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Solar Grass Cutting with Wireless and Manual Operation

Akash Deshmukh, Ashish Sawai, Atish Panmand, Tushar Patil, Prof. Pankaj Firake
Department of Mechanical Engineering
Rajarshi Shahu College of Engineering, Pune, India

Abstract: *This paper provides a summary and evaluation of technological advancements aimed at creating a more efficient and cost-effective grass cutter. Our objective is to investigate the different developments in grass cutter machinery and assess their performance. Presently, manual grass cutting devices are commonly employed. Through our survey, we discovered various types of grass cutters available in the market, including those powered by solar energy, electricity, and internal combustion engines. These grass cutters have limitations regarding the height of grass they can effectively cut. Our goal is to introduce an innovative concept primarily applicable in the agricultural sector. We intend to manufacture a grass cutting machine specifically designed for agricultural use, capable of cutting both crops in the field and grass.*

Keywords: Components, Grass Cutting Machine, Bluetooth Module

I. INTRODUCTION

In the past and continuing to the present, grass cutting in various settings such as schools, sports tracks, fields, industries, hotels, and public centers has been done manually using a cutlass. This manual cutting method is time-consuming as it requires human effort. Moreover, it often results in uneven cutting levels. This study focuses on efficiently cutting different types of foliage, including shrubs, stubborn plants, grass, flowers, and tree leaves. It also addresses the design of a machine, its effectiveness, durability, mode of operation, and material selection. The designed machine offers enhanced flexibility, mobility, and interchangeability. The objectives of this work include, but are not limited to, the following:

- Reducing the labor required for cutting not only weeds or grass, but also for trimming flowers and trees.
- Decreasing costs and cutting time, while simultaneously beautifying the environment.

An English engineer named Edwin Budding played a key role in enabling mechanical mowing during the early 19th century. While working in a textile mill, Budding noticed a machine used to shear the nap of velvet, which inspired him to develop a cylinder or reel-type mower. This type of mower, similar to the classic reel mower still found in stores today, consisted of blades arranged around a cylinder with a push handle. In 1870, Elwood McGuire of Richmond, Indiana designed a lighter and more efficient machine, popularizing push mowing. In the year 1885, the production of lawnmowers in the United States reached an annual volume of 50,000 units, with a significant portion being exported to countries across the globe.

Towards the end of the 19th century, individuals from various backgrounds began realizing the chore of pushing these mowers every week. They began experimenting with alternative power sources, initially considering horses but faced obstacles such as trampled roses. Steam-powered engines were also attempted, but the time required to start the boiler outweighed the benefits of cutting the lawn. By the early 1960s, gasoline-powered mowers became prevalent, leading to increased noise levels and air pollution. However, advancements in technology have led to the development of improved mower versions. Low-emission gasoline engines with catalytic converters are now manufactured to reduce air pollution, and enhanced muffling devices have been installed to minimize noise pollution. Battery-powered mowers are also becoming increasingly viable options.

II. LITERATURE REVIEW

According to Professor C. J. Shende, the researchers have developed a manually operated grass cutting device in this paper. This device is equipped with linear blades and remains unaffected by varying weather conditions. The primary

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aim of this study is to enable the grass cutter to move in different directions, allowing for the creation of various designs as needed. The height of the cut can be adjusted using a link mechanism. Furthermore, this device can be easily operated by unskilled labor. [1]

According to C. B. Mills, advancements in technology are leading to the development of enhanced versions of lawnmowers. Manufacturers are now producing low emission gasoline engines with catalytic converters to mitigate air pollution. Furthermore, improved muffling devices are being installed to reduce noise pollution. Battery-powered mowers are also becoming increasingly feasible. Despite being slightly smaller in size, with an average cutting width ranging from 17 to 19 inches, these new mowers operate silently and without the typical emission of blue smoke into the atmosphere. They can run for approximately an hour per charge. Additionally, their prices are comparable to high-end gasoline-powered mowers. [2]

According to Davidge E D, my intention is to transition my entire fleet to propane. This shift is beneficial not only for the environment but also for improving productivity. By using propane as fuel, I can save on costs while avoiding the time-consuming process of refueling at the pump, resulting in reduced labor expenses. Propane is a clean-burning system without any additives. Moreover, I can minimize maintenance requirements since there is no need to maintain a carburetor or fuel filter. [3]

According to Edwin Beard Budding, the inspiration for the lawn mower came to him when he observed a machine at a nearby cloth mill. This particular machine employed a cutting cylinder on a bench to neatly trim cloth, providing a smooth finish after weaving. Recognizing the potential application, Budding realized that a similar concept could be employed for cutting grass. The key was to mount the mechanism on a wheeled frame, allowing the blades to rotate near the surface of the lawn. [4]

III. METHODOLOGY

3.1. Working of Remote-control Lawn Mover:

The term "methodology" can accurately encompass two aspects: the theoretical analysis of methods suitable for a specific field of study, and the collection of methods and principles specific to a particular branch of knowledge. This chapter discusses the methods used to gather information required to complete the research. It involves a step-by-step process flow aimed at achieving the objectives of the project. Several methods were employed, including internet references, interviews with lecturers and technicians, and most importantly, group discussions.

3.2 Design of CAD Model

In our meticulous approach to designing a specialized machine, the overall design work was divided into two main parts:

System Design

Mechanical Design

System design primarily focuses on various physical constraints, ergonomics, space requirements, component arrangement on the main frame of the machine, number and positioning of controls, ease of maintenance, potential for further improvement, and the weight of the machine from the ground.

In mechanical design, the components are divided into two categories:

Design Parts

Purchased Parts

For design parts, detailed design is conducted, and the resulting dimensions are compared to the nearest available dimensions in the market. This simplifies the assembly process as well as post-production servicing work.

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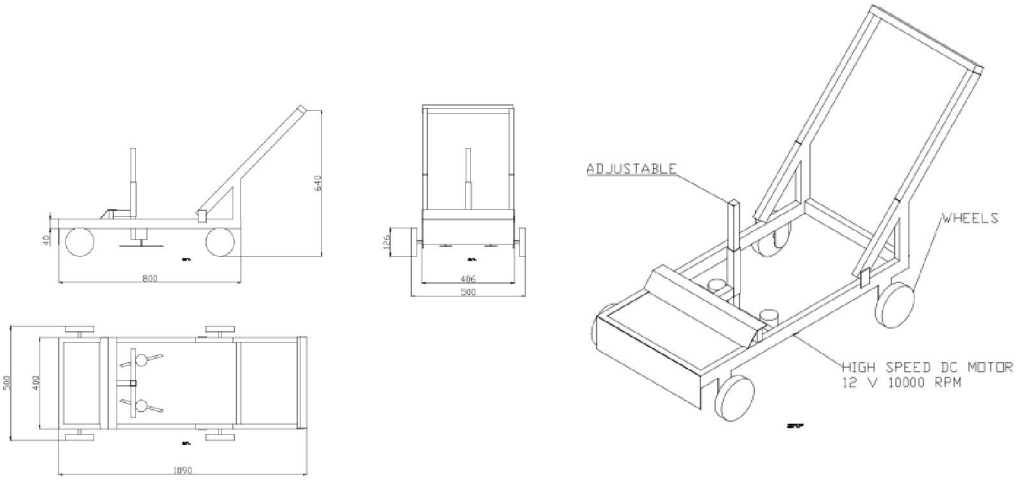

3.3 Selection of Components

3.3.1 Body of the machine

The machine body is constructed using square-shaped angles made of stainless steel. It consists of four wheels, and two motors are utilized to control their movement. A ground clearance of 200mm is provided to prevent the machine from getting stuck in the soil.

3.3.2 Wheels

The wheels are connected to the motor to control the machine's motion. The back wheel utilizes a tooth harrow wheel with slight projections to prevent it from getting stuck in the soil, while the front wheels are standard wheels. The design of the wheels provides good grip during seed planting, facilitating easy manoeuvrability of the machine in the desired direction.

3.3.3 Electronic components

The electronic components used in this machine serve the following functions:

3.3.3.1 Arduino UNO

The Arduino board is employed to control the machine's motion and adjust the seed flow.

3.3.3.2 L298 Motor driver

The motor driver is utilized to control the forward and backward movement of the motor.

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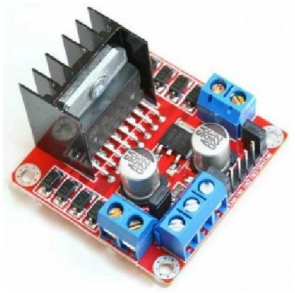
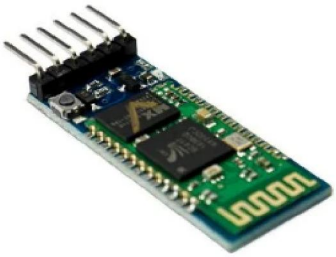


3.3.3.3 Bluetooth module

The Bluetooth module is connected to the Arduino, allowing the machine to be operated through a mobile device. The HC05 Bluetooth module is used as a UART serial converter module, enabling seamless wireless data transfer via Bluetooth.



3.3.3.4 Dc motor

Two dc motors are used for the movement of the machine. The dc motors are connected to the motor driver. The motor driver send the required power to the dc motor. The specification of the dc motor used is 3600 rpm(10v,120w). The main components of the Remote control Lawn Mover are, The main components of the Remote control Lawn Mover are:

3.3.3.4.1 Batteries

The solar grass cutter relies on a rechargeable battery to store the solar energy harnessed by the solar panels. This battery serves as the power source for the grass cutter, enabling it to operate effectively and environmentally friendly, eliminating the requirement for external power supplies.

3.3.3.4.2 DC motor

HIGH SPEED DC MOTOR 12 VOLT 10000 RPM FOR CUTTING GRASS

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3.3.4 Mechanism used for cutting grass rotary unit will be utilized:

3.3.4.1 Blades

HIGH SPEED DC MOTOR 12 VOLT 10000 RPM FOR CUTTING GRASS

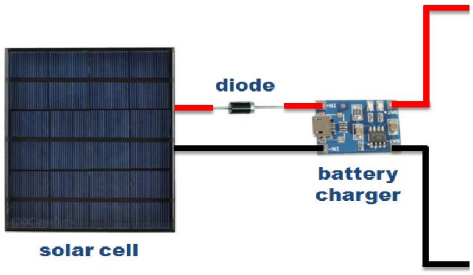
3.3.4.2 Solar charger

A solar charger is a portable device that harnesses solar energy to supply electricity to devices or batteries. These chargers have the ability to charge battery banks, including lead-acid or Ni-Cd batteries, with capacities of up to 48 V and several hundred ampere-hours (up to 4000 Ah). Such solar charger setups commonly employ an intelligent charge controller. These systems consist of a series of solar cells installed in fixed locations, such as rooftops of homes or base-station locations on the ground. The energy generated by these cells is then stored in a battery bank for later use during off-peak periods. Additionally, solar chargers can be used alongside mains-supply chargers to save energy during daylight hours.

Most portable chargers rely solely on solar energy for charging. However, there are some models, like the Kinesis K3 and GeNNex Solar Cell 2, that can be recharged either by the sun or by being plugged into a wall socket. Examples of solar chargers commonly used include:

- Small portable models designed to charge various mobile phones, cell phones, iPods, or other portable audio devices.
- Fold-out models intended to be placed on a vehicle's dashboard and connected to the cigar/12V lighter socket to maintain the battery's charge while the vehicle is not in use.
- Flashlights/torches, often equipped with an additional charging system such as a kinetic (hand crank generator).
- Public solar chargers installed permanently in public areas such as parks, squares, and streets, offering free charging access to anyone.

CHARGER UNIT TO SAVE SOLAR ENERGY TO BATTERY SOURCE:



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One of the most important steps in the development process is choosing the right components for the robot. The performance, durability, and cost of the robot are significantly impacted by the choice of components. By comparing various motors we decided to use two motor with 30 rpm speed, two solar plate of one Watt each. 12 V, 8 amp battery which provides battery backup for 2hrs. we also have used 2 Solar Plate of 1 Watt each, roller motor with 10 rpm and Vacuum cleaner of 12 Watt.

IV. WORKING OF THE SYSTEM

4.1 Automatic Mode via Bluetooth:

The solar grass cutting machine incorporates a Bluetooth communication system that enables control and operation through a mobile phone or a dedicated application.

The user establishes a wireless connection between their phone and the machine using Bluetooth technology.

The mobile application provides a user-friendly interface that allows the user to remotely control and monitor the machine's operation.

Through the application, the user can start or stop the machine, adjust cutting parameters such as cutting height or speed, and set up cutting schedules.

The application may also provide real-time feedback on battery status, grass condition, and cutting progress.

Bluetooth technology allows for a convenient and flexible operation, providing users with the ability to control the machine from a distance, reducing manual effort.

4.2 Manual Mode with Handle

The solar grass cutting machine is equipped with a manual mode that enables direct operation using a handle or control lever attached to the machine.

The handle features intuitive controls for starting, stopping, and maneuvering the machine.

The cutting mechanism can be activated or deactivated by the user through controls on the handle, allowing them to selectively cut specific areas.

The handle may include additional controls for adjusting the cutting height, speed, or other cutting parameters based on the user's preferences.

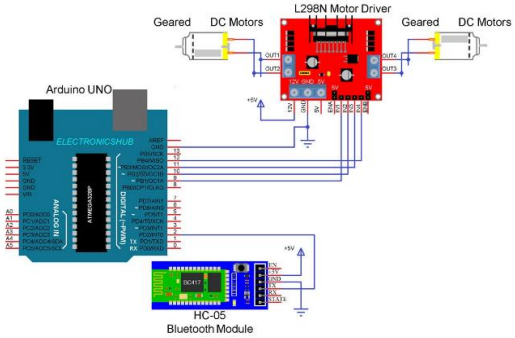
The user can guide the machine across the grass area, following desired cutting patterns or paths by manipulating the handle.

The manual mode provides a hands-on experience, allowing users to have precise control over the machine's movement and cutting actions.

Safety mechanisms, such as emergency stop buttons or proximity sensors, are integrated into the handle to ensure user safety during manual operation.

V. CIRCUIT DIAGRAM

The project's circuit diagram, which illustrates how the parts are connected, is shown below. HC 05 When a specific button is touched, this tool's serial connections send data through Bluetooth. Data is transmitted to the ARDUINO through TX, the ARDUINO transmits a signal, and the ARDUINO's signal is received by the RX. If the information obtained is 1, the data is confirmed. When the acquired information is 0, the Driven turns on and then shuts off.



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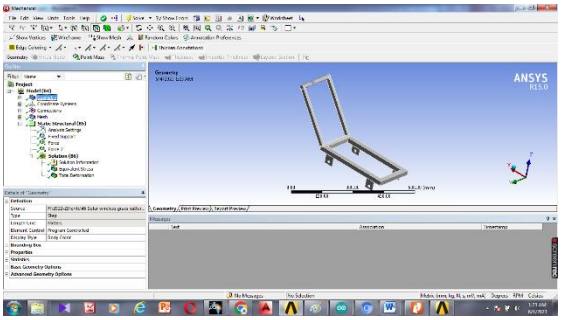
VI. SIMULATION

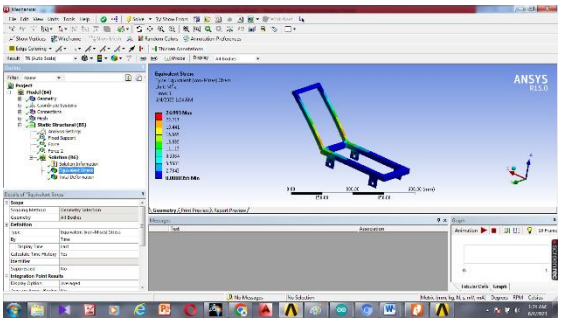
6.1.GEOMETRY

A geometry diagram in ANSYS is a visual representation of a structure or component's geometric model or CAD (Computer-Aided Design) model. It provides a graphical representation of the model's shape, dimensions, and features, which the ANSYS software uses as the foundation for analysis and simulation.



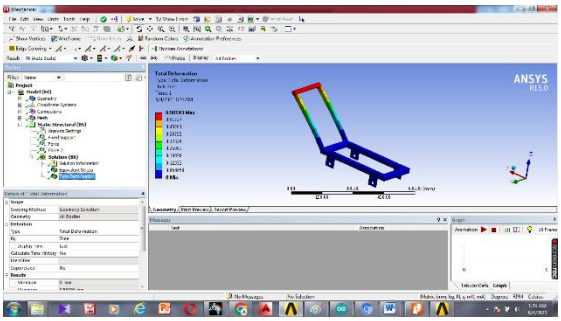
6.2 STRESS ANALYSIS DIAGRAM:

A stress analysis diagram in ANSYS is an illustration of how stresses are distributed within a component or structure. To represent stress levels, it uses colour contours or isolines. This graphic assists engineers in locating high stress locations, potential failure points, and making wise design choices to guarantee structural performance and integrity.



6.3 TOTAL DEFORMATION ANALYSIS:

In the terms of ANSYS, total deformation analysis is a simulation technique that determines and displays the total displacement and deformation of a structure or component under applied loads. It provides information on how the structure responds to loading circumstances by quantifying the size and direction of displacement at different sites in the model. Engineers may evaluate the integrity of the structure using this approach, spot places that have undergone significant deformation, and make well-informed design decisions that will increase performance and dependability.



VII. FUTURE SCOPE

7.1. Sod Cutter:

To simplify the process of tearing up and reseeding or resodding a lawn, sod cutters can be used. While homeowners typically do not own these machines, they can be rented from garden centres or equipment rental stores. Sod cutters

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resemble a cross between a lawnmower and a tiller, featuring sharp blades that cut through grass and its roots, allowing for easy removal. They are ideal for creating new garden spaces or preparing the ground for a fresh lawn.

7.2. Manual Shears

For meticulous yard maintenance, handheld grass shears can be utilized. These manual trimmers resemble large scissors and are useful for trimming the edges of the lawn, especially around patios, trees, and gardens. They prevent accidental damage that may be caused by mowers or trimmers. To ensure optimal performance, it is recommended to keep the blades sharp and clean, operating the shears similar to a pair of large scissors.

7.3 Edge Trimmers

Edge trimmers are commonly used to cut grass along the edges of the lawn and in areas that are inaccessible to lawnmowers. They feature a gas or electric motor with a spinning spindle that utilizes a hard plastic line to cut grass. Some heavy-duty trimmers come with cutting blades designed for thick brush rather than typical grasses. These tools are often referred to as "whipper-snippers" and serve as a useful grass-cutting option.

7.4. Lawnmowers

Lawnmowers are the most widely used type of grass cutter among homeowners. They come in rotary types with horizontal swirling blades or reel mowers with vertical cutting blades. Rotary mowers can be powered by gas or electricity, and they may be self-propelled or require manual pushing. Reel mowers are typically pulled behind lawn tractors and are suitable for large areas.

VIII. CONCLUSION

We have provided a comprehensive description of the grass cutter fabrication process. Our findings indicate that modern grass cutter machines exhibit superior efficiency compared to older models, thanks to the utilization of engines and improved blade materials. These advancements not only reduce the need for manual Labor but also make the machine popular for various applications, including garden maintenance.

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