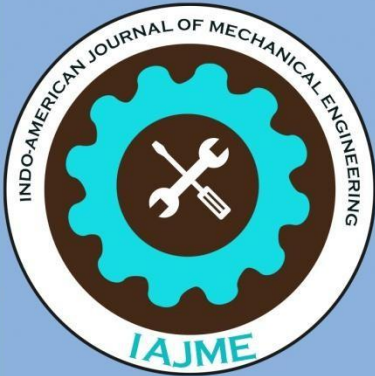




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AUTONOMOUS LAWN MOWER

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Abstract:

An autonomous lawn mower is an advanced robotic system designed to automatically mow lawns with minimal human intervention. Utilizing sensors, GPS, and AI algorithms, these machines can navigate complex environments, recognize obstacles, and efficiently trim grass to a specified height. They offer several advantages over traditional lawn mowers, including time-saving, energy efficiency, and reduced labor costs. These mowers are equipped with features like programmable schedules, rain sensors, and safety mechanisms, ensuring optimal performance while minimizing environmental impact. The development of autonomous lawn mowers marks a significant advancement in the automation of household and landscaping tasks, enhancing convenience and promoting sustainable practices in lawn care.

Keywords: *Autonomous Navigation, Obstacle Detection, GPS Tracking, Artificial Intelligence (AI), Computer Vision, Ultrasonic Sensors, Path Planning, Battery Management, Charging Station, Wireless Connectivity, Smart Lawn Care, Mobile App Control, Eco-Friendly Operation.*

1. INTRODUCTION

An autonomous lawn mower is a robotic lawn mower that uses advanced navigation systems and sensors to cut grass independently, without human intervention. It offers convenience, consistency, safety, and environmental benefits, and is ideal for residential and commercial lawn maintenance. The grass is a very common plant that grows naturally on earth which covers up to 40% of earth's land surface. Grasses are highly beneficial to nature and to mankind. It provides food, fuel, medicine, shelter and transportation. It provides protection against soil erosion and improves air quality and filter pollution. While grasses improve both human and animal life it can also be a pest, invasive and bringer of death and destruction. Invasive grass species when dried can cause fire. Some grass species can kill plants by choking and displacing them and competing to the soil nutrients and water resources. The invasive and uncontrollable nature of some species of grasses can greatly impact the environment and the economy. In order to address these issues it needs scientific and technological solutions. The solution can either be through chemical, organic or mechanical means. The grass can be controlled chemically by herbicides; however herbicides cause injury to non-target plants. During the Vietnam War in 1961-1971, the Americans used the infamous herbicides called Agent Orange to clear vegetation in large areas of Vietnam, Laos and Cambodia. It did successful defoliation but it caused huge amount of destruction to agricultural land and forest. Other forms of killing weeds is by organic means, solutions such as vinegar, dish soap, Epsom salts and borax which are low cost and can kill weeds. These can be with the use of hoes, broad forks, rakes, and numerous other garden implements to effectively control weeds. However, many gardeners get frustrated with this method, for they wait too long to perform this task.

2. LITERATURE SURVEY

N. Nivetha, Design and Implementation of Automatic lawn cutter, International Journal of Science Technology

&Engineering(IJSTE).The automating lawn cutter is a fully automated grass cutting robotic vehicle powered by solar energy that also avoids obstacles and is capable of fully automated grass cutting without the need of any human interaction. The grass cutter and vehicle motors are interfaced to an 8051 family micro -controller that controls the working of all the motors. It is also interfaced to an ultrasonic sensor for object detection. The micro controller moves the vehicle motors in forward direction in case no obstacle is detected. On obstacle detection the ultrasonic sensor monitors it and the microcontroller thus stops the grass cutter motor to avoid any damage to the object/human/animal whatever it is. Microcontroller then turns the robotic as long as it gets clear of the object and then moves the grass cutter in forward direction again. N.K.Santosh, Smart Solar Grass Cutter For Lawn Coverage, International Journal of Innovative Science and Research Technology.The present technology commonly used for cutting the grass is by using the manually handle device and gasoline powered. In this project we are going to automate the device for cutting the grass. The device consists of linear blade which is operated with the help of the motor the power supply for the motor is by using battery. The battery can be charge by using solar panel. In case of any obstacles in the path it is sensed by using an Ultrasonic sensor and two Infrared sensors.

Akshay Joshi, Design and Fabrication of Hybrid Operating Grass Cutter, International journal of engineering research & technology (IJERT).Hybrid powered grass cutter can be described as the application of solar energy to power an electric motor which in turn rotates a blade which does the mowing and trimming of lawn each to suit a particular need or convenience. It uses the photo voltaic panel to generate the energy needed to power the mower. The hybrid powered grass cutter will help to reduce air pollution as well as noise pollution produced by other types of grass cutter. Rotary mowers are based on the use of small but powerful engine that provides enough torque to spin a very sharp horizontal blade that cuts the grass upon contact.



Gokhale Shantanu Bhalchandra, Automated Mower Robot, International Research Journal of Engineering and Technology (IRJET) 1. The present technology commonly uses manually operated devices to cut the grass, creating pollution and energy loss. In this project, we introduce the automatic grass cutter for cutting grass. Automatic grass cutter can able to decrease the workload of cutting grasses in the field; also in this, the operating force is given by the rechargeable battery that is fixed to the cutter, sensors, and crane mechanism can able to find out the unwanted things and get around while the operation. The grass-cutter and motors used in the vehicle will be frontier with the Arduino mega2560, the entire motors' management.

Neha, Automated Grass Cutter Robot Based on IoT. International Journal of Trend in Scientific Research and Development. Hybrid powered grass cutter can be described as the application of solar energy to power an electric motor which in turn rotates a blade which does the mowing and trimming of lawn each to suit a particular need or convenience. It uses the photo voltaic panel to generate the energy needed to power the mower. The hybrid powered grass cutter will help to reduce air pollution as well as noise pollution produced by other types of grass cutter. Rotary mowers are based on the use of small but powerful engine that provides enough torque to spin a very sharp horizontal blade that cuts the grass upon contact.

Mallikarjun, "Automatic Solar Grass Cutter", International Journal for Research in Applied Science and Engineering Technology. The fully automated solar grass cutter is a grass cutting robotic vehicle powered by solar energy that also avoids obstacles and is cutting the grass without the need of any human interaction. The bot uses 12V batteries to power the vehicle movement motors as well as the grass cutter motor. We also use a solar panel to charge the battery so there is no need of charging it externally. The grass cutter and vehicle motors are interfaced to an 8051 family micro controller that controls the working of all the motors. It is also interfaced to an ultrasonic sensor for obstacle detection. The micro controller moves the vehicle motors in forward direction in case no obstacle is detected. On obstacle detection the ultrasonic sensor monitors it and the micro controller thus stops the grass cutter motor to avoid any damage to the object/human/animal whatever it is. Micro controller then turns the vehicle as long as it gets clear of the and then moves the grass cutter in forward direction again. This project of a solar powered automatic grass cutter will relieve the consumer from moving their own lawns and will reduce both environmental and noise pollution. Ultimately, the consumer will be doing more for the environment while doing less work in their daily lives.

B.P.Dilip, "Design and Implementation of Automatic Solar Grass Cutter," International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering. The present technology commonly uses manually operated devices to cut the grass, creating pollution and energy loss. In this project, we introduce the automatic grass cutter for cutting grass. Automatic grass cutter can able to decrease the workload of cutting grasses in the field; also in this, the operating force is given by the rechargeable battery that is fixed to the cutter, sensors, and crane mechanism can able to find out the unwanted things and get around while the operation. The grass-cutter and motors used in the vehicle will be frontier with the Arduino mega2560, the entire motors' management. The vehicle will be in boundary with the ultrasonic sensor to identify the object. On obstacle detection, the ultrasonic

sensor monitors it, and the Arduino thus stops the grass cutter motor to negotiate any damage to the object/human/animal, whatever it is. It consists of obstacle avoidance, android application, adjustable level of grass-cutter, and gear wire blade. Also, the design parameters are discussed in this paper. This study aims to develop an autonomous grass-cutting robot embedded with obstacle avoidance and grass level adjustments.

Mr.P.D.Patil, "Intelligent Solar Powered Grass Cutting Robot with Obstacle Avoidance", International Journal of Modern Electronics and Communication Engineering (IJMECE). One of the major problems associated with grass lawn is to maintain proper height of grass. Traditional methods available are based on manual grass cutting or manually operated lawn mowers, both requires skilled labour. The problem becomes very cumbersome, when area to be covered is very large. Many researchers have come up with the solution of automatic lawn mower. However, major issues with such machines are length of perimeter guide wire, high price tag & maintenance cost. If battery operated, then longevity of the battery. In this paper, an intelligent solar powered grass cutting robot with obstacle avoidance is presented. The system is consisting of ARM 7 controller to which colour and ultrasonic sensors are interfaced. The system was tested on different conditions and it is observed that, it can be used efficiently on flat lawn surface.

Bysani Sai Yaswanth, "Solar Power Based Agriculture Robot for Grass Cutting". Siddaganga Institute of Technology, Tumakuru. In India, most people are dependent on agriculture for their livelihood. grass cutting are the work that are carried out in the agriculture fields. Though there are many types of equipment available in the market, all are not used for multiple purposes. By developing a multipurpose agriculture robot input costs can be reduced. The proposed agricultural robot is an Internet of Things (IoT) based system. Through which users can monitor the condition of the crop and also perform some specific operation using an android app. For a non-technical farmer, it also helps to find a suitable crop based on some parameters related to crop using Machine learning. This paper intends to configure, create and manufacture the robot which carries out the cutting the grass and spraying of pesticides. This ensures the carrying out of agriculture operations in an efficient way.

Tomoyuki Yamaguchi, "Grass Cutting Robot for Inclined Surfaces in Hilly and Mountainous Areas". Ph. D. Program in Empowerment Informatics, School of Integrative and Global Majors, University of Tsukuba. Grass cutting is necessary to prevent grass from diverting essential nutrients and water from crops. Usually, in hilly and mountainous areas, grass cutting is performed on steep slopes with an inclination angle of up to 60° (inclination gradient of 173%). However, such grass cutting tasks are dangerous owing to the unstable positioning of workers. For robots to perform these grass cutting tasks, slipping and falling must be prevented on inclined surfaces. In this study, a robot based on stable propeller control and four-wheel steering was developed to provide stable locomotion during grass cutting tasks. The robot was evaluated in terms of locomotion for different steering methods, straight motion on steep slopes, climbing ability, and coverage area. The results revealed that the robot was capable of navigating uneven terrains with steep slope angles. Moreover, no slipping actions that could have affected the

grass cutting operations were observed. We confirmed that the proposed robot is able to cover 99.95% and 98.45% of an area on a rubber and grass slope, respectively. Finally, the robot was tested on different slopes with different angles in hilly and mountainous areas. The developed robot was able to perform the grass cutting task as expected.

3. PROPOSED SYSTEM

The proposed Autonomous Lawn Mower system utilizes a robust and waterproof platform, equipped with advanced navigation, obstacle detection, and cutting systems. The system employs GPS, lidar, and sensors to navigate and map the lawn, while detecting and avoiding obstacles. A rechargeable battery and charging system power the electric or gasoline-powered cutting blades. A microcontroller or computer controls the system, executing navigation, obstacle avoidance, and cutting algorithms. The system offers convenience, consistency, safety, and environmental benefits, making it an ideal solution for residential and commercial lawn maintenance.



Figure 1: Proposed autonomous lawn mower

This proposed methodology typically includes the following key components:

1. Navigation and Guidance:

Boundary Definition:

Perimeter Wire: Many older and some current models use a physical wire buried around the lawn's perimeter. The mower detects the signal from this wire to stay within the designated area.

GPS and RTK (Real-Time Kinematic): More advanced mowers utilize GPS and RTK technology for precise positioning. They can create virtual boundaries and navigate without physical wires.

Vision Systems: Some newer mowers employ cameras and sensors to map the lawn and identify obstacles, allowing for autonomous navigation.

Mapping: Some mowers create a map of the lawn to optimize mowing paths and ensure complete coverage.

2. Mowing Mechanism:

Cutting Blades: Typically, these mowers use rotating blades to cut the grass.

Cutting Height Adjustment: Users can usually adjust the cutting height through the mower's settings.

3. Obstacle Avoidance:

Sensors: Various sensors like ultrasonic, infrared, or visual sensors are used to detect obstacles such as trees, flowerbeds, or people.

Collision Detection: The mower is programmed to stop or navigate around detected obstacles.

4. Power and Charging:

Battery: Most autonomous lawn mowers are battery-powered, typically using lithium-ion batteries.

Charging Station: The mower automatically returns to a charging station when its battery is low. Some models can also be programmed to return to the station at specific times.

5. User Interface and Control:

Mobile App: Many mowers are controlled and monitored through a smartphone app, allowing users to schedule mowing times, adjust settings, and track the mower's progress.

Onboard Controls: Some models have a basic control panel on the mower itself.

6. Safety Features:

Lift Sensors: These sensors detect if the mower is lifted and automatically stop the blades.

Tilt Sensors: Similar to lift sensors, these detect if the mower is tilted beyond a safe angle and stop operation.

Emergency Stop Button: Most mowers have an easily accessible emergency stop button.

Advantages:

- 1. Convenience:** Autonomous lawn mowers save time and effort, allowing users to focus on other activities.
- 2. Consistency:** Autonomous lawn mowers maintain a consistent cutting pattern and height, ensuring a well-manicured lawn.
- 3. Safety:** Autonomous lawn mowers detect and avoid obstacles, reducing the risk of accidents and injuries.
- 4. Environmental Benefits:** Autonomous lawn mowers reduce emissions and noise pollution, promoting sustainable lawn maintenance.
- 5. Increased Efficiency:** Autonomous lawn mowers optimize cutting routes and patterns, reducing mowing time and energy consumption.
- 6. Reduced Labor Costs:** Autonomous lawn mowers minimize the need for manual labor, reducing costs for commercial landscaping and lawn maintenance services.
- 7. Improved Lawn Health:** Autonomous lawn mowers can be programmed to maintain optimal cutting heights and frequencies, promoting healthy lawn growth.
- 8. Enhanced Security:** Autonomous lawn mowers can be equipped with security features, such as GPS tracking and alarm systems, to prevent theft and vandalism.
- 9. Low Maintenance:** Autonomous lawn mowers require minimal maintenance, as they can automatically adjust cutting heights and navigate around obstacles.
- 10. Customization:** Autonomous lawn mowers can be programmed to accommodate specific lawn shapes, sizes, and features, ensuring a tailored lawn maintenance solution.

Applications:

- 1. Residential Lawns:** Autonomous lawn mowers are ideal for homeowners who want to maintain a well-manicured lawn without the hassle of manual mowing.
- 2. Commercial Landscaping:** Autonomous lawn mowers can be used in commercial landscaping applications, such as parks, golf courses, and large estates.
- 3. Golf Courses:** Autonomous lawn mowers can be used to maintain golf courses, reducing labor costs and improving efficiency.
- 4. Parks and Recreation:** Autonomous lawn mowers can be used in public parks and recreation areas to maintain large grassy areas.

5. Agricultural Applications: Autonomous lawn mowers can be adapted for agricultural applications, such as crop monitoring and harvesting.

6. Landscaping and Lawn Care Services: Autonomous lawn mowers can be used by landscaping and lawn care services to improve efficiency and reduce labor costs.

7. Municipalities: Autonomous lawn mowers can be used by municipalities to maintain public spaces, such as parks and green spaces.

8. Cemeteries: Autonomous lawn mowers can be used to maintain cemeteries and memorial gardens.

9. Airports and Military Bases: Autonomous lawn mowers can be used to maintain large grassy areas in airports and military bases.

10. Research and Development: Autonomous lawn mowers can be used in research and development applications, such as testing new sensors and navigation systems.

4. EXPERIMENTAL ANALYSIS

- **Performance Evaluation:** Measure how effectively the mower can cut the grass and cover the entire lawn area.
- **Efficiency Measurement:** Assess the mower's energy consumption, time efficiency, and ability to work autonomously for an extended period.
- **Obstacle Detection and Avoidance:** Evaluate how well the mower identifies and avoids obstacles such as trees, rocks, or garden furniture.
- **Navigation Accuracy:** Test the precision with which the mower navigates the lawn, including its ability to turn, adjust paths, and return to charging stations.
- **Weather Conditions:** Test the mower's ability to operate under varying weather conditions like rain or strong sunlight.
- **Grass Handling:** Determine how well the mower handles grass of different lengths and densities.

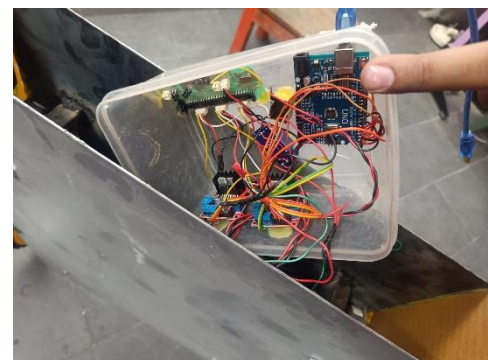


Figure: 2**5. CONCLUSION**

Autonomous lawn mowers have proven to be efficient in maintaining lawns, reducing labor costs and increasing productivity. They have advanced safety features, such as obstacle detection and emergency shutdown, reducing the risk of accidents and injuries. Furthermore, autonomous lawn mowers promote sustainable lawn maintenance, reducing emissions and noise pollution.

The accuracy of autonomous lawn mowers is also noteworthy, achieving consistent cutting heights and patterns, improving lawn appearance and health. As the technology continues to evolve, autonomous lawn mowers are poised to revolutionize the lawn maintenance industry, offering a convenient, efficient, and sustainable solution.

To further enhance the benefits of autonomous lawn mowers, continued research and development is necessary. This includes addressing minor issues and improving performance. Additionally, increased adoption of autonomous lawn mowers should be encouraged, promoting their benefits and value to homeowners and lawn care professionals.

Finally, integration with smart home systems should be developed, enhancing control and monitoring capabilities. Regulatory frameworks should also be established to ensure safe and responsible deployment of autonomous lawn mowers. With these developments, autonomous lawn mowers will become an indispensable tool for lawn maintenance.

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