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AUTONOMOUS SOLAR-POWERED GRASS CUTTER

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Abstract:

This study proposes a solar powered grass cutter which is an autonomous lawn mower that will allow the user to cut their grass with minimal effort. This study was created to solve the problem of power cut problem and environmental issue pertaining the air pollution that is caused by other types of lawn mower. Unlike other solar grass cutter in the market, this prototype has its advantage because it has a vacuum that takes its excessing grass that the blades had cut. This project is made possible with the use of Arduino based microcontroller. The Arduino is used to store all the codes that have been program and sends signal to the sensors and motors to do its individual tasks. With the help of the ultrasonic sensor, this prototype can avoid any obstacle that is blocking the way. This prototype has a shield mounted in front to push away the entire little object that can't be detected by the ultrasonic sensor. The Bluetooth module is used for the on/off of the prototype. It has 5 motors, the 3 A2212/13T 1000kv BLDC motor are for the two blades and one for the vacuums propeller while the other 2 motors are for the dc gear motor. It is a low cost and a user friendly project.

Keywords: *Autonomous Solar Grass Cutter, Arduino, Vacuum, Sensors, Motors*

I. INTRODUCTION

The first lawn mower was named as a push lawn mower by Edwin Beard Budding. The lawn-mower man has to push the lawn mower in order for it to cut the grass. In that way it uses a lot of efforts because it is used manually. On that case, people had come up with several type of lawn mower to lessen the efforts of lawn-mower man and to be more sufficient in cutting the grass. These are the several type of a lawn mower: Cylinder mower, Rotary Mower, Electric Mower, Petrol Mower, Hover Mower, and Robotic Mower.

In this generation, there are a lot of innovation that are been produced due to the help of our new technology. There is new innovation of a grass cutter that the technologists have gathered and these are the few: Electric Grass Cutting Machine, A Portable and Automatic Weed Cutter Device, Automatic Grass Cutter, Solar Grass Cutter with Linear Blades by Using Scotch Yoke Mechanism, Solar Powered Fully Automated Grass Cutting Machine.

This kind of grass cutter will have the ability to be controlled automatically and be able to restore the desired program in the memory. It has a micro-controller to interact with and control the other component that will give a maximum efficient output for the work. It also helps both consumer and environment to reduce health hazards andpollutions caused by the gasoline powered machine. The technologists innovated the project in the means of adding one BLDC motor for much widerarea coverage of cutting grass with an attachment of a vacuum in order to

clean the area directly, though this is not a hundred percent sufficient in taking the grass that is being cut. This lawn mower is named as a "Design and Development a Low Cost Autonomous Solar Grass Cutter Utilizing an Arduino Based Microcontroller". It is not only an autonomous machine but it is also affordable for the consumer.

II. METHODS

The purpose of this study is to present underlying effective methods to be used as a means and aid for the success of the study, as well as the procedures and techniques that underpin the realization of the study's objective. The methodological framework is the section of the study wherein it shows the steps that the researchers have to follow the process which is indicated in **Figure 1**.

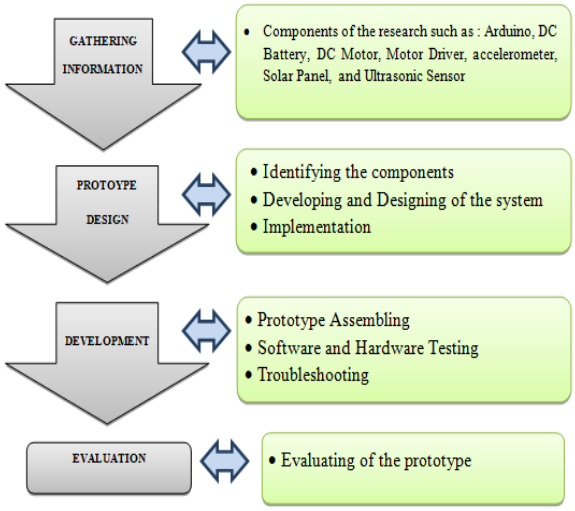

Fig. 1 Methodological Framework

A. Concept Design

The concept design is the baseline study of making the prototype. This section of the study implies the different views of the solar grass cutter. It is able to showcase the external aesthetic of this study.

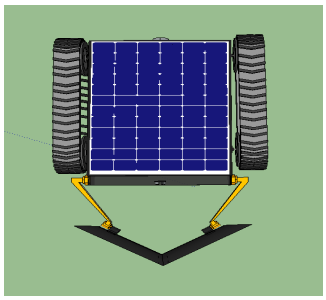

Fig. 2 Top View

In **Figure 2,** the top view is represented in order to illustrate the actual design prototype. This study uses a solar panel that is shown at the top portion of the solar grass cutter. The shield is design in that position so that it can push away all the small objects that the ultrasonic sensor hasn't able to detect. The linkage is design that way to support the shield properly.

The **Figure 3** indicates the exploded view.The letter A indicates the solar panel that is located at the top portion of the prototype. B represents the rubberized chained wheel. C states the shield. It is elevated from the ground so it won't be a hindrance for the prototype to move. The letter D is for the base. F is for the battery charger while the G is the Bluetooth module and H is the Arduino. The letter I is the motor driver then J is the battery management system. The ultrasonic sensor is indicated in letter K that acts as the eye that detects any obstacles ahead. While the battery capacity voltage meter is letter L. The M is for the BLDC motor A2212/13T 1000KV for the vacuum. The motor with the blade on the left side will rotate clockwise and the motor with the blade on the right side will rotate in counterclockwise. The vacuum will collect the grass from the center after being cut. Letter N is the DC gear box motor. O is for the bin that is used in the vacuum then P is for the tube of the vacuum. The letter Q represents the two BLDC motor that is used for the blades.

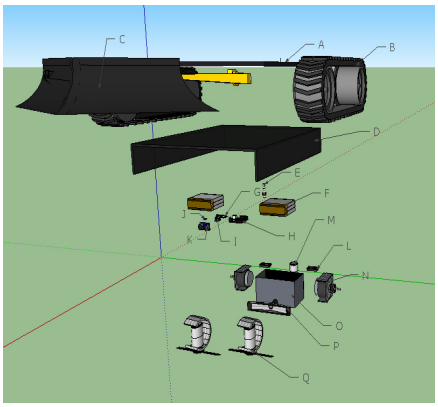

Fig. 3 Exploded View

B. Implementation

The implementation is done after the design and development of the prototype. The implementation of the project will be conducted on a flat surface and rough surface. This section will have its results/testing of the prototype. It will showcase the trials that the researchers had overcome through their testing process. The implementation helps to improve the project.

Testing and Results of Prototype

The parameters that the researchers have used to come up in their testing and results of the prototype are seen in**Table 3.1** below. The Table below indicates the trials, type of grass, date, type of surface and the output of the testing and results that the researcher have conducted.

TABLE I
TESTING AND RESULTS

TRIAL	TYPE OF GRASS	DATE	TYPE OF SURFACE	OUTPUT
Trial 1	Carabao grass		Rough surface	
Trial 2	Carabao grass		Rough surface	
Trial 3	No grass		Flat surface	
Trial 4	Carabao grass		Rough surface	
Trial 5	No grass		Flat surface	
Trial 6	No grass		Flat surface	
Trial 7	Carabao grass		Rough surface	

Block Diagram of Solar Grass Cutter

The figure 4 shows the block diagram of this study. It is seen in the figure below the visual representation of how the components are related to each other and how they work together.

The solar panel is connected to voltage supply which is the Lithium-ion. The motor one and two are connected to monster motor shieldand wired to the Lithium-ion that gives the power supply for them to work and it is also connected to Arduino that gives instruction to it on when should it tilt its wheel when the ultrasonic sensor can detect any obstacle ahead. The other voltage supply which is the Li-Po is connected to the three esc that is also connected to the three A2212/13T BLDC motor. The Arduino also programmed these three motors for the cutters and the vacuum for its speed. The ultrasonic sensor and Bluetooth module are connected into the Arduino.

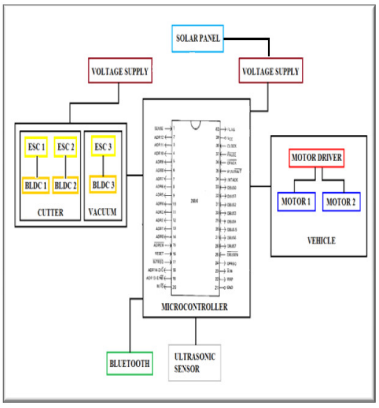

Fig. 4 Block diagram

III. RESULTS

The **Figure 5** showcases the isometric view of the prototype. The components arrangement is seen in this view.

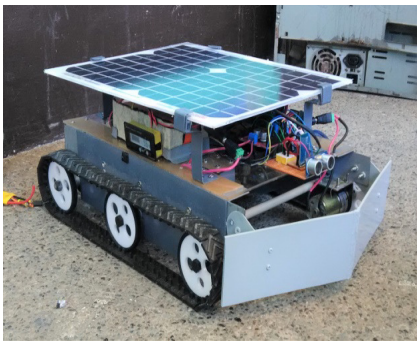

Fig. 5 Isometric View

A. Prototype Development

Shown in **Figure 6**, theactual photo of the front view of the prototype. The ultrasonic sensor is seen in the figure below which detects any obstacle ahead and sends signal to the Arduino that gives instruction to the gear motor of the chained wheel to avoid the obstacle. The shield helps to push away all the small objects that the ultrasonic sensor hasn't able to detect. The Lithium ion and the Li-Po's placement are seen in this view. The Lithium ion is for the two DC gear motor and the Li-Po is for the three A2212/13T BLDC motor

Fig. 6 Front View

B. Prototype Development

This section of the study where implementation are taken place

The researchers conducted a results/testing for their prototype's implementation. The trials that the researchers came up are seen in the table below.

TABLE II
TESTING AND RESULTS

TRIAL	DATE	TYPE OF GRASS	TYPE OF SURFACE	OUTPUT
1.	Jan.13, 2018	Carabao Grass	Rough	Working without heavy loads.
2.	Jan.27, 2018	Carabao Grass	Rough	Trouble encountered with Gear Motor.
3.	Jan.31, 2018	(No Grass)	Flat	Trouble encountered in rotation.
4.	Feb.2, 2018	Carabao Grass	Rough	Prototype's working with it's cutter.
5.	Feb.4, 2018	(No Grass)	Flat	Prototype's working but trouble encountered with it's rotation.
6.	Feb.7, 2017	(No Grass)	Flat	Prototype's working but encountered some problem in the program.
7.	Feb.8, 2018	Carabao Grass	Rough	DC Gear Motor couldn't handle the prototypes weight that prevents it to run.

Figure 7 shows the Bluetooth software application that this study uses in order to control the solar grass cutter. The application needs to connect to the Bluetooth module. It can be set to auto mode or it can be done manually by clicking the buttons forward, reverse, left and right. The motor wheel speed can be set to 100, 185 or 225. Activate BLDC is for the blades to switch on and to stop it you just have to click the Stop BLDC/Stop; reset first the Arduino to activate the BLDC.

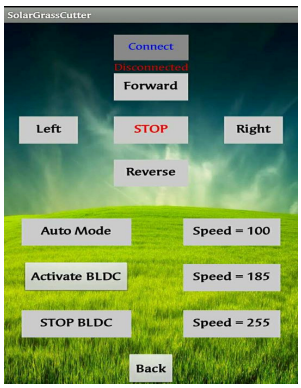

Fig. 7. Bluetooth Application

III. CONCLUSION AND RECOMMENDATIONS

- The innovated device offers a non-human interactive solar grass cutter.
- The Prototype has an excellent marketability.
- The Prototype is a user friendly device.

Recommendation

The following are recommended to further enhance the potential and performance of the device. In the completion, the researchers determined the following recommendations:

- Space must be wide enough for the grass cutter to do its job.
- Programming concept should be improved.
- A gear motor that is capable of carrying heavy loads of components that enable to run the prototype.

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