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IoT System for Distance and Battery Usage for Mobile Lawn Mower Machine

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KEYWORDS

IoT
Lawn mower
Ultrasonic Sensor

ABSTRACT

This project presents an innovative Internet of Things (IoT) system designed to revolutionize lawn maintenance practices. The proposed system integrates smart sensors into mobile lawn mower machines to enable real-time distance monitoring and battery usage optimization. The incorporation of sensors ensures precise lawn coverage and eliminating overlap. Moreover, data-driven insights on battery usage promote energy efficiency and extend mowing sessions. The user-friendly control unit and application provide seamless remote monitoring and control, empowering users to schedule and manage mowing sessions with ease. By harnessing IoT technology, this system enhances lawn maintenance efficiency, reduces energy consumption, and promotes sustainable practices in lawn care.

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1.0 INTRODUCTION

The project background for the development of an IoT system for distance and battery usage monitoring on a mobile lawn mower machine revolves around the need to address various challenges in traditional lawn care practices. Manual lawn mowing often results in inefficiency, imprecise data insights, and safety concerns. Users face difficulties in accurately tracking the distance covered during mowing sessions and monitoring the battery's health and usage patterns, leading to unexpected interruptions and increased maintenance costs.

With advancements in IoT technology, there is an opportunity to transform the lawn care industry by incorporating smart and connected solutions. IoT offers the potential to connect the mobile lawn mower to the internet, collect real-time data, and enable remote monitoring and control.

Integrating IoT capabilities into the lawn mower can significantly enhance its functionality and user experience[1]–[7].

The project is driven by the growing demand for smart and automated solutions that simplify daily tasks. Homeowners and landscaping professionals seek innovative technologies that streamline lawn maintenance while reducing manual efforts and enhancing convenience. Additionally, with the increasing focus on environmental sustainability, an IoT system for distance and battery usage monitoring can contribute to reduced energy consumption, optimized battery usage, and a more eco-conscious approach to lawn care[8]–[12].

Safety during lawn mowing operations is also a significant concern. The integration of autonomous navigation and obstacle avoidance features in the IoT-enabled mower can enhance safety by minimizing accidents and collisions with obstacles[1], [3], [13]–[16].

Furthermore, in the competitive landscaping and lawn care market, businesses and manufacturers aim to differentiate their products and services. An IoT-enabled mobile lawn mower with advanced monitoring and control features offers a unique selling point, attracting environmentally conscious consumers seeking efficient and smart lawn care solutions.

In summary, the project background emphasizes the need for an innovative IoT system that addresses the limitations of traditional lawn care practices. By leveraging IoT technology, the project aims to provide users with a smarter, more efficient, and environmentally conscious approach to maintaining their lawns.

2.0 METHODOLOGY

2.1 Project Methodology

The aim is to provide a clear and structured explanation of the strategies and procedures undertaken to design, develop, and implement the innovative IoT system. The project's primary goal is to create an advanced solution that revolutionizes lawn maintenance, providing users with precise distance monitoring, battery usage optimization, and enhanced user experience.

The methodology section of any project serves as a critical framework that outlines the systematic approach and techniques employed to accomplish the project's objectives. It offers a comprehensive roadmap, detailing the steps, processes, and tools used throughout the project's lifecycle, ensuring its successful execution.

2.2 Material

Material selection isn't just another step; it's a crucial crossroads for our project. Precise choices are essential to avoid costly delays or wasted resources. Imagine navigating a labyrinth, where each path represents a different material option. Each option offers unique strengths, flexibility, and cost considerations. But picking the wrong one can lead us down a dead end. To ensure we make the best choices, we need a deep understanding of each material's benefits, limitations, and how they interact under project pressures.

The methodology starts with a block diagram that acts as our roadmap. It lays out the project's input devices, processing unit, and output devices, visually depicting the information flow. This diagram serves as the foundation for the flowchart, which details the project's development stages. By visualizing the project in this way, we can make informed material decisions, ensuring a smooth and efficient journey towards our goals.

2.3 Block diagram

The block diagram is a diagram that has three elements that are an input device, a processing device, and an output device. The material of IoT system for distance and battery usage for mobile lawn mower machine starts with a voltage sensor that detect the total voltage of the battery. For the microcontroller (process) ESP32 has been chosen because of its strengths include high processing power and connectivity features. The value of the voltage will be shown on the I2C LCD. The program in the ESP32 will transfer to the worm motor to move the wheel during the cutting process and the blade to active for the grass cutting process. Figure 1 show the block diagram for mobile lawn mower machine.

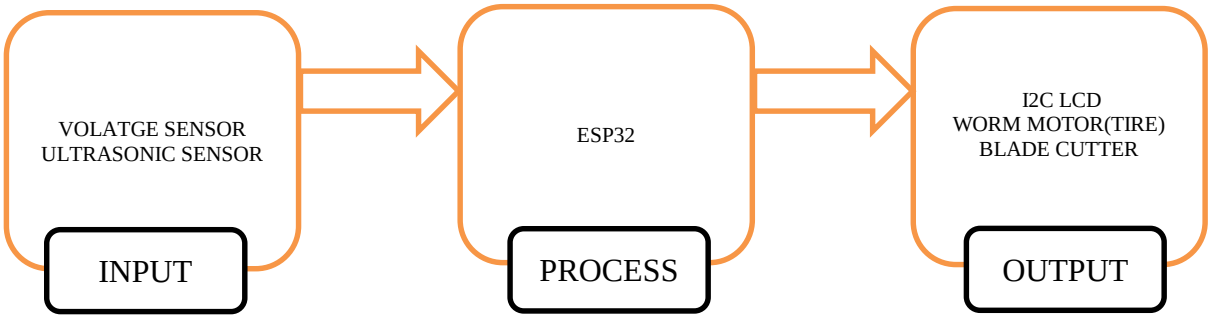

Figure 1: Block Diagram

2.3.1 Flowchart

Flowcharts are used in designing and documenting simple processes or programs. Like other types of diagrams, they help visualize what is going on and thereby help understand a process of works or project. Figure 2 shows the project flowchart. The flowchart shows how the lawn mower work. First the IoT will be initialize to start the robot and be prepare to track the voltage and distance. After the lawn mower is active, the lawn mower will start the lawn mowing process by moving with pattern programmed through ESP32. The data received by voltage sensor and ultrasonic sensor will be tracked in the software, thinger.io.

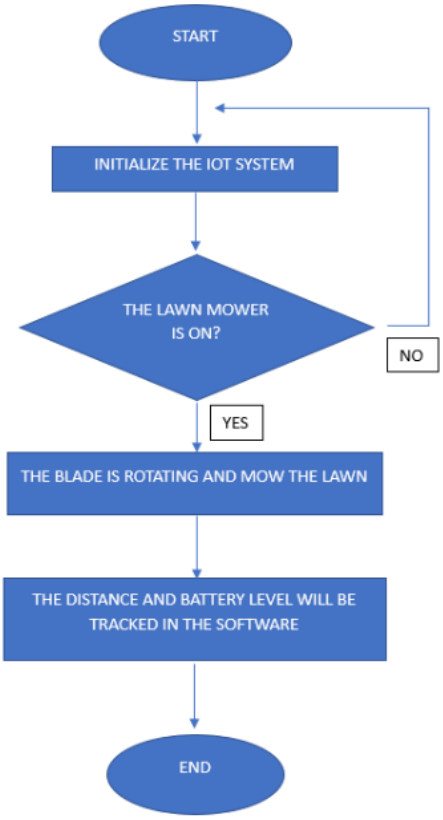

Figure 2: Flowchart

2.4 Principle of Operation

Make a rough sketch by using AutoCAD software. These are what it looks from top view and bottom view. The steel blade cutter will be at the bottom to cut the grass. Every electrical component will be put in an electrical box on top of the lawn mower. Figure 3 show the design of mobile lawn mower machine.

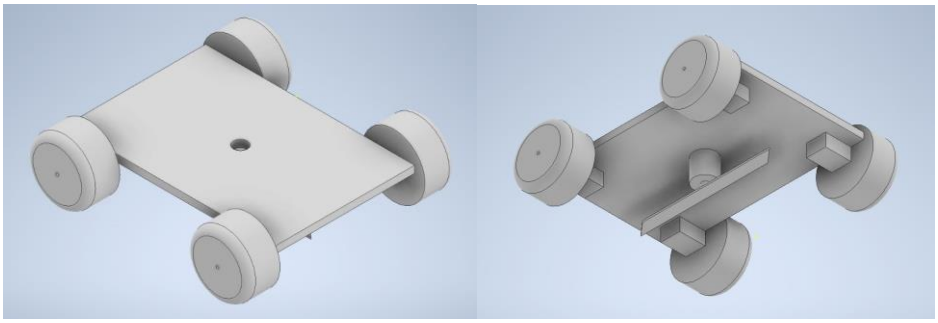

Figure 3: 3D Design Sketch

3.0 RESULTS AND DISCUSSION

The first graph shows the detection of ultrasonic sensor to the obstacle. The high amplitude of the graph is the farthest the ultrasonic can detect. When the graph is going down and getting near to 50cm and under, that is the time when the lawn mower will change the route of the grass cutting by following the coding. Then the graph is rise up again because that is the distance between the lawn mower with the next obstacle. They are far and getting close again. Figure 4 show the prototype of mobile lawn mower machine.

Figure 4: Result of hardware development

The second graph shows the measurement of voltage of the battery. The graph getting drop every second shows the voltage is used and getting lower than the first measurement. Figure 5 show the data graph form Thinger IoT platform.

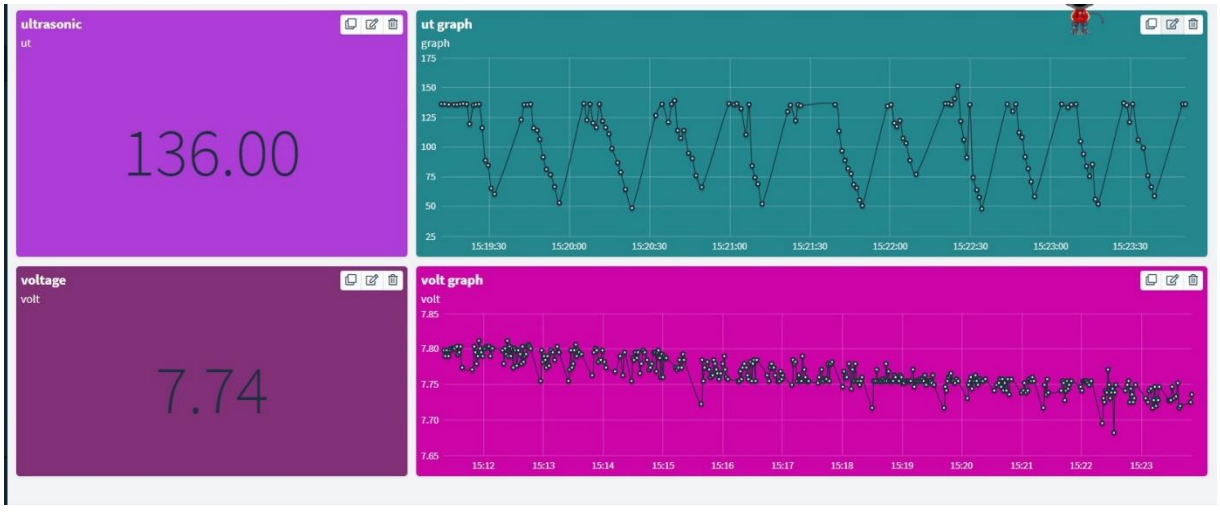

Figure 5: Graph for Ultrasonic detection and Voltage measurement

The data bucket shows the Data id collected which is the distance measurement and volt for the voltage measurement. It shows the data in a table form for every 1 minute. Table 1 show the data bucket collecting from Thinger IoT platform.

Table 1: Bucket list for the data collected

Date	DataId	Volt
1/12/2024, 3:23:49 PM	135.94906616210938	7.725046157836914
1/12/2024, 3:21:58 PM	134.2660675048828	7.746707916259766
1/12/2024, 3:20:59 PM	136.40806579589844	7.738584518432617
1/12/2024, 3:19:56 PM	52.870025634765625	7.754830837249756
1/12/2024, 3:18:06 PM	135.94906616210938	7.779200077056885
1/12/2024, 3:16:15 PM	135.94906616210938	7.754830837249756
1/12/2024, 3:15:12 PM	136.00006103515625	7.773784637451172
1/12/2024, 3:14:11 PM	135.5750732421875	7.768369197845459
1/12/2024, 3:12:19 PM	114.24005889892578	7.798153877258301
1/12/2024, 3:11:20 PM	136.0680694580078	7.798153877258301
1/12/2024, 3:10:20 PM	105.51905059814453	0
1/12/2024, 3:08:31 PM	79.66204071044922	0
1/12/2024, 3:06:43 PM	54.70602798461914	0
1/12/2024, 2:57:51 PM	0	0

4.0 CONCLUSIONS

This research successfully validates the project's aim of creating a smart mobile lawn mower with IoT capabilities. This technological advancement offers a promising solution for revolutionizing traditional lawn care by promoting convenience, efficiency, and eco-friendliness. Further development and testing are crucial to confirm its potential for widespread adoption and positive impact on both individual users and the environment. The research confirms the feasibility of the smart mobile lawn mower concept with distance and battery monitoring using IoT. This paves the way for further development, focusing on optimizing the technology, refining the user interface, and conducting field trials. By addressing these aspects, the project can move towards commercialization and contribute to a smarter and more sustainable approach to lawn maintenance.

Author Contribution

Muhammad Amirul Syafiq: Conceptualization, methodology, investigation, visualisation, writing and editing. Kharudin Ali: Investigation, supervision, writing, IoT and editing. Nazry Abd Rahman: Hardware development and data analysis.

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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