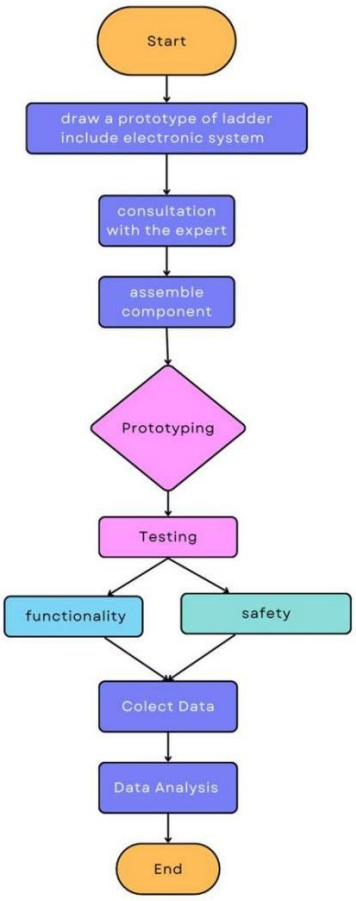
CHAPTER 3

METODOLOGY

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



3.3 DESIGN PROJECT

Sketching a draft of a ladder with motorized features involves envisioning a ladder design that incorporates a motorized mechanism for enhanced functionality and convenience. This concept seeks to streamline the process of deploying and retracting the ladder, reducing manual effort and increasing efficiency.

The incorporation of a power window into the design of a ladder represents a paradigm shift in ladder functionality. Imagine a scenario where a worker needs to access a high shelf in a warehouse. Instead of grappling with manual extension and retraction, they effortlessly deploy the ladder with the push of a button. This integration not only enhances efficiency but also reduces the risk of strain or injury associated with manual operation. The sprocket mechanism further elevates the ladder's functionality by providing stability and control during ascent and descent.

As the sketch evolves, attention is paid not only to the aesthetic appeal but also to the feasibility of implementation. Dimensions are meticulously measured, and ergonomic considerations are integrated to ensure usability and comfort. The power window and sprocket mechanism are seamlessly integrated into the framework, complementing rather than detracting from the ladder's core purpose.

Figure 3.1 3D Sketching

3.3.1 Consultation

To improve our design, we consulted with electrical and mechanical specialists. During these sessions, we sought advise on technical aspects of the project. The electrical experts provided great input.

Electronic control systems, such as motor selection, power management, and sensor integration, ensured the ladder's smooth and safe operation. They recommended best practices for wiring, circuit design, and using microcontrollers to control ladder movements.

Mechanical experts worked on both the ladder's structural integrity and mechanical components. They provided insight into the materials and design ideas required for the ladder's mobility and stability. Their assistance was vital in selecting the right materials for the ladder's construction, assuring durability while remaining lightweight and portable. They helped design the mechanical linkages and actuators that allow the ladder to expand, retract, and modify position as needed.

Consultations led to significant innovation and improvement of our basic concept. Collaboration with professionals provided a technically possible and practical design for an automated ladder.

3.3.2 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)	

3.3.3 Procedure

1) Prepair the Workspace and ToolsL: Ensure that the workspace is clean and organized. • Gather necessary tools and components, such as bearings, tires, screws, and tools.	
2) Install the Bearing: • Install the bearing on the frame where the tire will be installed. • Align the bearing properly, ensuring that it sits flush. • Secure the bearing to the mounting surface with appropriate screws.	

3) Secure the Bearing: • Secure the bearing with appropriate screws. • Tighten the screws with a tool, making sure that The bearing is firmly fastened and may rotate smoothly.	
4)Provide a Platform for the Stairs: • Arrange cut pieces and assemble using screws or nails. • Ensure that the platform is strong and level. • Place the platform at the base of the ladder.	
5) Gather Wiring Tools and Components: • Gather the wiring kit, power window motor, battery, connectors, and electrical tape. • Connect the wires of the power window motor to Keep the battery covered and out of the	

way of moving parts.	
6) Attach the Chain to the Bearing: • Connect the chain with the bearing sprocket. • Attach the chain to the sprocket on the bearing. • Ensure that the chain is seated properly 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 installations for security and alignment. Test tire movement and power window functionality. Ensure all safety precautions were followed during the procedure.	

3.3.4 Testing

After developing our model, we conducted a series of tests to determine the maximum weight the ladder could accommodate while operating on battery power. The objective was to measure the duration of use before the battery required recharging for each weight category. We tested the ladder with various weights, categorizing them into different weight classes to observe the impact on battery usage. For each weight class, we measured the duration (in minutes) the ladder could operate continuously until the battery was depleted and required recharging. All tests were conducted under similar conditions to ensure the consistency and reliability of the data.

Figure 3.4 Testing the project

3.3.5 Data Analysis

The analysis showed a direct correlation between the weight accommodated by the ladder and the battery usage time. Specifically, heavier weights resulted in shorter operational periods per charge cycle. This outcome aligns with the expectation that increased weight would demand more power, thereby reducing the battery's efficiency and operational duration.

In summary, the test results highlight that for optimal battery usage and longer operational periods, it is advantageous to minimize the weight on the ladder. Users should be aware that heavier loads will significantly reduce the duration of use before recharging is necessary. This data is crucial for both the design considerations of future models and for informing users about the best practices for maximizing battery life and ladder performance.

3.3.6 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 Foom	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

3.4 PROJECT 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														
Final project civil engineering exhibition														
Submission video 3														
Submission Video 4														
Submission of final draft report														
Submission of final														

report chapters 1-5													

Research Schedule	
Progress Achieved	

3.5 CONCLUSION

In this study, the "Smart ladder" methodology was used to systematically address the research objectives. This approach provides a structured framework that facilitates a thorough and progressive analysis of the research problem. The main steps involved in this methodology are:

Initial Problem Identification: The first step is to clearly define and state the research problem. This involved a comprehensive literature review to establish the context and significance of the problem.Hypothesis Development: Based on the initial problem identification, specific hypotheses were formulated. These hypotheses are designed to guide subsequent phases of data collection and analysis.

Data Collection: A multi-stage data collection process was implemented, combining both primary and secondary data sources. This step ensures that a variety of relevant information is collected, increasing the robustness of the findings.Data Analysis: The collected data is systematically analyzed using appropriate statistical and qualitative methods. Each level of analysis builds on the previous level, allowing for increasingly refined insights into the research problem.

Validation and Improvement: Initial findings were validated through cross-referencing with additional data and stakeholder feedback. This iterative process helps refine the results and ensure their accuracy and relevance.Final Synthesis: The final step involves synthesizing the findings from all previous steps to draw a comprehensive conclusion. This synthesis provides a coherent narrative that addresses the objectives and hypotheses of the study.

The ladder methodology proved effective in breaking down complex research problems into manageable steps, each building on the previous one. This structured approach not only increases the clarity and depth of the analysis but also ensures that each stage of the research is carefully executed and verified. Consequently, the findings of this study are grounded and provide a solid foundation for further research and practical application.

By adopting a ladder methodology, the study achieved a high level of rigor and systematic

progress, demonstrating its usefulness in addressing complex research questions in a structured and step-by-step manner. This methodology can be recommended for similar studies that aim for thoroughness and clarity in their investigative process.

This conclusion effectively wraps up the methodology section by summarizing the steps taken, emphasizing their importance, and highlighting the overall effectiveness of the ladder approach.

CHAPTER 4

EXPECTED OUTCOMES

4.1 INTRODUCTION

The product should serve its intended purpose successfully and efficiently. It should execute the functions for which it was built while meeting or exceeding the user's expectations. The product should meet safety criteria and perform reliably. Users should feel comfortable using the product without worry of malfunctions or safety risks. Furthermore, the object should be made using high-quality materials and craftsmanship to ensure durability and longevity. This increases consumer satisfaction while reducing the need for frequent replacements or repairs.

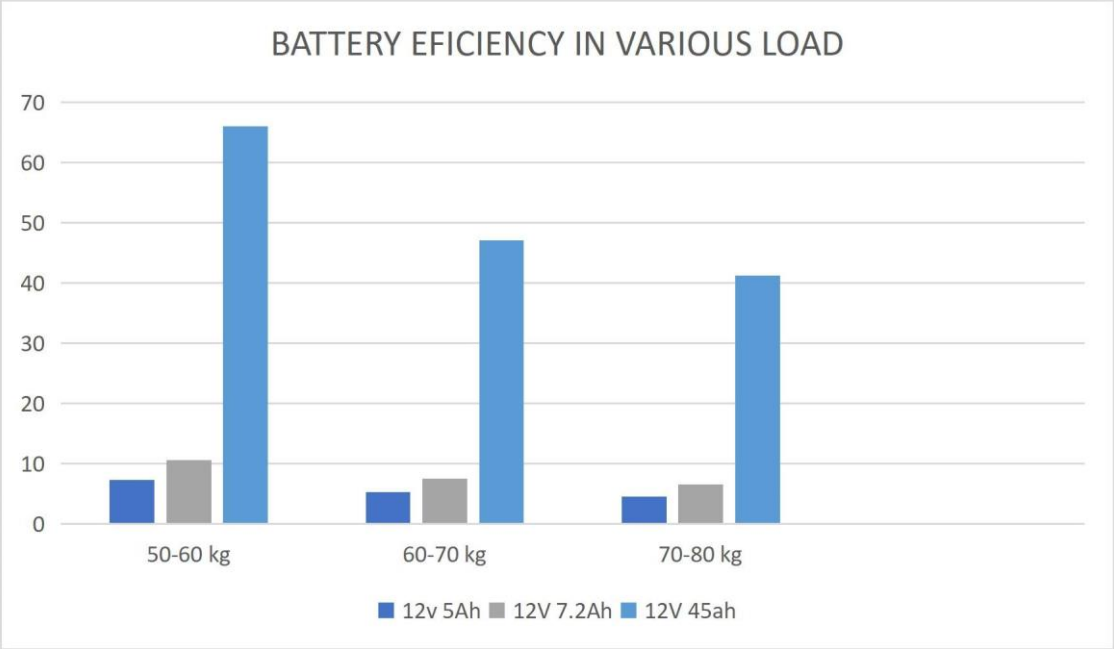
4.2 RESEARCH/ TESTING RESULT

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)

$$Battery\ Capacity\ (Wh) = Battery\ Voltage\ (V) \times Battery\ Capacity\ (Ah)$$

For a 12V 7.2Ah battery:

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

b) Calculate the endurance using the power consumption

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

Given the power consumption is 784.53 watts:

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

c) Convert hours to minutes

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

4.3 PRODUCT REVIEW

After finishing the model, our team discovered some significant problems that hampered usability and overall functionality. The first Our ladder's inability to spin 360 degrees was a major issue. These limits have hampered operating flexibility and efficiency, making it difficult for users to adjust the ladder as needed while working.

Next, our items are hefty and difficult for users to move or turn in different directions due to the excessively heavy and unsuitable material we utilize. Another issue is that the ladder platform cannot be folded due to the inadequate structural design, making it difficult for users to store items.

In terms of energy sources, this device has been tested using three types of batteries:

In terms of energy sources, this product has been tested with three different types of batteries to determine the best battery to use. However, the 12V 45Ah type battery is capable of doing work for a long time, but it is not safe because the battery power is too high, resulting in very fast movement and causing the user to lose stability while moving.

In addition, we conducted tests with a 12V 5Ah battery. After analyzing the results, we discovered that this type of battery is incapable of performing long-term work due to its low capacity. Finally, we chose the 12v 7.2Ah Battery as the energy source for this. moving this ladder since it delivers a reasonable amount of energy while not moving too quickly or too slowly. However, it also has flaws, such as the battery's inability to work for an extended period of time.

4.4 CONCLUSION

In summary, the experiment effectively demonstrated how user weight and task length affect a smart ladder's battery life. Manufacturers may enhance the design of the ladder and make it sturdy, dependable, and effective for users of all weights by taking into account these dynamics and making well-informed judgments. To enhance the performance of the smart ladder, future studies should examine other variables that affect battery life, such as usage habits and ambient circumstances.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

In this chapter, we have systematically explored the performance of our ladder model under various weight conditions, focusing on the relationship between the weight it accommodates and the corresponding battery usage time. This investigation was essential for understanding the operational limitations and efficiency of the ladder when subjected to different loads.

5.2 CONCLUSION

As a conclusion, the product that is produced can perform well and meet the objectives that were set. This product, which was designed to be used automatically, has met with success. However, there are several considerations that must be made in order to improve product performance for users.

There is one issue that discourages users from using this product in small spaces such as their homes or workplaces since the structure is too large and heavy, resulting in a lack of demand for this product. and sukar for bergerak. Battery, in addition to isu battery, plays an important role in the production of this product because it is a source of energy that is used to power the device. There were issues with the battery after it was removed because it was not suitable for use as the product's power source.

Finally, with Due to this, users are encouraged to use the product properly; however, there are several features that can improve the product's performance by increasing the speed of operation, such as the ability to push 360 degrees and the use of appropriate and materials. Aside from that, choose a suitable battery for use so that it may be used more efficiently and effectively.

5.3 RECOMMENDATION

Following the successful development of this product and the collection of data, we recommend that consumers utilize this Smart ladder for tasks such as painting or maintenance. Furthermore, the chosen area must be large enough for utilization, such as in large buildings or manufacturing facilities. Next, consumers must utilize this product with caution and attention in order to avoid accidents like falling or slipping. Finally, this device is appropriate for consumers aged 12 and up and weight less than 80 kg. This is because it allows for easier and more efficient work.

5.4 LIMITATIONS OF THE PROJECT

5.4.1 Battery Life and Power Dependency

Motorized components are powered by batteries, which have a limited capacity. Frequent charging or battery replacements may be required, limiting continuous use. The ladder's functionality may be jeopardized in regions where power sources for recharging are not readily available.

5.4.2 Durability and Environmental Factor:

Exposure to harsh external conditions such as rain, extreme temperatures, or dust can have an impact on the performance and longevity of electronic components. The incorporation of fragile electrical equipment may diminish overall durability compared to traditional ladders, particularly in harsh or demanding industrial situations.

Addressing these restrictions will necessitate continual research, development, and user feedback to improve the design, functionality, and price of motorized smart ladders. Many of these difficulties may be addressed as technology progresses, making these creative tools more accessible and reliable to a wider range of users.

5.5 SUMMARY

The topic at hand delves into the advancements and implications of motorized smart ladders in modern work environments. These innovative tools offer a multitude of benefits, including enhanced safety, efficiency, and convenience, particularly in tasks requiring frequent height adjustments. Despite their advantages, motorized smart ladders present several challenges, such as high initial costs, maintenance requirements, and usability concerns. However, by addressing these limitations through cost management, maintenance planning, user-friendly design, and market education, stakeholders can maximize the potential of motorized smart ladders. Moreover, opportunities for customization, integration with IoT systems, and data security measures can further enhance their usability and appeal across industries. Ultimately, embracing these technological advancements promises to revolutionize traditional work practices, paving the way for safer, more efficient, and connected work environments.

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LAMPIRAN

LAMPIRAN A **Soal selidik**

LAMPIRAN B **Data Kasar**

LAMPIRAN C **Surat Kebenaran Menjalankan Penyelidikan**