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IOT Based Solar Grass Cutting Robot

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Abstract
The IoT based solar grass cutting robot is an innovative solution that combines the power of the Internet of Things (IoT) and solar energy to create an efficient and eco-friendly way to maintain lawns and gardens. This robot is designed to be autonomous, which means it can operate on its own without human intervention, and it is equipped with sensors and cameras that enable it to navigate and identify obstacles in its environment. The robot uses solar energy to power its operations, which makes it cost-effective and sustainable. The data collected by the sensors and cameras are sent to a cloud server via the internet, where it can be analyzed and used to improve the robot's performance. Overall, the IoT based solar grass cutting robot is an excellent solution for anyone who wants to maintain a beautiful lawn or garden while reducing their carbon footprint.

Keywords: Microcontroller, Ultrasonic Sensor, Arduino board

1.Introduction

An IoT-based solar grass cutting robot is a cutting-edge solution designed to provide a convenient and eco-friendly way to maintain lawns and gardens. The robot combines the power of the Internet of Things (IoT) with solar energy to deliver an autonomous lawn mowing experience.

The robot is equipped with sensors and connectivity features that enable it to communicate with the cloud and other smart devices. This connectivity allows users to remotely control the robot using their smartphones, tablets or computers. Users can also monitor the status and location of the robot in real-time.

The solar-powered feature of the robot means that it can operate continuously without requiring any external power source. The robot utilizes solar panels to harness energy from the sun, which is then used to power its electric motor and other onboard systems.

The grass cutting mechanism of the robot is designed to cut grass efficiently while minimizing the impact on the environment. The robot uses sharp blades to cut the grass, which results in clean and even cuts. Additionally, the robot's cutting mechanism is designed to minimize the noise level, making it an ideal solution for residential and commercial environments.

Overall, an IoT-based solar grass cutting robot is a sophisticated solution that combines the latest advancements in IoT and renewable energy to provide a sustainable and efficient way to maintain lawns and gardens. It offers a range of benefits, including reduced energy consumption, noise pollution, and maintenance costs.

- Lightweight material
- Low budget
- Rigidity of blade
- Quick & Effective
- Our project is a battery powered mechanized grass cutter.
- To build a home purpose lawn mower.
- To produce a user-friendly home purpose lawn mower.
- To produce a cost-efficient lawn mower.
- To conduct and analyze the domestic purpose lawn mower

2. Literature review

1. Solar grass cutting robots are autonomous machines designed to reduce human intervention in maintaining lawns and gardens. These robots are powered by solar panels, which provide them with a renewable source of energy. In this literature review, we will discuss the research conducted on solar grass cutting robots.
2. A study conducted by J. Chincholkar et al. in 2016 presented the design and development of a solar-powered grass cutter. The robot was equipped with a solar panel and a rechargeable battery, which powered the motor and the cutting blades. The authors tested the robot on different types of grass and found that it was effective in cutting grass up to a height of 3 inches. The robot was also able to navigate uneven terrain and obstacles.
3. Another study by J. Pradeep et al. in 2018 proposed a design for a solar-powered grass cutter that could be controlled using a mobile application. The robot was equipped with a GPS system, which enabled it to navigate the lawn and avoid obstacles. The authors conducted experiments to test the effectiveness of the robot and found that it was able to cut grass up to a height of 4 inches.
4. A more recent study by T. Wong et al. in 2020 presented a solar-powered grass cutter that used machine learning algorithms to improve its performance. The robot was equipped with sensors that could detect the density and height of the grass, which allowed it to adjust its cutting height accordingly. The authors tested the robot on different types of grass and found that it was able to cut grass up to a height of 6 inches.

Overall, the research conducted on solar grass cutting robots suggests that they are an effective and efficient solution for lawn maintenance. These robots offer several benefits, including reduced carbon emissions, lower maintenance costs, and reduced human intervention. However, further research is needed to improve their performance and reliability, especially in adverse weather conditions.

3. Working principle

The working principle of IoT-based solar grass cutting robots can be divided into three main components: sensing, processing, and actuation.

Sensing:

The robot is equipped with various sensors, such as GPS, ultrasonic sensors, and optical sensors, that help it to navigate the lawn and detect obstacles. The sensors also detect the density and height of the grass, which helps the robot to adjust its cutting height accordingly.

Processing:
The data collected by the sensors is processed by a microcontroller or a computer onboard the robot. The microcontroller uses algorithms to analyze the data and make decisions, such as determining the optimal cutting path and adjusting the cutting height.

Actuation:

Once the robot has processed the data and made a decision, it uses its actuators to carry out the required action. The actuators are responsible for controlling the movement of the robot and the cutting blades. The robot uses its wheels to move around the lawn and its cutting blades to cut the grass.

In addition to these three components, the IoT-based solar grass cutting robot is also equipped with a communication module, which enables it to connect to the internet and communicate with other devices. This communication module allows the robot to receive commands and send status updates to a remote server or a mobile application.

Overall, the working principle of IoT-based solar grass cutting robots involves collecting data from various sensors, processing the data using algorithms, and using actuators to carry out the required action. This technology offers several benefits, such as reduced carbon emissions, lower maintenance costs, and improved efficiency.

4. (a) Main Components

4.1 Solar Panel

The 17 Watt 18 Volt solar panel from Voltaic is lightweight, waterproof, and designed for long term outdoor use in any environment. The panel uses high-efficiency monocrystalline solar cells, and is UV- and scratch-resistant.Features are Waterproof and High-efficiency monocrystalline cells. Less in Size and Weight. For maximum power output, orient the panel towards the sun.

4.2 DC Gear Motor

A gear motor is a motor designed with an integrated gearbox. Gear motors function as torque multipliers and speed reducers thus requiring less power to move a given load. The design of the gearbox structure, lubrication and type of coupling affects its performance.

4.3 DC Motor & Tires

A DC motor is an electrical device that converts direct current (DC) electrical energy into mechanical energy."BO" likely refers to "brushed-outrunner," which is a type of DC motor that has the stator (stationary part) on the inside and the rotor (rotating part) on the outside.A high-quality motor would typically have tight Tolerances, high-quality bearings, and other features designed to improve its performance, efficiency, and durability.

Tires are an important component in many projects, including those related to robotics, automation, and mobility. In a Solar Grass Cutter Robotproject, tires would likely play a crucial role in helping the robot maintain its balance and stability.

4.4 Battery

The battery is a critical component of a Solar Grass Cutter Robotproject, as it provides the necessary power to operate the robot. The voltage and capacity of the battery will depend on the power requirements

of the project, and The battery chemistry will determine its performance characteristics such as energy density, discharge rate, and cycle life.

4.5 Ultrasonic Sensor

An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound (i.e. the sound that humans can hear). Ultrasonic sensors have two main components: the transmitter (which emits the sound using piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the target).

4.6 Arduino Board

Arduino is an open-source hardware and software platform that is designed for building and prototyping electronic devices. It consists of a microcontroller board that can be programmed using a simple and intuitive programming language.

4.7 Wi-Fi Module & Motor Driver Module

The Wi-Fi module in the Solar Grass Cutter Robot is an essential component that enables the rover to communicate wirelessly with other devices on a Wi-Fi network. This wireless communication capability is crucial for sending telemetry data, receiving commands, and transmitting scientific data. The Wi-Fi module is compatible with standard Wi-Fi protocols and can be configured to work with a variety of Wi-Fi networks.

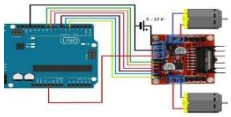
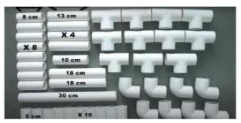
A motor driver IC is an integrated circuit chip that controls motors in autonomous robots and embedded circuits.

4.8 PVC Pipes

PVC pipes are commonly used for manufacturing sewage pipes, water mains and irrigation. Possessing very long-lasting properties, PVC pipes are easy to install, lightweight, strong, durable and easily recyclable, making them cost-efficient and sustainable.

5. (b) Specification

	NAME OF THE COMPONENT	SPECIFICATIONS	COMPONENT
1.	Solar panel	18V, 27watts	
2.	DC gear motor	12V, 3amp	

3.	DC motor	12V, 60 rpm, 0.3amp	
4.	Turbo Wheel	6 inchwheel	
5.	Battery	12V, 1.3.amp	
6.	Ultrasonic Sensor	40 cm Range	
7.	Arduino Board	1 quantity	
8.	Wi-Fi Module	ESP- 12E	
9.	Motor Driver Module	1 quantity	
10.	PVC Pipes	Pipes = 26 Joints = 11 L Joints = 8	
11.	Blade	Stainless steel	

6. Design & Fabrication

7.Results AND DISCUSSION

Calculations :

1. Solar Panel Rated Power = 18V, 27W
2. DC Motor Rated Voltage = 12V, Rated Current = 0.3 AMH
3. DC battery Rated Voltage = 12V, Ampere hour = 1.3 AMH
4. Number of Batteries = 2
5. Solar panel Efficiency = 18%

DC Motor For Wheel :

DcMotor for wheel = 12V,0.3amp
Power of the motor = 3.6watts
Total power of motor for 4 wheels = 4*3.6

DC Motor For Cutter :

DC motor for center = 12V, 1.3amps
Power required for cutter = 12*1.3apms = 15.6watts.

Total Power From The Battery :

Total power from battery = No. of batteries * volts * current
= 2*12*1.3
= 31.2watts.

Total Power From Motors :

Total power from the battery = 14.4 + 15.6 = 30watts

Total Power From Battery = Total Power From Motors :

31.2watts = 30watts

Total Time Taken To The Charge The Battery From Solar Panel :

Charge the battery from solar panel = 27watts * 0.18 = 4.86watts
Total power from the battery / 4.86 = 31.2/4.86 = 6 hours (approximately)

Operating Hour Per Day = 1hour

7. Conclusion:

In conclusion, IoT-based solar grass cutting robots are a promising solution for lawn maintenance, offering a range of benefits, including reduced carbon emissions, lower maintenance costs, and improved efficiency. These robots are powered by renewable energy sources, such as solar panels, and are equipped with various sensors and communication modules that enable them to navigate the lawn and communicate with other devices.

The working principle of IoT-based solar grass cutting robots involves collecting data from sensors, processing the data using algorithms, and using actuators to carry out the required action. The robot is able

to navigate the lawn, detect obstacles, and adjust its cutting height based on the density and height of the grass.

Research conducted on IoT-based solar grass cutting robots has shown promising results, with several studies demonstrating their effectiveness in maintaining lawns and gardens. However, further research is needed to improve their performance and reliability, especially in adverse weather conditions.

Overall, the IoT-based solar grass cutting robot is a sustainable and efficient solution for lawn maintenance, and its potential for further development makes it an exciting prospect for the future of gardening and landscaping.

8. Acknowledgement

I would like to acknowledge the engineers, scientists, and researchers who contributed to the development and improvement of this mechanism. Their tireless efforts in advancing the field of robotics have paved the way for the creation of innovative technologies like the robotic detector with rocker bogie mechanism.Lastly, I would like to acknowledge the organizations and institutions that supported the research and development of this technology. Their investment and belief in this project have made it possible for the robotic detector with rocker bogie mechanism to become a reality and benefit society in numerous ways.

9. Future scope

The future scope of IoT-based solar grass cutting robots is promising, and there is potential for further advancements in this field. Here are some of the future possibilities for this technology:

1. Autonomous Navigation: Future IoT-based solar grass cutting robots may incorporate advanced navigation systems that allow them to navigate lawns and gardens more efficiently, even in complex environments. The integration of advanced sensors, such as lidar and machine vision, can enhance their ability to detect and avoid obstacles.
2. Artificial Intelligence: Incorporating artificial intelligence (AI) algorithms can enable the robot to learn from its environment and make decisions based on real-time data. The AI can help optimize the cutting path, adjust cutting height, and even predict potential issues before they occur.
3. Cloud Computing: Cloud computing can enhance the capabilities of IoT-based solar grass cutting robots by enabling them to access more computing power and storage. This can help to process large amounts of data and improve the accuracy of the algorithms.
4. Multi-Tasking: Future robots may be designed to perform multiple tasks simultaneously, such as mowing the lawn while also watering or fertilizing it. This can lead to a more holistic and efficient approach to lawn maintenance.
5. Environmental Monitoring: IoT-based solar grass cutting robots may incorporate environmental sensors to monitor air and soil quality, temperature, and humidity. This data can be used to optimize the cutting schedule and adjust the robot's behavior to promote healthy lawn growth.
6. Integration with Smart Homes: With the rise of smart homes, IoT-based solar grass cutting robots may be integrated with home automation systems, allowing for remote control and monitoring of the robot's activities.

In summary, the future scope of IoT-based solar grass cutting robots is vast, and there is much potential for further innovation and development in this field. Continued research and development efforts can lead to more advanced, efficient, and sustainable lawn maintenance solutions.

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