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# Autonomous Solar Powered Grass Cutting and Herbicide Spraying Robot

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***Abstract***:This project discusses the development and fabrication of an autonomous grass cutter and herbicide spraying robot. This robot uses a spinning type cutter driven by a dc motor. The robot is designed to cover a large uniform area and work is done continuously once the device is powered up. Two 6V batteries are used to power the cutter and the motors for the movement of the robot.PIC microcontroller is used to control the motors and the valves. The battery is connected to a solar panel for recharging this avoids the need to connect manually or automatically to a charging dock. The robot is fully autonomous and is capable of finding a path in any enclosed environment in a chaotic pattern and avoids obstacles in its path. The sensor used is an ultrasonic sensor which is capable of detecting obstacles and sending this data to the pic controller for appropriate action. The herbicide sprayer is used to apply liquid herbicides to prevent weed growth.

## 1.INTRODUCTION

A lawn mower or a grass cutter is a machine utilizing one or more revolving blades to cut a grass surface to an even height. The height of the cut grass may be fixed by the design of the mower, but generally is adjustable by the operator, typically by a single master lever, or by a lever or nut and bolt on each of the machine's wheels. The blades may be powered by muscle, with wheels mechanically connected to the cutting blades so that when the mower is pushed forward, the blades spin, or the machine may have a battery-powered or plug-in electric motor. The most common power source for lawn mowers is a small internal combustion engine. Smaller mowers often lack any form of propulsion, requiring humanentirely on its own, or less commonly by an operator by remote control. Two main styles of blades are used in lawn mowers. Lawn mowers employing a single blade that rotates about a single vertical axis are known as rotary mowers, while those employing a cutting bar and multiple blade assembly that rotates about a single horizontal axis are known as cylinder or reel mowers.

Solar power is the conversion of energy from sunlight into electricity, either directly using photovoltaics (PV), or indirectly using concentrated solar power. Concentrated solar power systems use lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam. Photovoltaic cells convert light into an electric current using the photovoltaic effect. power to move over a surface; "walk-behind" mowers are self-propelled, requiring a human only to walk behind and guide them. Larger lawn mowers are usually either self-propelled "walk-behind" types, or more often, are "ride-on" mowers, equipped so the operator can ride on the mower and control it. A robotic lawn mower is designed to operate either entirely on its own, or less commonly by an operator by remote control. Two main styles of blades are used in lawn mowers. Lawn mowers employing a single blade that rotates about a single vertical axis are known as rotary mowers, while those employing a cutting bar and multiple blade assembly that rotates about a single horizontal axis are known as cylinder or reel mowers.

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## 2.LITERATURE REVIEW

Paths are generated by treating unknown regions in the environment as free space. As obstacles are encountered en route to a goal, the model of the environment is updated and a new path to the goal is planned and executed[1]. This paper presents an overview of autonomous mobile robot path planning focusing on algorithms that produce an optimal path for a robot to navigate in an environment[2]. This paper develops an optimal path planning scheme for autonomous lawnmowers, including the minimum working k'time, the minimum energy consumption mode and the mixed Operation mode[3]. The method for recognition of lawn information in mowing

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robots (Robomower) is proposed. The mowing robots will be expected to work in open areas such as parks[4]. Computer simulations using various choices of chaotic patterns reveal that the pattern of chaotic orbit generated by Chua's circuit is the best in the sense of wide area coverage, high availability of design documentation and simple circuit.[5]. There are two types of energy source electric and gasoline as the market appetite many different designs have been made each suited to a particular purpose[6]. The task of planning trajectories for mobile robots has received considerable attention in the research literature. However, rare research addresses the
issue relate to lawn mower designs. Optimal and efficient path planner for a lawn mower[7].

Design and implement a Behavior-Based Lawn Mower Robot controller that can be used to mow grass from lawns and play grounds autonomously. The controller uses "sense-act" approach to work in dynamic, unstructured and unknown environment without having any reliance on surrounding world information [8].

algorithms for navigation which improve performance and efficiency of lawn mowing [9]. Path planning technology is one of the important problems in intelligent robot. Firstly, based on the characteristics of intelligent mowing robot and traditional circuitous path planning algorithm, a new "p-d" circuitous path planning algorithm was proposed in the rectangular work.[10].

The largest multi-gang mowers are mounted on tractors and are designed for large expanses of grass such as golf courses and municipal parks, although they are ill-suited for complex terrain.

Most of the existing system uses an internal combustion engines and need an operator to make it work this increases extra work for people with long work hours. It also increases air and noise pollution.

DRAWBACKS TO BE OVERCOMES

The batteries are recharged by a solar panel. The cutter blades are driven by a dc motor.

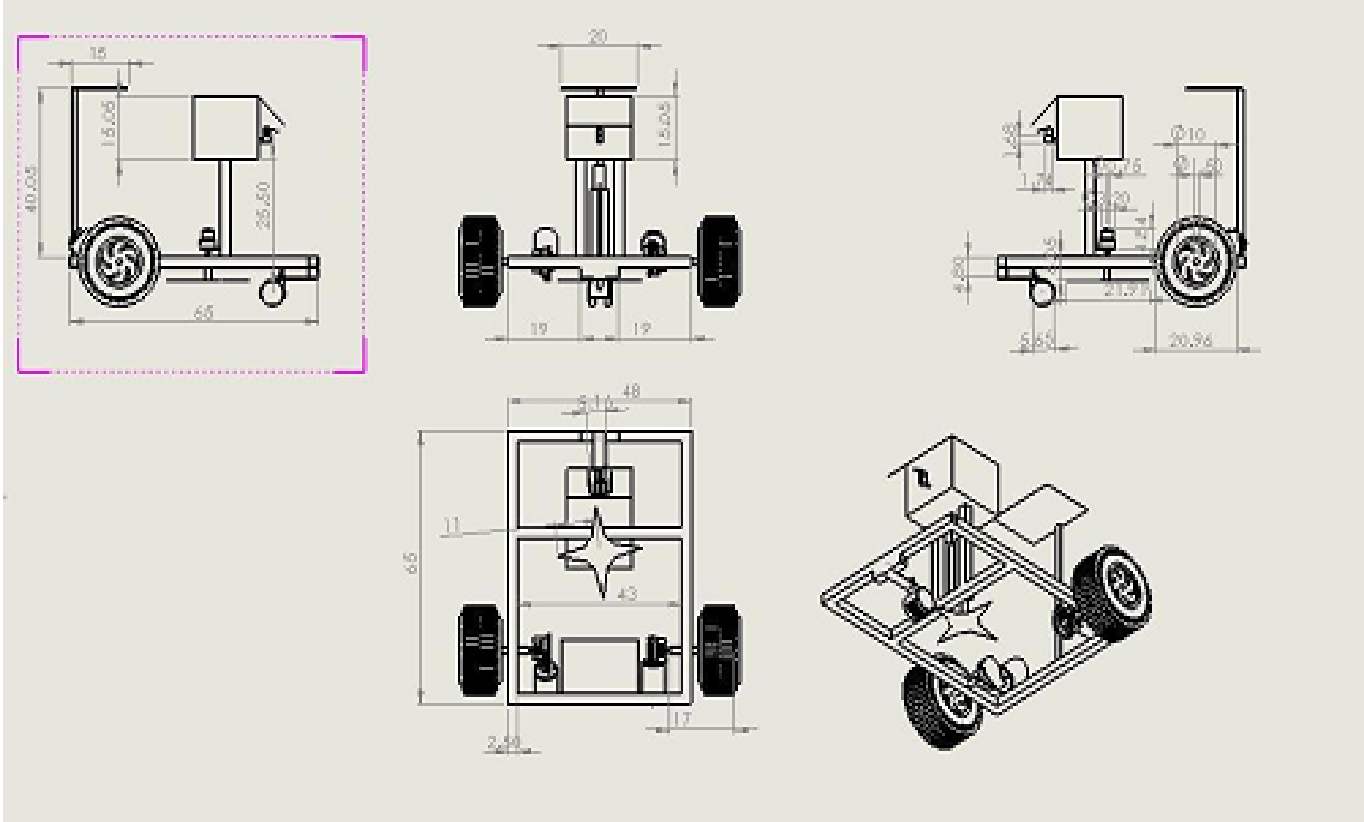

**Fig: Solid Works**

Lawn mowers are often based on random goal choosing and also shape of mowing area is usually determined by a wire hidden under the ground. This allows us to use advanced

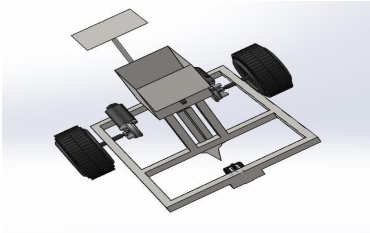

**Fig: Solid Works assembly**

Solid works 2016 was used to create the mechanical design of the project. Each component was designed using solid works and saved as solid works part document and the final assembly consisting of all components is saved as solid assembly document. The solid assembly document is used to create a drawing with dimensions and saved as solid works drawing document this contains all necessary dimensions.

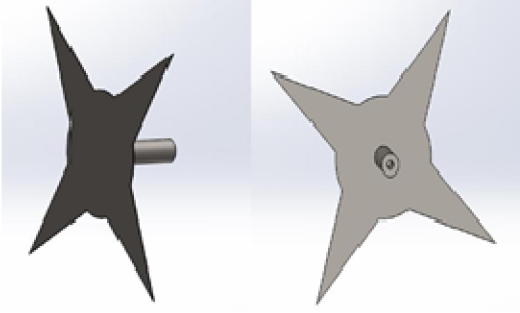

**Fig: 5.1.4 Solid Works part cutter**

7. WORKING OF THE ALGORITHM

This autonomous grass cutting robot is used to cut and irrigate grass in a plane surface like football ground and lawns for residential areas.

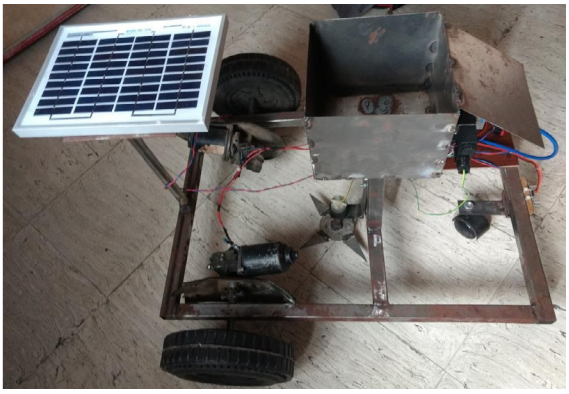

**Fig: Completion of mechanical fabrication**

The robot motion is controlled by a relay and pic microcontroller. The microcontroller also controls the relay circuit which turs on and off the dc solenoid valve connected to the reservoirThe ultrasonic sensor connected to the pic determines the obstacle present and the microcontroller decides the direction to which he robot has to turn this is continuously followed and the grass in the path of the robot is cut continuously. The battery of the robot is recharged by a solar panel and the need of a charging dock or tether is avoided completely.

8.POWER CALCULATION

Storage capacity of the battery

X (battery size in AH) * Y (battery voltage) =Z (power available in watt hours)

Since we use two batteries of 6V and 4.5 AH connected in series the current gets added.

(4.5 +4.5) AH * 6V = 27 WH.

Energy used by various devices

Solenoid valve = 1.5W

DC motor 500 rpm = 6V * 0.5A = 3W

Dc wiper motor running at lowest speed = 1A * 6V = 6W

Other electronic components = 1W

Total power used = 3 + 6+ 12+ 2 = 11.5W

Power generated by solar panel

Solar panel for 1hour generate = 12W

CALCULATION OF WORK TIME

Cutter radius = 0. 21m

Rate of forward motion = 0.5m/sec

Width of cut = 0.21 * 2 m = 0.42m

Area cut in one second = 0.42 * 0.5m2 = 0.21m2

Time taken to cower 25m2 = 25 / 0.21 = 119.04s or 2 minutes

The above calculation is done considering the area a straight narrow strip but in real time the area is a square or a rectangle with a number of obstacle each turn takes about 2 seconds.Considering this the time increases with each turn and the number of obstacle also increases the time for cutting

During the turn the area cowered is given by

(1/2)*((0.42)2 * (22/7)) = 0.28m2.

10 ANALYSIS REPORT

These are the problem raised during the various test runs.

TEST RUN 1

FAILURE:

- The robot turning more than 180 degree when an obstacle is detected.
- Turning direction sequence was not as per the design.

RECTIFICATION:

- The angle of direction was corrected to 180 degrees.
- Turning direction sequence was optimized to the design specification.

TEST RUN 2

FAILURE:

- Detecting distance very high was causing the border untouched by the cutter.

RECTIFICATION:

- Detecting distance reduced to 15CM. TEST RUN 3

FAILURE:

- The solar panel mounted on the reservoir is unstable.
- Cutter radius small and the turn radius was high causing cutting

less area of grass in one sweep.
RECTIFICATION:
• A separate mount was added for solar panel.
• Cutter radius was increased so that the cutting time is reduced and more area is cowered in a single sweep.

## CONCLUSION

This paper presents the design and development of an autonomous solar powered grass cutting and herbicide spraying robot for lawn maintenance application. The hardware of the proposed system including both the mechanical structure and the embedded system is based on very easily accessible materials, making it a feasible option for low-budget applications. In conclusion this design performs better than other low cost designs using similar hardware, but grants performance comparable to designs using expensive hardware and sensors.

## REFERENCE

Alexander Zelinsky (1996)' A Mobile Robot ExplorationAlgorithm'- IEEE transactionsonrobotics and automation, vol. 8, NO. 6, pp 707-717.

N. Sariff , N. Buniyamin(2006)' AnOverview of Autonomous Mobile Robot PathPlanningAlgorithms'- 4th StudentConferenceonResearch and Development, pp 184 -188.

Bing-Min Shiu, Chun-LiangLin(2006)' Design of anAutonomousLawnMowerwithOptimalRoutePlanning'.

KensukeTsubata, Keiji Suzuki, SadayoshiMikami, Ei-IchiOsawa( 2009),' Recognition of LawnInformationforMowing Robots'- 4th International ConferenceonAutonomous Robots and Agents, pp 15-20.

PitikhateSooraksa, KitdakornKlomkarn,(2010),'"No-CPU" Chaotic Robots FromClassroom to Commerce'.

Guo-ShingHuang, Hsiung-ChengLin, Keng-ChihLin, Shih-HungKao(2010),' Intelligent Auto-SavingEnergyRoboticLawnMower'.

Ping-Min Hsu, Chun-LiangLin(2010),' OptimalPlannerforLawnMowers'.

Muhammad Wasif (2011),'Design and Implementation of AutonomousLawn-Mower Robot Controller'.

StepanDalecky, Petra Snaselova, RadimLuza,MarekZak,JaroslavRozman, Frantisek V. Zboril (2016),' Smart Mowers as a Part of a Smart City'.

Jie-hua ZHOU, Ji-qiang ZHOU, Yong-sheng ZHENG, Bin KONG (2016),'ResearchonPathPlanningAlgorithm of IntelligentMowing Robot Used in LargeAirportLawn' - International ConferenceonInformationSystem and Artificial Intelligence, pp 375 – 379.