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Solar Powered Mobile Operated Grass Cutter

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Abstract: Solar energy is a clean, freely available, and abundantly available renewable energy. It is also the most important of the non-conventional sources of energy because it is non-polluting and therefore helps decrease the greenhouse effect. Talking about the grass cutter that uses fuel for working, they emit gases contributing to the greenhouse effect as well as contribute to air pollution. Grass cutters operated through electric power also need manpower to operate. So, the best way to put an end to these problems is to use an automatic grass cutter that uses renewable energy resources for its charging as opposed to an electric cable extension. In this paper, we will show the technological progress in automatic solar grass cutters and how they have tackled some problems and also optimizations in solar power consumption.
Keywords: Fully Automated Grass Cutter, Solar Panel, Internet of Things, Fire Detection and Extinguishing Mechanism in Grass Cutter.

I. INTRODUCTION

Nowadays, pollution is one of the major factors of global warming as the usage of non-renewable resources is too much excessive. Due to the emission of unwanted gases caused by global warming, an alternative was electricity and the best alternative (renewable resource) to derive electricity is solar energy. Solar powered automatic grass cutter is an automatic system that is powered by solar energy obtained from sunlight. The devices use a solar panel, which is the best usage of solar energy due to which we generate electricity. Solar - powered automatic grass cutters are designed to cut grass in public places like hotels, parks, and colleges and also in private properties like homes, gardens, and lawns.

In today's world as technology is increasing day by day traditional grass cutters are replaced with solar- powered grass cutters. This solar-powered grass cutter is equipped with an ultrasonic sensor that works as obstacle detection, and an ultrasonic sensor in the device is planned to avoid the system from colliding with obstacles while in motion in real-time grass cutter, as the system does not require any human interaction. Apart from that, in one of the papers, it is interesting to know that infrared sensors are used in the grass cutter to make comparison of cut grass with uncut grass. Moreover, safety considerations also have been given attention to the device not being in operation when it is lifted by a human in the air, using a collapsible blade. The literature published in this field shows us the advancements in design. Solar power is the focus in development of these designs. Many papers focus on the autonomous operation of the grass cutter. This is achieved by use of various sensors and controlling systems so that efficient and safe operation is ensured. So, there is huge benefit of using solar powered grass cutters like reduced carbon emissions and cost savings in the long run. It is also hugely beneficial in using automatic solar powered grass cutters as this reduces the human effort to little or no effort thus making it way easier to take care of the gardens compared to hiring a gardener and the toilsome work done by human effort in hot weather conditions. Overall, it is an area of great interest and many people have contributed to the betterment of the grass cutter technologies by their work. It will be interesting to know how much the safety and efficiency could possibly be increased in future.

II. DOCUMENT OVERVIEW

1) Muhammad Naqib, Danial Mohd Nazri, Amardeep Singh, and Charam Singh [2022]

Their objective was to solar power grass cutter, to design a home charger as alternative way of charging, to optimize the power generated by the solar panel and finally, analyze the effectiveness of solar power optimization on grass cutter machine. The results tell us that the optimization of solar power based on the tracking of the sun and the effect tilt angles have on its performance.

2) Shaikh Mohd Sameer M.S., Venkatesh S. Venkatesh S. Thevar, Suraj K. Patil, Nitish S. Mangalpawar, Pramod G. Rahate [2021]

They made a grass cutter with two motors for motion purpose and another motor for grass cutting function. Theyhaveshownaninterestingpointbyusingstainlesssteelasthematerialselectionforthegrasscutterblade as it does not undergo corrosion when the grass cutter is operated in wet weather.

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3) Mahendra Kalaskar, Vaibhav Adhau, Yash Tanpure, Ganesh Thakkare, Jay Chavan, and Tushar Mohod [2022]

Now-a-days, IC engine based traditional manual grass cutter is used. Solar power which is available naturally will be used to provide the force of drive. Also the machines gas two blades to cover more area which will work in less time. The main problem statement is fabricating a grass cutter machine system that makes the use of solar energy.

4) Mallikarjun Mudda, Vishwa Teja, Srujan Kumar, Praveen Kumar [2018]

The paper describes about how to reduce the human effort. The automatic grass cutter is going to perform the operation of grass cutting with the others components are attached to the device like ultrasonic sensor is used for obstacle detection as the device found any hurdles it would its direction of movement and starts to move in other direction .it uses many components to preparing the grass cutting machines like DC motor for the rotation of wheels and blade that controls the mechanism of the device.

5) Tushar Baingane, Sweta Nagrale, Suraksha Gumgaonkar, Girish Langde, Shaila Ramteke, Prof. V.M Dhumal [2018]

This paper review wide range of technologies which are involved in the grass cutting device, as innovation of new technology is taking place day by day. The grass cutter consists of Microcontroller Arduino AT mega 328, IR sensor Batteries, and solar panel as the solar charging device. As it best cheap alternative of using of solar energy instead of electricity, as this paper analysis the operation and working principle of automatic grass cutter. While safety is the main purpose while the designing of the project.

6) Mothibeli Joseph Pita, Peter BaonheSob [2021]

In this publication, the objective was to design and fabricate a solar grass cutter which is feasible in size, light in weight, is cost effective and which operates in rural areas. Mild steel was selected by them for frame and stand as it is cheaper, easy to weld and readily available in markets. Their solar cutter is though not automatic, but worth to praise. It can operate up to 10 meters away from the charging station. It is 1.5 meters long and weighs only 6 kg. It has a sheet metal blade that can be easily connected to the motor shaft using nut and washer. The grass cutter can be used for 2 hours if there is no sun on that day. In order to protect the battery from overcharge, it has a solar charge controller which cuts off when the battery is charged and turns on when the battery is flat.

7) S. S. Gouda, R. K. Moharana, and R. Mohapatra [2017]

The paper presents the design and development of a robotic grass cutting machine that is powered by solar energy and includes automatic speed control. The authors describe the components used in the machine, including a solar panel, battery, microcontroller, and motor. They explain how the speed control system works, which adjusts the speed of the motor based on the amount of sunlight available, and describes the testing and evaluation of the machine. The results showed that the machine was able to efficiently cut grass while maintaining a consistent cutting speed, and it had the potential to reduce greenhouse gas emissions and noise pollution. Overall, the paper presents a promising solution for eco-friendly and sustainable lawn maintenance.

III. PROPOSED SYSTEM

While there have been technological advancements in the solar power based grass cutter (manual and automatic), it seems like there is still a gap that needs to be filled in the safety concern. That gap is to detect and extinguish fire in scenarios of lawn fires that arise due to outdoor grills, improper disposing of smoking materials or by usage of tools that create spark. These problems can particularly arise in areas of dry vegetation, areas having hot weather or drought prone areas. So, the grass cutter can be used in these scenarios to detect and extinguish fire by implementing a fire detector (flame sensor) to the grass cutter and providing it with a water tank. Our proposed system is a solar power based grass cutter with automatic irrigation and fire extinguishing mechanism. The water tank can be used for irrigation and at the same time, act as an emergency water tank for extinguishing fire. It can be helpful in detection and extinguishing of fires.

This way the proposed system will have versatility in it as one major component which it carries can be used for two different functions rather than employing two different components which will add weight to the device. Moreover, this way it can be ensured that the emergency components are working fine as it also happens that items that are intended for use only in critical situations may fail by being unused for a large amount of time. If any problem arises, it will be taken care of. This will ensure that the equipment's are always ready for emergency usage.

Now, let us understand the working of this proposed grass cutter in terms of the devices being used in it in the following methodology section.

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IV. METHODOLOGY

The grass cutter is equipped with an UNO, an ultrasonic sensor, DC motors, a soil moisture sensor module, two L293Ds, an IR sensor and Node MCU.

*Below figure generally represents basic working, though there is a change in actual model as Node MCU has been used as a secondary microcontroller so that data of fire directed or not will be given to the user monitoring the device. Furthermore, 2 DC motors are added to drive the rear wheels to move the grass cutter. The ultrasonic sensor detects obstacles in front and changes the direction based on the condition of threshold distance in front for the direction change. Two DC motors have been connected to L293D which is connected to the UNO. These DC motors are responsible for motion of grass cutter and direction change when condition of minimum distance to object in front occurs. The direction is changed by the non-symmetric motion of motors.

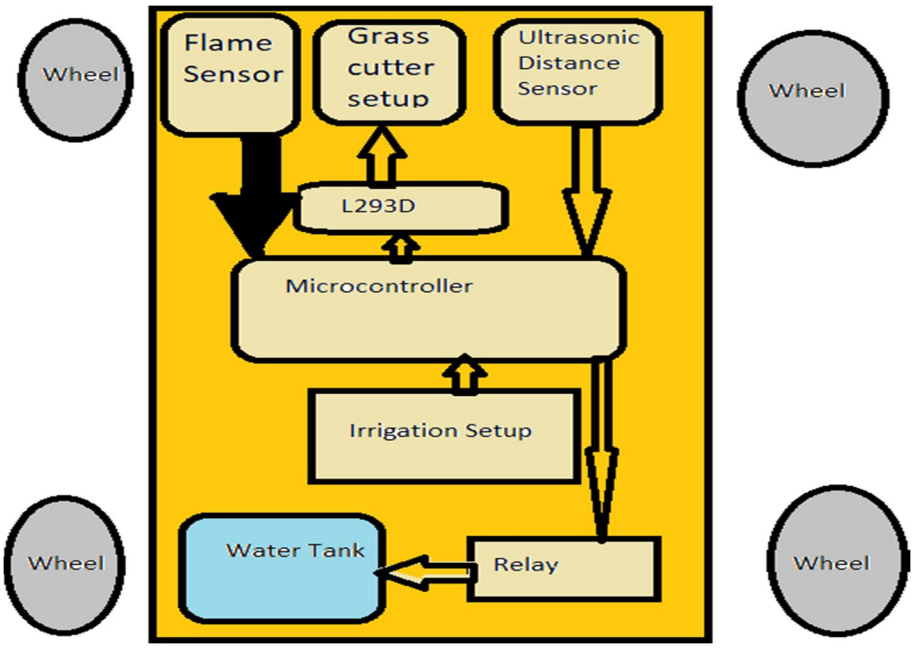


Figure1: Block Diagram of proposed system

An IR sensor has been used in the grass cutter so that it can show that whenever fire is detected, not only the water pumps starts, but data is also sent to the user/ owner/ the one monitoring the grass cutter. This data is displayed in Blynk IOT app. The main feature that differentiates our grass cutter is the usage of fire detection and extinguishing mechanism.

The water pump we will use is a 12V water pump. It will be in the water tank and will push the water in the direction the IR sensor has been placed (in front of the mover). This way the issue of lawn fires can be handled. Of course, more progress needs to be made in future for far detection of fire and effectiveness of extinguishing it. In this setup, the driving motors being used are two DC motors of 100 RPM rotation. This will reduce the speed of motion of grass cutter so that grass can be cut effectively.

The grass cutting motor is connected to the PWM pins in the UNO. Using PWM signals the speed of rotation of grass cutting motor can be controlled. This is advantageous as we can control the speed of motor depending upon the grass size i.e. more speed for cutting taller grass patches.

Below is an initial circuit designed in which the motors have been set to rotate at 101 RPM by using 37 ohm resistances in circuit. Apart from that, there is a relay connected to a DC motor that represents the water pump (for representation purposes only).If the soil moisture is detected to be less than 30% then the UNO will ON, the DC motor acting as the pump through the relay. This is how the irrigation setup can work.

Talking about the fire safety system, we can use an IR sensor (modified as flame sensor) which if detects thefire, can turn on the water pump to extinguish the fire ahead of the device. * Keep in mind that this is not the actual setup that has been implemented. This circuit is being shown only for giving an idea of some of the working. The real device has also been equipped with Node MCU and an IR sensor has been connected to it so that when fire is detected the user monitoring the device can know of it. Apart from this, there are other major changes in the circuitry as well as there are different components from those shown above used in the actual device. This is how by employing two different microcontrollers the overall system will function.

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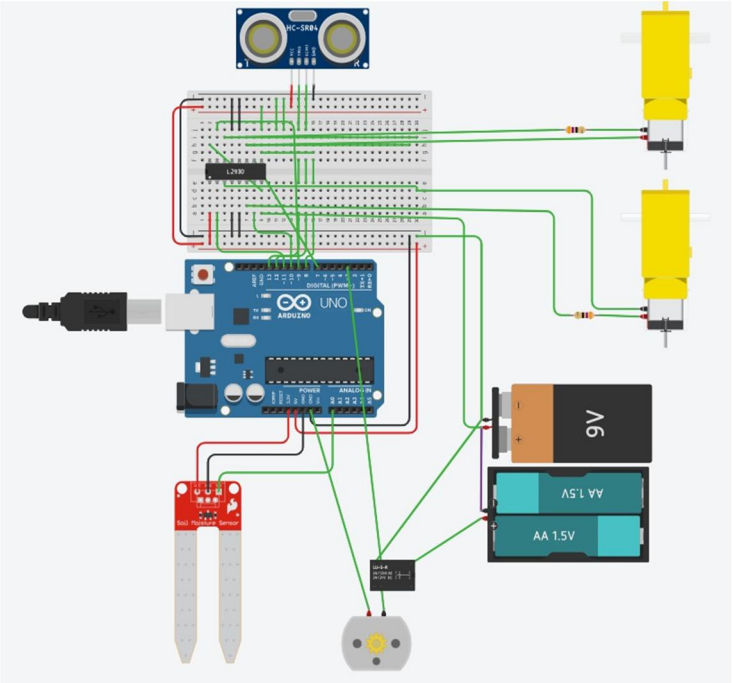


Figure2: Circuit for representation purpose*

V. FUTURE SCOPE

Though there is an incredible amount of advancement observed by reading these papers, that can also be used to make a grass cutter consisting of all these features, still, there needs to be future research for the betterment of fire extinguishing technology in the automatic grass cutters. In California, lawn fires might be an issue. So, basically talking about where the research should be done is as follows –

1) Improvement of fire detecting mechanism so that if there is a fire far away in lawn, that too can be detected in case where the lawns are not square, circular or rectangular but with shapes that don't allow for direct visual detection of fire.
2) The water tank equipped grass cutter will not be able to extinguish a large fire, so a system should be designed such that external water supply with a powerful water pushing mechanism in the grass cutter be implemented so that large fires can be put under control.
3) Taking an idea from the Apple's smart watches, a call can be sent to fire department whenever a fire is uncontrollable or is spreading quickly.
4) A modified version of this grass cutter can also be used for rural areas so as to clean up wild grass in agricultural lands. By making a heavy duty device, the grass cutter design can transform to other usable designs too.
5) Solar panel is an issue of high cost in the device; if possible a cheaper alternative to the expensive solar panels can be undertaken like low quality but durable solar panels because mainly grass cutter is only used once a week, so even slow charging can be sufficient as there is no small time constraint for charging the grass cutter.

A commercial product machine weighs over 100 Kgs and works on gasoline engine. Introducing new devices that are less than 10 Kgs heavy and are robotic in nature, can lead to a huge transformation in this field as well as making them cheaper and more accessible to the public can also be achieved.

VI. CONCLUSION

The advancement in grass cutter technology has been significant, whether it is in terms of using renewable solar energy or in making the grass cutter safety equipped. Still, lawn fires are an issue of paying attention to, so in new designs there should be fire detection and extinguishing mechanism so that an overall safer device can be provided to the public especially in areas of hot weather, drought conditions as when the weather is dry the vegetation is more at risk of catching fire even by a spark.

Furthermore, though the grass cutter is loaded with various features, the cost to the customers should be feasible so that it can be more accessible to the public. So, here the topic of this review paper can be concluded and possibly, it can be helpful for future engineers and designers in making the grass cutter a better version of what it is today.

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Also. this is a good idea for a startup in Indian markets as most of the devices used in here are conventional ones. Replacing these with smart lawn movers can potentially attract customers like colleges with huge grass fields, corporate offices with lawns, big private properties etc.

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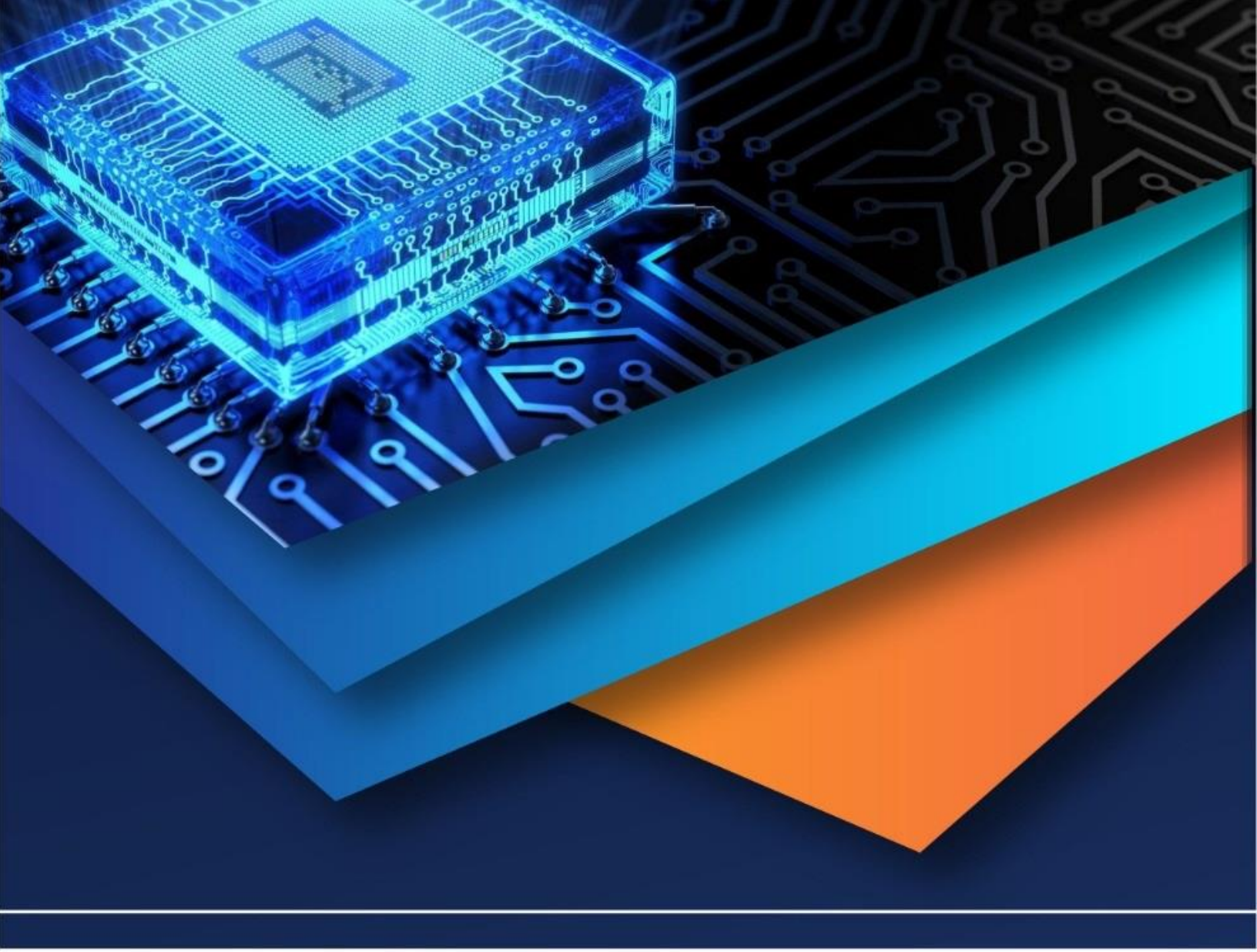
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