IOT ENABLED SOLAR GRASS CUTTING ROBOT

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Abstract: **This paper presents an innovative IoT-enabled grass-cutting robot designed to streamline lawn maintenance processes with enhanced efficiency and convenience[1]. The robot, controlled through the Blynk mobile application[3,4] , operates in both Manual [6] and Automatic modes[7,8] , offering users versatile control options tailored to their preferences and works efficiently through the solar power[9]. In Automatic mode, the robot utilizes ultrasonic sensors[10,11] for obstacle avoidance, ensuring safe and efficient navigation across the lawn area. Through seamless integration with the Blynk app, users can effortlessly switch between modes, customize cutting parameters. The incorporation of ultrasonic sensors represents a significant advancement in the robot's capabilities, enabling it to detect obstacles and autonomously adjust its course to avoid collisions while ensuring continuous grass cutting. This feature enhances the safety of the lawn maintenance process, minimizing the risk of damage to both the robot and surrounding objects.**

Keywords— IOT, Blynk App, Node MCU, Microcontroller, Blynk Cloud Platform, Mobile AppInterface, Solar Panel

I. INTRODUCTION

This paper introduces an advanced IoT-enabled grass-cutting robot designed to optimize lawn maintenance with enhanced efficiency and convenience and charging the battery through an renewable energy source of Solar power. The robot is controlled via the Blynk mobile application, offering dual operational modes—Manual and Automatic. This flexibility allows users to tailor the robot's functionality to their specific needs and preferences. In Automatic mode, the integration of ultrasonic sensors enables the robot to navigate autonomously, detecting and avoiding obstacles to ensure uninterrupted and safe operation.

The use of ultrasonic sensors marks a significant leap in the robot's capabilities, allowing it to make real-time adjustments to its path, thereby avoiding collisions and maintaining continuous grass cutting. This automated obstacle avoidance feature not only enhances the safety of the lawn maintenance process but also minimizes potential damage to the robot and its surroundings.

The IoT integration via the Blynk app offers users an intuitive interface for remote monitoring and control, providing unparalleled convenience and flexibility. This semi-automated approach to lawn care is designed to meet the needs of both residential and commercial users, accommodating a variety of lawn sizes and terrains. The robot's ability to adapt to different cutting preferences and navigate obstacles autonomously ensures efficient and consistent grass cutting with minimal user intervention.

II. LITERATURE SURVEY

***1. D. K. Kim* (2021):** "Smart Lawn Mower System using IoT and Machine Learning Techniques".This study proposes a smart lawn mower system that uses IoT and machine learning techniques. The system uses a camera and sensors to detect grass and obstacles and can be controlled remotely. This study provides insights into how machine learning can be incorporated into the fully automated solar grass cutter project.

2.B. S. Singh and S. K. Singh*(2020)*: ”IoT-Based Solar-Powered Smart Agriculture System for Sustainable Crop Cultivation” . This study presents the development of an IoT-based solar-powered smart agriculture system that can be used for crop cultivation. The system uses IoT sensors and solar panels for monitoring and controlling the agricultural environment. This study provides insights into the use of IoT in agriculture and how it can be incorporated into the fully automated solar grass cutter project.

3. A. M. A. Hanan and R. Ahmed(2020): “Design of an Automated Grass Cutter Robot with Bluetooth Connectivity”. This study presents the development of an automated grass cutter robot using Bluetooth connectivity. The system uses ultrasonic sensors and DC motors to navigate and cut grass. This study provides insights into how different connectivity options can be used in the fully automated solar grass cutter project.

4. K. C. Chua* (2018)*: “ Development of an Automated Lawn Mower with Obstacle Avoidance Using Arduino Microcontroller and Ultrasonic Sensor”. This study presents the development of an automated lawn mower using an ultrasonic sensor and Arduino microcontroller.

5. Ms. Lanka Priyanka(2015): In this paper they have fabricated “grass cutting machine” with tempered blades are attached to this grass cutter. This grass cutter is manually operated as well as automatic operated. The materials commonly used GI sheet, motor, wheel, Al sheet, switch, wire, square pipe and insulating material.

Problem Statement

In the Existing System there is a major drawback like there is no proper PWM Control. So due to no Control of PWM signal ,the backup time of a device is remain constant only for 1 hour by providing same power to module from starting to ending which can also may heat up the motor driver if we use more power output for long time . Table: 1 shows a detail description for that and there is a need of human to control mower for every time due to no integration of automatic mode and refer the table calculation in result section.

III. PROPOSED SYSTEM

The proposed system for an ”IoT Enabled Solar Grass Cutting Robot” is designed to revolutionize lawn maintenance by integrating IoT technology with sustainable energy solutions. This advanced system offers dual operational modes—manual and automatic—controlled via the Blynk application, providing users with unprecedented flexibility and precision. In manual mode, users have full control over the robot’s movements (forward, backward, left, and right) and can adjust the speed of both the vehicle and the grass cutting motor, optimizing power consumption from Blynk Sliders with out using any physical PWM Controllers. In automatic mode, the robot navigates autonomously, using sensors(Ultrasonic) to avoid obstacles and maintain more efficiency as shown in Fig 2.

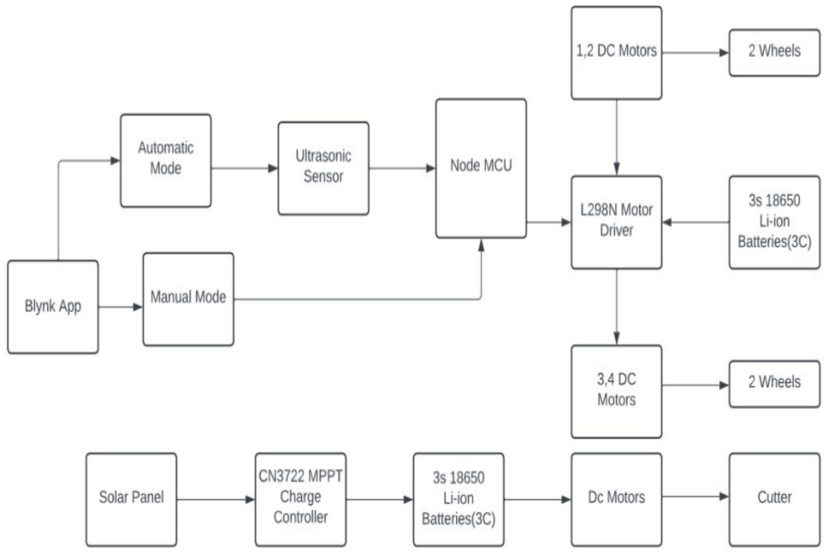

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Fig:2 Block Diagram of Proposed System

WORK FLOW

Communicating from Blynk Application to Node MCU through Wifi is very simple and secured, Make sure all necessary requirements are done in Blynk application to communicating with Node MCU like providing necessary wifi Credentials in the program and creating necessary blynk widgets and assign particular Virtual pins for Widget and getting Authorization key for secure communication between Blynk and Device. After setup Turn on the Hotspot of Mobile/LAN and then connect to node MCU according to credentials .Once connected the Node MCU to WiFi. Then go to Blynk application and check whether that controlling Template is at Online Mode. If it is in online mode then try to control the device though different widgets .If It is in Offline then try to connect with hotspot by providing proper credentials .If Signal from Blynk to Node MCU, then control device according to your need .If signal Not Received then check your connections and Virtual pins connected to widgets. After completing the Necessary Requirement then End the Process as shown in Fig 3.

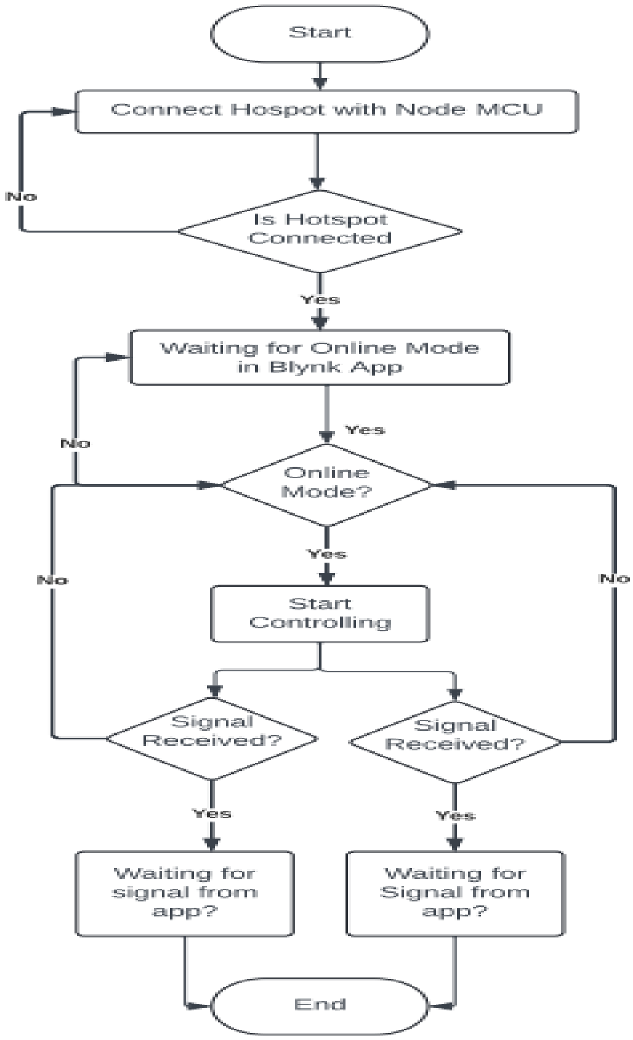

Fig:3 Working Flow

DESIGN OF HARDWARE

3C 18650 Li-ion Battery : A 3C lithium-ion battery can discharge at a rate three times its capacity, providing higher power output for devices requiring more energy with better efficiency and reliability with log life than normal lead acid battery.

Node MCU(Esp 8266): Node MCU is an open-source IoT platform that integrates the ESP8266 Wi-Fi module. The firmware runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and the hardware is typically based on the ESP-12 module.

L298N Motor Driver: The L298N motor driver is a popular and versatile module used for controlling motors in robotics and other electronic projects. It is based on the L298N dual H-bridge motor driver IC, which allows it to control the speed and direction of two DC motors, or one stepper motor, simultaneously with maximum of 2A peak.

Ultrasonic Sensor: The HC-SR04 is a popular ultrasonic sensor widely used for distance measurement in various applications, such as robotics, obstacle avoidance, and automation. It utilizes ultrasonic sound waves to determine the distance to an object by measuring the time it takes for the sound waves to travel to the object and back.

$$\text{Distance} = \frac{Time(in\ microseconds) \times \text{ Speed of Sound}}{2}$$

Time is the roundtrip time it takes for the pulse to travel towards object and back to sensor.

Speed is the speed of sound in air (typically around 343m/s at room temperature.

775 Motor: The 775 motor is a high-performance DC motor known for its high torque and high-speed capabilities, making it suitable for a wide range of applications, from power tools to robotics and electric vehicles. The motor's design includes double ball bearings, which enhance its durability and performance.

Solar Panel: Solar panels are devices that convert sunlight into electrical energy using photovoltaic (PV) cells. They are a critical component in many renewable energy systems, providing a sustainable and eco-friendly power source. Solar panels help reduce dependency on fossil fuels, lower energy costs, and decrease greenhouse gas emissions.

IV. RESULT

In the proposed System there is a proper PWM Control from the blynk application through Sliders for Both Grass cutting and drive motors. **So based on the PWM Control we can extend the backup time of a device for little more time than existing method to cut the grass** as shown PWM controls in Table:2 and integrated both manual and automatic mode to help the owner from human free in automatic mode by avoiding obstacles instead of only manual control.

Let us consider the Capacity of Battery(Ah) is 6Ah(Ampere Hour) and choose the drive motors with capable torque of 6Kg-cm for each motor.

Fig:4 Grass Cutting Robot

Backup time Evaluation

Hours Calculation : $Battery(Ah)/Total\ Current\ Draw(A)$ --- **eq 1**

Hours to Hours and Minutes=Decimal part x60= Minutes **--- eq 2**

Duty Cycle(D)=($Ton\ /Ttotal$) $x\ 100$ **-- eq 3**

Ton/Ttotal= (Value in slider/255(Max value of analog write function))

From eq1 we can calculate the estimated run time of a device in hours.

From eq2 we can calculate the hours and minutes from hours obtained in eq1.

From eq3 we can calculate the Duty Cycle percentage.

Table 1: Comparision Table

EXISTING SYSTEM					**PROPOSED SYSTEM**				
Duty Cycle (%)	**Current Draw (A) (Drive Motors)**	**Current Draw (A) (Grass Cutting motor)**	**Total Current Draw (A)**	**Estimated Run Time (Hours)**	**Duty Cycle (%)**	**Current Draw (A) (Drive Motors)**	**Current Draw (A) (Grass Cutting Motor)**	**Total Current Draw (A)**	**Estimated Run Time (Hours)**
100%	4.0	2.0	6.0	1.0 Hour	100%	4.0	2.0	6.0	1.0 Hour
100%	4.0	2.0	6.0	1.0 Hour	90%	3.6	1.8	5.4	1.12 Hours
100%	4.0	2.0	6.0	1.0 Hour	80%	3.2	1.6	4.8	1.25 Hours
100%	4.0	2.0	6.0	1.0 Hour	70%	2.8	1.4	4.2	1.42 Hours
100%	4.0	2.0	6.0	1.0 Hour	60%	2.4	1.2	3.6	1.67 Hours

V. CONCLUSION

IOT Enabled Solar Grass Cutting Robot is a powerful and versatile machine which can efficiently cut the grass with out dependency on Electricity and Using renewable sources of energy which reduce the labour cost and using less efforts to control the machine even by the owner. This machine can control not only the Skilled person, Even the unskilled person can control the machine through Blynk application Very Easily while controlling the speed of the drive motors and grass cutting Motor. Comparing to the Existing method this is a very easy and Can cover more area due to large capacity of Battery very efficiently. Adding of camera's compatible to microcontroller board and integrating of Artificial

Intelligence Technology can identify the grass and moving towards the grass and integrating of GPS can help to move the Particular location based on the latitude and longitudes.

VI. REFERENCES

[1] A.K. Barapatre, R. Sadiwala. Energy and resources management for Multiple Access in Massive IoT network. J. Integr. Sci. Technol. 2023, 11 (3), 518.

[2] AbdelRahman H. Hussein, "Internet of Things (IOT): Research Challenges and Future Applications" "International Journal of Advanced Computer Science and Applications" 2019.

[3] https://docs.blynk.io/en

[4] P. Bhagyalakshmi, T. Vikas, V. Kalyan, S. Chakrapani, J. Manohar, SOLAR BASED GRASS CUTTER USING NODE MCU JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR) 2023.

[5] Nilam Shetye , Dattaraj Naik, Ajay Gawas, Neha Hallikeri , Geeta Bagati." R-MCC (Remotely Mobile Control Car) " "International Research Journal of Engineering and Technology (IRJET)" 2021.

[6] B. K, R. N. Design of remote monitored solar powered grasscutter robot with obstacle avoidance using IoT. Glob. Transitions Proc. 2022, 3 (1), 109–113.

[7] B. Ibrahim, V. Siva Brahmaiah, P. Sharma. Design of smart autonomous remote monitored solar powered lawnmower robot. Mater. Today Proc. 2020, 28, 2338–2344.

[8] Neha, Syeda Asra, "Automated Grass Cutter Robot Based on IoT", "International Journal of Trend in Scientific Research and Development", Appa Institute of Engineering and Technology, Vol. 2, 2018.

[9] Hassan, H.M. Abdullah, U. Farooq, et al. A wirelessly controlled robotbased smart irrigation system by exploiting arduino. J. Robot. Control 2021, 2 (1), 29–34.

[10] Amit kumar Bharti, Arvind Kumar Bharti, Asharaf Raza,Ashwani Kumar,Aamir, "Obstacle Avoiding Robot" "International Journal For Research in Applied Science and Engineering Technology", 2022

[11] Hassan, H.M. Abdullah, U. Farooq, et al. A wirelessly controlled robotbased smart irrigation system by exploiting arduino. J. Robot. Control 2021, 2 (1), 29–34.

[12] P. Chandra Sekar, K. Prathima, M. Sai Jyotish, S. Sasi Vardhan, 5B.subba Rao, M. Sudheer, "SOLAR POWERED GRASS CUTTING ROBOT," IJCRT, 2023