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Research Paper on Development of Android Controller Solar Grass Cutter Robot

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Abstract: *Manual grass cutting requires man power, time and it may create non-uniform structure of grass height. Hence to avoid all these issues it is essential to create a system which can cut the grass without any human involvement. This research implements the grass cutting robot which has battery which can be charged by solar energy. This robot can be operated using android phone. This system can be created with minimum cost as compared to other existing systems. This system has additional features such as obstacle detection automatically avoid the obstacle and when the battery percentage is low it returns to its operator's location This is rugged, durable and maintenance free. This system is pollution free due to the use of solar energy to charge the battery.*

Keywords: Android, Bluetooth, Grass Cutter, Solar Energy

I. INTRODUCTION

The automation is useful at various stages of human life. The beautiful evenly cut grass increases the beauteousness of any hotel, house, park, meeting hall etc. Hence uniform grass cutting is important to maintain the prestige of any house or hotel. The manual grass cutting is possible using human being but it usually consumes time and energy of human being. Also, the manual grass cutting is inefficient and many time results in non-uniform structure of grass. Hence to avoid all these issues it is better to use automated grass cutting robot machine which can be operated through android phone.

This research implements the android operated grass cutting robot. This system establishes connection with android phone using Bluetooth. This robot's motion includes following motions forward, backward, left turn, right turn and grass cutter on/off. All these motions are controlled by android application. This robot is operated by using 12V 7.5AH battery. To charge this battery solar panel is connected above the battery.

Many researchers have proposed a similar design of solar based grass cutting robot. Firas B. Ismail et al. [1] implemented a design in which the blades of cutter are placed at the middle of four wheels of robot. This will create disturbance during the grass cutting process. If the size of grass is larger, this will stop the wheel and hence this system cannot be used in an efficient manner. Bincy Abraham et al. [2] and Mallikarjun Mudda et al. [3] proposed a similar system of grass cutting robot. But this system cannot control by android smart phone. It has ultrasonic sensor which can detects the obstacle. This system automatically changes its path if the sensor senses any obstacle. Also, this system does not contain four wheels. Hence sometimes it creates a problem of balancing in real time working scenario. Rishabh Gupta et al.

[4] published a survey paper on solar based grass cutting robot. They had explained the various similar systems and their pros and cons. Sagar V. Palve et al. [5] implemented a

similar system but this paper failed to show the actual model of the system.

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II. MATERIAL AND METHODS

Material

DC Motor

This system uses 4 DC motors of 12V rating to which 4 wheels are connected. This motor converts DC electrical input into mechanical energy by rotational motion of shaft. This motor is cheaper and requires less electrical voltage for its operation as compared to other similar motors. The figure 4 below shows the DC motor.

Figure 1: - DC motor

Solar Panel

This system uses 12V, 10-Watt solar panel. It has aluminum frame and its surface is made up with tampered glass material. This panel is consisting of mono crystalline silicon. This panel is compact, lightweight and economical as compared to other existing panels of similar rating. Figure 6 below shows the solar panel.

Figure 2: - 12V, 10 W solar panel

Bluetooth Module

This research uses an Arduino, HC-05 Bluetooth module to transfer the commands from android smart phone to the system. This HC-05 Bluetooth module is mounted on the system along with some relays. Initially user connects its smart phone with this module. After a successful connection user can provide the desired direction change command to the system from maximum 10-meter distance. Also, user can switch ON and OFF the grass cutter through its mobile using the android application.

HC-05 Bluetooth module is mainly used for short-range wireless connectivity. This is economical and durable module as compared to other existing Bluetooth modules. Figure 3 below shows the HC-05 Bluetooth module.

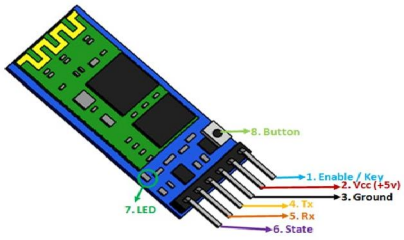

Figure 3: - HC-05 Bluetooth module

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LCD Display

This research uses 15 by 2 LCD (Liquid Crystal Display) screen to display the direction of movement of this system. It also shows the ON and OFF status of Grass Cutter. This is a preferable module over seven segment and multi segment LED modules. This is because it is economical and it can show any special and custom character, animations and so on. This module can show 15 characters on each line and it has 2 such lines. Each character is on this LCD module is displayed in 5*7-pixel matrix. This LCD consists of Command Register to store the commands provided to this module. The Data Register in LCD module is used to store the data displayed on LCD display. Figure 2 below shows the 15*2 LCD module.

Figure 4: - 15*2 LCD Module

Motor Driver IC

The DC motor in this system is connected with analog output pin of ATmega328P microcontroller. But this microcontroller can produce maximum 5V of DC output voltage. The DC motor connected with this system requires

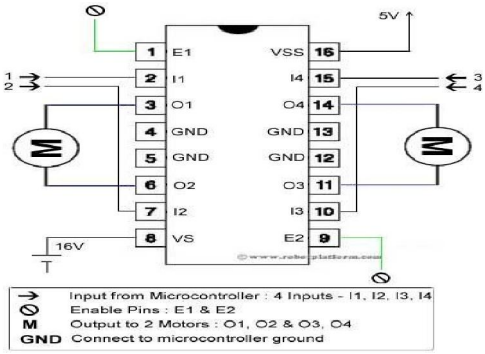

Figure 5: - Motor driver IC L239D

12V DC input voltage to operate. Hence L293D motor driver. IC is connected between microcontroller output pin and DC motor input. This IC acts as a current amplifier. It takes low current signal from microcontroller and after amplification provides high current signal to DC motor. This high current signal is useful to drive the DC motor

Ultrasonic Sensor

Ultrasonic sensors are electronic devices that calculate the target's distance by emission of ultrasonic sound waves and convert those waves into electrical signals. The speed of emitted ultrasonic waves traveling speed is faster than the audible sound. There are mainly two essential elements which are the transmitter and receiver. Using the piezoelectric crystals, the transmitter generates sound, and from there it travels to the target and gets back to the receiver component. To know the distance between the target and the sensor, the sensor calculates the amount of time required for sound emission to travel from transmitter to receiver. The calculation is done as follows:

$D = 1/2\ T * C$

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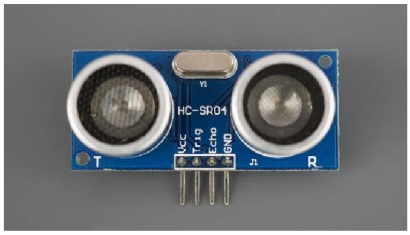

Figure 6: - ultrasonic sensor

Arduino

This research uses Arduino platform with ATmega328P microcontroller. This microcontroller has 28 pins and it is cheaper and efficient as compared to other microcontrollers. Any new C++ language code can be first tested in arduino-1.5.7-windows software. After verifying this code, it can be loaded into the Arduino platform using simple USB cable connected between PC and Arduino kit. The figure 1 below shows the Arduino IDE kit along with ATmega328P microcontroller

Figure 7: -Arduino with ATmega328P microcontroller

Method

This research uses DC 12V 7.5AH battery supply to operate whole system. This battery is connected with solar panel. Hence solar energy is used to charge this battery. This system has 4 DC motors to which 4 wheels are connected and the blades for grass cutting are connected at the front side of this system. To operate this system the connection must be established between this system and android smart phone.

Both these are connected using Bluetooth. After the successful connection the user can operate this system using android application installed on smart phone. User can switch ON and OFF the grass cutter. Also, he can move this grass cutter in vertical and horizontal direction. The figure 7 below shows the complete system.

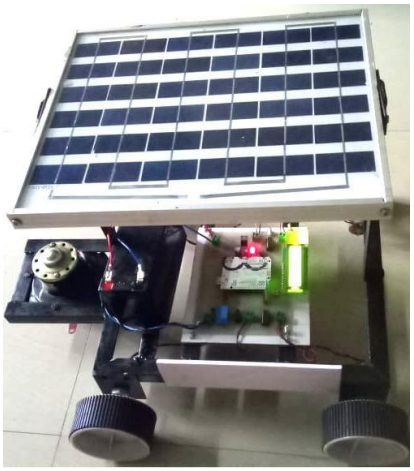

Figure 8: - Proposed system

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III. PROPOSED FRAMEWORK

The figure 8 below shows the block diagram of proposed framework.

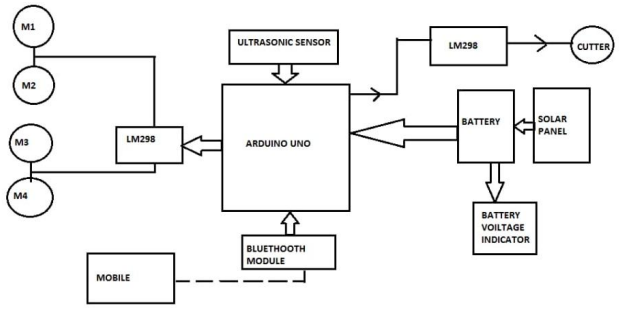

Figure 9: - Block Diagram

As shown in figure 8 above, Solar Panel is connected to battery. Battery provides 12 V DC supply to the system which can be minimized to 5V DC voltage using voltage regulator. The Arduino is operated with 5V DC voltage. The LCD module, Bluetooth module, DC motors, buzzer are connected with output pins of ATmega328P microcontroller.

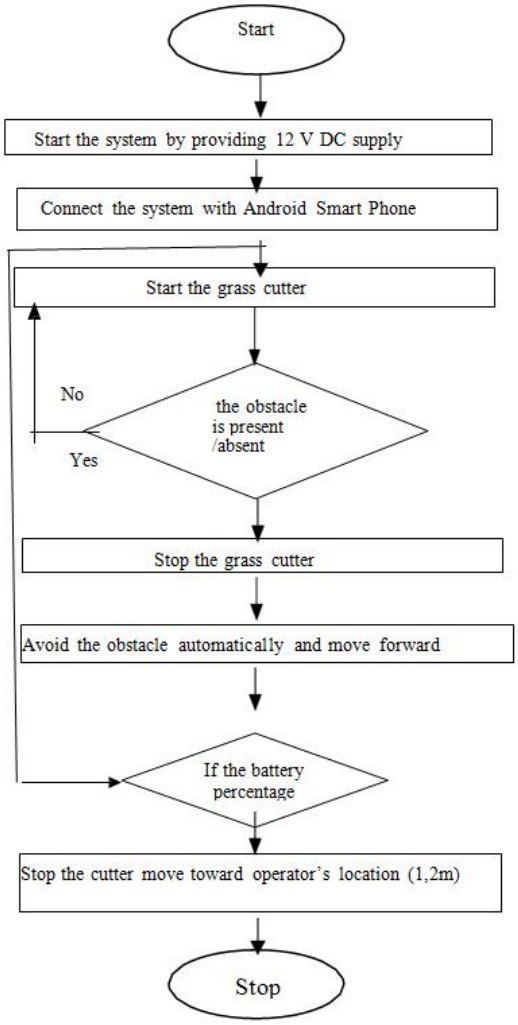

Figure 10: - Flowchart of the system

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As shown in figure 10 above, initially the 12 V battery supply needed to start. This supply will be converted into 5V DC supply using voltage regulator. This 5V supply will be provided to microcontroller. The Bluetooth module needed to be started and connected to the android smart phone. Once the connection is established between the smart phone and the system, user can move this system in vertical and horizontal direction using android application in smart phone. User will start the grass cutter to cut the grass of desired location. After completing grass cutting task, user will switch OFF the grass cutter using android smart phone. Then the main system can be switched OFF by disconnecting the 12V battery supply to the system.

IV. PROS, CONS AND APPLICATIONS

Pros:

Portable structure with Compact size
Simple operation
Less cost
Uniform grass cutting is possible
Reduces human efforts Cons:
This system cannot be operated in presence of rain.

Application:

This system can be used to cut the grass of cricket ground, football ground, garden etc.

V. CONCLUSION

This research shows the implementation of smart phone operated grass cutter. This grass cutter can be operated using android smart phone within a 10-meter range. The user can perform horizontal and vertical movement of grass cutter using android application in smart phone. This system uses 12V 7.5AH lead acid battery. This battery can be charge by solar energy. To charge this battery the 12V, 10Watt solar panel is connected with this system. This system is cheaper, rugged and durable.

With the use of this system human efforts for grass cutting are highly minimized. Also, manual grass cutting can create non-uniform grass size. But with the use of this system the grass cutting is uniform, and one can use this system to cut the grass of any playground.

FUNDING

This research is self-funded. The author of this paper invested the complete amount to create this system.

CONFLICT OF INTEREST

All the authors of this publication declare that they have no any conflict of interest for publication of this research.

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DECLARATION

This research does not perform experiment on any living thing such as human participant or animals.

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