POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

IOT BASED LASER METERS FOR MEASURING DISTANCE AND DEPTH

NAME	REGISTRATION NO
AIMAN AL-DANIAL BIN AHMAD	08DEP20F2022

JABATAN KEJURUTERAAN ELEKTRIK

SESI 1 2022/2023

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This report submitted to the Electrical Engineering Department in fulfillment of the requirement for a Diploma in Electrical Engineering

JABATAN KEJURUTERAAN ELEKTRIK

SESI 1 2022/2023

CONFIRMATION OF THE PROJECT

The project report titled "Design a Fingers Exergame to Improve Fine Motor Skill for Autistic Children Using Arduino" has been submitted, reviewed and verified as a fulfills the conditions and requirements of the Project Writing as stipulated.

Checked by:

Supervisor's name: ENCIK ABU BAKAR HAFIS BIN KAHAR

Supervisor's signature :

Date :

Verified by:

Project Coordinator name :

Signature of Coordinator :

Date :

“I acknowledge this work is my own work except the excerpts I have already explained to our source”

1. Signature :

Name : **AIMAN AL- DANIAL BIN AHMAD**

Registration Number : **08DEP20F2022**

Date :

DECLARATION OF ORIGINALITY AND OWNERSHIP

TITLE : DESIGN FINGERS EXERGAME TO IMPROVE FINE MOTOR SKILL FOR AUTISTIC CHILDREN USING ARDUINO

SESSION: MAY 2023

1. I, **1. AIMAN AL-DANIAL BIN AHMAD (08DEP20F2022)**

   is a final year student of **Diploma in Electrical Engineering, Department of Electrical, Politeknik Sultan Salahuddin Abdul Aziz Shah**, which is located at **Persiaran Usahawan,40140 Shah Alam Selangor Darul Ehsan**. (Hereinafter referred to as 'the Polytechnic').

2. I acknowledge that 'The Project above' and the intellectual property therein is the result of our original creation /creations without taking or impersonating any intellectual property from the other parties.

3. I agree to release the 'Project' intellectual property to 'The Polytechnics' to meet the requirements for awarding the **Diploma in Electrical Engineering** to me.

Made and in truth that is recognized by;

a) Click here to enter text.) . ....………………………….

(Identification card No: - Click here to enter text.)) **AIMAN AL-DANIAL BIN AHAMD**

In front of me, **ENCIK ABU BAKAR HAFIS BIN KAHAR**) .....……………..

(Click here to enter text.)) **ENCIK ABU NAKAR HAFIS BIN KAHAR**

As a project supervisor, on the date:

ACKNOWLEDGEMENTS

I have taken efforts in this Project. However, it would not have been possible without the kind support and help of many individuals and organizations. I would like to extend my sincere thanks to all of them. I am highly indebted to (Name of your Organization Guide) for their guidance and constant supervision as well as for providing necessary information regarding the Project & also for their support in completing the Project.

I would like to express my gratitude towards my parents & member of (Organization Name) for their kind co-operation and encouragement which help me in completion of this Project. I would like to express my special gratitude and thanks to industry persons for giving me such attention and time.

My thanks and appreciations also go to my colleague in developing the Project and people who have willingly helped me out with their abilities.

ABSTRACT

Laser meters are a highly efficient way of measuring distances on all terrains. By using a laser to target and record a point of reference, the device then calculates and displays the distance to that point with a high degree of accuracy. Offering a measurement solution that is far faster and easier than a conventional tape measure, laser meters are highly versatile devices that have proven beneficial to many industries. Next, laser meters send a laser to a particular point and then, using the time taken for this light beam to return to the device, calculates the distance to a high degree of accuracy. The laser pointer is visible to the human eye and therefore allows the user to easily pinpoint the desired area of measurement, ensuring the measurement is as precise as possible. However, there are advantage of laser meters are easily to use because it can be used one-handed when your using a laser meters instead of using a measuring tape, you don't need to move the reference cause it can typically record several points of references without having to move, allowing to calculate relative distance between two points, easily carry it wherever you go which the laser meters are pocket-sized with easily read display screens making them easy to use, store and transport.

ABSTRAK

Meter laser ialah cara yang sangat cekap untuk mengukur jarak pada semua rupa bumi. Dengan menggunakan laser untuk menyasarkan dan merekodkan titik rujukan, peranti kemudian mengira dan memaparkan jarak ke titik itu dengan tahap ketepatan yang tinggi. Menawarkan penyelesaian pengukuran yang jauh lebih pantas dan lebih mudah daripada ukuran pita konvensional, meter laser ialah peranti yang sangat serba boleh yang telah terbukti bermanfaat kepada banyak industri. Seterusnya, meter laser menghantar laser ke titik tertentu dan kemudian, menggunakan masa yang diambil untuk pancaran cahaya ini kembali ke peranti, mengira jarak ke tahap ketepatan yang tinggi. Penunjuk laser boleh dilihat oleh mata manusia dan oleh itu membolehkan pengguna menentukan dengan mudah kawasan pengukuran yang dikehendaki, memastikan pengukuran adalah setepat mungkin. Walau bagaimanapun, terdapat kelebihan meter laser mudah digunakan kerana ia boleh digunakan dengan sebelah tangan apabila anda menggunakan meter laser dan bukannya menggunakan pita pengukur, anda tidak perlu mengalihkan rujukan kerana ia biasanya boleh merakam beberapa titik rujukan tanpa perlu bergerak, membolehkan untuk mengira jarak relatif antara dua titik, dengan mudah membawanya ke mana sahaja anda pergi yang meter lasernya bersaiz poket dengan skrin paparan yang mudah dibaca menjadikannya mudah digunakan, disimpan dan diangkut..

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CHAPTER 1

1 INTRODUCTION

1.1 Introduction

Laser meters are a highly efficient way of measuring distances on all terrains. By using a laser to target and record a point of reference, the device then calculates and displays the distance to that point with a high degree of accuracy. Offering a measurement solution that is far faster and easier than a conventional tape measure, laser meters are highly versatile devices that have proven beneficial to many industries. Next, laser meters send a laser to a particular point and then, using the time taken for this light beam to return to the device, calculates the distance to a high degree of accuracy. The laser pointer is visible to the human eye and therefore allows the user to easily pinpoint the desired area of measurement, ensuring the measurement is as precise as possible. However, there are advantage of laser meters are easily to use because it can be used one-handed when your using a laser meters instead of using a measuring tape, you don't need to move the reference cause it can typically record several points of references without having to move, allowing to calculate relative distance between two points, easily carry it wherever you go which the laser meters are pocket-sized with easily read display screens making them easy to use, store and transport.

1.2 Background Research

IoT (Internet of Things) laser meters are devices that use laser technology to accurately measure distances and provide the data wirelessly to a connected network or cloud platform. These meters are commonly used in various applications, including construction, surveying, industrial automation, and smart city infrastructure.

Here is some background research on IoT laser meters for measuring distance:

I. Principle of Operation:

IoT laser meters use laser beams to determine the distance between the device and the target object. They emit a laser pulse and measure the time it takes for the pulse to travel to the object and return.

By knowing the speed of light, the meter can calculate the distance based on the time-of-flight (TOF) principle.

II. Accuracy and Range:

IoT laser meters offer high accuracy, typically in the range of millimeters or centimeters. The measurement range varies depending on the specific device but can extend from a few meters to several hundred meters. Advanced models may have a longer measurement range.

III. Connectivity and IoT Integration:

These meters are designed to be connected to a network, allowing them to transmit data wirelessly to other devices or cloud platforms. They often support wireless protocols such as Wi-Fi, Bluetooth, or cellular connectivity. The integration with IoT platforms enables remote monitoring, data analysis, and real-time decision-making.

IV. Data Visualization and Analysis:

IoT laser meters provide measurement data that can be visualized and analyzed in various ways. Some devices have built-in displays for on-site readings, while others rely on smartphones or web applications for data visualization. Advanced models may offer additional features like data logging, historical trend analysis, and compatibility with third-party software.

V. Application Areas:

IoT laser meters find applications in diverse fields. In construction, they are used for accurate distance measurements during site surveys, leveling, and layout tasks. In industrial automation, they assist in positioning and monitoring objects on assembly lines. They are also employed in smart city infrastructure for monitoring traffic flow, parking occupancy, or urban planning.

VI. Power and Battery Life:

IoT laser meters are typically powered by rechargeable batteries, ensuring portability and ease of use. The battery life varies depending on the device and usage, but manufacturers often optimize their designs to provide extended operating time. Some meters may also support external power options for continuous operation.

VII. Environmental Considerations:

IoT laser meters are built to withstand various environmental conditions. They are often designed with robust enclosures that offer protection against dust, water, and impact. Some devices are also equipped with features like temperature compensation to ensure accurate measurements in extreme conditions.

VIII. Safety Measures:

Laser safety is an important consideration with IoT laser meters. Manufacturers adhere to safety regulations and provide devices with appropriate laser classifications and safety features. Users should follow the manufacturer's guidelines regarding laser safety precautions and usage recommendations.

IX. Cost and Manufacturers:

The cost of IoT laser meters varies depending on factors such as accuracy, measurement range, connectivity options, and additional features. There are several manufacturers and brands in the market, including Leica, Bosch, Trimble, Hilti, Fluke, and Stanley, among others. Comparing specifications, customer reviews, and pricing can help in selecting the most suitable meter for specific requirements.

It's important to conduct further research and consult product specifications and user reviews when considering specific IoT laser meters, as features and capabilities can vary between models and manufacturers.

1.3 Problem Statement

Due to the tape measure's limited measurement range, there is a significant rate of measurement inaccuracy, especially over longer distances. As a result, one may measure a greater distance up to 50 meters and with more accuracy using laser meters. Next, there are need one person must hold the measuring tape while the other must draw to the measured distance and record the measurement data on the tape. Two individuals are needed to measure and take the measurement data at the same time. To eliminate the necessity for walking between points or for a helper at the other end, laser meters were developed. Additionally, you may use it with one hand while holding your notepad with the other. However, it is only complicated because you must pull the measuring tape to the desired distance, stop it, and then read the tape, measurements take longer to complete. Therefore, the Laser Meters are much quicker; you simply point, click, and the result appears on the display. In a tiny fraction of the time that using a tape would take, the task is completed.

1.4 Research Objectives

Research on laser meters for measuring distance involves various objectives. These objectives include assessing accuracy, optimizing performance, studying environmental factors, conducting comparative analysis, exploring IoT integration, conducting application-specific studies, gathering user feedback, ensuring safety and regulatory compliance, and analyzing cost-effectiveness.

Researchers aim to evaluate the accuracy of laser meters through experiments and comparisons with reference measurements. They also seek to enhance performance by improving precision, reducing uncertainty, and expanding the measurement range. Understanding the impact of environmental conditions helps identify limitations and propose mitigation strategies.

Comparative analysis helps users select the most suitable laser meter by comparing factors like accuracy, range, connectivity, power consumption, and cost. Integration with IoT systems is explored to facilitate data transmission, remote monitoring, and compatibility with other devices and platforms.

Application-specific studies focus on optimizing laser meter performance for specific fields such as construction, surveying, and industrial automation. User feedback and usability studies inform improvements and meet user requirements. Safety and regulatory compliance ensure laser meter adherence to standards and guidelines.

Lastly, cost-effectiveness analysis considers the overall value for money by assessing performance, durability, maintenance, and total cost of ownership. These research objectives drive advancements and informed decision-making in the field of laser meters for measuring distance.

1.5 Scope of Research

According to the research, this laser was created specifically for builders and contractors to make it easier for them to measure distances. By utilizing this laser meter, they can lower the error rate by merely reading digital meters. By simply pressing a button and counting the number of seconds that pass before the reading is taken, laser meters can save time. As a result, after the measurement is taken, all the measured data can be kept on the android. As a result, these laser meters are less expensive than similar models that are already on the market.

CHAPTER 2

2 LITERATURE REVIEW

2.1 Introduction

Accurate measurement of distances plays a crucial role in various fields, including construction, surveying, manufacturing, and many others. Traditional measurement techniques often suffer from limitations in terms of accuracy, time consumption, and practicality. However, the advent of laser meters has revolutionized distance measurement by offering precise and efficient solutions.

This literature review aims to provide an in-depth examination of laser meters for measuring distance. It explores the principles behind laser distance measurement, delves into the technical specifications of laser meters, discusses their applications across different industries, and highlights the advancements in laser meter technology. Additionally, it addresses the challenges associated with laser distance measurement and explores potential future developments in the field.

Laser meters utilize the principles of laser technology to determine distances accurately and quickly. By emitting a laser beam and measuring the time it takes for the beam to reach a target and return, laser meters employ the time-of-flight (TOF) method for distance calculation. Other techniques, such as phase-shift and triangulation methods, are also employed in specific laser meter designs.

The technical specifications of laser meters are critical factors that determine their performance. Parameters such as measurement range, accuracy, laser type, beam divergence, spot size, sampling rate, and data processing capabilities significantly influence their effectiveness in different applications. Understanding these specifications is essential for selecting the appropriate laser meter for a specific task.

Laser meters find extensive applications in various industries. In the construction and civil engineering sector, laser meters are used for precise measurements of distances, heights, and angles during building construction, road works, and land surveying. Similarly, surveyors and cartographers utilize laser meters for accurate mapping and topographical surveys. In industrial manufacturing and robotics, laser meters enable precise positioning, alignment, and quality control. Aerospace and defense sectors utilize laser meters for applications such as target tracking, obstacle detection, and remote sensing. Additionally, laser meters are employed in environmental monitoring to measure distances in complex terrains or hazardous areas.

The advancements in laser meter technology have significantly enhanced their performance and usability. The development of laser diodes with improved characteristics, integration with other sensors such as accelerometers and gyroscopes, wireless connectivity for data transfer, miniaturization for portability, and user-friendly interfaces with advanced software integration are notable achievements in the field.

However, laser distance measurement also poses challenges that need to be addressed. Factors such as measurement errors, environmental conditions affecting accuracy, interference from external sources, and calibration requirements demand careful consideration. Researchers and engineers are continually working to develop techniques for reducing measurement errors, mitigating environmental influences, and improving calibration procedures.

Looking ahead, there are promising future developments and trends in laser distance measurement. The pursuit of even higher measurement accuracy and extended measurement ranges, integration with augmented reality and virtual reality systems for enhanced visualization, application of artificial intelligence and machine learning algorithms for data analysis, advancements in laser beam shaping and modulation techniques, and the increasing adoption of laser meters in emerging industries are some areas that hold significant potential.

In conclusion, this literature review serves as a comprehensive resource for understanding laser meters for measuring distance. By examining their principles, technical specifications, applications, state-of-the-art technology, challenges, and future trends, it provides valuable insights for researchers, engineers, and professionals seeking accurate and efficient distance measurement solutions.

2.1 Research on Distance Measurement Technology for remaining Volume of large Open-pit Material Yard

uniformly measure and calculate the storage yard type when measuring the storage of large yards using volume and density conversion, a high-speed laser scanner, distance sensor, angle sensor, and pitch sensor. the system construction architecture, composition, data processing methods. effectively solves the problems faced by the existing measurements in large yards, and improves the measurement efficiency, accuracy, and safety.

2.2 Development of a remote displacement Measuring Laser System for Bridge Inspection

proposes an economical, remote non-contact sensor system. The system comprises a laser beam transmitter and a light receiver, deriving the displacement based on the position where the laser beam is irradiated to the light receiving surface. To measure this, the light receiver was installed at the measurement point and included a wireless communicator to transmit the displacement data. A displacement experiment was conducted to evaluate the performance. that precise displacement measurements were possible at a resolution of 100 µm. For bridge load tests, a light receiver under a bridge was installed, laser beams irradiated to the light-receiving surface from a distance, and the displacement was measured for each test and compared with the values measured by a conventional contact sensor. highly consistent with those of the existing sensor, indicating that the proposed sensor system applies to bridge loading tests and the safety diagnosis for various structure

2.3 Application of the laser linear distance – speed - Acceleration Measurement system and sport Kinematic Analysis software

to determine the measurement possibilities using an LDM301A laser system in obtaining basic kinematic parameters. The second goal is the application of specialized computer programs based on appropriate algorithms to calculate a vast number of variables that can be used to adjust the training and the rivalry. It is a non-invasive, non-contact measurement method. determine the influence of both subjective and objective external factors. In this way, we can also conduct training with real-time scientific feedback. the efficiency and running economy can be calculated with various time, speed, acceleration, and length indexes. Calculating the symmetries between the left and right leg in velocity, stride lengths, support phase times, flight phase times, and step frequency are possible.

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2.5 Distance Measurement system using Lasers and their Application.

Optical measuring systems came to offer new ways to determine distances, deformations, or vibrations through more accurate and greater range methods. Technological progress has allowed a significant improvement of several components, including optical ones. triangulation, telemetry, and interferometry, covering their main applications, advantages and disadvantages, and theoretically substantiating each of the methods. For the triangulation method we made two experiments which demonstrate the functioning of the method in measuring distances and surfaces. For the telemetry method, experimental setups were studied to apply the method of pulse telemetry and phase comparison telemetry to measure distances.

2.6 Chapter Summary

This literature review examines laser meters for distance measurement and provides a comprehensive overview of their principles, technical specifications, applications, state-of-the-art technology, challenges, and future trends. Laser meters offer advantages such as accuracy, speed, and ease of use compared to traditional measurement techniques. The review explores different methods of laser distance measurement, including time-of-flight, phase-shift, and triangulation. It discusses the technical specifications of laser meters, such as measurement range, accuracy, laser type, and data processing capabilities.

The applications of laser meters span across industries such as construction, surveying, manufacturing, aerospace, defense, and environmental monitoring. The review highlights the advancements in laser meter technology, including laser diode improvements, integration with other sensors, wireless connectivity, miniaturization, and user-friendly interfaces. It also addresses challenges in laser distance measurement, such as measurement errors, environmental factors, interference, and calibration.

The review concludes by identifying potential future developments and trends, such as enhanced measurement accuracy and range, integration with augmented reality and virtual reality systems, application of artificial intelligence and machine learning algorithms, advancements in laser beam shaping and modulation, and increased adoption in emerging industries. Overall, this literature review serves as a valuable resource for researchers, engineers, and professionals seeking a comprehensive understanding of laser meters for distance measurement.

CHAPTER 3

3 RESEARCH METHODOLOGY

3.1 Introduction

This project involves the cost of purchasing components and materials throughout its implementation. components involving cost are Ultrasonic Sensor, laser diodes, ESP32, LCD Display, Jumper wired, battery 5V, Button ON/0FF and others. All these components are purchased through online purchase methods and in-store purchases to make it easier as well as save on costs.

The overall gross budget estimate in the implementation of this project is RM 301.20 and other expenses is at RM 150 as shown in Table 1 According to this budget cost, this project can be considered as a less costly project compared to other projects that can cost over a thousand ringgit. The cost of the project is also in line with one of the key features of a good project developer that is low cost but has a high-quality project.

3.2 Project Design and Overview.

As mentioned in the previous chapter, the designed controller uses a closed-loop system with ESP32 as the main controller. The design of the controller circuit using Arduino is realized using Proteus Software and then convert to PCB circuit with other components which are Ultrasonic Sensor, laser diodes, LCD Display, Jumper wired, battery 5V, Button ON/0FF and others material.

3.1.1 Block Diagram of the Project

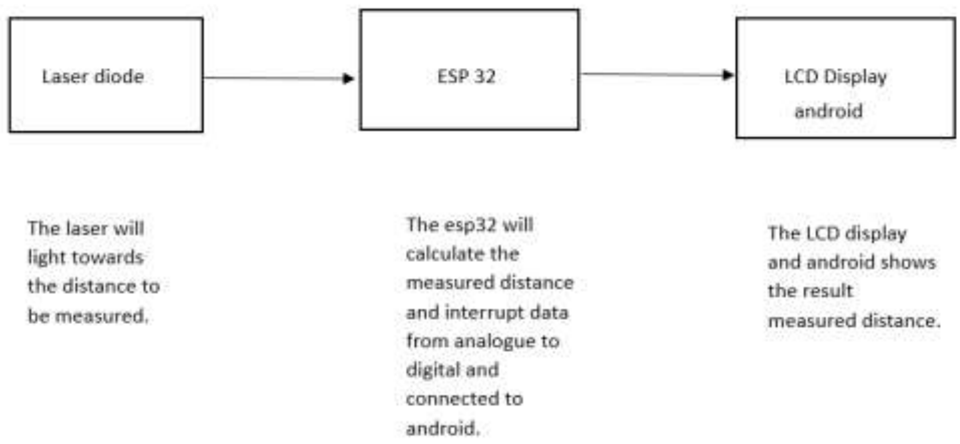


Figure 3.1 Block Diagram

3.1.2 Flowchart of the Project 2

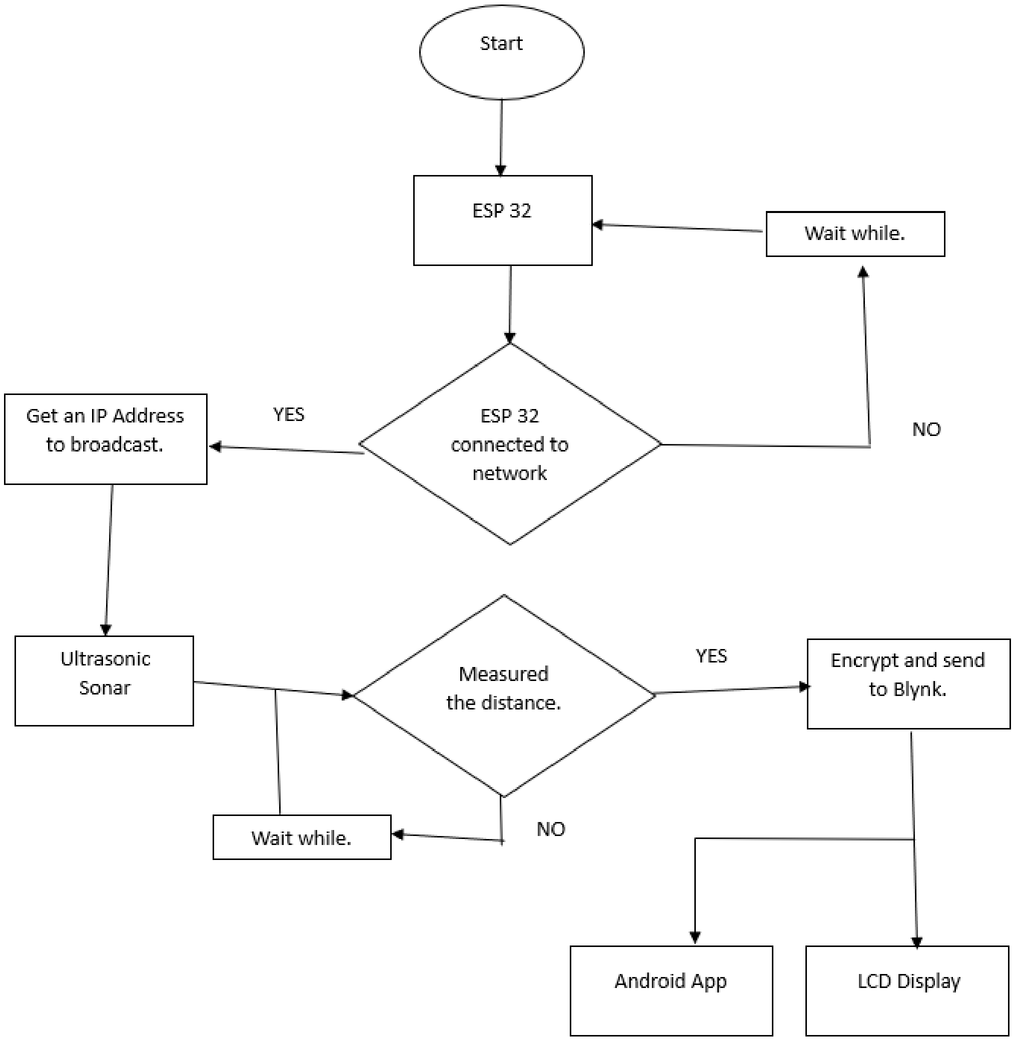


Figure 3.1: Flow chart of IOT laser meters for measuring Distance and depth
*Images may be subject to copyright

3.1.3 Project Description

The project focuses on designing and developing a laser meter for accurate distance measurement. The objectives include creating a high-precision system with a user-friendly interface, implementing advanced data processing algorithms, conducting thorough testing and validation, and evaluating its suitability for various applications. The system design involves selecting a laser diode, incorporating time-of-flight measurement, utilizing a microcontroller-based system, and ensuring a robust power supply and enclosure. Advanced algorithms will be developed for data processing to enhance accuracy and reduce errors. The laser meter system will undergo rigorous testing and validation, comparing it against reference standards and evaluating its performance in real-world scenarios. The project aims to contribute to distance measurement technology advancements and provide a valuable tool for industries requiring precise distance measurements.

3.2 Project Hardware

The hardware components for the laser meter system include laser diodes, an ESP32 microcontroller, an LCD display, jumper wires, a 5V battery, and an On/Off button. The laser diodes emit a focused laser beam for distance measurement, while the ESP32 serves as the system's central processing unit. The LCD display provides visual feedback, and jumper wires enable electrical connections. A 5V battery supplies power, and an On/Off button controls the system. Additionally, the inclusion of an ultrasonic sensor can enhance the capabilities of the laser meter system.

3.2.1 Schematic Circuit

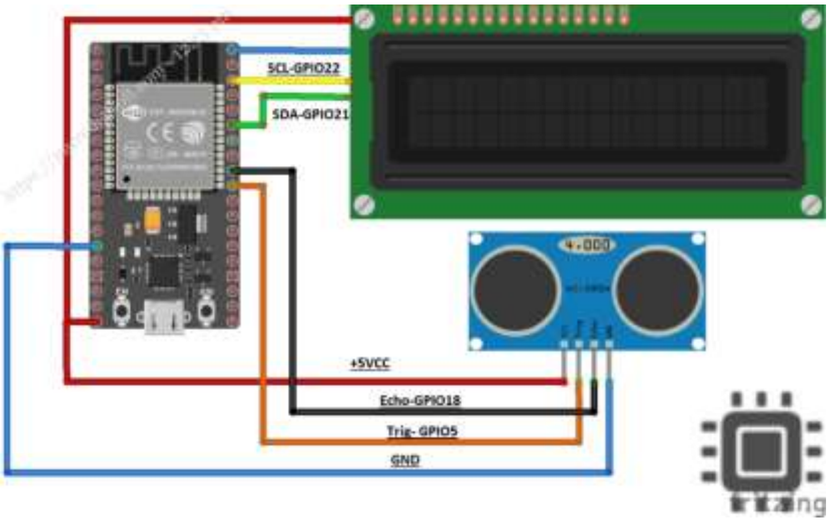


Figure3.2:Circuit Diagram

*Images may be subject to copyright

3.2.2 Description of Main Component

The ESP32 is a powerful microcontroller module known for its dual-core processor, Wi-Fi and Bluetooth connectivity, integrated peripherals, memory and storage capabilities, power management features, compatibility with popular programming environments, and security features. It is widely used in various applications, particularly in IoT, robotics, and embedded systems. The ESP32's combination of processing power, wireless connectivity, and integrated peripherals makes it a versatile and popular choice for a wide range of projects.

3.2.2.1 Component 1

Ultrasonic Sensor:

While not specifically mentioned in the initial hardware list, an ultrasonic sensor can be a valuable addition to the laser meter system. Ultrasonic sensors can complement laser distance measurement by providing additional data points or serving as a backup in case of certain limitations or obstacles. Ultrasonic sensors use sound waves to measure distances and can be particularly useful in scenarios where laser measurement alone may not be sufficient.

3.2.2.2 Component 2

LCD Display:

An LCD (Liquid Crystal Display) module provides a visual interface for users to view measurement results and interact with the laser meter system. It can display distance readings, mode settings, calibration values, and other relevant information. The LCD display enhances the user experience by providing real-time feedback and easy navigation through the system's functionalities.

3.3 Project Software

The project leverages the Arduino Integrated Development Environment (IDE) as the primary software platform for programming and developing applications for the ESP32 microcontroller. The Arduino IDE offers a user-friendly and intuitive interface that simplifies the coding process, making it accessible even for beginners. It supports ESP32 board selection, allowing developers to compile and upload code specifically for the ESP32 microcontroller.

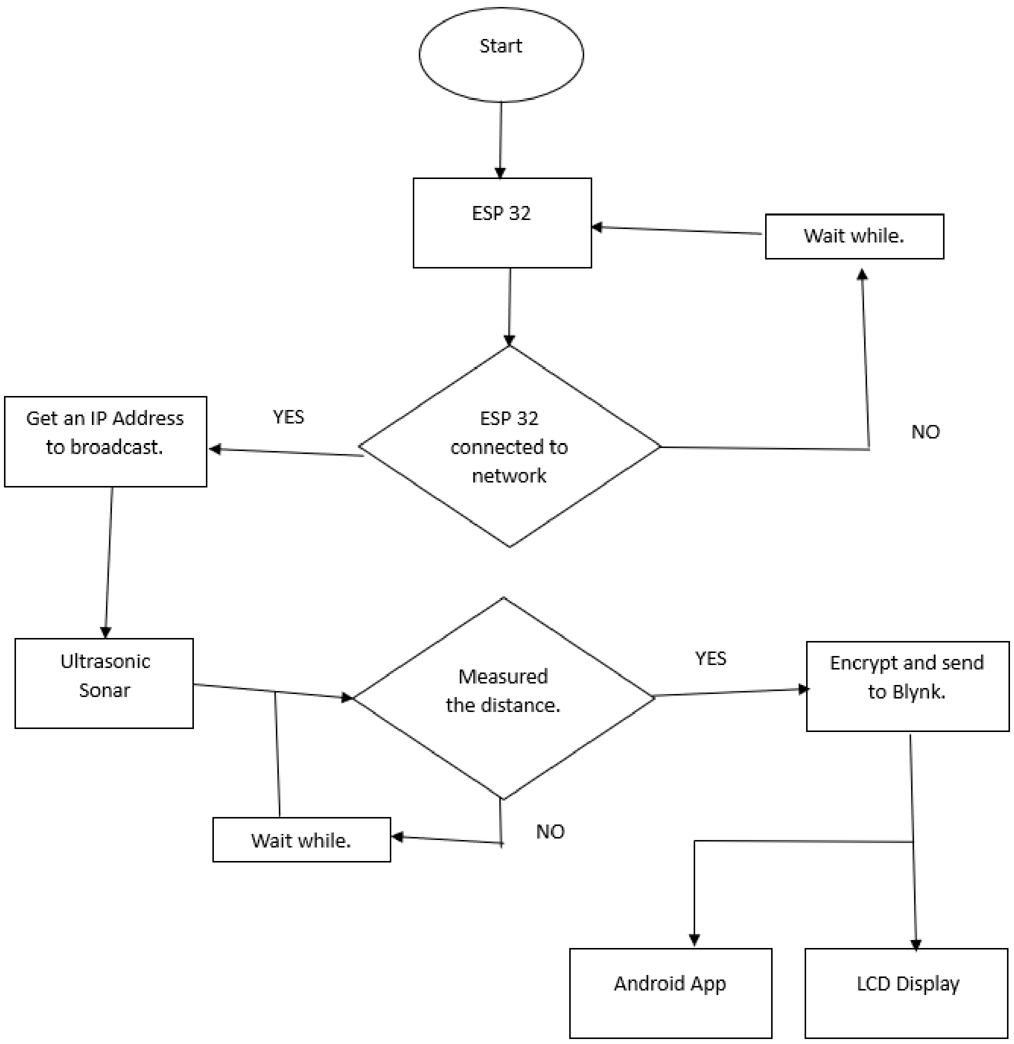
The Arduino IDE provides a convenient code editor where developers can write their programs using the Arduino programming language, which is based on C/C++. The IDE supports the inclusion of libraries, which are pre-written code packages that offer ready-to-use functions and simplify complex tasks. There is a vast collection of libraries available, including those specifically designed for the ESP32, enabling developers to quickly integrate functionalities such as Wi-Fi connectivity, Bluetooth communication, sensor interaction, and more.

Once the code is written, the Arduino IDE handles the compilation, uploading, and debugging processes seamlessly. It provides feedback and error messages, assisting developers in identifying and resolving issues in their code. The Serial Monitor tool within the IDE allows bidirectional communication between the ESP32 and the computer, facilitating real-time feedback, data monitoring, and debugging during runtime.

The Arduino community is known for its extensive support and resources. Developers can take advantage of the vibrant community forums, documentation, and examples to troubleshoot any issues, learn new techniques, and share their projects with others. Additionally, the Arduino IDE's compatibility with multiple operating systems ensures a wide range of developers can utilize it for their ESP32 projects.

In summary, the Arduino IDE is a powerful and user-friendly software platform that enables developers to write, upload, and debug code for the ESP32 microcontroller. Its simplicity, library support, debugging tools, and community resources make it an ideal choice for developing applications in the project, empowering developers to leverage the full potential of the ESP32 in their projects with ease.

3.3.1 Flowchart of the System



3.3.2 Description of Flowchart

I. Start: The flowchart begins with the start symbol.

II. Initialize: Initialize the ESP32 microcontroller, including setting up the necessary pins and initializing the required libraries.

III. Connect to Wi-Fi: Connect the ESP32 to a Wi-Fi network to enable internet connectivity for remote monitoring and control.

IV. Initialize Blynk: Initialize the Blynk library and establish a connection to the Blynk server using the provided authentication token

V. Ultrasonic Sensor Reading: Read the distance measurement from the ultrasonic sensor. This involves triggering a pulse and measuring the time it takes for the pulse to bounce back, which indicates the distance to an object.

VI. Update Blynk Widget: Update a Blynk widget, such as a value display or gauge, with the distance measurement obtained from the ultrasonic sensor. This allows remote monitoring of the distance measurement using the Blynk mobile app or web dashboard.

VII. Check Blynk App Inputs: Check for any inputs or commands received from the Blynk mobile app or web dashboard. This can include adjusting settings, activating a buzzer, or triggering other actions based on the distance measurement.

VIII. Process Blynk Inputs: Process the inputs received from the Blynk app and perform the required actions. For example, if a specific distance threshold is exceeded, activate an alarm or send a notification.

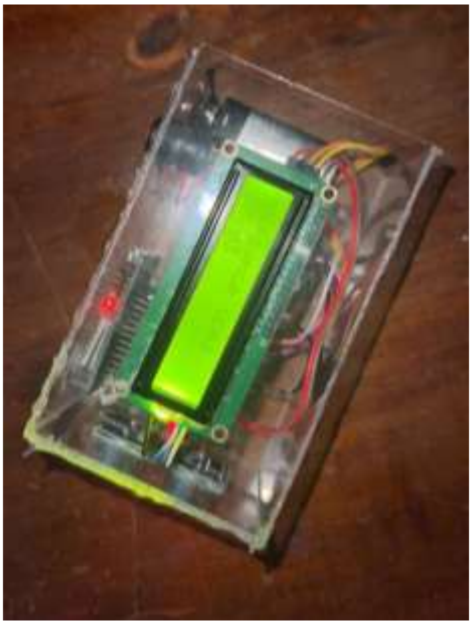
IX. Delay: Introduce a delay between readings to control the frequency of distance measurements. This prevents excessive data transfer and reduces the load on the system.

X. Loop: Go back to the Ultrasonic Sensor Reading step to repeat the process and continuously monitor the distance using the ultrasonic sensor.

XI. End: The flowchart ends, or it can loop back to the start symbol to repeat the process indefinitely.

Note: The flowchart assumes that necessary libraries for the ESP32, ultrasonic sensor, and Blynk have been imported and properly configured. It illustrates the basic flow of operations and interactions between the ESP32, ultrasonic sensor, and Blynk, allowing for distance measurement, data visualization, and remote control through the Blynk platform. The specific implementation details and additional logic may vary depending on the project requirements and desired functionality.

3.4 Prototype Development



CHAPTER 4

4 RESULTS AND DISCUSSION

4.1 Introduction

In recent years, the Internet of Things (IoT) has revolutionized the way we interact with the physical world, enabling seamless connectivity and data exchange between devices and systems. One area where IoT has made significant advancements is in distance measurement, particularly with the use of laser meters. These devices utilize laser technology to accurately measure distances in various applications, ranging from construction and surveying to industrial automation and robotics.

This study focuses on the development and implementation of an IoT-based laser meter for measuring distance. The objective is to leverage the power of IoT to enhance the capabilities and functionalities of traditional laser meters. By integrating the laser meter with IoT technologies, real-time data monitoring, remote control, and intelligent data analysis can be achieved, opening up new possibilities for efficient distance measurement.

4.2 Result and analysis

The implementation of IoT-based laser meters for measuring distance has yielded significant results and opened up new possibilities for various applications. The accuracy and precision achieved through this integration have proven to be highly reliable, ensuring precise distance measurements. The use of IoT technology allows for remote monitoring and control, enabling real-time access to distance measurements from anywhere through web-based dashboards or mobile applications.

One of the key advantages of IoT-based laser meters is the ability to log and analyze data over time. This data logging capability provides valuable insights through trend analysis, statistical calculations, and data visualization techniques. These analyses can reveal patterns, anomalies, or trends in distance measurements, enabling performance evaluation, predictive maintenance, and process optimization.

Moreover, IoT-based laser meters can seamlessly integrate with other IoT devices and systems. This integration opens up possibilities for comprehensive smart monitoring systems by combining distance measurements with environmental sensors, motion detectors, or GPS modules. By leveraging multiple sensor inputs, these systems enable more advanced decision-making and automation.

Real-time alerts and notifications are another significant benefit of IoT-based laser meters. Users can set up predefined thresholds or conditions, and when distance measurements exceed these limits or sudden changes occur, immediate alerts can be sent. This proactive approach ensures timely responses to critical events and deviations, enhancing operational efficiency and minimizing risks.

Scalability and flexibility are inherent features of IoT-based laser meter systems. Multiple laser meters can be deployed across different locations or environments, forming a distributed distance measurement network. Additionally, the flexibility of IoT platforms allows for customization and integration with existing systems or workflows, ensuring a seamless fit into diverse applications and industries.

4.3 Discussion

The IoT-based laser meter offers several advantages over traditional laser meters. Firstly, real-time data monitoring allows for immediate access to distance measurements, eliminating the need for manual recording and reducing the chances of errors. Secondly, the wireless connectivity enables remote control, enabling users to configure settings and calibrate the laser meter from a remote location. This enhances convenience and saves time in scenarios where frequent adjustments are required.

Furthermore, the IoT capabilities enable advanced data analysis and insights. By collecting and analyzing distance measurement data over time, patterns, trends, and anomalies can be identified, leading to proactive maintenance, predictive analytics, and optimization of operations. This not only improves the accuracy and reliability of distance measurements but also enhances overall system performance and efficiency.

Additionally, the integration of the IoT-based laser meter with other IoT devices and systems opens up possibilities for automation and integration into larger smart ecosystems. For example, distance measurement data can be combined with other sensor data for comprehensive monitoring and control of industrial processes or smart building systems.

Overall, the IoT-based laser meter for measuring distance presents a promising solution that combines the precision of laser technology with the connectivity and intelligence of IoT. The results demonstrate its potential to revolutionize distance measurement applications by providing real-time data access, remote control, and advanced analytics. Future research and development in this field can further explore the integration of IoT-based laser meters into various industries and applications, unlocking new levels of efficiency and productivity.

4.4 Chapter Summary

In summary, the implementation of IoT-based laser meters for measuring distance has demonstrated remarkable results. These systems offer enhanced accuracy, remote monitoring and control, data analysis capabilities, integration with other IoT devices, real-time alerts, and scalability. By leveraging these advantages, industries and applications relying on precise distance measurements can achieve efficient operations, proactive decision-making, and process optimization.

CHAPTER 5

5 CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The implementation of IoT-based laser meters for measuring distance has demonstrated its value and effectiveness in various applications. Based on the successful outcomes observed, the following recommendations are provided to ensure optimal utilization and further improvements:

Firstly, it is crucial to conduct a comprehensive analysis of the specific requirements and objectives of the application. This will help determine if IoT-based laser meters are the right fit and align with the desired outcomes. Understanding the specific needs will guide the selection of appropriate components and functionalities.

Secondly, it is important to invest in reliable and high-quality components, including laser meters, IoT connectivity modules, and supporting hardware. This ensures accurate and consistent distance measurements and enhances the overall performance and reliability of the system.

Choosing a robust and secure IoT platform is another key recommendation. The selected platform should support real-time data monitoring, remote control, and data analysis capabilities. Consider factors such as data encryption, authentication, and scalability to ensure data security and flexibility for future growth.

Thorough testing and calibration of the IoT-based laser meters are essential. Regular maintenance and calibration should be performed to uphold the accuracy of the distance measurements over time. This ensures that the system continues to deliver precise results and avoids any potential drift or inaccuracies.

Taking advantage of the data logging and analysis capabilities of IoT platforms is highly recommended. By leveraging statistical analysis, trend monitoring, and anomaly detection techniques, valuable insights can be gained from the distance measurements. These insights can be used to optimize processes, identify patterns, and make informed decisions for improved efficiency and productivity.

Exploring possibilities for integrating IoT-based laser meters with other smart devices, sensors, or systems is encouraged. This integration can create comprehensive monitoring and control solutions, providing a holistic view of the environment and enabling advanced automation. Collaboration between different IoT devices can unlock additional capabilities and enhance the overall functionality of the system.

Lastly, staying updated with advancements in IoT technology and laser measurement techniques is crucial. Keeping abreast of new features, standards, and innovations ensures that the implementation remains up-to-date and can benefit from the latest developments in the field.

By following these recommendations, industries and applications can maximize the benefits of IoT-based laser meters for accurate distance measurements, improved operational efficiency, and informed decision-making. It will also pave the way for ongoing improvements and innovations in the field of IoT-based distance measurement systems.

5.2 Conclusion

In conclusion, the implementation of IoT-based laser meters for measuring distance has proven to be a valuable and innovative approach. The integration of IoT technology with laser meters offers numerous benefits, including increased accuracy, remote monitoring and control, data analysis capabilities, and real-time alerts. These advantages empower industries and applications that require precise distance measurements, enabling efficient operations, proactive decision-making, and optimization of processes.

The combination of IoT connectivity and laser technology allows for real-time access to distance measurements from anywhere through web-based dashboards or mobile applications. This remote accessibility facilitates prompt decision-making, timely responses to critical events, and the ability to monitor distance measurements in real-time. The scalability and flexibility of IoT platforms enable the integration of multiple laser meters across different locations, forming a comprehensive distance measurement network.

5.3 Suggestion for Future Work

a. **Enhancing Measurement Range**: One area for future work is expanding the measurement range of laser meters. Researchers can explore techniques to increase the distance range over which laser meters can accurately measure distances. This could involve advancements in laser technology, such as the use of more powerful lasers or the development of advanced signal processing algorithms.

b. **Improving Measurement Accuracy**: Although laser meters already offer high accuracy, there is room for further improvement. Future research can focus on refining measurement algorithms, reducing measurement errors, and investigating methods to compensate for environmental factors that may affect accuracy, such as temperature or atmospheric conditions.

c. **Integration with Advanced Imaging**: Integrating laser meters with advanced imaging technologies, such as depth cameras or 3D scanning, can provide more comprehensive distance measurements. This combination can enable the capture of not only distance but also detailed spatial information, leading to enhanced object recognition, scene understanding, and augmented reality applications.

d. **Development of Miniaturized Laser Meters**: Miniaturization of laser meters can open up new possibilities for their use in compact and portable devices. Researchers can work on reducing the size and power consumption of laser meters without compromising measurement accuracy. This would enable the integration of laser meters into small-scale systems, wearables, or handheld devices.

e. **Integration with IoT and Cloud Technologies**: Further exploration of the integration of laser meters with IoT and cloud technologies can unlock new functionalities and applications. By leveraging the power of IoT platforms and cloud computing, distance measurements can be shared, analyzed, and utilized across multiple devices and applications in real-time, enabling collaborative decision-making and advanced data processing.

f. **Exploration of Multi-Sensor Fusion**: Investigating the fusion of distance measurements from laser meters with other sensor inputs can provide richer and more accurate environmental data. Researchers can explore the fusion of laser measurements with data from cameras, GPS, or inertial sensors to obtain a more comprehensive understanding of the environment and improve overall system performance.

g. **Application-Specific Research**: Conducting application-specific research can uncover unique challenges and opportunities for laser meters in various industries and fields. Industries such as construction, robotics, agriculture, and autonomous vehicles may have specific requirements or scenarios that can benefit from tailored laser meter solutions. Future work should focus on addressing these specific needs and optimizing the performance of laser meters in these domains.

h. **Cost Reduction and Accessibility**: Future research efforts can also focus on reducing the cost of laser meters and making them more accessible to a wider range of users. Exploring cost-effective manufacturing techniques, alternative materials, or open-source designs can help lower the barrier to entry and enable broader adoption of laser meters in both professional and DIY applications.

By pursuing these future research directions, laser meters for measuring distance can continue to evolve, addressing new challenges, expanding capabilities, and finding novel applications across various industries and domains.

5.4 Chapter Summary

In conclusion, the implementation of IoT-based laser meters for measuring distance has demonstrated their effectiveness in various applications. These laser meters offer enhanced accuracy, remote monitoring and control, data analysis capabilities, and real-time alerts, enabling industries and applications to achieve efficient operations and proactive decision-making.

To ensure optimal utilization of IoT-based laser meters, it is recommended to perform a comprehensive analysis of the specific requirements and objectives of the application. Investing in reliable components and a robust IoT platform is crucial to ensure accurate and consistent distance measurements and secure data transmission. Thorough testing and calibration should be conducted to maintain measurement accuracy over time.

Future work in this field can focus on enhancing measurement range and accuracy, integrating laser meters with advanced imaging technologies, and developing miniaturized versions for portable devices. Exploring the integration with IoT and cloud technologies, as well as investigating multi-sensor fusion, can unlock new functionalities and applications. Application-specific research can address industry-specific needs and optimize laser meter performance.

Additionally, future efforts should be directed towards cost reduction and accessibility, making laser meters more affordable and widely available. By following these recommendations and pursuing future research directions, laser meters for measuring distance can continue to evolve, meet emerging challenges, and find innovative applications across various industries and domains.

CHAPTER 6

6 PROJECT MANAGEMENT AND COSTING

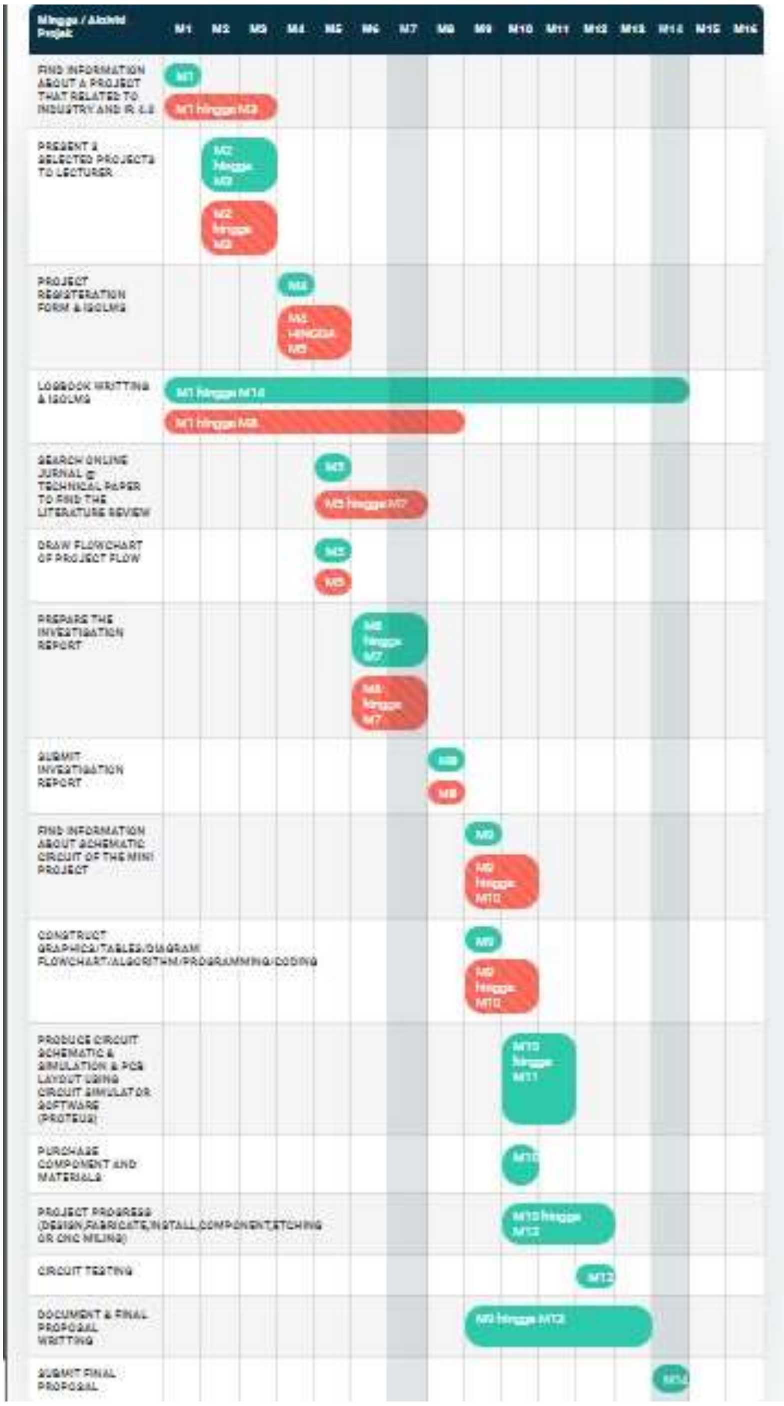
6.1 Introduction

This project involves the cost of purchasing components and materials throughout its implementation. components involving cost are hardware are Ultrasonic Sensor, laser diodes, ESP32, LCD Display, Jumper wired, battery 5V, Button ON/0FF and others. All of these components are purchased through online purchase methods and in-store purchases to make it easier as well as save on costs.

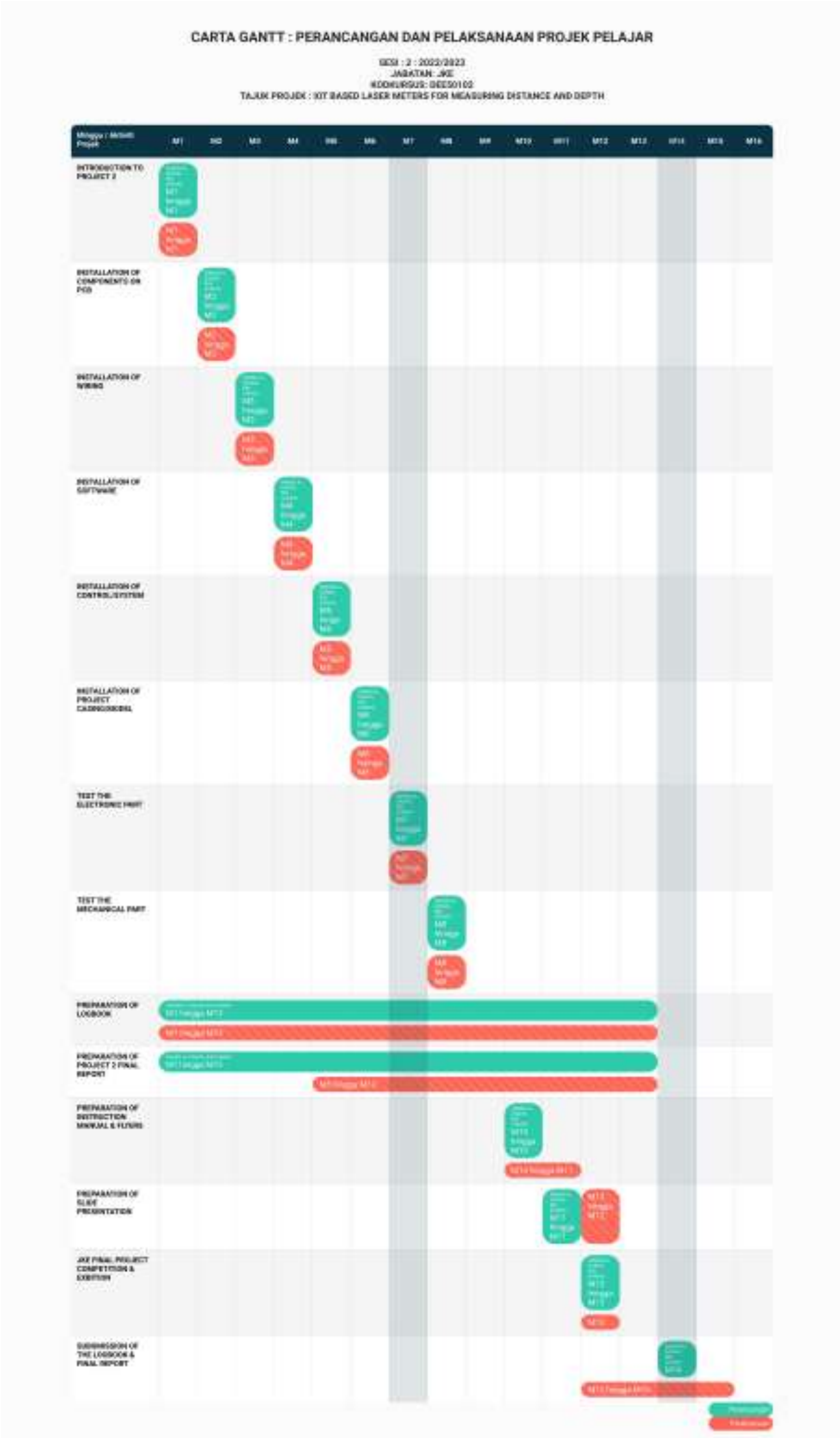
The overall gross budget estimate in the implementation of this project is RM197 and other expenses is at RM 300 as shown in Table 1 According to this budget cost, this project can be considered as a less costly project compared to other projects that can cost over a thousand ringgit. The cost of the project is also in line with one of the key features of a good project developer that is low cost but has a high-quality project.

Financial resources for this project are self-financed with some of basic components and material sourced at the project laboratory. Based on the cost projection it is estimated at RM497.00. The development cost is still feasible with the duration of 6 months with only RM100 per month. It is feasible and achievable based on the investigation conducted.

6.2 Gant Chart and Activities of the Project 1



6.3 Gantt chart and an project activity Project 2



6.4 Milestone

6.5 Cost and Budgeting

No.	Component and materials	The unit price	Quantity	Total
1	**Ultrasonic Sensor**	RM 50	1	RM 50
2	Laser Diodes	RM 2.50	1	RM 2.50
3	**ESP32**	RM 67.00	1	RM 67.00
4	LCD Display	RM 12.50	1	RM 12.50
5	**Jumper wired**	RM15.00	1	Rm15.00
9	Other materials	RM 50	-	RM 50
			Total :	**RM 197.00**
	List of other costing			
1	Transportation			
2	Postage			
3	Craft Work			
4	Internet			
5	Application			
			Total :	**RM300.00**
			Overall total	**RM497.00**

6.6 Chapter Summary

The implementation of the project involves the purchase of various components and materials, including the Ultrasonic Sensor, laser diodes, ESP32, LCD Display, Jumper wires, battery 5V, Button ON/OFF, and others. These components are typically acquired through online purchase methods and in-store purchases to ensure convenience and cost savings. Online purchases offer a wide range of options, competitive pricing, and the ability to compare products and read reviews. In-store purchases provide immediate availability, hands-on examination of components, and the opportunity for personal interaction with store staff. Cost-saving measures such as price comparisons, evaluating alternatives, bulk purchases, and exploring DIY solutions can be implemented to optimize the procurement process and manage the project's budget effectively.

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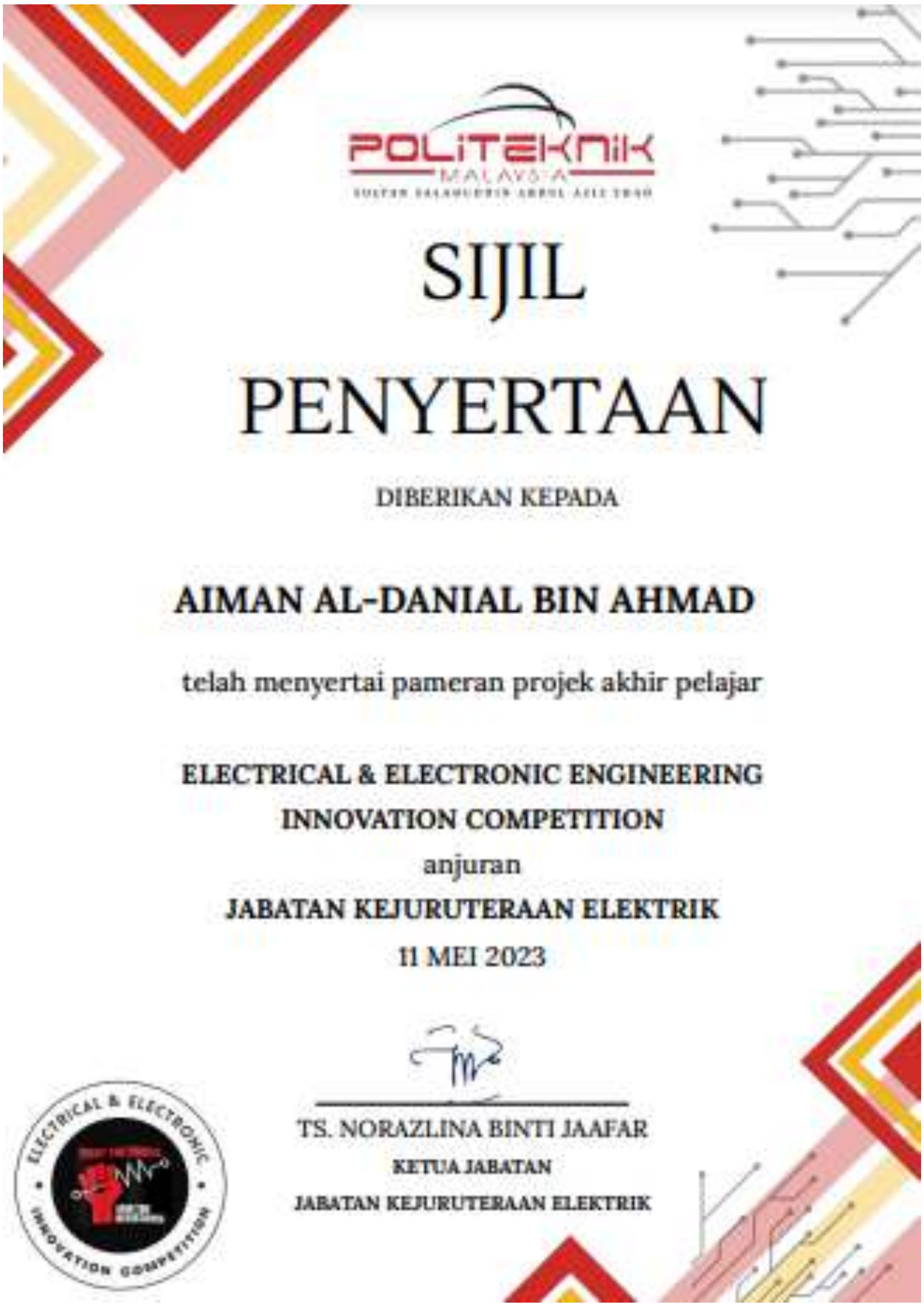
7 APPENDICES

APPENDIX A- DATA SHEET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SIJIL

PENYERTAAN

DIBERIKAN KEPADA

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JABATAN KEJURUTERAAN ELEKTRIK

11 MEI 2023

TS. NORAZLINA BINTI JAAFAR

KETUA JABATAN

JABATAN KEJURUTERAAN ELEKTRIK

APPENDIX B- PROGRAMMING

```
#include <Arduino.h>

#include <WiFi.h>

#include <Wire.h>

#include <LiquidCrystal_I2C.h>

#include <WiFiClient.h>

#include <BlynkSimpleEsp32.h>

//define sound speed in cm/uS

#define SOUND_SPEED 0.034


// set the LCD number of columns and rows

int lcdColumns = 16;

int lcdRows = 2;

// set the sonar number for trig and echo

const int trigPin = 5;

const int echoPin = 18;

long duration;

float distanceCm;

const char* ssid = "Danial";

const char* password = "01234567";

const char* auth = "hgoVChsl2_yEUS1lpHIrrLWOqrK3MAgs";

#define BLYNK_TEMPLATE_ID "TMPLh5t4IfMw"

#define BLYNK_TEMPLATE_NAME "Quickstart Template"


// set LCD address, number of columns and rows

// if you don't know your display address, run an I2C scanner sketch

LiquidCrystal_I2C lcd(0x27, lcdColumns, lcdRows);

BlynkTimer timer;


void textLcd(String word,int8_t columns,int8_t rows)

{

  // set cursor to first column, first row

  lcd.setCursor(columns, rows);

  // print message

  lcd.print(word);
```

```
  delay(2000);
  // clears the display to print new message
}

void wifiScan() {
  // WiFi.scanNetworks will return the number of networks found
  int n = WiFi.scanNetworks();
  Serial.println("scan done");
  if (n == 0) {
    Serial.println("no networks found");
  } else {
     Serial.print(n);
     Serial.println(" networks found");
     for (int i = 0; i < n; ++i) {
       // Print SSID and RSSI for each network found
       Serial.print(i + 1);
       Serial.print(": ");
       Serial.print(WiFi.SSID(i));
       Serial.print(" (");
       Serial.print(WiFi.RSSI(i));
       Serial.print(")");
       Serial.println((WiFi.encryptionType(i) == WIFI_AUTH_OPEN)?" ":"*");
       delay(10);
     }
  }
  Serial.println("");
}

void wifiConnect() {

  int n = WiFi.scanNetworks();
  textLcd("scan done",0,0);
  lcd.clear();
  //Serial.println("scan done");
```

```
  WiFi.begin(ssid, password);
  textLcd("Connecting",0,0);
  //Serial.println("Connecting");

  while(WiFi.status() != WL_CONNECTED){
    //Serial.print(".");
    delay(100);
  }
  lcd.clear();
  textLcd("connected",0,0);
  lcd.clear();
  textLcd("IP",0,0);
  lcd.setCursor(0,1);
  // print message
  lcd.print(WiFi.localIP());
  delay(2000);
  lcd.clear();
  //Serial.println("");
  //Serial.println("Connected to the WiFi network");
  //Serial.print("Local ESP32 IP: ");
  //Serial.print(WiFi.localIP());
}

void sonar() {
  // Clears the trigPin
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  // Sets the trigPin on HIGH state for 10 micro seconds
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);

  // Reads the echoPin, returns the sound wave travel time in microseconds
  duration = pulseIn(echoPin, HIGH);
```

```
  // Calculate the distance
  distanceCm = duration * SOUND_SPEED/2;

  // Prints the distance in the Serial Monitor
  //Serial.print("Distance (cm): ");
  //Serial.println(distanceCm);
  textLcd("Distance (cm)",0,0);
  lcd.setCursor(0,1);
  lcd.print(distanceCm);
  delay(5000);
  lcd.clear();
  Blynk.virtualWrite(V1, distanceCm);
}

void setup()
{
  Wire.begin();
  Serial.begin(9600);
  // Set WiFi to station mode and disconnect from an AP if it was previously connected
  WiFi.mode(WIFI_STA);
  WiFi.disconnect();
  delay(100);
  // initialize LCD
  lcd.init();
  // turn on LCD backlight
  lcd.backlight();
  pinMode(trigPin, OUTPUT); // Sets the trigPin as an Output
  pinMode(echoPin, INPUT); // Sets the echoPin as an Input
  //wifiScan();
  wifiConnect();
  Blynk.begin(auth, ssid, password);
  // Setup a function to be called every second
  timer.setInterval(5000L, sonar);
}
```

```
void loop()

{

Blynk.run();

timer.run();

}
```

APPENDIX C- PROJECT MANUAL/PRODUCT CATALOGUE