International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 04 | April - 2023 Impact Factor: 8.176 ISSN: 2582-3930

Design And Fabrication of Solar Powered Smart Ground Marking and Grass Cutting Machine

Mr. Samrat Kavishwar[1] Bhawna D. Taywade[2], Ishika P. Rathod[3], Koyal L. Hingwe[4], Karanlal M. Pathade[5] , Kshitij C.Nikose[6] , Prajwal P.Kandalkar[7] , Sanket P.Yewale[8]

[1]*Professor, Department of Mechanical Engineering, Nagpur Institute of Technology, Nagpur.*

[2345678]*Students, Department of Mechanical Engineering, Nagpur Institute of Technology, Nagpur.*

Abstract -

There are various types of tools used by contractors to create marking lines, both automatically and manually. In this modern age, most contractors use machines to save time. However, the high cost of purchasing machines restricts line marking work, especially in educational institutions. Based on observations, educational institutions face some problems while doing line marking work. The manual process of refilling the marking medium takes a lot of time. In addition, old marking tools are difficult to operate, especially for unskilled operators dealing with large-scale marking products, and they are difficult to carry due to their large size. The objective of this project is to design and fabricate tools that can facilitate the marking process, along with a smart grass cutting application. These tools will be affordable for commercial use. The automating lawn cutter is a semi-automated grass cutting vehicle that includes ground marking, powered by solar energy and capable of avoiding obstacles. The grass cutter and vehicle motors are interfaced with a controller that controls the working of all the motors. The controller moves the vehicle motors in a forward direction in case no obstacle is detected. On obstacle detection, the ultrasonic sensor monitors it, and the microcontroller stops the grass cutter motor to avoid any damage to any object, human, or animal. The microcontroller then turns the robotic as long as it gets clear of the object, and then moves the grass cutter, along with marking features, in the forward direction again.

Keywords: Solar Energy, Ground marking, Grass cutting, Automation, Remote control etc..

1. Introduction

The first step in the methodology is to design a product that fits the objectives. The fabrication process uses certain methods, such as using a lathe machine to produce threads on adjustable rods. Field testing is carried out to ensure that the tool works properly, and modifications are made to fix any problems during the test.

The Smart Line Marking Machine product has been proven to be light, easy to use, and affordable. Suggestions for improvement include increasing the variety of functions, increasing the battery capacity to enable longer work time, and adding aesthetic value.

Road marking is essential for controlling and guiding traffic, particularly in urban areas where traffic rates and intersections are higher. Road marking serves as a source of information and indications for users, describing the pathway and conveying messages in the form of signs and signals. It is also used for regulation and warning purposes, which are clearly visible and easily studied.

In their work on road marking analysis for autonomous vehicle guidance, Stefan Vacek,Constantin Schimmel, and Rudiger Dillmann [1] describe the importance of road signs and signals, lane marking, lane detection, and lines used in lane markings. The design and structure of arrows, classification, and other factors are considered while marking signs on the road. Their work provides the necessary information for road geometry, arrows, and lines being used. The conclusion of their work is that the approach to road marking analysis is divided into two parts: line border markings and painted arrows.

For road marking, primary measures for road safety should be considered. Appropriate marking, as well as proper detection, is required. In their work on evaluation and road marking feature extractions, Thomas Veit, Jean Tarel, P. Nicolle, and P. Charbonnier [3] provide a systematic approach to evaluate specific algorithms for extracting features about road marking from images. Their work explains three important steps, including road marking feature extraction, geometric model estimation, and geometric model tracking parameters along with an image sequence.Grass cutter machines have become very popular today. Most common machines are used for soft grass furnishing. The main parts of the Grass cutting machines are DC motor, relay switch for controlling motor, Battery for charging it through solar panel. It is placed in a suitable machine structure. The motors having 350rpm and 35rpm are connected to the electric supply by the use of a roll of wire. The linear blades are attached in this machine. Working principle of the grass cutter is providing a high speed rotation to the blade, which helps to cut the grass. The blade will get kinetic energy while increasing the rpm. The cutting edges are very smooth and accurate. Also electric grass cutting machines are much easier to be used in garden, lawn and grass fields. In order to enhance the beauty of home-lawns and gardens, Grass

cutting machines are the best available option in the industry. With the help of a lawn mower which is a machine with revolving blades to help us cutting lawns at even length, people can easily maintain and beautify their lawns and gardens without any hassle.

2. Problem Identification

Based on observations, educational institutions face several problems when performing line marking work. The manual process requires frequent refills of the marking medium and takes a considerable amount of time. In addition, the old marking tools are difficult to handle by unskilled operators, especially when working on large-scale marking projects. They are also difficult to carry due to their large size. Power consumption is becoming increasingly important for the future. The solar-powered grass cutter with ground marking is a simple yet highly useful device that can be used to maintain lawns in gardens, schools, and colleges.

The rapid growth of various high-tech tools and equipment has made our jobs more comfortable and sophisticated. The objective of this research work is to fabricate a grass cutting machine with ground marking system that operates using solar energy. Power plays a crucial role in all aspects of human life and work. The cutting mechanism with ground marking consists of a flat blade rigidly fixed to the frame behind the spiral arrangement. This configuration enables the blade to contact at least one reel bar of the spiral blades during their rotation.

3. Objectives

1. To design and develop an equipment that can make the line marking process easier.
2. To fabricate a line marking equipment using Bluetooth communication.
3. To fabricate an affordable line marking equipment for commercial use.
4. Attachment of grass cutting system within this machine
5. All power derived from solar energy
6. All function can operate remotely using Android application.

4. Literature Revie

That's a great initiative to facilitate and reduce the cost of doing line marking work at educational institutions. By developing affordable and easy-to-use marking tools, you can help these institutions save time and money while also making the line marking process more efficient. Additionally, providing various marking mediums can offer greater flexibility for line marking, allowing institutions to choose the best option for their needs. Overall, your project can make a positive impact on the line marking industry and provide more accessible options for educational institutions.These marking tools are affordable and easy to operate. The large capacity of the marking medium saves time as it automatically works. In addition, various marking mediums should emphasize in this project as there are various types of marking mediums such as oil and paint. This tool allows various marking mediums to be used during line marking process. In conclusion, this tool makes marking working work easier because the product easy to handle and save more time during the line marking process.

Regular line markings on sports pitches have been in use since the 19th century, coinciding with the formation of the Rugby Football Union and the Football Association. As each governing body introduced their own rules and regulations, different pitch markings were created for each sport. Around the same time, the England Croquet Club began offering lawn tennis on grass surfaces, which also necessitated the use of line markings.

Since the vast majority of these sports were played on grass surfaces, some form of line markings were necessary. Among the earliest materials used to create pitch markings were dust and wood shavings. Over time, these were replaced by limestone materials and chalk, which could be easily crushed to create simple dry marking compounds. These compounds were easy to spread and, as a bonus, the chalk and limestone materials were white, which improved the visibility of the pitch lines by reflecting light.

Early pitch marking materials didn't last long, as they were easily washed away by rain. To combat this problem, weed killer was sometimes used as a substitute for white line marking materials, or creosote was employed. This practice was acceptable between the 1960s and 1980s, but today it is illegal to use lime and creosote for this purpose. During this period, a wide range of marking products became readily available, offering enhanced engineering techniques and better designs.

- ***Sivarao, T.J.S.Anand, Hambali, Minhat, Faizul***
- This paper provides a review of research conducted on the subject of automated tractors. An autonomous tractor is a vehicle that can operate without or with minimal human control, self-propelled and automatically guided along a desired path. The benefits of such a system are numerous for the agriculture industry, including reduced labour costs, improved output efficiency by eliminating human errors, and saved time. Researchers and inventors have developed various implements, including sensors, global navigation satellite systems, machine vision, laser triangulation, ultrasonic transmitters, geomagnetic controllers, actuators, and servo motors. While some of these developments have been successful and encouraging, others have proven impractical for commercial implementation due to certain limitations
- ***Pratik Patil, Ashwini Bhosale, Prof. Sheetal Jagtap***

This article describes an automatic lawn cutter that aims to make grass cutting easier for users. The device incorporates various sensors to detect and avoid objects and humans while mowing. Its main objective is to allow users to specify the mowing area and the desired grass height via a keypad, reducing the need for manual intervention. The design features a microcontroller, such as the ATmega 16, as well as multiple sensors, an LCD display, and a keypad.

- ***Ernest L. Hall***
- Another example of an autonomous lawn cutting system is the Weed Eater developed by the Weed Eater Corporation. This solar-powered and emission-free mower operates on its own by harnessing enough solar energy. The robot has 34 iridescent solar cells embedded on top of its platform, and it can handle properties up to 13,500 sq-ft. The system works on the same principle as the Lawn Ranger, using a cable buried beneath the lawn's surface. The mower relies on this wire and its sensors to navigate and stay on track. It will continue to operate as long as it has energy from the sun. The robot is equipped with a flexible bumper that activates when it hits an obstacle, causing it to back up and continue on a different path. One advantage of this mower is that it cuts grass into a mulch, eliminating the need for a grass catcher or raking.
- ***Jain, Sagar Patil, Prashant Bagane, Prof. Mrs. S. S. Patil***

Solar Based Wireless Grass Cutter, International Journal of Science Technology and Engineering, Vol. 2, 2016, 576-580. They have prepared wireless grass cutter. They have used solar panel so it is not required to charge battery externally and battery is continuously charged at constant voltage when grass cutter is in working. The battery is getting charged by using day light and we can use it as per our convenience . Because of two DC motor both forward and backward motion of grass cutter can simultaneously possible.

- ***Ashish Kumar Chaudhari, Yuvraj Sahu Prabhat Kumar Dwivedi, Harsh Jain Reference Book***

Experimental Study of Solar Power Grass Cutter

Robot, , International Journal of Advance Research and Innovative Ideas in Education, Vol. 2, 2016, 6873. In this paper author explained that solar plate which is placed above the grass cutter generates solar energy and use this energy for working the grass cutter. Also, using driver circuit for controlling speed of motor as per the requirement. For preventing battery from overcharging and over discharging regulator is placed into the system and it should be placed in series. They have provided LCD display unit which displays voltage generated during solar rays trapping. Due to seasonal conditions if battery is not charged they can provide the power bank to charge the battery instantly.

- ***Praful Ulhe, Manish D. Inwate, Fried D.Wankhede, Krushnkumar S. Dhakte***

Modification of Solar Grass Cutting Machine, International Journal for Innovative Research in Science & Technology, Vol. 2, 2016, 711-714 In this paper they have prepared manually operated grass cutter with spiral roller blades due to spiral blades increases the efficiency of cutting. For adjusting the height reel cutter is component placed on grass cutter. The battery can be charged during working conditions and it also having AC charging. For collection of cut grass a box is placed over grass cutter so the cut grass put outside the lawn. It is having light in weight and compact in design.

- ***T. Karthick, S. Lingadurai, K. Muthuselvan, M. Muthuvanesh, C. Pravin Tamilselvan***

Grass Cutting Machine Using Solar Energy, International Journal of Research in Mechanical, Mechatronics and Automobile Engineering, Vol. 2, 2016, 1-5. In this paper author fabricated grass cutting machine with rotary blades by using solar energy. The solar energy is trapped in the photovoltaic cell to generate electricity. The cells may be grouped in the form of panels or arrays. Solar panel is placed such that to absorb high intensity from sun and it will incline at 450. The main function of solar charger is increased current during batteries are charging and also disconnect when they are fully charged. By considering ground clearance they can adjust the height of grass.

5. Proposed System The proposed work is planned to be carried out in the following manner:

1) Study of basic concepts of transformer less gridtied inverter.
2) Finding the problems from conventional system by surveying literature.
3) Design and study of clamp pump circuit.
4) Analysis of the proposed topology.
5) Study of the control strategies.
6) Comparative analysis of proposed topology with conventional transformer less topologies.

5.1. Block Diagram

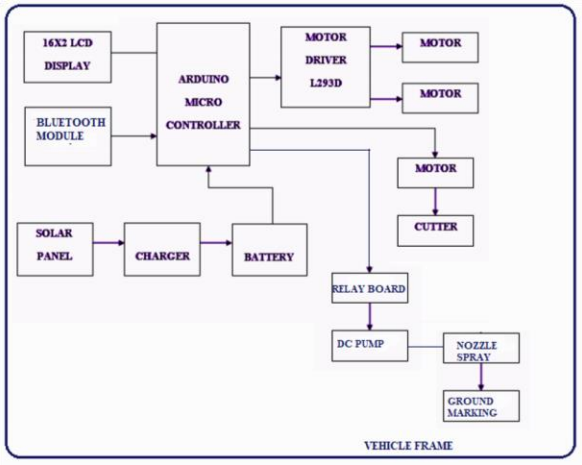


Fig. 1. Proposed system

5.2. Working

- The solar panel in this project converts solar energy into electrical energy, which is then stored in a battery.
- The energy stored in battery further utilized for various function like driving the robot and for cutting operation.
- The first step is to start the whole circuit board by plug in pin from battery to board.
- After plug in whole circuit board is ON. LED lights indicates the ON function.
- Also open Application on android i.e. transmitter side.

- Once the LED light on the transmitter(remote)side the LED light on the receiver side (robot's Bluetooth module) are properly connected, the connection will properly established.
- Press the keys on application for forward, backward, left, right movement.
- The ultrasonic sensor is located at the bottom front of the robot and is activated when it senses the object in front of it.
- Additionally, a high-speed DC pump is connected to the relay board, which can be wirelessly activated to discharge white ground marking paint.
- The nozzle can spray marking paint towards the ground, and we can remotely adjust the speed of the DC pump and the thickness of the marking using the application.

This product uses two types of mechanical movement: wireless movement and movement using an electric motor. Manual movement involves pressing the brakes to drain the medium, while the electric motor is used to operate the pump in storage.

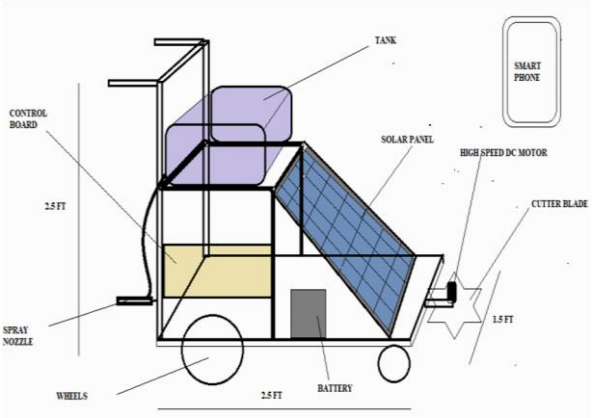


Fig.2. Conceptual Design

5.3. Hardware & Software Required

- Arduino Uno Controller (R3-ATmega 328)
- Solar Panel 25w
- Bluetooth module (HC-05)
- DC pump (DC12V)
- 12V DC Power Supply,
- 5V DC Regulator (7805 IC)
- LCD display (16*2) (DC 5V)
- Relay (12V)
- Adapter (12v 2Amp)
- Battery (12v 7Amp)
- Tank (5 Lit)
- High speed Motor (5000 RPM)
- Cutter blade
- LEDs
- Resistors, Capacitors and Diodes • Other.

Arduino Uno (12v)

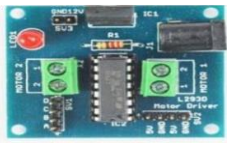
The Arduino Uno is an open-source microcontroller board developed by Arduino.cc. It is based on the Microchip ATmega328P microcontroller and features digital and analog input/output (I/O) pins that can be used to interface with expansion boards (shields) and other circuits..

LCD Display

An LCD (Liquid Crystal Display) is a thin, flat panel used to electronically display text, images, and moving pictures. It is commonly used to replace other types of displays, such as seven-segment LEDs. The 16x2 LCD display is a popular type of LCD.

Motor driver

A motor driver is a current amplifier, the performance of motorfdrivers is to grasp a low-current control signal and then turn it into a higher-current signal that can run a motor. In Fig is the L293D Motor Controller



Bluetooth module (HC-05)

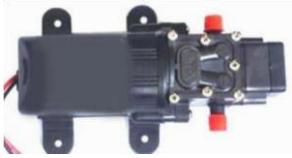
HC-05 module is simple to use Bluetooth SPP (Serial Port Protocol) module, designed for clear wireless serial connection format. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband.

High torque Dc motor (60 RPM)

Robot is an electromechanical sleight which reacts in environment in one or some other way. Decisions and actions taken by its autonomous to do a particular work. Robot is a mechanical device that is manmade whose motion is schemed, planned, triggered, model sensed and controlled.

High pressure DC Pump

DC-powered pumps use direct current from a motor, battery, or solar power source to move fluids in a variety of ways. Motorized pumps usually operate on 12 volts of DC power and can be used for applications such as pumping water or fuel.



Wheels

It used to drive the whole machine. As the High torque motor attached to wheels, when button is pressed whole system runs automatically.

Relay Board

A relay is usually an electromechanical device that is actuated by an electrical current. The current flowing in one circuit causes the opening or closing of another circuit.

Battery

A 12 V, 7 Amp Battery is high power battery easily handle all the function.

Main things are to collect electrical energy from solar panel and provide to various components for running specific function.

Plastic Water Tank

The storage capacity of plastic water tank up to 5 litter. It is used for supplying the water as well as to spray the marking colour to the ground.

Pipe

A pipe is attached to the DC pump and tank, and liquid flows through the pipe when the pump is turned on, spreading through a nozzle. This setup can be used for both pesticide and water spray applications.

High Speed DC Motor & Cutter Blade The cutter blade is attached to a high-power RPM motor that is capable of cutting crops efficiently. The motor has an RPM of up to approximately 5000, which provides sufficient cutting power for the task at hand

It's true that high-speed motors can be used for crop harvesting and can make the process easier and more cost-effective for farmers. However, the size of the cutter blade will depend on the specific crop being harvested and may vary. It's important to ensure that the cutting equipment is appropriate for the crop and is operated safely to prevent injury to both the equipment operator and the crops being harvested.

Solar Panel

This is a great idea for a project as it promotes the use of renewable energy in agriculture, which is essential for sustainable development. By converting solar energy into mechanical energy, you can power a grass cutter without the use of non-renewable sources of energy. This can help reduce the carbon footprint of agriculture and increase the efficiency of crop management. Additionally, using a solar-powered grass cutter can save farmers money on fuel costs and reduce their dependence on fossil fuels. Overall, this is a great way to promote clean energy and sustainable agriculture practices.

.

- **Software used**

Software tools

1PROTEUS IDE
HI-TECH compiler
C- Language

 Proteus is a widely used simulation software that allows designers to simulate and test circuits with a microcontroller without having to physically build the circuit. The software provides an easy-to-use interface and a variety of tools for designing and testing electronic circuits.

 HI-TECH compiler is a popular compiler used for developing embedded systems. It provides a complete ANSI C development system and an assembler for the language. It is commonly used for programming microcontrollers.

 C language is a high-level programming language used for developing a wide range of applications, including operating systems, embedded systems, and scientific applications. It is a structured language that is easy to understand and provides a variety of programming constructs and data types. It is widely used in the development of microcontroller-based systems due to its efficiency and ease of use.

 Reasons used for C language 1. Easy to understand 2. Various computer platforms can be used to compile the c program.

Steps to upload the code.

Step 1: writing the program or code.
Step 2: compiling and debugging the code.
Step3: uploading the code to the microcontroller.

6. Flow Chart

That's a good summary of methodology and the importance of following proper procedures in project development. Methodology plays a crucial role in any research or project, as it guides the researcher or project team in selecting the most appropriate methods and techniques for collecting and analysing data to answer the research question or achieve the project objectives. Following a well-defined methodology helps ensure that the research or project is conducted systematically and rigorously, leading to more reliable and valid results. Additionally, adherence to proper procedures and using the right materials is essential to ensure the project is completed on time, within budget, and meets the required quality standards

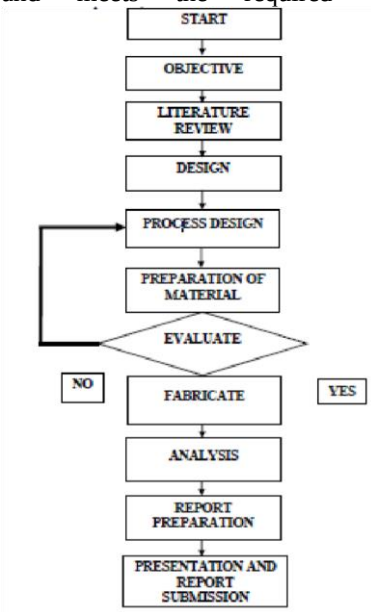


Fig.3.Flow chart

7. Calculation

1. Selection of electric motor

A) 30 RPM DC motor SPEED = 30
B) RPM VOLTAGE = 12 VOLT
C) WATTS = 18 WATT

2. Torque of the motor

A) Torque = (P X 60) / (2 X 3.14 X N)
B) Torque = (18X 60) / (2 X 3.14 X 30)
C) Torque = 5.72 Nm Torque = 5.72 x 10^3 N-m D) The shaft is made of MS and its allowable shear stress = 42 MPa
E) Torque = 3.14 x fs x d^3 / 16 5.72 x 10^3 = 3.14 x 42 x d^3 / 16 D = 8.85 mm
F) The nearest standard size is d = 9 mm.

3. Electrical (electric) power equation

A) Power P = I × V Where V = 12 W = 18 I=18/12=1.5
B) A H.P = .02414

4. Solar panel calculation

A) VOLT = 12 V
B) WATT = 5 W
C) W = V X I 5 = 12 X I I = 5/12 I = 420ma

5. Battery calculation

A) BAH /CI = 8 ah/420ma = 19 hrs
B) To find the Current Watt = 18 w
C) Volt = 12v Current =?

P= V x I 18 =12 x I I = 18/12 = 1.5 D) AMPS battery usage with 1.5 AMPS BAH /I 8/1.5 = 5.3 hrs.

6. DC Pump

Q=k √ p p=20 psi k=5.6 Q=5.6 √20

Q= 25 GPM

Q=Flow Rate (GPM), P=Operating PSI of head/Outlet K=K Factor of Head/outlet

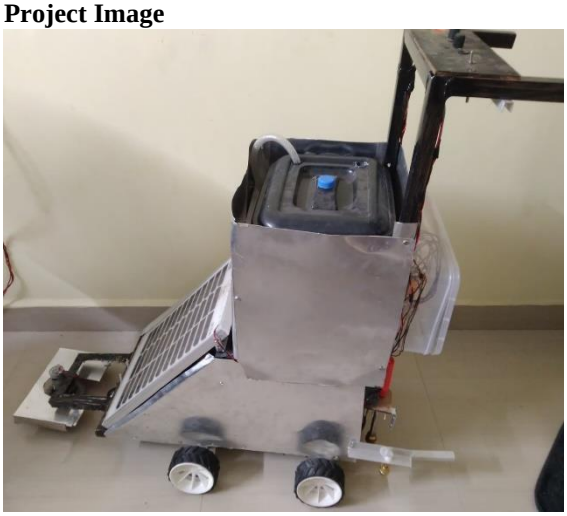
(ii) *Analysis*

For 1 litre, the flow rate of the Sprinkler is 476seconds. For the project the flow rate of the sprinkler is 200 seconds.

The area of the sanitizer covered is 600mm.

The acquired Flow rate is 17GPM

Project Image



7. Conclusion

It is clear that the Smart Line Marking Machine has several advantages over traditional line marking machines. Not only is it easier to operate, but it is also more affordable and environmentally friendly. Additionally, while the current motor may not be suitable for heavy-duty work, there is room for improvement and upgrades to make the machine more powerful and accurate .Overall the project successfully developed a useful piece of equipment that can benefit both commercial and educational institutions. With continued improvements and upgrades, the Smart Line Marking Machine has to potential to become an even more valuable tool in the line marking industr**y.**

References

[1] Stefan Vacek, Rudiger Dillmann and Constantin Schimmel, "Road marking analysis for autonomous vehicle guidance", 3rd European conference on mobile robots, Freiburg, Germany, September 19-21, 2007. [2] R. Deepak Kumar, M. Naveen Prasad, S. Pradeep and S. Shankar, "Design and fabrication of semiautomatic road reflector stud installation machine", IOSR Journal of\ Mechanical and Civil Engineering, e ISSN: 2278-1684, p ISSN: 2320-334X/ ICAET-2014/me/volume-6/15, PP 20- 23. [3] Thomas Veit, Philippe Nicolle, Jean Philippe Tarel and Pierre Charbonier, "Evaluation of road marking features extraction", 11th international IEEE conference on Intelligent Transportation System, October 12-15, 2008.

[4] Mr K. S. H. Ramji, S. Suresh, M. S. Nixon and S. S. Rajan, "Design and fabrication of automatic road stud installation machine and pavement marking machine", IJSRD/ Vol 6, Issue 01, 2018. [5] J. Naveen, C. Karuppaiah, S. Hari M. and R. Flavin, "Design and fabrication of low-cost road marking machine", IJOER/Vol 4 Issue 3, 2016. [6] Sheikh A. V. Rehman and A. K. Duggal, "Suitability of different material used for road marking: A review", IRJET/ Vol 2 Issue 02 May 2015. [7] T. V. Dormidontova and A. V. Filatova, "Research of influence of quality of material on road marking of highways", Procedia Engineering, Elsevier, 2016 [8] Sultan Mohyuddin,Digesh K D, Vivek T K, Nazeya Khanam F and Vidyashree H V, Automatic Grass Cutter, International Journal of Science, Technology and Engineering ,Vol.2,2016,2349-784X.

[9] Taj Mohammad Baloch & Thien Ching Kae, "Design & modelling prototype of a robotic lawn mower". University Technology PETRONAS, 31750 Bandar Seri Iskandar, Perak Darul [IEEE], 2008.

[10] Srishti Jain, Amar Khalore and Shashikant Patil, "Self-Efficient and Sustainable Solar Powered Robotic Lawn Mower", International Journal of Trend in Research and Development, Vol-2, Issue-6, pp- 294, 2015.

[11] Amol T. Bagul1, Shivani G. Deore2, Ashish D. Dhage3 & Prof. S. S. Bhardwaj4, "A Review on Smart SolarGrass cutter with Lawn Coverage", Imperial Journal of Interdisciplinary Research (IJIR), Vol-3, Issue-5, pp- 438, 2017.

[12] E Naresh, Boss Babu, "Grass Cutting Machine by Solar Energy Power" International Journal & magazine of Engineering, technology, management & research, Vol-3, Issue-5, pp- 302, May 2017.