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Fully Automated Solar Grass Cutter using IoT

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Abstract:- The use of renewable energy resources has been increasing day by day, such as solar power. It leads to a growing interest in developing new systems which make use of it. One such system is the fully automated solar grass cutter, it uses solar energy to power itself and store solar energy in a battery in the form of electrical energy.It can also be controlled remotely by using the internet of things (IoT) or controlled automatically when connected to a power supply. The overall system efficiency is 94.37% and the existing model has 54% efficiency. This projectuses several components such as the Arduino Uno, Node MCU, ultrasonic sensor, motor drivers, solar plates, and DC motors. The IOT mode uses the ThingSpeak cloud application. Thisdevice is designed to automatically detect the obstacle and cut grass in a lawn while being powered by solar energy.The maximum efficiency during clear weather, of the charge controller is98% at maximum solar voltage, while the maximum efficiency of charge control during cloudy weather conditions is about 70%.

Keywords:- *Arduino UNO,Node MCU, Ultrasonic Sensor, Solar Plates, DC Motors, DC Motor Driver, Blades, Battery.*

I. INTRODUCTION

Maintaining a neat and clean lawn can be a challenging task, particularly for large areas like parks, hospitals, etc. [15][16]Grass can grow quickly, and regular maintenance is necessary to keep it fresh and looking good. Using traditional ways such as electrical grass cutters and gasoline grass cutters. These cutters require more time and a lot of human effort. Gasoline grass cutter produces pollution and electrical grass cutter requires a large number of wires connected to the socket. To solve this problem, we have designed a fully automated solar grass cutter using IoT[14][17].

The system is powered by solar plates that convert sunlight i.e., solar energy[3][4][6] into electrical energy, which is then stored in batteries. These batteries [20]power the DC motors that control the movement of the grass cutter. The system can be controlled automatically by connecting to the power supply and it can be controlled remotely[19] using the Internet of things (IoT). The IoT mode makes use of the ThingSpeak cloud application[21], which allows the user to monitor and control the grass cutter from anywhere in the world.

Fig. 1: Grass Cutter

II. LITERATURE SURVEY

"Development of an Automated Lawn Mower with Obstacle Avoidance Using Arduino Microcontroller and Ultrasonic Sensor" by K. C. Chua, et al. (2018): This study presents the development of an automated lawn mower using an ultrasonic sensor and Arduino microcontroller. The system uses the same components as our project and incorporates obstacle avoidance.

"Smart Lawn Mower System using IoT and Machine Learning Techniques" by D. K. Kim, et al. (2021): 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 andcan be controlled remotely. This study provides insights into how machine learning can be incorporated into the fully automated solar grass cutter project.

"Design of an Automated Grass Cutter Robot with Bluetooth Connectivity" by A. M. A. Hanan and R. Ahmed (2020): 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.

"IoT-Based Solar-Powered Smart Agriculture System for Sustainable Crop Cultivation" by B. S. Singh and S. K. Singh (2020): 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.

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Overall, the literature survey highlights the importance of using renewable energy sources, such as solar power, and IoT connectivity in developing automated grass-cutting systems. The studies provide valuable insights into the use of ultrasonic sensors, machine learning, and different connectivity options in developing these systems. The fully automated solar grass cutter project can benefit from these insights to further optimize and improve its design.

III. METHODOLOGY

The development process involved designing the system architecture, developing software code, assembling the hardware, testing the system, integrating with the IoT application, optimizing the system, and deploying it in the intended location. The system architecture was designed based on the project requirements and included the Arduino Uno, Node MCU, ultrasonic sensor, motor driver, solar panel, DC motor, battery, and IoT application Thingspeak cloud. The software code was developed using the Arduino IDE and enabled the system to perform its intended function of cutting grass automatically. The hardware was assembled by connecting the various components as per the system architecture designand tested to verify that allcomponents were functioning as intended. The system was integrated with the IoT application Thingspeak cloud, to enable remote monitoring and control of the grass cutter. The system was then optimized by identifying areas for improvement and making necessary adjustments. Finally, the system was deployed in the intended location, and end-users were provided with training on how to use and maintain it.

A. Block Diagram

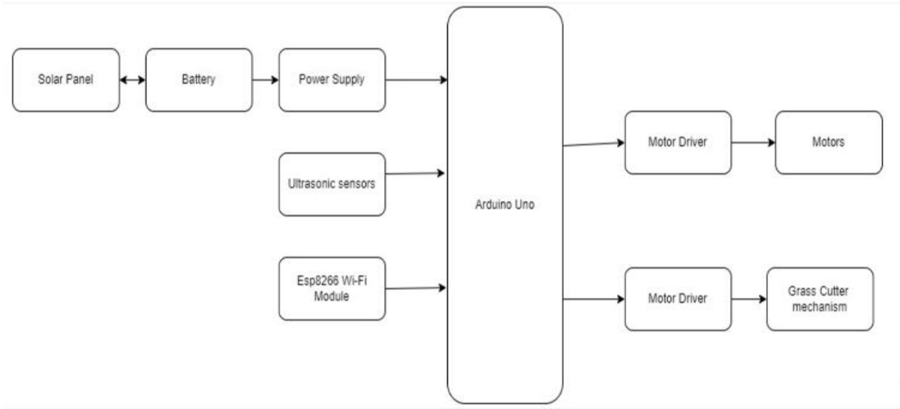

Fig. 2: Block diagram

B. Flow Chart

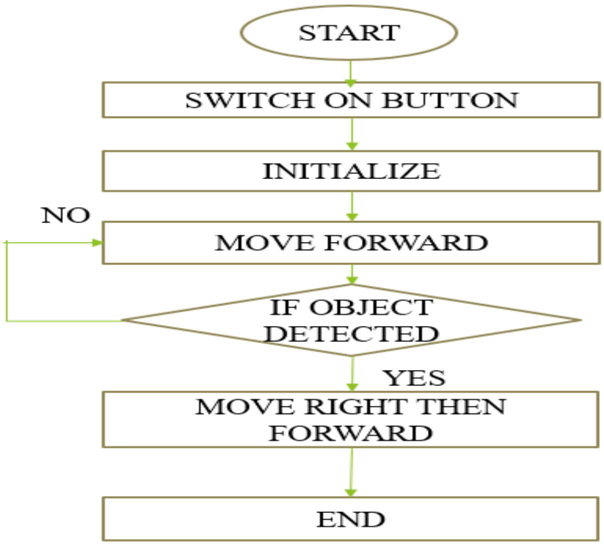

Fig. 3: Flow chart

C. Thingspeak Application

ThingSpeak is an open-source Internet of Things (IoT) application and cloud platform that enables users to collect and store sensor data in the cloud, analyze and visualize that data, and create IoT applications. ThingSpeak supports a large range of IoT devices and protocols. The platform provides tools for real-time data analytics and visualization and allows users to create custom dashboards and alerts. ThingSpeak also supports integration with other IoT platforms and services, allowing users to build end-to-end IoT solutions. Some common applications of ThingSpeak include environmental monitoring, smart agriculture, industrial automation, and home automation.

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Fig. 4: Thingspeak cloud

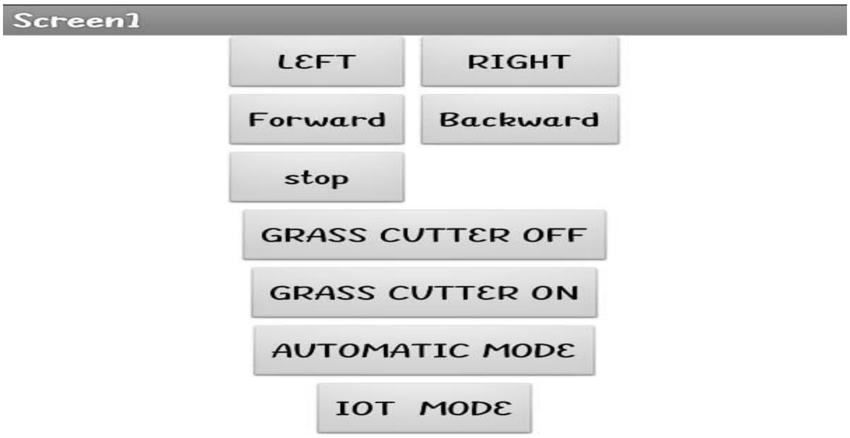

Fig. 5: IOT app

IV. HARDWARE COMPONENTS

A. Arduino UNO

The Arduino UNO is an open source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc and initially released in 2010. The Arduino UNO board has several parts i.e. analog pins, digital pins, ICSP pin, voltage regulator, USB port, power LED indicator. This is programmed using IDE, which means integrated development environment.

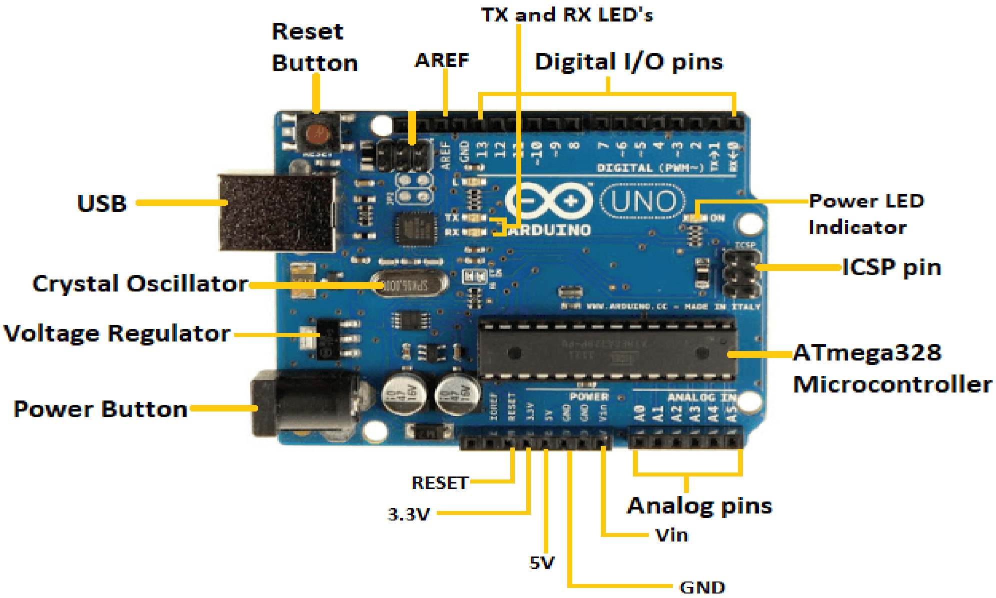

Fig. 6: Arduino UNO

B. *L293D Motor Driver*

L293d IC, a motor controller, is a semiconductor. It uses very little power to function, like other ICs. The other ICs could accomplish the same functions as L293d, but they are powerless to drive the motor. L293d provides a steady, reversible direct current to the Motor. Using this standard motor driver or motor driver IC, two DC motors are controlled in either direction. The two DC motors are controlled simultaneously by the 16-pin IC L293D in any direction. According to this, a single L293D IC can run two DC motors.

Technical specification:
Dimensions – 44x37 mm
Supply Voltage: 4.5V to 36V
Output Current: 600mA per channel
Protection Diodes: Included
Control Pins: 4
Output Pins: 2 per channel

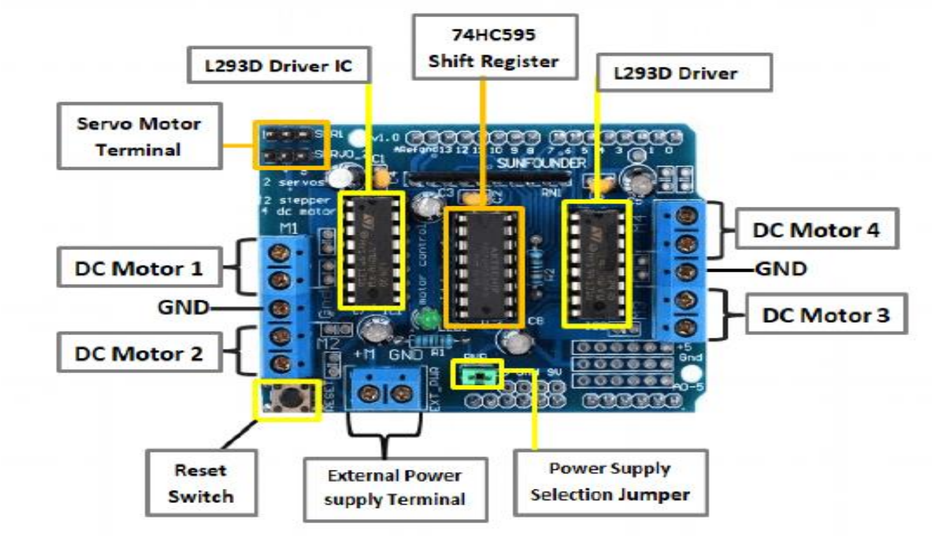

Fig. 7: L293D Motor Driver

C. *Node MCU*

NodeMCU is an open-source Lua-based firmware and **development board** specially targeted for IoT-based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware that is based on the ESP-12 module.

Technical Specification:

- Microcontroller: Tensilica 32-bit RISC CPU Xtensa LX106
- Operating Voltage: 3.3V
- Input Voltage: 7-12V
- Digital I/O Pins (DIO): 16
- Analog Input Pins (ADC): 1
- UARTs: 1
- SPIs: 1
- I2Cs: 1
- Flash Memory: 4 MB
- SRAM: 64 KB
- Clock Speed: 80 MHz
- USB-TTL based on CP2102 is included onboard, Enabling Plug n Play.

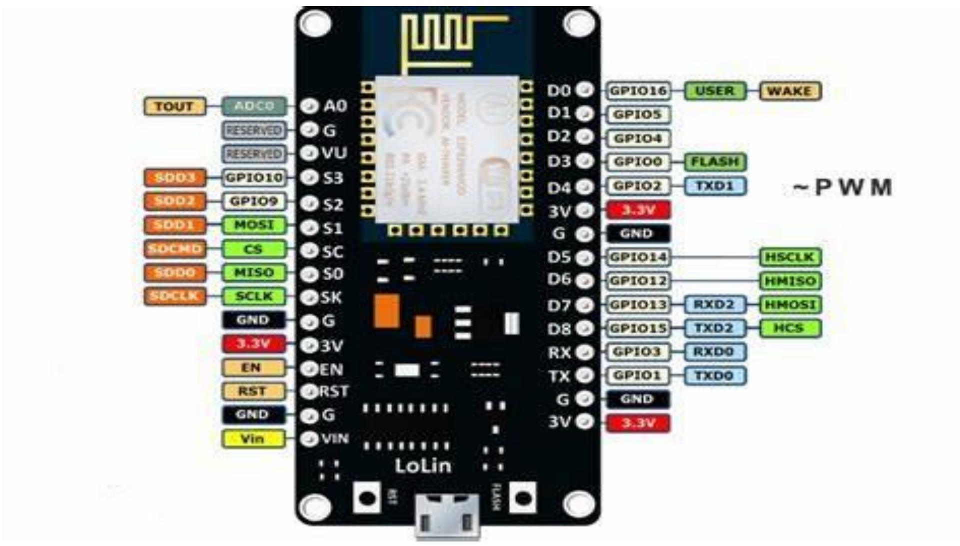

Fig. 8: Node MCU

D. Ultrasonic Sensor

An ultrasonic sensor is a device that uses ultrasonic sound waves to detect a target object's distance and then it turns the sound that is reflected back into an electrical signal.It uses a formula to calculate the distance between the target object and the sensor D = 1/2 T x C

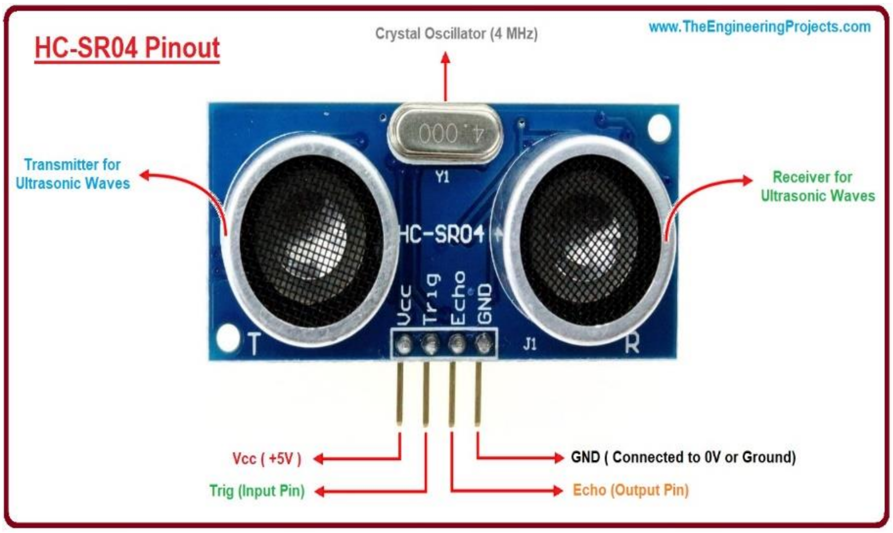

Fig. 9: Ultrasonic Sensor

E. Solar Panel

The solar panel is a device that converts solar energy into electrical energy and that is stored in a battery. The entire process is known as photovoltaic effect.

Fig. 10: Solar Panel

F. DC Motor

A DC motor is an electrical machine that converts electrical energy into mechanical energy. In a DC motor, the input electrical energy is the direct current which is transformed into mechanical rotation.

Fig. 11: DC Motor

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V. RESULTS

The system was successfully implemented and tested. The solar panel was able to harvest sufficient solar energy to power the motors. The ultrasonic sensor was able to detect obstacles accurately and stop the grass cutter from colliding with them. The motor drivers were able to control the speed and direction of the grass cutter efficiently. The system was able to send real-time data to the ThingSpeak cloud and the user was able to monitor and control the system remotely using the IoT application.

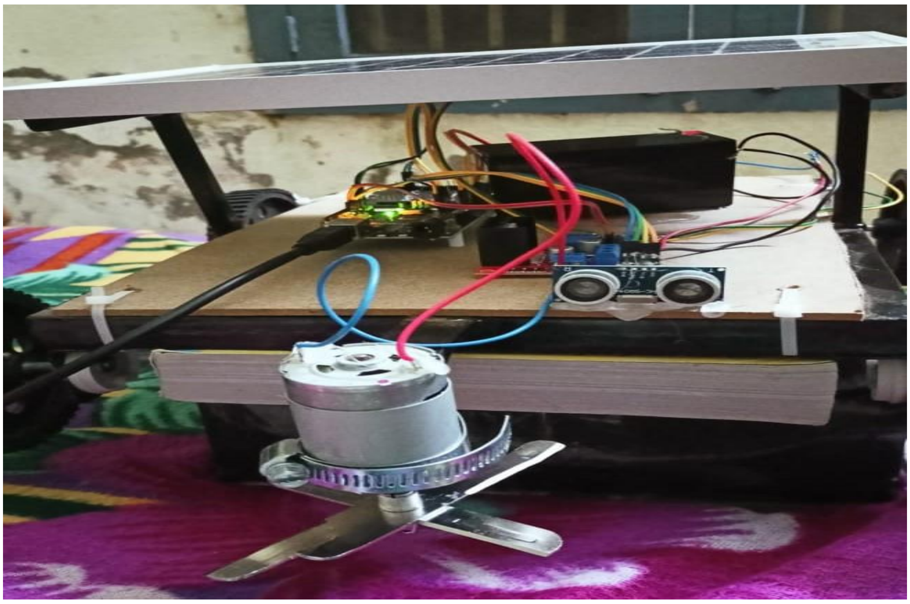

Fig. 12: Front view of grass cutter

Fig. 13: Top view of grass cutter

Table 1: Comparison Between Existing & Present Models

CONVENTIONAL GRASS CUTTER	AUTOMATED SOLAR GRASS CUTTER
Efficiency=54%	Efficiency=94%
Cause more pollution	Cause less pollution
More effort	Less effort
High maintenance required	Low maintenance required
Remote control not available	Remote control available
More noise	Less noise
Less efficient	More efficient

The time required to charge the battery from the 5-watt solar panel is
Wattage hour of battery = Amp hour*Total voltage
Wattage hour of battery = 1.3*12
Wattage hour of battery = 15.6Whr
Time required for charging = wattage hour of battery/panel wattage
Time required for charging = 15.6Whr/5W
Time required for charging = 3.12 hr

Hence the charging time is almost equal to 3.12 hours for complete charging i.e. 100% of the battery.

Width of the vehicle: 0.34 meters
For 1 minute it moves: 3 meters
Total area occupy = width x length m^2
= 0.34x3 m^2 =1.02 m^2
For one hour area occupy = 60x1.02=61.2 m^2

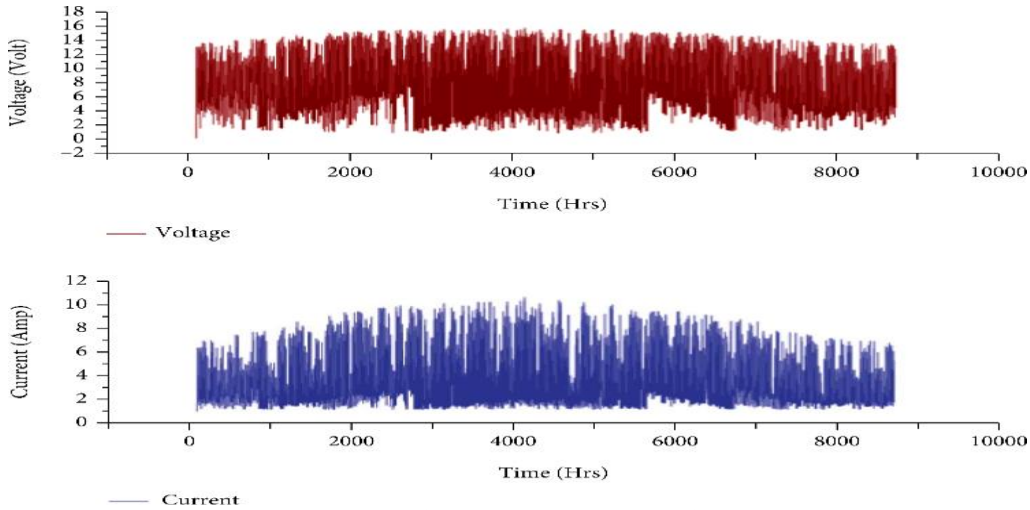

Fig. 14: graph of the solar panel running for 1 year

VI. CONCLUSION

The fully automated solar grass cutter using IoT components is an eco-friendly and cost-effective solution to reduce human effort in grass cutting. The system uses solar energy to power the motors, making it sustainable and cost-effective. The ultrasonic sensor and motor drivers enable the system to detect obstacles and control the speed and direction of the grass cutter efficiently. The system is connected to the Thing Speak cloud, which provides real-time data monitoring and analysis. The user can control and remotely monitor the cutter using the IoT application. This system has the potential to revolutionize the lawn and garden maintenance industry by reducing human effort and increasing efficiency. This cutter is highly efficient and the moment of the mower is changed by the user by giving instructions through mobile phones. Therefore equipment can be protected from damage, by not hitting any obstacle and reduces the risk to humans. Hence this grass cutter can reduce the cost-effectiveness and it is easy to maintain. Future work includes the development of a mobile application that allows for more advanced control of the system and the integration of more sensors for more accurate data collection.

REFERENCES

[1.] J. Liu and Y. Zhang, "Design of an automatic grass cutter based on an ultrasonic sensor," 2015 International Conference on Artificial Intelligence and Industrial Engineering (AIIE), Jinan, 2015, pp. 263-266, doi: 10.1109/AIIE.2015.17.

[2.] C. H. Li and K. L. Lin, "An autonomous grass-cutting robot with obstacle detection and environment perception," 2016 2nd International Conference on Robotics and Artificial Intelligence (ICRAI), Hong Kong, 2016, pp. 121-126, doi: 10.1109/ICRAI.2016.7818421.

[3.] N. T. Q. Hoang and V. H. Nguyen, "Development of a solar-powered autonomous grass-cutting robot," 2019 International Conference on System Science and Engineering (ICSSE), Ho Chi Minh City, Vietnam, 2019, pp. 29-32, doi: 10.1109/ICSSE.2019.8912615.

[4.] Tushar Baingane1, Sweta Nagrale2, Suraksha Gumgaonkar3, Girish Langade4, Shaila Ramteke5 Prof.V.M.Dhumal6, “Review on Fully Automated Solar Grass Cutter”, International Research Journal of Engineering and Technology (IRJET) Volume 5, Issue 2, Feb 2018.

[5.] Bidgar Pravin Dilip1 , Nikhil Bapu Pagar2 , Vickey S. Ugale3 , Sandip Wani4 , Prof. Sharmila M.5, “Design and Implementation of Automatic Solar Grass Cutter”, International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering Volume 6, Issue 4, April 2017.

[6.] Ms. Yogita D. Ambekar1, Mr. Abhishek U.Ghate2 “SOLAR BASED GRASS CUTTER”, International Journal of Electrical and Electronic Engineers (IJEEE) Volume 9, Issue 1, June 2017.

[7.] Mrs. Melba D’Souza Ms. Vaidhavi B. Naik Ms. Rucha V Bicholkar, “Automatic Solar Grass Cutter”, IJSTE - International Journal of Science Technology & Engineering | Volume 3 | Issue 12 | June 2017.

[8.] “RF Controlled Metal and Deleterious Gas Detecting ROVER” Dr.Mallikarjun Mudda, Dr. Thangadurai N, World Journal of Engineering Research and Technology, 4 (1), 221-229, 2017.

[9.] Vicky Jain, Sagar Patil, Prashant Bagane, Prof.Mrs.S.S. Patil, Solar Based Wireless Grass Cutter, International Journal of Science Technology and Engineering, Vol.2,2017,576-580.

[10.] Ashish Kumar Choudhari, Yuvraj Sahu, Prabhat Kumar Dwivedi, Harsh Jain, Experimental Study of Solar Power Grass Cutter Robot, International Journal of Advance Research and Innovative Ideas in Education, Vol.2,2016,68-73.

[11.] Pankaj Malviva, Nukul Patil, Raja Praapat, Vaibhav Mandloli, Dr.Pradeep Kumar Patil, Prof Prabodh Bhise, Fabrocation of Solar Grass Cutter, International Journal of Scientific Research in Science , Engineering and Technology, Vol.2,2016,892-898.

[12.] Praful P. Ulhe, Manish D. Inwate, Fried D. Wankhede, Krushna Kumar S. Dhakte, Modification of Solar Grass Cutter Machine, International Journal

for Innovative Research in Science and Technology, Vol. 2,2015, 711711-714.
[13.] T. Karthick, S. Lingadurai, K. Muthuselvan, M. Muthuvanesh, C. Pravin Tamilselvan, Grass Cutting Machine using Solar Energy, Internation Journal of Research in Mechanical.
[14.] M. Ryalat, M. Alsherqatli, and H. Elmoaqet, "IoT-aided smart lawnmower," *International Symposium on Computer Science and Intelligent Control*, pp. 1–8, 2019.
[15.] H. Arora, J. A. Sagor, V. Panwar et al., "Design and fabrication of autonomous lawn mower with water sprinkler," *Think India Journal*, vol. 22, no. 17, p. 2101, 2019.
[16.] A. Hassan, H. M. Abdullah, U. Farooq et al., "A Wirelessly Controlled Robot-based Smart Irrigation System by Exploiting Arduino," *Journal of Robotics and Control (JRC)*, vol. 2, pp. 29–34, 2021.
[17.] T. Munasinghe, E. W. Patton, and O. Seneviratne, "IoT application development using MIT App inventor to collect and analyze sensor data," in *IEEE International Conference on Big Data*, pp. 6157–6159, Los Angeles, CA, USA, 2019.
[18.] J. Arshad, R.Tariq, S. Saleem et al., "Intelligent greenhouse monitoring and control scheme: an arrangement of Sensors, Raspberry Pi based Embedded System and IoT platform," *Indian Journal of Science and Technology*, vol. 13, pp. 2811–2822, 2020.
[19.] J. Katona and A. Kovari, "Cost-effective wi-fi controlled mobile robot," in *11th International Symposium on Applied Informatics and Related Areas (AIS 2016)*, pp. 28–31, Hungary, 2016.
[20.] P. Vorel and J. Martiš, "Battery powered lawn mower," *ECS Transactions*, vol. 105, no. 1, pp. 567–574, 2021.
[21.] R. M. Asif, J. Arshad, M. Shakir, S. M. Noman, and A. U. Rehman, "Energy efficiency augmentation in massive MIMO systems through linear precoding schemes and power consumption modeling," *Wireless Communications and Mobile Computing*, vol. 2020, Article ID 8839088, 13 pages, 2020.