

DC Motor Based Economical Grass Cutting Machine Using Arduino: A Survey

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Abstract: Regular grass cutting is required in lawns at school, college, company, marriage hall premises. Also it is required in different farms. Currently in India, a lengthy and time-consuming conventional method of the grass cutting is used. Working with the traditional grass cutters like cutlasses, hand scissors, machetes is a very hectic, time consuming and risky task. This gave rise to the need of grass cutting machine which will reduce human efforts and make the grass cutting work efficient and easier. The major drawbacks in the present grass cutters are green gas production resulting in high pollution, high noise production, complicated structure, high maintenance and expensive. Our system proposes a low-cost grass cutter which includes a cutting blade. In proposed system DC motors are used for grass cutting along with blades and system is controlled using Arduino controller. This paper focuses on the literature survey and the drawbacks of existing systems. The paper provides the methodology, simplified structure and a low cost designing for the grass cutting machine.

Keywords: lawn mower, grass cutting machine, DC Motor, Arduino.

I. Introduction

Along with shelter, food and cloths, maintaining the high-class lifestyle has become a modern man's need. To maintain the modern lifestyle infrastructure maintenance is one of most considered factors. Maintaining lawns to enhance the beauty of the place has become a trend. Grass grows in any environmental conditions if space is available. The need of maintaining lawns has increased the need of the grass cutter in the market.

In older day's machetes, hoes, cutlasses, hand scissors were used for the lawn mowing purpose. Working with these traditional lawn cutters was very hectic and time-consuming work. Hence, there was a need of machine which will reduce human efforts and would make the grass cutting work easier. The first lawn mower was developed in 1980 with very simple designs. Later on, with the advances in technology lawn cutters working on petrol and diesel were developed. This increased the efficiency of the work and also was easy to use. They also increased the accuracy of the lawn cutting. But there was still a problem of fuel consumption and there were many technical issues like high maintenance. Also, this machine was costly.

As per the time, modern man understood the value of nature. Protecting nature has become the most important task. The lawn cutters available in the market were more polluting. This developed a need of inventing a grass cutter which will be less polluting and still provides the same efficiency as that of the present lawn cutters. Also, this is an era of automation. While technology was trying to meet the environmental needs, inventors were trying to reduce the human efforts and make everything automatic.

Due to the increasing need of the efficient lawn cutters various types of machines were developed. These lawn cutters are mainly of solar powered or electrical lawn cutters. Here in this paper, we have elaborated the detail work done on both the types of lawn cutters and also the methodology for the low-cost lawn cutter.

II. Literature survey

[14] In 1980 Dale F. Sweet proposed first design of the grass cutter and filed the patent for it. His design was very basic. It included two wheels attached to a shaft one to the rear side and another to the front side. And also had a handle but there was very low rolling resistance and hence the efficiency was very less.

To improve the drawbacks of the design proposed by the Dale, William R Lesig III proposed a design of lawn cutter [15]. He proposed a design with sufficient width of blades to minimize the rolling resistance and provided a stable mechanical support. He proposed the three point ground support system with two rears and one front wheel.

These were two basic design patents filed for the grass cutter designing. Later on due to the changing need of market, users and environment many different designs were proposed and many patents were filed. [16] In 2017, Huang jinxing, a Chinese Inventor filed a patent for a design in which he used sweep careless mechanism. This mechanism made his system strong, efficient and low cost.

Recently in 2020 [17] Shao Yajun filed a patent for weed cutter which was capable of collecting forage. [18] Brian, Andrew and Balutis filed a patent for automated lawn mower robot which performs the mowing

action for decoded area as per the user requirement.

During these inventions and various studies done on the designing of the grass cutting machine designs focused mostly on the power source required for driving the machine. Based on that proposed designs can be characterized in two major groups that solar powered grass cutters and electrical grass cutters as follows.

A. Solar powered grass cutters

[1] In 2003, Victor and Verna designed an electrical power operated grass cutter. The major advantage of this grass cutter was it was eco-friendly. This machine does not emit carbon monoxide in the air. Also, the noise level was reduced. Major problem with this machine was its complex design. Due to complex design, maintenance and operation was also difficult task.

In order to reduce the drawbacks of this design various solutions were given by the inventors. [5] Shresthi Jain, Amar Kalhore provided the designing for self-efficient and sustainable solar powered lawn mower. This paper proposed a designing for solar powered vision based robotic lawn mower. This robotic machine was autonomous. Patterns for grass cutting were pre-installed in the machine. This is the major drawback of this machine. Pre-installed patterns don't make it user friendly. These students provided the design for solar powered grass cutter. This was environmentally friendly grass cutter but it was manual.

[3] In 2014, Amrutesh Et al. designed a lawn mower. Proposed system was solar powered and manual. This machine was useful for small scale lawn maintenance like for schools, hospitals. They provided very simple design thus the machine was highly user friendly. But the major issue with this design was cost. It was highly expensive for the common man.

Solar powered intelligent grass cutter robot was introduced by Ajay Shah, Sahil, Pratik and Saurabh [6]. This machine is automatic. User has to enter the dimensions of the area while starting and the rest of the work will be completed automatically. But again, the complex designing and high cost were drawbacks with the proposed design.



Fig 1. Fully automated solar powered grass cutting machine

Along with this major research, there were several other designs provided to reduce the drawbacks. The solution provided for the power sources was mostly solar-powered machines. But again, there was the drawback of high cost and complex structure with the solar-powered systems. To achieve the automation of the system various solutions are provided like Bluetooth connection, android app development, and autonomous robots but there is still a problem with the efficiency of the proposed solutions. In general, the major drawbacks in present systems are cost, efficiency, pollution and complex structure.

[10] Pratik, Mahesh, Milind, Lokesh and C.J. Shende proposed the designing of a manually handled device which consists of linear blades and is ineffective by climatic conditions. By using the link mechanism, the height of the blade can be adjusted. The blades can be moved in various directions as per user requirement and the device is easy to handle.

B. Electrical Grass Cutters

[4] Ankur Dave and Ashwini Dixit gave an idea about electrical lawn cutting machine designing in their paper.

They used high speed rotating blades and cordless electric mowers which were powered by 12 V rechargeable batteries.

[13] Basil Okafor introduced a self-powered grass cutter. He used collapsible blades made up of high carbon steel. The uniqueness of his design was the pulley system that he developed for the speed multiplication purpose. In his paper, he explained the driver belts, pulley system, blades and driver shaft designing along with the selection of the motor for cutting purpose. The design was purely based on mechanical designing.

Edwin Budding designed a lawn cutting machine. He got the idea of a grass cutting machine from a cloth

trimming machine used by the tailors that use cutting cylinder. A similar idea was used in grass cutting machinedesigning.

[11]P Bulski worked on the pollution created due to the sound of the traditional lawn cutters. To get the appropriate result for this issue he replaced the gasoline motor with an electrical motor. He identified the main reason for every type of pollution caused was the petrol- driven mechanism. Hence he decided to use the electrical motor for the cutting purpose which not only reduced the noise pollution but also reduced air pollution. This also helped to meet the environmentalneeds.



Fig.2.Falcon electrical lawn mower Roto drive-33

[12]PrafulUlhe in his paper gave an idea of the electrical lawn cutters driven manually. This design used spiral blades for efficient cutting. Spiral roller blades increase the efficiency of cutting. The height of this cutter was adjustable. Results mention in the paper shows that this grass cutter used to cut the grass uniformly and can be run on different types of grasses efficiently.

Along with the various electrical and solar powered grass cutters there were few designs proposed for battery operated grass cutters. [19]In April 2020 Muhammad Ashraf, MussamilHussain, Muhammad Abdullah proposed a design for hand held operated machine which was powered by 12v/1.35A rechargeable battery. This was purely mechanical based design and was durable, strong and efficient but also it was a very complex design.



Fig 3. Honda petrol grass cutting machine

Currently in the market most used grass cutting machines are petrol and diesel grass cutters. These are two or four stroke grass cutting machines. Though there are many disadvantages of these machines, people prefer petrol or diesel machines because they are very handy, efficient also the cost is low as compared to electrical and solar powered machines and are available with various types of blades which makes it more efficient. From the market survey we listed out major characteristics of these machines and compared them in following table.

| Parameters | Two- stroke machine | Four-stroke machine | Electrical machine |
|----------------------|-----------------------------------|--------------------------------|-------------------------|
| Source of power | Petrol | Petrol | Electricity |
| Power requirement | High | Low as compared to two- stroke | Approximately 2hp |
| Maintenance | Low as compared to 4stroke | High | Very low |
| Transport | Easy because of compact designing | Difficult | Difficult |
| Torque produced | High | Low | Low |
| Noise production | More | More | Very low |
| Green gas production | More | Less than two-stroke | No green gas production |
| Handling | Easy | Easy | Easy |
| Cost | Cheaper | Expensive | Expensive |

Table. 1 comparison between two-stroke and four-stroke machines

III. Methodology

According to the need of the users and the drawbacks discussed in the previous sections, the new design should be able to operate independent of manpower and also less pollutant. The design proposed in this section focus on mainly two factors viz. power source and efficiency. Using rechargeable batteries as a power source will reduce the pollution amount in a greater context. Another major focus of the design is simpler structure. This is to enable the user-friendly and easy operation of the system. Use of battery will remove the noise creating a two-stroke or four-stroke combustion machine which will be replaced by the DC electric motor powered with a battery. This will help in achieving zero green gas emission.

The machine consist of a driving motor, cutting motor, 12 V battery, rear and front wheels, Arduino controller. The battery will be used to drive the DC motors used for driving and cutting purpose. For controlling the DC motors, level of cutter Arduino controller is used.

To achieve smooth cutting round shaped 80 teeth blades are used. These blades are lighter and very efficient. Two rotate these blades we are using low rpm and high powered DC motor which will easily produce minimum torque of 0.4 N-m. This DC motor will be driven by the motor driver which is controlled by the Arduino controller. This controller is powered by the battery provided with circuitry. The whole circuit and components are placed on the casing which is provided with 4 wheels. These 4 wheels are driven by the DC motor and controlled again by the motor driver driven by the controller. This work is going on under UG B E project.

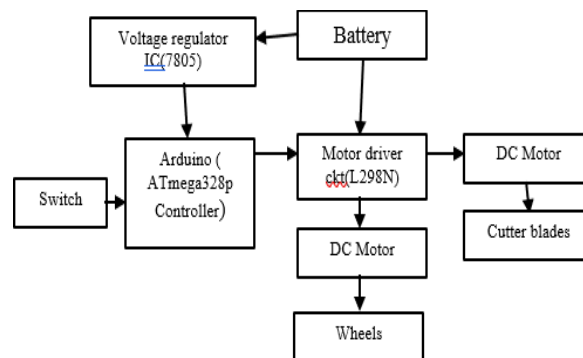


Fig. 4 Block Diagram of proposed system

IV. Advantages and applications of the proposed design

The use of battery reduces pollution. Noise production is negligible and there is zero green gas emission. The design proposed in this paper is simple to fabricate and also to operate. This makes the system compact, less in weight and easily portable. A simpler structure also reduces maintenance and thus reduces the cost. Hence, this system is economically affordable. Also using Arduino controller we can make it more automatic and in future we can make it android or IOT based so that from remote place also it can be controlled.

The system proposed here can be used for small scale grass cutting like in hospitals, small lawns, and household lawns. The use of high voltage battery and solar panels will make the system suitable for large scale grass cutting. As per future needs, sprinklers can also be added to the machine to keep the soil moderately moisture with the help of a soil moisture sensor.

V. Conclusion

After doing the literature survey we can say that grass cutters which run on petrol or diesel are creating lot of pollution and as the prices of petrol and diesel are increasing day by day they are not economical although they are more efficient. On other hand electrical grass cutters are developed to eliminate the pollution problems but they are not automatic. So grass cutting machine proposed in this paper is to eliminate a greenhouse gas emission which is the major cause of climate change. The design proposed in this paper reduces the time, human efforts and manpower required for the grass cutting purpose. The use of electrical components reduces the need for maintenance. Electrical power used in this system reduces air pollution and noise production. Using Arduino it is made economical as well as automatic.

This portable mower can be used to maintain and trim grass and weed in gardens, residences and establishments, small scale farming as a possible replacement for the gasoline-powered grass cutters.

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