VIVA-TECH IJRI
ANNUAL RESEARCH JOURNAL
VIVA-TECH INTERNATIONAL JOURNAL FOR RESEARCH AND INNOVATION
ANNUAL RESEARCH JOURNAL
ISSN(ONLINE): 2581-7280

Development of Grass Cutting Machine

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Abstract : *Energy is one of the major parameters for establishing growth and progress of the country, rather the standard of living depends directly upon the per capita energy consumption. The reel mower, invented by Edwin Beard Budding in 1830, revolutionized lawn care by introducing a mechanical alternative to manual hand tools. Its rotating cylindrical blades, mimicking scissors, offer precise and efficient grass cutting. With increasing environmental concerns, manual mowers have regained popularity for smaller lawns, promoting healthier turf while minimizing noise pollution. In our campus, the presence of overgrown grass in certain areas poses potential hazards such as accidents, injuries, and insect bites. Manual cutting of these areas is time-consuming and labour-intensive. To address these challenges, this project focuses on developing a solar-powered grass cutting machine for efficient and cost-effective operation. The machine incorporates a horizontal cutting blade driven by a rotating roller. This design aims to facilitate faster and more economical grass cutting. We explore the design, functionality, and sustainability of this solar-powered solution, emphasizing its eco-friendly nature by eliminating the need for fuel or electricity, thereby reducing emissions and promoting a more sustainable approach to lawn maintenance. This paper summarize and reviews technological development for making efficient and effective grass cutter.*

Keywords – *Agrochemicals, Environmental, Manure, Photosynthesis, Yard.*

1. INTRODUCTION

Indian agriculture faces significant challenges, including a persistent shortage of agricultural labour due to factors such as increased non-farm job opportunities, rural-to-urban migration, and the low social status associated with agricultural labour. Grass cutting, a crucial agricultural practice, is traditionally performed manually, a labour-intensive and time-consuming process. This project aims to design and analyze a cost-effective grass cutting machine specifically for small-scale farmers in rural India. By mechanizing this process, we aim to address the labour shortage, reduce production costs, and ultimately enhance the economic viability of farming in rural communities. The Solar Powered Manual Grass Cutter, an innovative solution, integrates sustainability with efficiency. This eco-friendly device utilizes solar energy to power a manual grass cutting mechanism, offering a greener alternative to fuel-dependent options. Designed for both precision and user-friendliness, it combines traditional manual operation with modern solar technology.

This project approach eliminates the need for external power sources, resulting in a quieter and more efficient operation compared to traditional gas or electric cutters. The target audience includes homeowners, landscaping companies, and farmers, particularly those residing in areas with limited access to electricity and it emphasizes research and development to optimize energy efficiency and user experience, ultimately promoting sustainable lawn care practices, raising awareness about renewable energy technologies, and exploring future advancements such as automation and smart technology integration. This solution promotes environmentally responsible lawn care while addressing the pressing need for labour-efficient agricultural practices.

1.1 Need of Machine

When compared to conventional gas or electric mowers, solar-powered manual lawn cutters offer significant environmental advantages. By operating emission-free, they contribute to a cleaner atmosphere and reduced carbon footprint. This aligns with the global transition towards renewable energy sources, fostering sustainability by minimizing reliance on non-renewable resources and promoting environmentally responsible lawn care practices. Furthermore, these cutters eliminate the ongoing operational costs associated with fuel and electricity consumption, making them a cost-effective long-term solution. The manual operation of these devices allows for precise and personalized lawn care, reducing reliance on automated, energy-intensive approaches. Finally, the quiet operation of solar-powered cutters minimizes noise pollution, creating a more peaceful environment for both users and their neighbours during lawn maintenance.

2. LITERATURE REVIEW

Akshay Ramteke et al. 2022 [1] summarizes and reviews technological development for making efficient and cost effective grass cutter. Their aim is to study the various developments in the grass cutter machines and their performance. Current technology commonly used for cutting the grass by the manually handled device from the survey we found that various types of grass cutter available in market which are run by means of solar, electric and internal combustion engine.

Li and Wang, 2021 [2] explored the integration of smart technologies in solar-powered manual grass cutters. Their study proposed the incorporation of sensors and automated features, such as obstacle detection and navigation assistance, to enhance the efficiency and usability of these devices. This suggests a potential evolution of solar-powered grass cutters towards more sophisticated and user-friendly solutions.

Brown and Lee, 2020 [3] investigate into the ergonomic design of solar-powered manual grass cutters have been conducted to enhance user experience. He explored the ergonomic aspects of these devices, considering factors such as weight distribution, handle design, and maneuverability. Their findings indicated that well-designed solar-powered grass cutters not only contribute to environmental sustainability but also offer improved usability for operators.

Aditya S. Rajmani et. al 2019 [4] highlighted the continuous increase in the cost of fuel and the effect of emission of gases from the burnt fuel into the atmosphere, this necessitated the use of the abundant solar energy from the sun as a source of power to drive a lawn mower. A solar powered lawn mower was designed and developed, based on the general principle of mowing. The designed solar powered lawnmower comprises of direct current (D.C) motor, a rechargeable battery, solar panel, a stainless-steel blade and control switch. Mowing is achieved by the D.C motor which provides the required torque needed to drive the stainless-steel blade which is directly coupled to the shaft of the D.C motor. The solar powered lawnmower is operated by the switch on the board which closes the circuit and allows the flow of current to the motor which in turn drive the blade used for mowing. The battery recharges through the solar charging controller. Performance evaluation of the developed machine was carried out with different types of grasses.

Mr. Shreedhar aski, 2018 [5] reviewed all the literature survey and by knowing the needs, suitable design of solar grass cut was made. The components were chosen based on the design requirement and considering few of the other parameters in order to meet all the constraints. Based on the revive prototype model of the hardware and software system along with the ultrasonic sensor were demonstrated and required output was obtained. The blade was designed in such a way that, it can cut the grass efficiently and also height from the ground level can be adjusted from 2mm to 70mm. A panel is placed in a position where it can obtain maximum energy of the sunlight. So, among eco-friendly grass cutter this.

T. Rajeswara rao, 2018 [6] **e**xplored the advantages of solar-powered technologies in agricultural and landscaping applications. Highlight their ability to reduce operational costs and environmental impact by leveraging renewable energy sources. Demonstrate how these technologies eliminate fuel expenses, minimize greenhouse gas emissions, and decrease reliance on fossil fuels. Emphasize that solar-powered equipment generally has fewer moving parts, resulting in lower maintenance costs and greater durability. As communities seek sustainable practices, promote the adoption of solar energy in outdoor tools, which not only supports environmental health but also enhances economic viability for users, making it an attractive choice for individual and community initiatives.

3. PROBLEM STATEMENT

In our campus, certain sections experience rapid, uneven growth of long grass, which requires regular cutting by manual labour. This process not only demands significant physical effort and time but also exposes workers to potential hazards, such as cuts, falls, and insect bites commonly associated with long grass. The reliance on manual methods for grass cutting increases the risk of injuries and fatigue, particularly on uneven terrain. Although various grass cutting machines are available in the market, most are fuel- or electricity-powered, presenting additional challenges. These machines, while effective at managing dense or tall grass, come with high operating costs due to fuel or electricity consumption and require regular maintenance to function optimally. This equipment also contributes to noise and environmental pollution, counteracting sustainable campus goals.

4. OBJECTIVES

- To minimize the physical labour required for grass cutting by integrating solar power assistance.
- To utilize solar energy to reduce environmental impact and reliance on fossil fuels.
- To decrease the time needed for efficient grass cutting.
- To operate quietly with minimal noise pollution, making it ideal for residential areas.
- To ensure ease of use with a simple and ergonomic design for a comfortable mowing experience.

5. PROPOSED METHODOLOGY

This stage of project is done to minimize the likelihood of error, management cost, assess risk, and evaluate the potential success of the intended project. In any event, once an engineering issue or problem is defined, potential solutions must be identified. Following are the flow chart including steps follows while completion the project.

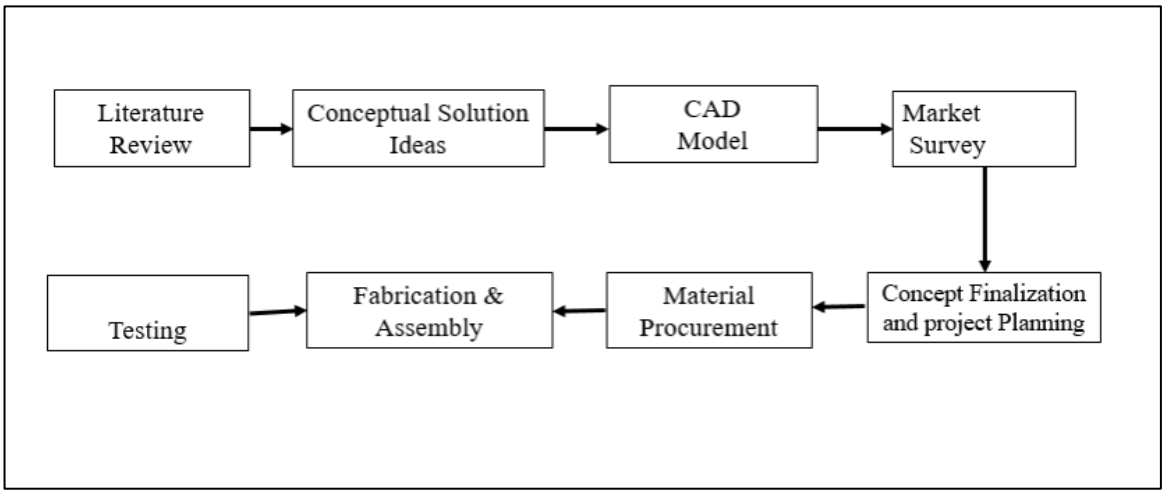

Fig 1 Flow Chart of Project Completion

5.1 Literature Review

The review reveals that solar-powered grass cutting machines have gained significant attention due to their eco-friendly nature and potential to reduce manual labour. Existing research explores various designs, including manual and automatic models, focusing on factors like efficiency, battery life, and cutting height. Challenges identified in previous studies include the need for efficient solar panel utilization, reliable battery storage, and robust motor selection. This project aims to address these challenges by incorporating a high-efficiency solar panel, a long-lasting battery, and a powerful motor. The goal is to develop a solar grass cutting machine that is both efficient and practical, contributing to sustainable lawn care practices.

5.2 Conceptual Solution Ideas

The problem or objective was clearly defined to provide focus. An open brainstorming session was encouraged, allowing all participants to feel comfortable sharing their thoughts without judgment, which facilitated a free flow of ideas. Ideas were prioritized through group voting or discussion, identifying the most promising concepts for further exploration.

5.2.1 Solar Grass Cutter

This grass-cutting machine is a manually operated device that gives users full control over its operation and cutting performance. From start to finish, the machine's design allows the operator to manage each step of the mowing process, ensuring a thorough and even trim for the lawn.

To initiate the machine, the operator presses the power button, which starts the motor. The motor, once activated, drives the rotation of the cutting blade, a vital component responsible for the actual trimming of grass. Designed to rotate at high speeds, this blade is crafted to efficiently slice through the grass as the machine moves forward, producing a neat and uniform cut. The blade's sharpness and efficiency make it well-suited for various grass types, ensuring a clean result across different terrains.

As the machine operates, the user steers it across the area needing maintenance, whether it's a large lawn or a small yard. The operator's guidance is key, as it enables precise control over the machine's direction and ensures the blade covers all areas evenly, avoiding patches of uncut grass. The manual nature of this machine gives the user an advantage, as they can address specific sections that need extra attention or trim hard-to-reach spots, such as corners or lawn edges, with precision.

A valuable feature of this grass-cutting machine is the adjustable blade height, which is available on many models. This allows the user to modify the cutting height to achieve a desired grass length, catering to different preferences or requirements. For instance, a shorter setting may be ideal for a closely cropped look, while a higher setting might be preferable for a fuller, slightly longer lawn. This versatility makes the machine adaptable to various mowing needs, making it suitable for maintaining residential yards, gardens, or even smaller parks.

The motor's consistent speed is another essential aspect of this machine's functionality. By maintaining a steady rotational speed, the motor ensures that the blade operates evenly throughout the task, reducing the risk of uneven cuts or missed spots. This consistency leads to a professional finish, as each pass of the machine leaves behind a smooth and uniform lawn surface. The stability of the motor also contributes to the durability and longevity of the machine, as it reduces wear from uneven or fluctuating speeds.

Once the cutting task is complete, the shutdown process is straightforward. The operator simply switches off the machine by pressing the power button again, which stops the motor. This, in turn, brings the blade to a halt, allowing the user to safely store or transport the machine. The ease of use and safety mechanisms in this power-down sequence help prevent accidental injuries or mishaps after the work is done.

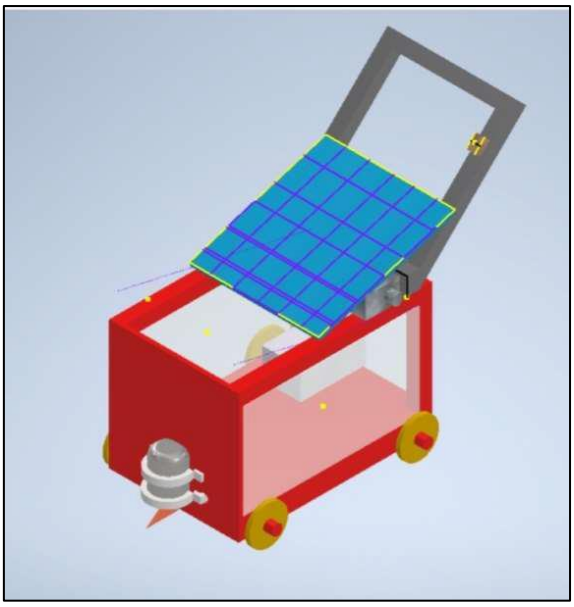

Fig 2 Solar Grass Cutter

5.3 Concept Finalization and Project Plannig

To begin, a thorough market analysis is essential to identify the target market segments, including residential, commercial, and agricultural users. By understanding their specific needs, we can tailor the product's features accordingly. Key features to consider include the power source (gas, electric, or battery), cutting width, self-propulsion capability, mulching function, and bagging capacity. Once the core features are determined, the design phase can commence. This involves creating detailed design drawings and 3D models, prioritizing ergonomic design and safety features. Technical specifications, such as engine power, cutting height adjustment, wheel size, and battery capacity (if applicable), must be precisely defined.

Project planning for a grass cutting machine involves defining the scope, timeline, and resource allocation. This includes breaking down the project into phases like design, prototyping, manufacturing, marketing, and after-sales service. Each phase requires detailed planning, including task scheduling, resource allocation, and risk assessment. Effective project planning ensures timely execution, cost control, and product quality. Following are the Gantt charts which shows the proper planning of the project with timeline.

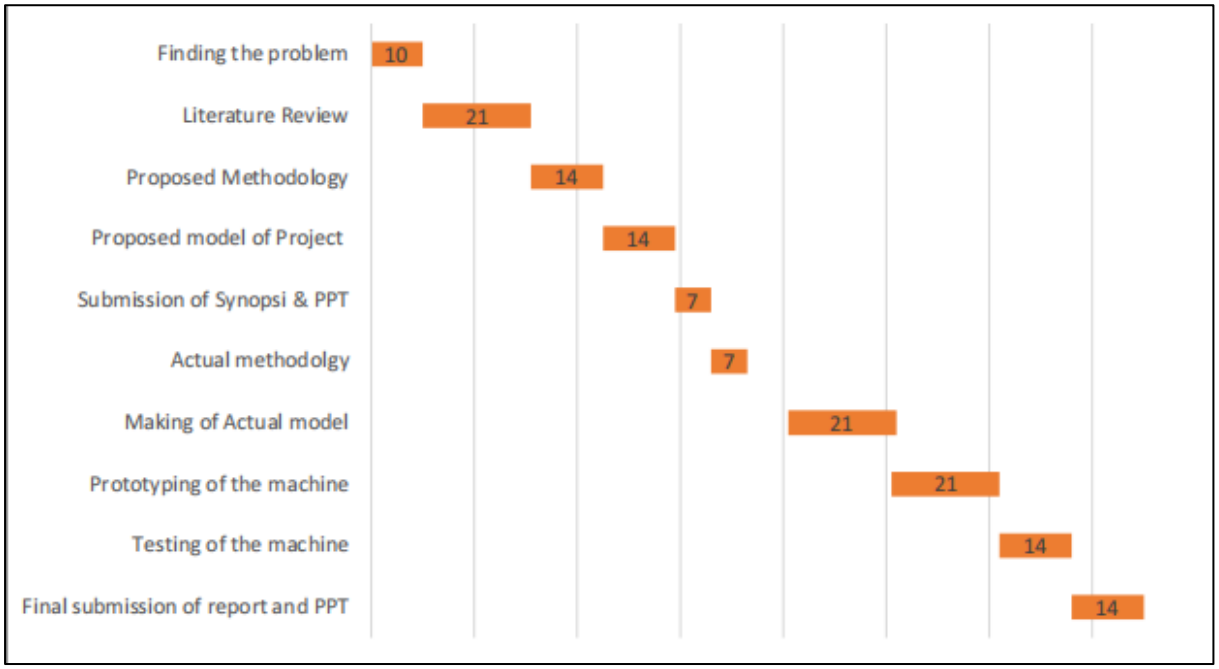

Fig 3 Gantt Chart

5.4 Fabrication and Assembly

Creating a solar-powered manual grass cutter involves integrating a solar panel, rechargeable battery, motor, and cutting mechanism. The solar panel collects sunlight and charges the battery, which powers the motor. The motor drives the cutting mechanism, typically a rotating blade or reel, enabling grass cutting. It’s essential to design a system that efficiently harnesses and stores solar energy to ensure sustained operation. Additionally, incorporating safety features and ergonomic design enhances the overall usability of the solar-powered grass cutter. Steps to be consider while assembling the project are as follows:

i. Design and Frame Construction
ii. Solar Power System
iii. Handle and Control
iv. Wheels for Mobility
v. Testing and Adjustments

6. CONCLUSION

The development of the solar-powered manual grass-cutting machine represents a significant advancement in sustainable lawn care technology. By harnessing renewable solar energy, this innovative solution addresses the critical challenges associated with traditional gas powered equipment, including air and noise pollution, high operational costs, and environmental impact. The machine's manual operation ensures that users maintain control and precision while reducing the physical labour involved in grass cutting. With features such as adjustable blade settings and a user-friendly design, it caters to a diverse range of users, from homeowners to agricultural professionals.

The solar grass cutter promotes safe and effective lawn care without depending on nonrenewable energy sources, making it especially advantageous in rural and isolated locations with limited access to electricity. This device not only improves the look of outdoor areas but also advances the more general objectives of sustainability and environmental responsibility by reducing carbon emissions and encouraging eco-friendly behaviours. All things considered, the solar-powered manual grass-cutting machine establishes a new benchmark for effective, secure, and eco-friendly lawn care, opening the door for further advancements in gardening and farming techniques.

Acknowledgement

This project would not have been possible without the invaluable support and guidance of our project guide MR. Priyank vartak and our institute and all group members. I am deeply grateful to all those who encourage and motive us everytime for successful completion of this project.

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