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"Revolutionizing Lawn Care: AI-Driven Solar-Powered Humorless Grassland Mower With IoT Integration"

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Abstract

Objective: The primary objective of an AI-driven solar-powered humorless grassland mower with IoT integration is to provide an innovative, sustainable, and efficient solution for grassland maintenance, addressing the challenges of traditional lawn care methods while promoting environmental stewardship and technological advancement.
Methods: Developing an AI-driven solar-powered humorless grassland mower with IoT integration involves integrating various technologies and methodologies such as AI Algorithm, Solar Power System Design, Robotics and Automation, IoT Integration, User Interface and Control System.
Findings: It can vary depending on the specific objectives, implementation, and testing conducted. It can provide valuable insights into its performance, sustainability, reliability, and user acceptance, helping to inform further development and optimization efforts**.**
Novelty: By introducing novel features and approaches in these areas, an AI-driven solar-powered grassland mower with IoT integration can offer unique capabilities and benefits that set it apart from conventional lawn care equipment and contribute to advancements in sustainable landscaping practices. This paper proposes an innovative AI-Driven Solar-Powered Humorless Grassland Mower with IoT Integration. Traditional manual lawn mowing not only demands labor but also contributes to environmental pollution through nonrenewable resource consumption. To address these challenges, our solution leverages advanced technologies to transform grassland upkeep. The mower is equipped with a range of IoT sensors including ultrasonic, proximity, GPS, and cameras. These sensors enable real-time data collection and decision-making, allowing the mower to adjust its mowing schedule based on forecasted data and navigate around obstacles. Furthermore, during periods of poor sunlight or low battery levels, the mower autonomously returns to its self-charging station for recharging. Data collected by the mower can be sent to the cloud for further analysis and storage. Users have the convenience of remotely controlling

the mower through a smartphone app or web interface, enabling initiation, termination, or scheduling of mowing sessions from anywhere. Our AI-integrated IoT solution offers a sustainable and efficient approach to grassland maintenance, reducing labour requirements and environmental impact while maximizing operational autonomy.

Keywords: AI-driven Grassland Maintenance, Sustainable Lawn Care, AI-driven Environmental Management , Solar-Powered Lawn Care, Autonomous Lawnmowers, Sustainable Lawn Care .

I. INTRODUCTION

Grass cutting plays a pivotal role in maintaining the allure of gardens and yards, serving as a cornerstone in the landscape design of both urban and suburban areas. However, the conventional methods of grass cutting, whether manual or machine-based, have exhibited shortcomings, ranging from lack of precision to environmental pollution. Manual cutting often falls short in achieving desired accuracy and uniformity, while machine-operated cutters contribute to pollution through the emission of toxic gases, primarily fueled by traditional energy sources like fuels or coals. The necessity for a more efficient, precise, and environmentally sustainable approach to grass cutting has become increasingly apparent. In response to these challenges, the confluence of Artificial Intelligence (AI) and the Internet of Things (IoT) presents a promising opportunity. This synergy offers the potential to revolutionize grass cutting practices by introducing smart, autonomous, and sustainable solutions. This paper aims to introduce and explore the design, development, and operation of an AI-Driven Solar-Powered Humorless Grassland Mower with IoT Integration, which represents a significant advancement in lawn maintenance technology. By harnessing solar energy and integrating AI and IoT principles, this innovative grass cutter aims to address the limitations of traditional methods while minimizing environmental impact.

Furthermore, this paper delves into the evolving landscape of robotic systems, transcending conventional automation to embrace connectivity and intelligence. Through an in-depth examination of the symbiotic relationship between IoT and robotics, it explores the benefits, challenges, and real-world implementations of IoT-driven robotic systems augmented by AI. Additionally, the paper investigates AI's multifaceted role in enhancing robotic systems, encompassing perception, cognition, learning, and interaction.

By providing insights into the potential of AI and IoT technologies in transforming grass cutting practices, this paper contributes to the advancement of sustainable landscaping solutions and underscores the importance of innovation in meeting the evolving needs of urban and suburban environments.

1.ARTIFICIAL INTELLIGENCE (AI)

Artificial intelligence (AI) stands as a multifaceted field within computer science, aiming to imbue machines with the ability to undertake tasks typically necessitating human intelligence. This interdisciplinary domain encompasses various methodologies, yet recent strides in machine learning, particularly deep learning, have catalyzed a profound transformation across diverse sectors of the technology landscape. At its core, AI endeavors to empower machines to emulate, and in some cases surpass, the cognitive capacities of the human mind. From the advent of autonomous vehicles to the widespread integration of generative AI tools like ChatGPT and Google’s Bard, AI is steadily permeating into daily existence, becoming an integral component of contemporary life. Consequently, organizations spanning all industries are directing significant investments towards harnessing the potential of AI technologies.

The advent of AI has ushered in a new era characterized by enhanced efficiency, innovation, and problem-solving capabilities. Through sophisticated algorithms and data-driven insights, AI systems can discern patterns, make informed decisions, and adapt to dynamic environments. This unprecedented level of intelligence equips machines with the capacity to undertake an array of tasks autonomously, ranging from image recognition to natural language processing.

Furthermore, the proliferation of AI-driven solutions has facilitated the development of novel applications and services, fostering unprecedented levels of convenience, productivity, and personalization. However, the integration of AI also raises ethical, societal, and regulatory considerations. As AI systems become increasingly autonomous and pervasive, concerns regarding privacy, bias, accountability, and job displacement come to the forefront. Thus, fostering responsible AI development and deployment is imperative to ensure that these technologies align with ethical principles and serve the collective interests of humanity.

2.INTERNET OF THINGS (IoT)

The Internet of Things (IoT) has emerged as a transformative technology, reshaping the way we interact with our environment and revolutionizing various industries. At its core, IoT refers

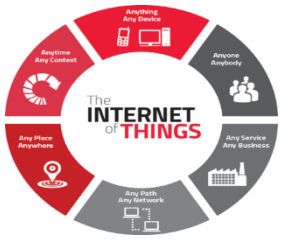

Figure 1: The Internet of Things (IoT)

to the network of interconnected physical objects, or "things," embedded with sensors, software, and connectivity capabilities, enabling them to communicate and exchange data with other devices and systems over the internet. These "things" can range from everyday objects like appliances and vehicles to industrial machinery and infrastructure components. By integrating sensors and connectivity, IoT enables these objects to collect and transmit data, facilitating real-time monitoring, analysis, and control. This interconnected ecosystem of devices holds immense potential to enhance efficiency, productivity, and convenience across diverse domains.

3.SOLAR PHOTOVOLTAIC

Solar photovoltaic (PV) technology represents a pivotal advancement in renewable energy generation, offering a sustainable and environmentally friendly alternative to traditional fossil fuel-based power sources. PV systems harness the power of sunlight by utilizing electronic devices known as solar cells to directly convert solar radiation into electricity.

II. LITERATURE REVIEW

P. Bulski et al. determine that the machine's sound causes noise pollution. He investigates the sound produced by the equipment, with the goal of removing the sound while also reducing the grass mostly on field or even the floor. Because using a motor pollutes the environment, my suggestion is to use an electric lawn mower.[1]

In this paper, Ms. Lanka Priyanka et al. have designed a lawn cutting machine with tempered blades. In addition to being computerised, this grass cutter can be handled manually. GI sheet, motor, wheel, Al sheet, switch, cable, rectangular tube, and inert material is one of the most suitable materials.[2]

In this paper, Praful P. Ulhe et al. have used a hand grass cutter with spiral roller blades to boost slicing efficiency. The mower has a height-adjustable loop trimming element. The lawn cutter could cut all varieties of grasses equally. [3]

Automation is rapidly growing in the present technology. So automation plays a vital role in the agricultural field which is helpful for the farmers. In the earlier days, the grass cutters used were manually handheld devices. So the old grass cutters need to be replaced by automated ones.[4]

Grass cutter machines have become very popular today. Most of the times, grass cutter machines are used for soft grass furnishing. In a time where technology is merging with environmental awareness, consumers are looking for ways to contribute to the relief of their own carbon footprints. Herein, we propose a model of the automatic grass cutting machine. Automatic grass cutting machine is a machine which is going to perform the grass cutting operation on its own. This model reduces both environment and noise pollution .[5]

The Ultrasonic distance sensor provides precise, non-contact distance measurements from about 2cm to 3meters. It is very easy to connect to Micro Controllers, propeller chip, or Arduino, requiring only one i/o pin. The sensor has amale3-pinheader used to supply ground, power and signal[6]

III. WORKING PRINCIPLE

The grass cutter robot is placed on the lawn and turned on. The robot's sensors detect the grass height and map the boundaries of the lawn. The grass cutter robot uses its algorithms to determine the most efficient mowing pattern. The robot moves around the lawn, cutting the

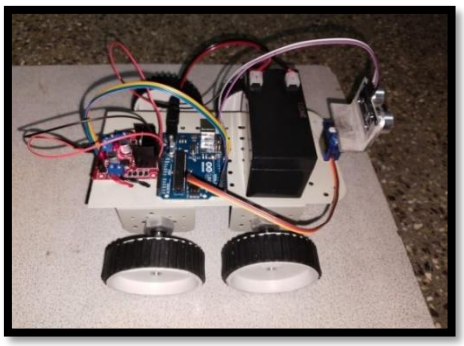

Figure 2: Implemented model(testing model)

grass to a consistent height. As the grass cutter robot moves, it continually updates its position and status to the cloud-based software platform using the IoT gateway.
The platform uses this information to monitor progress, track battery life, and detect any issues. Users can monitor the grass cutter robot's progress and adjust its settings using a mobile app or web interface. They can also schedule grass cutting tasks and receive notifications when the robot's battery is running low. When the grass cutter robot's battery is running low, it automatically returns to its self-charging station to recharge. Once fully charged, the robot resumes mowing. Users can view detailed analytics and reports on lawn maintenance, including grass growth trends, cutting frequency, and estimated savings in time and energy. IoT-empowered automated grass cutter offers a convenient and efficient way to automate lawn maintenance tasks. The system allows users to monitor and manage their lawns remotely, reducing the time and effort required for traditional grass cutting methods.

Figure 3: Implementation of the product(business model)

IV. WORKING MODEL

we has developed in this work is fully automated robotic vehicle without any human interaction, which uses solar energy to operate, the main advantage of this vehicle is, It detects obstacles and takes the deviation with the help of ultrasonic sensors and micro controllers. The working process of the grass cutter consist of DC motor, which provides high rotational speed to the blades. Due to high speed of blades the grass gets trimmed by shearing action. In present scenario manually handled devices are used for trimming the grass, which needs an operator to move the vehicle manually, by using AI-Driven Solar-Powered Humorless Grassland Mower with IoT Integration and the labour cost, maintenance cost can be eliminated to a certain extent compare to Manually Operated Machine. Based on a literature survey, it was found that, currently almost all the grass cutter devices work with liquid fuel, which causes pollution. In order to overcome these issues, fully automated solar grass cutter has developed, which supports the green technology initiative, by reducing the pollution. It uses solar energy to run the motor and blades, by using solar energy, the machine fulfills the growing need for renewable energy. Considering environmental awareness, it is most efficient and eco-friendly which overcomes the drawbacks of fuel based grass cutters such as
(i) fuels, which are non-renewable

(ii)Need proper maintenance, such as lubricant.

This machine was designed by considering important aspects such as efficient, accuracy, eco-friendly, durable and low cost. The major components of Fully Automated Solar Grass Cutter are solar panel, batteries, microcontroller, sensors, motor driver, DC motors and blade. The abundant solar energy was collected, with the help of solar panel which was used as a source of energy. The batteries were used to store the electrical energy produced by the solar panel. Micro controller was used to store the program codes which controls the direction of the grass cutter motion. Sensor was used to detect the obstacles in the path of the vehicle and sends the signal to micro-controllers, then micro controller sends the signals to motor driver so that wheels would take the deviations, which helps in avoiding the damage to the vehicle. Two types of DC motors were used based on the requirement of rotational speed. The DC motors with 30 RPM were used to move the vehicle and DC motors with 500 RPM was used for the blade rotation.

V. PROBLEM STATEMENT

- Mowing requires significant human effort, which can be tiring and time-consuming.
- Achieving different patterns and designs in mowing takes a considerable amount of time and effort.
- Traditional grass cutters with heavy engines contribute to noise and air pollution due to combustion.
- Fuel-powered engines require regular maintenance such as oil changes, adding to the overall time and cost.
- Traditional grass cutters are heavy, cumbersome, and inconvenient to move around, making them difficult to carry.
- Operating fuel-based grass cutters requires manpower, leading to labor costs. Additionally, there's a lack of IoT-based automatic grass cutters, which could potentially reduce the need for manual labor.

VI. PROPOSED SYSTEM

- Integrating artificial intelligence and Internet of Things (IoT) technology allows for intelligent decision-making and remote control capabilities, enhancing the efficiency and functionality of the grass cutter.
- Utilizing solar energy as a power source makes the grass cutter environmentally friendly and reduces reliance on fossil fuels, contributing to sustainability.
- The inclusion of ultrasonic sensors enables the grass cutter to detect obstacles in its path and autonomously navigate around them, ensuring safe operation and reducing the risk of collisions or damage.
- The ability to adjust the cutting height via a web interface provides flexibility and customization options, allowing users to adapt the grass cutter to different types of terrain and grass lengths.
- By leveraging IoT technology, the grass cutter can be remotely monitored and controlled, eliminating the need for direct human intervention during operation. This automation reduces manpower requirements and increases efficiency.

VII. METHODOLOGY

Requirement Analysis and Component Collection: Identified the project requirements and gathered all the necessary components needed for building the grass cutter.

Component Specification Study: You studied the specifications of each component, including the pin configurations of the ultrasonic sensor, L298N motor driver, DC motors, Arduino Uno board, and NodeMCU**.**

Individual Component Testing: Tested each component individually to ensure they are working properly. This included checking the functionality of the sensor and motor driver with the motors.

Sensor and Motor Interfacing: Interfaced the ultrasonic sensor and proximity sensor with both the Arduino and NodeMCU boards.

Motor Driver Interfacing: We connected the DC motors to the motor driver, and then interfaced the motor driver with both the Arduino and NodeMCU boards.

Model Development: We constructed the physical model of the grass cutter, including the steel chassis and angles for holding the DC motors.

Code Integration: Merged the code for all the components used in the project, likely including code for sensor data processing, motor control, and any other required functionalities.

Component Integration: Placed all the components onto the steel chassis, likely securing them in place and ensuring proper connections between each component.

VIII. BLOCK DIAGRAM

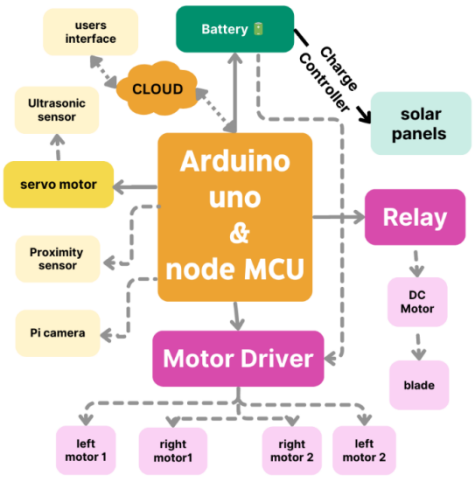

Figure 5: Block diagram

1.ARDUINO UNO

The Arduino Uno R3 is a versatile microcontroller board built around a removable ATmega328 AVR microcontroller in a dual-inline-package (DIP) format. It features 20 digital input/output pins, with 6 capable of PWM output and 6 functioning as analog inputs. Programming the Arduino Uno is made simple through the Arduino IDE, allowing users to load programs onto the board with ease.

With its user-friendly interface and extensive support community, the Arduino Uno R3 serves as an excellent platform for beginners and experienced users alike to dive into embedded electronics projects. Whether connecting it to a computer via USB or powering it with an AC-to-DC adapter or battery, the Arduino Uno R3 offers flexibility and convenience for a wide range of applications..

2. MOTOR DRIVE

L298N module is a high voltage, high current dual full-bridge motor driver module for controlling DC motor and stepper motor. It can control both the speed and rotation direction of two DC motors. This module consists of an L298 dual-channel H-Bridge motor driver IC. This module uses two techniques for the control speed and rotation direction of the DC motors

3. ESP32-CAM

The heart of the ESP32-CAM is an ESP32-S System-on-Chip (SoC) from Ai-Thinker. Being an SoC, the ESP32-S chip contains an entire computer—the microprocessor, RAM, storage, and peripherals—on a single chip. While the chip's capabilities are quite impressive, the ESP32-CAM development board adds even more features to the mix. Let's take a look at each component one by one.

4. ULTRASONIC SENSOR

The ultra - sonic sensor HC-SR04 was introduced. One such practical sensor has a span of 2cm to 400cm of non-contact estimation capacity and a went accuracy of up to 3mm. A ultrasonic transmitter, a beneficiary, and a control circuit are completely remembered for each HC-SR04 module.

The HC-SR04 has four pins something one ought to know about: VCC (power), Trig (trigger), Echo (getting), and GND (ground) . One will uncover that setting up and involving this sensor for your first assortment observing mission is a pleasure. The sensor incorporates progressed control hardware that could likewise assist with keeping away from "bouncy" information from the program.

CONCLUSION

We have presented the design and implementation of our innovative AI-Driven Solar-Powered Humorless Grassland Mower with IoT Integration. This autonomous system leverages environmental data to make informed decisions, offering an efficient solution for lawn maintenance. Its scalability and centralized control make it adaptable to various environments, including expansive lawns and commercial areas. We are confident that our system will revolutionize the field of lawn maintenance and set a new standard for IoT-enabled automation. Moving forward, we plan to enhance by incorporating timer options, allowing users to schedule cutting tasks according to their preferences..

REFERENCES

1. Mamtaj Alam,Virendra Vikram Singh IOT Based Grass Cutter with Solar Pannelin International Journal of Scientific & Eng ineering Research Volume 10, Issue 4, April-2019. https://www.ijser.org/researchpaper/IOT-BASED-GRASS-CUTTER-WITH-SOLAR-PANNEL.pdf
2. Ms. Rutuja A. Yadav, Ms. Nayana V. Chavan, Ms. Monika B. Patil, Prof. V .A. Mane. Automated Solar Grass Cutter in International Journal of Scientific Development and Research (IJSDR). Vol.2, February 2017. https://www.ijsdr.org/papers/IJSDR1702016.pdf
3. Bidgar Pravin Dilip, Nikhil Bapu Pagar, Vickey S. Ugale, Sandip Wani, Prof. Sharmila M. Design and Implementation of Automatic Solar Grass Cutter in International Journal of Advanced Research in Electrical(IJARE). Vol.6, April 2017. https://www.jetir.org/papers/JETIRCR06026.pdf
4. Ms. Bhagyashri R. Patil, Mr. Sagar S. Patil. Solar Based Grass Cutting in International Journal of Electrical and Electronics Engineers (IJEEE). January June2017. http://www.arresearchpublication.com/images/shortpdf/1483686153_N276_IJEEE.pdf
5. Vishal Sharma and Parvinder S. Sandhu. "Design and Development of an IoT based Intelligent Solar Tracking System." Procedia Computer Science, vol. 132, pp. 1550-1559, 2018.
6. Hafez, A.Z. & Yousef, A.M. & Harag, N.M., 2018. "Solar tracking systems: Technologies and trackers drive types – A review," Renewable and Sustainable Energy Reviews, Elsevier, vol. 91(C), pages 754-782. https://ideas.repec.org/a/eee/rensus/v91y2018icp754-782.html
7. Jayanthi G, Balachander K. Powell Metaheuristic Cat Swarm optimized Sugeno Fuzzy Controller based Deep Belief Network for energy management in Hybrid electric vehicles. J. Integr. Sci. Technol. 2023, 11 (2), 488. https://pubs.thesciencein.org/journal/index.php/jist/article/view/488
8. P. Vorel, J. Martiš. Battery Powered Lawn Mower. ECS Transactions. 2021, pp 567–574. https://downloads.hindawi.com/journals/wcmc/2022/1971902.pdf
9. Jayanthi G, Balachander K. Powell Metaheuristic Cat Swarm optimized Sugeno Fuzzy Controller based Deep Belief Network for energy management in Hybrid electric vehicles. J. Integr. Sci. Technol. 2023, 11 (2), 488 (2), 488. https://pubs.thesciencein.org/journal/index.php/jist/article/view/488