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Smart Grass Cutter Using Solar Power System

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Abstract: The Smart Grass Cutter is a solar-powered device that autonomously cuts grass, providing cost and labour savings. Its environmental impact is minimized as it utilizes a solar panel to charge a battery, which is integrated with an Android app for remote control, reducing electricity costs. The inclusion of obstacle and flame sensors enhances both safety and efficiency by enabling the mower to navigate around obstructions and detect potential fire hazards. This automated grass cutter, driven by solar power, presents a more economical and environmentally responsible alternative to traditional, noisy, and polluting cutters. The design incorporates essential components such as a solar panel, charge controller, sealed lead-acid battery, high-speed DC motor, and multiple sensors, ensuring independent operation.

Keywords: Smart Grass Cutter, Solar-Powered, Automated, Solar panel, DC Motor.

1.Introduction

In today's modern world, appearance matters, and many countries, like Canada and America, have regulations for maintaining lawns at a certain height. If exceeded, there can be penalties. This poses a challenge for homeowners, as finding time for lawn care can be difficult. Hiring someone is an option, but it can be costly, especially if the equipment used is heavy and fuel-based. To address these issues, we propose an automated grass cutter controlled via mobile, using solar power as the energy source. Solar energy is abundant and emission-free, making it an ideal renewable energy option. The solar-powered grass cutter operates with an electric motor, eliminating the need for gasoline and reducing emissions. The use of solar energy makes it environmentally friendly and cost-effective. To enhance its functionality, we've incorporated ultrasonic sensors to detect obstacles and adjust the machine's direction accordingly. Additionally, a flame sensor alerts users to potential fire hazards, providing an added layer of safety.

The traditional method of maintaining lawns involves significant investment in terms of time, labor, and fuel costs. Our project addresses these challenges by offering a convenient and eco-friendly solution. The solar-powered grass cutter, accessible via mobile control, not only reduces the burden on homeowners but also makes lawn care a more engaging task for all family members, including kids. In India, where solar energy is abundant, our project aligns with the ongoing research and development in solar technologies. With 300 days of sunshine annually, our solar-powered grass cutter harnesses this energy to efficiently trim lawns, eliminating the need for external power sources and fuel expenses.

Incorporating solar power, ultrasonic sensors, and flame detection, our project transforms lawn care. This environmentally conscious and sustainable approach improves efficiency, providing homeowners with a safer, more convenient, and cost-effective alternative that reduces environmental impact compared to conventional methods.

2.Literature Survey

*2.1 Shyam Lal Sharma (2019)*has developed Automated Solar Grass Cutter is a fully automated ass cutting robotic mover powered by solar energy with solar penal that also avoids obstacles and is capable of fully automated grass cutting without the need of any human interaction. The system uses 10Vbatteries to power the mover movement motors as well as the grass cutter motor.

*2.2 Vorugnti.BharathKumar, N.Sravani, S.A.Sowmiya,B.Venu, D.Harshed (2020)*has developed a project that aims at fabricating a grass cutting machine which makes the grass cutter based motor run through solar energy. Power plays a great role wherever man lives and works. The living standard and prosperity of a nation vary directly with the increase in the use of power. The electricity requirement of the world is increasing at an alarming rate due to industrial growth, increased and extensive use of electrical gadgets.

*2.3 Pushpendra Tyagi, Aman Agarwal, Aman SinghKalhans, Alok Kumar, Amit Kumar (2018)*has concluded that from time immemorial, thesun has been the major source of energy for life on earth. The solar energy was being useddirectly for purposes like drying clothes, curing agricultural produce, preserving food articles,etc. Even today, the energy we originate from fuel-wood, petroleum, paraffin, hydroelectricityand even our food originates obliquely from sun. Solar energy is almost unbounded.

2.4 Ramya.E, Jose Anand, Renugha Devi.R,Neethu Anna Issac, Roshni Prasenth.K (2021) has implemented the designing andfabricating a solar grass cutter with water spraying system using RF Technology to reduceman power, pollution and usage of electricity in gardening. Both the grass cutting and thewater spraying application can be executed in parallel. Worlds electricity requirement isgrowing at an alarming price because of commercial growth, improved and huge use ofelectrical gadgets.

2.5 Mrudal Kanhekar, Pranay Pohankar,Prashikdable, Sachinwaghmare, Saurabh Munghate (2022) explained that cutting the grass itselfrequires human effort, time and can create a unique structure of grass length. Therefore toavoid all these problems it is important to build a system that can cutting grass withouthuman involvement. This operation uses a lawn mower with a battery that can be chargedwith solar power. This can be done using an android phone. This program can be created at alower cost compared to other existing programs.

2.6 Debangsu Kashyap, Urbashi Bordoloi, Amlan Aoichoirryya Buragohain(2020) explained that the Grass cutting is a time- consuming and labor-intensive process. The technology that is available in the present-day for grass cutting operation is mostly the manually handled Diesel operated cutter. These types of equipment operating under non-conventional sources of energy emit green- house gases and pollute the environment and also responsible for climate change. These grass cutters are also a source of noise pollution that adversely affects the health of the cutter and the surrounding people. The cost of diesel is another matter for consideration. To mitigate the problems of the conventional cutter, a solar-powered automatic grass cutter is designed.

3. Methodology

3.1 Existing System

Traditional grass cutters typically rely on fuels, resulting in high running costs and noiseproduction. These conventional machines are cumbersome, demanding substantial strength and energy for operation, leading to increased time consumption and potential injuries due to their heavyweight. The human-made pollution associated with fuel and gas-powered grass cutters raises environmental concerns, impacting our homes and daily lives. Motor-powered push grass cutters contribute to noise and air pollution through combustion in the engine.

Moreover, electrical lawn mowers, with their dangerous belts and motors, pose challenges for daily use, especially for the elderly, young, or disabled individuals. The inefficiency of gas-powered lawn mowers adds to air pollution concerns, given their emission of gases. The rising fuel and gas prices further contribute to the drawbacks of this system. In light of these issues, there is a pressing need for a more sustainable and user-friendly grass cutting solution that addresses the drawbacks of the conventional fuel-based and gas-powered alternatives.

3.2 Proposed System

Proposing an innovative system, our solar-powered grass-cutting robot embraces sustainable practices, reducing its environmental impact. Its programmable nature caters to diverse user preferences, enabling customization for specific grass lengths and garden layouts. Incorporating advanced technologies like IR obstacle sensors and Ultrasonic sensors ensures a high level of safety by preventing potential collisions and damages during operation.

In addition to these features, the robot implements a flame sensor for enhanced safety measures. This further highlights our commitment to addressing environmental and safety concerns. The Android mobile application, equipped with Bluetooth capability, offers users a seamless and intuitive control interface. The integration of Arduino technology enhances the robot's responsiveness and adaptability, facilitating efficient navigation through complex terrains.

Our project not only tackles the time-consuming aspect of grass cutting but also addresses environmental and noise concerns, showcasing the harmonious blend of technological innovation and sustainable living practices. The user-friendly design, coupled with flexible operation modes, caters to a broad range of user needs. Providing both Automatic and Manual modes empowers users to select their preferred level of control, making the robot suitable for various lawn maintenance scenarios.

This comprehensive project signifies a significant advancement in redefining traditional grass-cutting methods. It presents a contemporary and eco-friendly alternative that resonates with the changing needs of homeowners and the broader environmental consciousness. By integrating a flame sensor and prioritizing safety, our grass-cutting robot stands as a beacon for sustainable living practices and technological innovation in the realm of lawn maintenance.

4. Experimental System

4.1 System Architecture

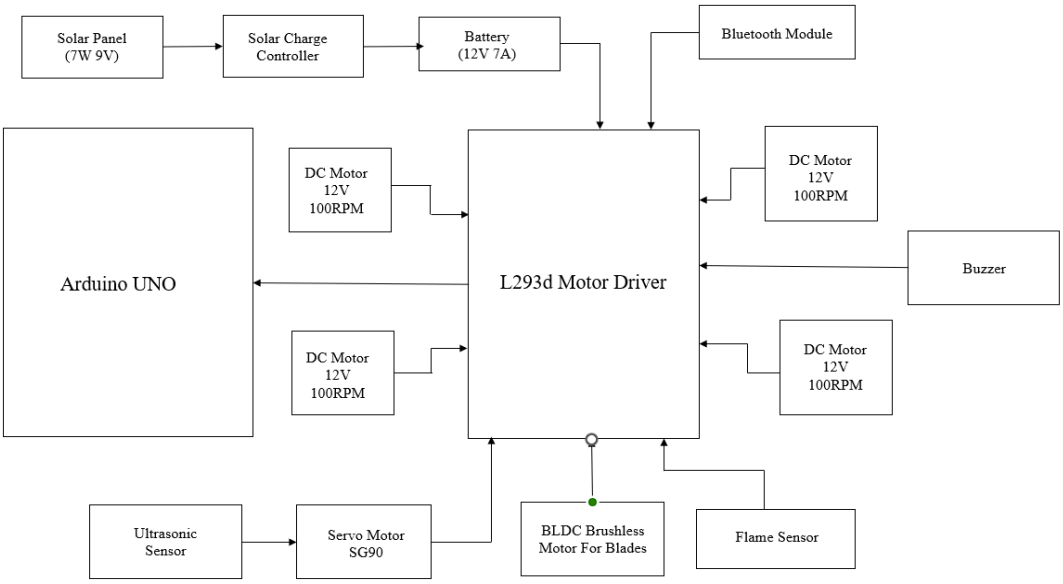

Fig.1.Block Diagram

At the core of this sophisticated system is the Arduino Uno, functioning as the central intelligence and primary processing unit. It meticulously orchestrates the seamless coordination and control of a diverse array of components, demonstrating a remarkable level of integration and intelligence.

The four 100 RPM 12V DC motors, under the precise management of the L293D motor drive, contribute to the synchronized wheel propulsion of the robot. This ensures not only efficient movement but also a harmonious execution of tasks.

The collaborative synergy between the ultrasonic sensor and the servo motor stands out as a key feature enhancing the robot's adaptability. These components work in tandem, playing a pivotal role in real-time obstacle detection and subsequent dynamic course adjustments. This adaptability is a crucial aspect, ensuring the robot's ability to navigate its environment effectively.

In the event of fire detection, a swift and effective response is guaranteed through the flame sensor and accompanying buzzer. This instant alert system adds a layer of safety, emphasizing the system's readiness to address potential hazards promptly.

The task of grass-cutting is entrusted to a high-performance BLDC brushless motor, emphasizing the system's dedication to efficiency and precision in executing its primary function.

Powering the entire system is a robust 12V 7.5Ah rechargeable battery, which draws its sustenance from a 7W, 9V solar panel. The meticulous regulation of the power ecosystem by a solar charge controller ensures optimal charging and utilization, underscoring the system's commitment to sustainability and energy efficiency.

This comprehensive overview provides insight into the harmonious integration and synergistic functionalities of each component. It highlights the culmination of intelligent design, self-sufficiency, and an environmentally conscious approach in crafting a highly capable solution for automated grass-cutting tasks.

4.2 Algorithm Specifications

While the process of initializing the system may appear straightforward, it plays a crucial role in laying the groundwork for the fully automated solar grass cutter. Configuring the Arduino Uno involves precisely defining the roles and functions of interconnected components, including the intricate task of setting up pins for motor control, sensors, and communication interfaces. This initial step is pivotal, ensuring the entire system is ready for seamless operation with each component appropriately configured for its specific function within the complex network.

Power management emerges as a critical aspect of the algorithm, guaranteeing the sustained functionality of the grass cutter. The system vigilantly monitors the battery level to assess its charge status, providing essential information about the power reserve. If the algorithm detects a low battery level, it promptly initiates a charging process utilizing abundant solar energy. This intelligent use of renewable resources ensures the system remains powered and operational, contributing to an environmentally sustainable and efficient solution.

The obstacle avoidance functionality remains a cornerstone feature, enhancing the grass cutter's adaptability to its surroundings. The ultrasonic sensor, a key component in this aspect, continuously scans the environment for potential obstacles. If an obstacle is detected within a predefined distance, the algorithm triggers the servo motor to change the robot's direction dynamically. This response ensures effective obstacle avoidance, preventing collisions and enhancing the overall efficiency of the grass-cutting operation. Every instance of obstacle detection is logged by the system, providing valuable data for subsequent analysis and improvement.

Fire detection represents another critical feature embedded in the algorithm, emphasizing the system's commitment to safety. The flame sensor is activated to monitor the environment for potential fire hazards. In the event of fire detection, the algorithm triggers the buzzer to provide an audible alert, ensuring any potential threat is promptly communicated. Simultaneously, the system meticulously logs every fire detection event, creating a comprehensive record for analysis. This data-driven approach enables the system to respond proactively to potential hazards, enhancing the overall safety of the grass-cutting operation.

The algorithm seamlessly integrates provisions for manual control via Bluetooth, adding a layer of flexibility to the system's operation. Establishing a Bluetooth connection to a dedicated mobile app empowers users to take manual control when needed. If manual control is initiated, the algorithm acts as the bridge between user commands and motor control actions, translating and executing the corresponding movements.
Grass cutting operations are at the forefront of the system's tasks, and the algorithm meticulously orchestrates this essential function. The activation of the BLDC brushless motor dedicated to grass-cutting operations ensures a powerful and efficient cutting process. The system continuously monitors the cutting process, making real-time adjustments to cutting height or speed based on predefined parameters. This dynamic adaptation guarantees the grass cutter operates with optimal efficiency, delivering precise and effective grass-cutting capabilities.

Continuous monitoring is a fundamental process ingrained in the algorithm, ensuring the system remains vigilant and responsive to its environment. The system continually monitors its status, operational data, and various events, creating a comprehensive and real-time understanding of its surroundings. This continuous monitoring strategy positions the grass cutter as an intelligent and adaptive entity, capable of responding effectively to changing conditions. By staying constantly aware, the system enhances its overall efficiency and performance.

Safety measures are seamlessly integrated into the algorithm, addressing the potential risks associated with the grass-cutting operation. The algorithm includes checks to ensure the system operates within predefined safe parameters, covering factors such as motor temperature and performance. This minimizes the risk of motor overheating or damage during operation. In the event of critical issues or emergencies, the algorithm triggers emergency stop procedures to halt the system's operation safely. This proactive approach to safety guarantees the grass cutter operates with reliability, minimizing the risk of accidents or damage.
The system shutdown process marks the final step in the algorithm, encapsulating a controlled and deliberate conclusion to the grass-cutting operation. Once the assigned task is complete or if a critical issue occurs, the algorithm orchestrates a graceful shutdown of the entire system. This methodical conclusion ensures the grass cutter disengages from its operation in a safe and controlled manner, preventing potential complications. The

system shutdown process is a crucial component of the algorithm, contributing to the overall safety and reliability of the fully automated solar grass cutter.

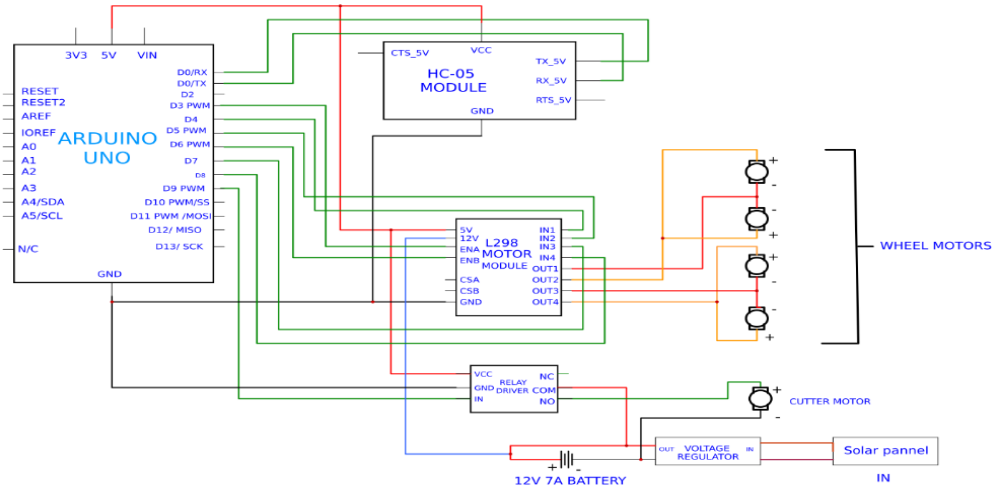

Fig.2.Overall System Circuit Diagram

4.3 Key Components

The Smart Grass Cutter integrates cutting-edge technologies for efficient and eco-friendly lawn maintenance. The system encompasses solar panels for energy generation, batteries for intelligent energy storage, and a versatile microcontroller (Arduino UNO) seamlessly connected to the L293D motor driver. Augmenting its capabilities, the Smart Grass Cutter incorporates Ultrasonic Sensors, Flame Sensors, and a Servo SG90 to enhance environmental awareness and safety by facilitating obstacle detection, flame sensing, and dynamic direction changes.

Capturing solar energy through photovoltaic panels, the system ensures uninterrupted operation, adeptly storing energy in batteries for sustained functionality, even in limited sunlight conditions. The compact yet powerful Arduino UNO controller executes control codes, enabling autonomous movement and efficient grass-cutting duties.
For propulsion and grass cutting, the Smart Grass Cutter employs 12V DC motors (100 RPM) for smooth vehicle movement, complemented by a high-speed 1400KV BLDC brushless motor powering the cutting blade. The inclusion of a Servo SG90 adds versatility, facilitating dynamic changes in direction for obstacle avoidance.

Environmental consciousness is at the forefront of the Smart Grass Cutter's design. By harnessing solar power, it significantly reduces the ecological footprint compared to conventional gas-powered alternatives. Solar energy not only diminishes greenhouse gas emissions but also ensures substantial long-term cost savings. The system, equipped with a 7W 9V solar panel and powered by a 12V 7A rechargeable battery, represents a sustainable and eco-friendly approach to grass cutting.

This innovative technology marks a pivotal transition toward cleaner and greener lawn maintenance practices, showcasing the harmonious coexistence of advanced technology with nature. The Smart Grass Cutter signifies a paradigm shift in the industry, demonstrating the feasibility of achieving both environmental consciousness and operational efficiency.

The integration of an Ultrasonic Sensor, Servo SG90 for dynamic direction changes, and a Flame Sensor with buzzer operation significantly enhances the capabilities of the Smart Grass Cutter. The Ultrasonic Sensor plays a crucial role in improving obstacle detection, allowing for precise maneuvering. Meanwhile, the Servo SG90 imparts agility to navigate challenging terrains. The Flame Sensor, along with a buzzer, promptly notifies users in the event of fire detection, ensuring a quick and informed response to potential hazards.

Furthermore, the Ultrasonic Sensor's real-time feedback enhances the adaptability of the grass cutter in complex environments, offering continuous data for optimal navigation. The Servo SG90's capacity to make intricate

adjustments ensures seamless course corrections, ultimately boosting the overall efficiency of the grass-cutting process. Additionally, the Flame Sensor's sensitivity guarantees accurate fire detection, providing an additional layer of safety in diverse operating conditions. The synergized functionalities of these advanced sensors underscore the Smart Grass Cutter's commitment to precision, safety, and high performance in autonomous grass-cutting tasks.

4.4 Device Implementation

The system can be implemented as a Stand-alone device to perform the grass cutting operation. The device consists of

- Arduino UNO
- L293d Motor Drive
- Ultrasonic Sensor mounted on top of Servo SG90
- Flame Sensor
- Buzzer
- 12V 100 RPM DC Motor (4No.s)
- BLDC Brushless Motor
- Bluetooth Module
- Battery
- Solar Panel

The Smart Grass Cutter exemplifies a cutting-edge system blending renewable energy and automation principles. Commencing its operations, the system harnesses solar power through photovoltaic panels, utilizing the photovoltaic effect to convert sunlight into electrical energy. This eco-friendly approach minimizes environmental impact and eliminates the reliance on non-renewable, polluting fuels like gasoline, commonly used in traditional grass cutters.

The generated electrical energy is intelligently stored in batteries, serving as a power reservoir for uninterrupted and efficient operation, even in periods of limited sunlight or during nighttime. At the heart of this autonomous grass cutter lies the Arduino UNO, a compact yet powerful controller orchestrating various functions and operations. Acting as the brain of the device, it stores and executes the control code, transforming the Smart Grass Cutter into a fully automated and user-friendly tool.

Facilitating mobility, the Smart Grass Cutter employs DC gear motors strategically connected to its three wheels, providing the necessary torque and control for precise wheel rotation. These motors seamlessly integrate with a motor driver, ensuring optimal speed and direction control. Specifically for grass cutting, a dedicated Brushless motor is employed, intricately linked to a specially designed cutting blade.

What distinguishes this system is its adaptability, featuring a cutting blade mounted on an adjustable plate. This design allows operators to customize the cutting height, ranging from 12mm to 25mm above ground level. This adaptability ensures the Smart Grass Cutter can effectively handle grass of varying heights, maintaining a manicured appearance.The buzzer activates upon detecting a fire, concurrently initiating an immediate halt in the robot's operation.

The device should perform the following steps

1. Start
2. Move forward
3. Stop when obstacle is detected
4. Searching hindrance free pathand changing direction
5. Stop and trigger alarm when fire is detected
6. Repeat

5. Result and Discussion

The revolutionary development of a Smart Grass Cutter Using Solar Powered System is a significant stride in meeting the specific demands of residences and establishments endowed with lawns that are unsuitable for traditional tractor-driven mowers. This cutting-edge machine stands out for its commendable capacity, positioning itself as a viable and efficient replacement for the conventional gasoline-powered counterparts prevalent in the market. The deliberate selection of renewable energy sources, tailored to meet the machine's power requirements,

underscores a strategic commitment to sustainability, offering users a cost-effective, eco-friendly solution.Under the title of "Smart Grass Cutter Using Solar Powered System," the project takes a forward-looking approach, aiming not only to meet current needs but also to provide a foundation for easy use and potential modifications for future users. The user-centric design ensures that the machine remains adaptable and accessible, fostering a user-friendly experience.The economic advantages inherent in the solar-powered grass cutter render it particularly suitable for the common man, aligning with contemporary sustainability goals. By eliminating fuel costs and significantly reducing pollution associated with traditional grass cutters, this machine emerges as an environmentally conscious alternative. A notable feature that enhances its practicality is the ability to charge the battery while in motion. This innovative capability extends the usability of the machine, allowing for prolonged operations even during nighttime, catering to diverse user needs.

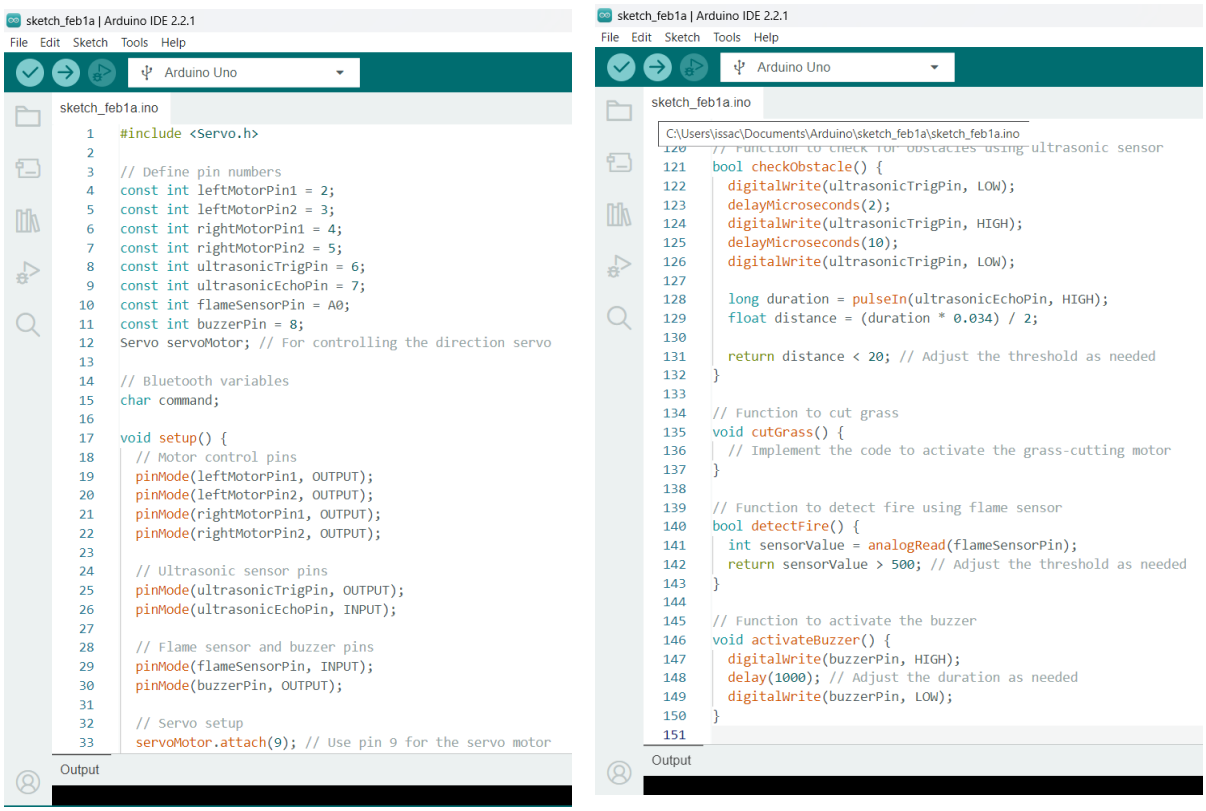

Fig.3.Source Code Implemented In Arduino

Fig.4.Top View of the Grass Cutter

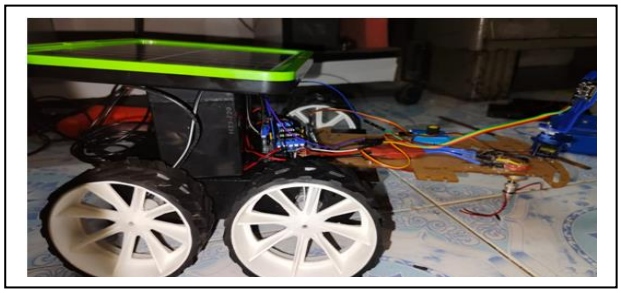

Fig.5.Side View of the Grass Cutter

The minimal running costs associated with the Smart Grass Cutter Using Solar Powered System, coupled with a design emphasizing durability and longevity, positions this machine as a practical, sustainable solution for lawn maintenance. Users stand to benefit not only from the economic advantages but also from the reduced environmental impact, aligning with a global shift toward more eco-friendly practices. In essence, the Smart Grass Cutter Using Solar Powered System represents a harmonious blend of innovation and functionality. As we continue to navigate the landscape of sustainable solutions, this machine stands as a testament to the possibilities

of merging advanced technology with environmental responsibility. With its forward-thinking design, economic benefits, and eco-friendly operation, the Smart Grass Cutter Using Solar Powered System stands poised to redefine the future of lawn maintenance, providing users with a reliable, efficient, and environmentally conscious tool.

6. Conclusion

In conclusion, the designed model of the smart grass cutter using solar-powered system represents an economic and user-friendly alternative in the realm of lawn maintenance. Its capacity to harness renewable energy not only reduces operational costs but also contributes to environmental sustainability by curbing pollution. The incorporation of features like battery charging during operation and night-time usability enhances the machine's practicality and efficiency. The success of this project lays the foundation for future advancements and modifications. The live streaming capability and remote control functionality from distant locations further accentuate the machine's adaptability and convenience. As we move towards more sustainable and efficient solutions in various domains, the smart grass cutter usingsolar-powered system stands as a testament to innovation in the field of lawn care, catering to the diverse needs of users while promoting eco-conscious practices.

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