A project report on

Automatic Grass Cutter

Submitted in partial fulfilment for the award of the degree of

Bachelors In Electronics And Computer

Bachelor of Technology in ELECTRONICS AND COMPUTER

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I hereby declare that the thesis entitled "AUTOMATIC GRASS CUTTER" submitted by ADITYA SINHA(21BLC1590),APARAJITH L(21BLC1566),MITHRAVINDA NAMBIAR(21BLC1602), for the award of the degree of Bachelor of Technology in Electronics And Computer, Vellore Institute of Technology, Chennai is a record of bonafide work carried out by me under the supervision of Dr Paravathy Ak.

I further declare that the work reported in this thesis has not been submitted and will not be submitted, either in part or in full, for the award of any other degree or diploma in this institute or any other institute or university.

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Signature of the Guide:

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Date:14/11/2024

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ABSTRACT

In this paper, we describe the structure of an Automatic Grass Cutting Machine, its construction and the testing of the resultant prototype of the machine with an objective of providing a low energy and automated solution for profession for lawn maintenance. The proposed system makes use of a central controller which is an Arduino Uno. This controller acts as the heart of the entire machine as due to its features, it ensures that the automation is both flexible and reliable. Several essential components of the system include but not limited to L293D motor driver shield, ultrasonic sensor, and DC motors for autonomous functions.

The device's primary purpose is to move about the given lawn area and carry out the automatic cutting of grass whilst avoiding many obstacles that may lie in its path. The automatic cutting machine can apply ultrasonic sensors on the obstacle to determine whether the machine will change its course on movement and how the machine will cut grass without assistance. This takes care of the labor that is necessary to carry out lawn mowing which at the same time saves energy in the sense that the system is self-drive and it is efficient.

Additionally, the concept of "breaking the ice" with innovative solutions is inherent in this design. The device offers a fresh perspective on traditional lawn maintenance by integrating automation, energy efficiency, and smart obstacle navigation into a single compact device. By addressing the common challenges faced in manual lawn mowing, this device provides a modern, hands-free approach that could transform lawn care practices.

This paper describes the construction of the device and the testing scheme that was designed in order to perform tests of the designed grass cutting machine. The first test results demonstrate that the automatic cutting device carries out grass cutting and at the same time avoids most of the obstacles in an efficient manner and the second part of breaking ice which are freezing over grass and eventually cutting the grass beneath it

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Table Of Contents

Introduction 7

Components 7

Literature Survey 7

Methodology 9

Flow Chart 11

Results And Discussions 12

Conclusion 12

Refrences 14

List Of Figures

Figure 1.0 11

I. INTRODUCTION

Automation technologies are developing to provide new opportunities for simplifying common tasks in people's everyday lives, maintaining their lawns in every weather included. Traditional lawn mowing is usually labour-intensive, time-consuming, and may require a lot of physical effort. In the case of an automated grass-cutting machine, it would be a piece of work without much hassle on behalf of the user. The project presented here focuses on a grass-cutting machine based on Arduino, which leads us to the use of sensors for automation to cut grass efficiently and safely as well break ice in winter season. The system is designed to be user-friendly, and it is designed with obstacle detection that prevents collision but, instead dynamically manoeuvres the machine around the obstacle.With the add on feature of breaking ice for winter usage Index terms: robotic mower, automation, obsolete lawn mowing challenges. This paper describes the development process of such a machine, components, and functionality and presents a feasible solution to traditional grass-cutting challenges with automation in a process that usually requires manual input.

II. COMPONENTS

The following are the components of this automated grass cutter, selected to assure the best output on functionality, reliability, and energy efficiency:

- ***Arduino Uno:*** *This is the system's microcontroller, which receives and processes sensor input and sends out such signals to the motors. The Arduino executes a pre-written code that drives machine movement and the cutting action through runtime sensor response.*
- ***L293D Motor Driver Shield:*** *It connects between Arduino and the motors for the control of the direction and speed of DC motors. It allows for bidirectional movements; hence, the machine can move around obstacles.*
- ***Ultrasonic Sensor:*** *Attached at the front of the machine, this sensor detects obstacles by sending ultrasonic waves in the form of rays and measures its reflection. Obstacle detection within a certain range, collision avoidance thru stopping of the whole Arduino, and changing direction.*
- ***DC Gear Motor:*** *A high-powered motor for rotating blades; it provides the required torque for efficient cutting across varying grass densities, therefore making the cutting uniform in nature.*

Each component above communicates thru a circuit with the other to ensure effective power distribution across the system.

III. LITERATURE SURVEY

The evolution of automated grass-cutting systems has shifted from simple perimeter-based models to sophisticated, energy-efficient robots that leverage advanced navigation and renewable energy. Early designs, limited by random navigation and frequent overlaps, wasted energy and time. Recent improvements, as highlighted in studies, incorporate GPS and adaptive path-finding algorithms, allowing robots to navigate precisely, reduce overlap, and avoid missed spots, thus improving efficiency. Solar power integration further extends operational time and reduces dependence on external power sources, making these machines sustainable alternatives to traditional mowers. Research demonstrates that solar-powered models can operate continuously during daylight, minimizing environmental impact and aligning with eco-friendly lawn care practices. Multi-functional robotic vehicles, designed with sensor fusion techniques, now enable additional agricultural tasks like soil tillage, offering flexibility across diverse applications. These advancements in energy-efficient algorithms, solar power usage, and multi-functionality reflect a growing focus on sustainable automation in outdoor tasks. Economic analyses confirm the long-term cost-effectiveness of these innovations, positioning solar-powered robotic lawn mowers as valuable tools for residential and commercial users who seek efficient, environmentally conscious solutions for lawn maintenance.

A solar-powered smart lawn mower controlled via an Internet of Things (IoT) system to address the need for sustainable lawn maintenance. Traditional mowers are inefficient and environmentally harmful, prompting the design of a mower that minimizes human intervention while promoting energy efficiency. The system includes hardware components like a brushless direct current motor and Raspberry Pi for edge computing, alongside software for motor control and communication via an Android app. Experimental results show an average electrical efficiency of 89.5%, significantly outperforming conventional mowers. This study concludes that the IoT-based solar-powered mower is an effective, eco-friendly solution for lawn care, with potential for future enhancements like autonomous operation.Lawn mowing is crucial for maintaining an aesthetically pleasing environment and controlling grass growth, yet traditional methods can be labor-intensive, time-consuming, and may lead to musculoskeletal disorders (MSDs) over time. In today's fast-paced world, investing time in lawn mowing is often impractical. While automated lawn mowers could alleviate these issues, many existing models are expensive, energy-inefficient, and lack safety features. This study aims to address these limitations by designing a portable, safer, and more efficient autonomous lawn mower resembling a mini four-wheeler, equipped with an electromagnetic trimmer, a bendable solar panel for battery charging, and a proximity sensor for obstacle detection. The design process involved a survey of 200 individuals to identify customer needs, which were analyzed using the Kano Model and translated into technical requirements via Quality Function Deployment (QFD). A 3D model was created, refined through simulations, and tested for stability and performance, emphasizing lightweight materials like aluminum alloy for improved portability. Experimental results confirmed enhancements in safety, energy efficiency, and *overall functionality, although some features, such as a grass collection box and advanced sensors, were excluded to maintain cost-effectiveness and portability. This study successfully presents a cost-effective, lightweight, and innovative automated lawn mower, paving the way for future enhancements to further improve its capabilities*

The Fully Automated Grass Cutter, a solar-powered robotic lawnmower designed for autonomous operation using ultrasonic sensors for obstacle avoidance. Motivated by the need to reduce pollution from gas-powered mowers and high fuel costs, this project seeks to innovate in a stagnant industry by leveraging accessible electric motors and solar technology. The design comprises three sections: the electrical setup with a 12-volt battery system, the software development for the Arduino Uno microcontroller, and the mechanical construction of the mower. Performance evaluations confirm its versatility across various terrains and effective safety features. While the solar panels extend runtime, the paper notes a lack of detailed analysis on power efficiency. In conclusion, the mower successfully demonstrates a feasible, eco-friendly solution for lawn care, with future improvements suggested in obstacle detection, navigation, and grass collection mechanisms.Addressing the inefficiencies of traditional seed sowing and grass cutting methods that are labor-intensive, time-consuming, and prone to inconsistencies. Key issues include inefficiency over large areas, physical strain from manual labor, and inaccuracies in seed distribution and grass cutting. The proposed design features a wheeled chassis for rough terrain navigation, a seed sowing mechanism with a hopper, a rotating blade for grass cutting, and a microcontroller for control. Sensors are included for obstacle avoidance and navigation. The methodology involves component selection, fabrication, programming, and testing to evaluate performance in seed sowing accuracy and grass cutting efficiency. Results indicate effective seed planting and even grass cutting, with the rover demonstrating autonomous navigation. The analysis highlights design effectiveness and suggests areas for future performance improvements

IV. METHODOLOGY

The functioning of the system involves assembling hardware and programming software. The methodology followed for the development is a structured one hereinafter:

- **A. Hardware Assembly**: *The components are assembled onto a frame that holds the Arduino, motors, battery, sensor, and cutting blades. The motor driver shield is mounted on the Arduino for controlling the functions of the motors. The ultrasonic sensor is positioned on the front, angled to detects any obstacles in the path of the machine.The ice breaker blade is mounted on the backside of device which helps the device to break ice in front before moving forward*
- **B. Software Programming**: *Programming for the system is done in the Arduino environment. In the code, the following is included:*
    - *Declaration of input/output pins and initialization of sensors and motor drivers.*
    - *Obstacle detection logic-continuously scan for obstacles with the mounted ultrasonic sensor. If an obstacle is detected, the machine stops and traces its direction to get a clear path.*
    - *Motor Control: Dc motors to be on to move and rotation of the blade. The motor driver shield provides the facility for changing the speed and direction of motors depending on sensor data input.*
    - *Cutting Control: The blade motor switches on while operating along an ascertained path, thus avoiding cutting grass at unwanted places.*

The machine travels in a pre-programmed flow chart that loops continuously between these functions with each other.

V. FLOW CHART

The system can be summarized below:

1. ***Start**: System powers up, component initialization at their usual default setting*
2. ***Obstacle Check**: Ultrasonic Sensor is in constant checking mode for any obstacles.*
    - ***Yes (Obstacle Found)**: If the obstacle is present, the machine stops, moves back a bit in the motion and turns to a new direction to avoid the obstacle.*
    - ***No (No Obstacle)**: If no obstacle is detected, the machine moves forward and switches the motor for the blade on.*
3. ***Cut Grass**: The machine moves forward while the motor cuts the grass.*
4. ***Ice Breaker:** When the machine detects ice it breaks then going ahead with cutting grass behind it*
5. ***Loop**: The cycle will keep going on until manually stopped. This is the logic that will make it keep moving and cutting while nothing is touched by the machine.*

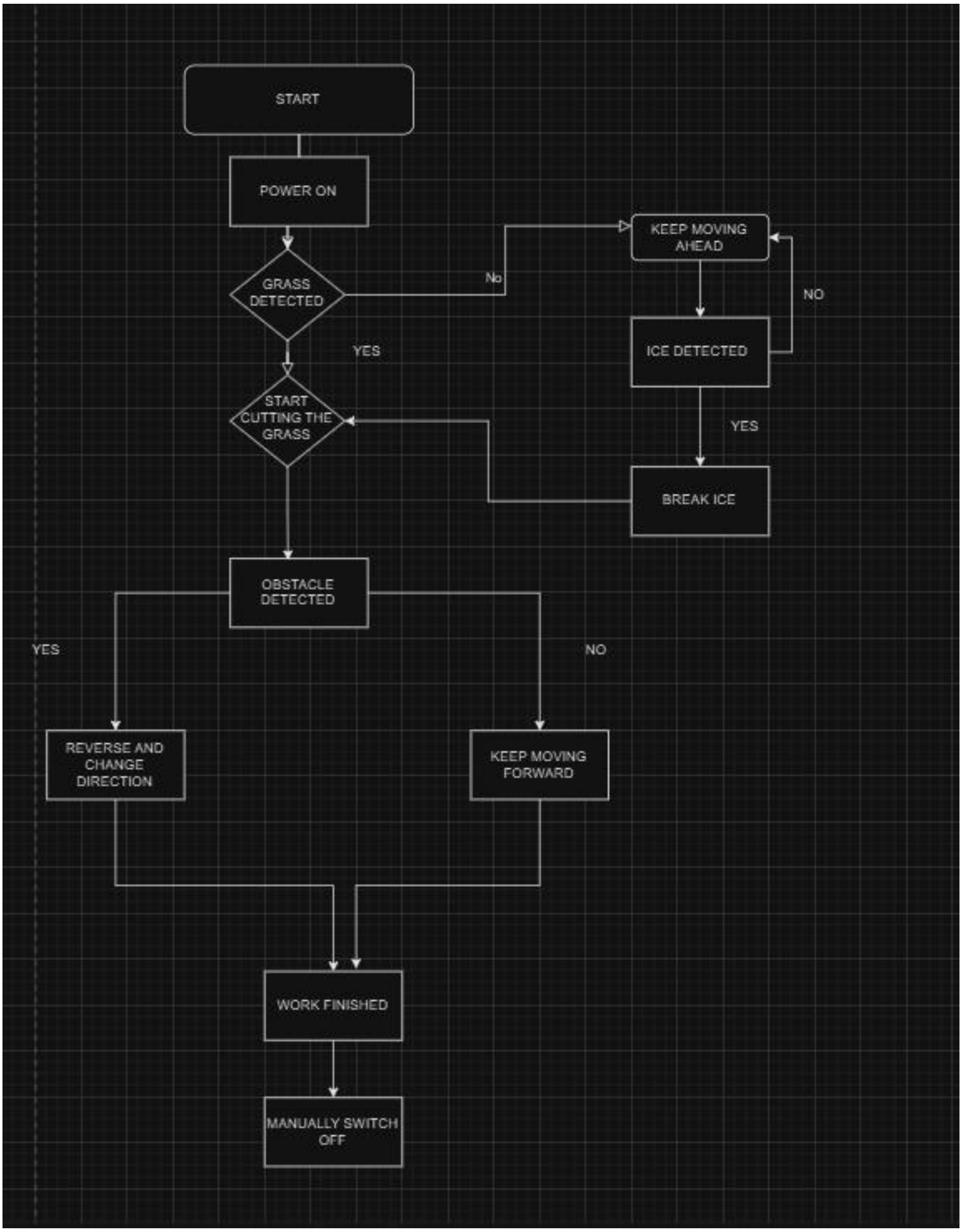

Figure 1.0

VI. RESULTS AND DISCUSSION

Initial testing of the prototype shows successful automated grass cutting. It efficiently detects obstacles and navigates around them, hence minimizing the need for human supervision. The quality of the cut was normal, with performance only sometimes depending on the grass's density and type of terrain.

- ***Observations***
  - ***Efficiency**: The machine cuts on its own, without any section being repeated in the area that it cuts; therefore, it is effective in its work.*
  - ***Obstacle Avoidance**: The ultrasonic sensor system did successfully prevent collisions, although minute adjustments were always required for unusually shaped obstacles.*
  - ***Energy Consumption**: This is designed in a very power-saving way. It draws a negligible amount of power compared to its operational time, hence can be conveniently used for any amount of time.*

VII. CONCLUSION

The Automatic Grass Cutting Machine is an innovative and energy-efficient solution toward lawn maintenance in all year round, reducing labour and bringing precision in lawn care. With an Arduino-based system and sensor-driven navigation, the machine manages autonomous grass cutting while avoiding obstacles. This is a proof-of-concept project in building simple automation using microcontrollers and other components for tasks usually done precisely by hand. It thus promises great avenues in household automation. From the results, this proves that both the design and functionality of the machine can be used for more general applications in residential and commercial improvements in lawn care.

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