Design of Smart Agriculture Machine

Gaurav Srivastava[1] Aditya Yadav[2] Shri Nishant Tripathi[3]
[1,2,3]Department of Electronics Design & Technology
[1,2,3]NIELIT, Gorakhpur, India

Abstract— This project is an autonomous lawn mower that will allow the user to the ability to cut their grass with minimal effort. Unlike other robotic lawn mowers on the market, this design requires no perimeter wires to maintain the robot within the lawn. Through an array of sensors, this robot will not only stay on the lawn, it will avoid and detect objects and humans. An extra facility of seeding is also provided wherever we wanted in the field using a motor and a Camera display with TV is also used for continuous watch on the work. This design is still in the prototype stage due to financial and time constraints. Documentation includes all major design aspects. This project will continue in hopes to market the design.

Key words: Solar Panel, Relay, DC Motor, Battery, Blades, Comparator, Ultrasonic Sensor

I. INTRODUCTION

In the time where technology is merging with environmental awareness, consumers are looking for ways to contribute to the relief of their own carbon footprints. Pollution is man-made and can be seen in our own daily lives, more specifically in our own homes. Green technology initiatives are being support by both the government and cooperates business. Our new design for an old and outdated habit will help both the consumer and the environment.

This project of a solar powered automatic lawn mower [1] [3] will relieve the consumer from mowing their own lawns and will reduce both environmental and noise pollution. This design is meant to be an alternate green option to the popular and environmentally [2] hazardous gas powered lawn mower. Ultimately, the consumer will be doing more for the environment while doing less work in their daily lives. The hope is to keep working on this project until a suitable design can be implemented and then be ultimately placed on the market.

II. SYSTEM OVERVIEW

This design contains a microcontroller [5], multiple sensors, and a solar charging system. Adding these elements together, we get our robotic lawn mower. The sensors are the eyes of our robot. The goal was to let our robot see the difference between grass and concrete while monitoring its surroundings continuously. Initially, we had an idea what type of sensors we wanted to use.

Since concrete/dirt and grass are distinctively different in density and moisture levels, the humidity was a good factor to distinguish both materials. In addition to sensing humidity, we wanted object detection; both humans and objects. In which case, we went with using a passive infra-red sensor to detect the heat radiation from humans and an ultrasonic sensor to detect if the robot was heading into an object. Safety is the main concern when designing a robot with blades. We wanted our robot not to start operating if it was being held in the air by the user. Knowing that the user would be randomly holding the robot we needed a sensor to detect orientation [4].

The nickel-metal hydride (NiMH) was found to be the best battery because given a low charging current, it will not over charge. Sizing the battery will depend on what we are powering, specifically the motors. The needed torque did not need to be a lot because we were going to have a small prototype design.

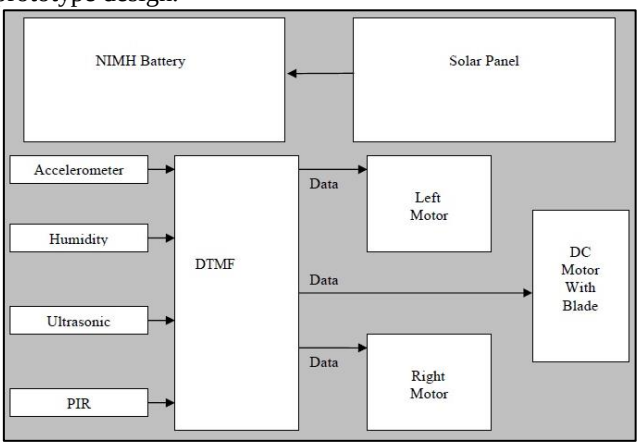

Fig. 1: System Block Diagram

Determining where to place our sensors is crucial to the overall effectiveness of our design. Initially, we knew to place the humidity sensor facing down into the ground. The solar panels were to be placed horizontal on the robot because to achieve maximum sun exposure. The microprocessor must be in the robot to protect it from the natural elements. Our ultrasonic sensor will be mounted directly in front of the robot for maximum detection. The only sensor that will be angled is the PIR because it needs to detect humans and since the robot is at ground level itmust be facing up to effectively detect humans. Our preliminary design is shown in figure 2.

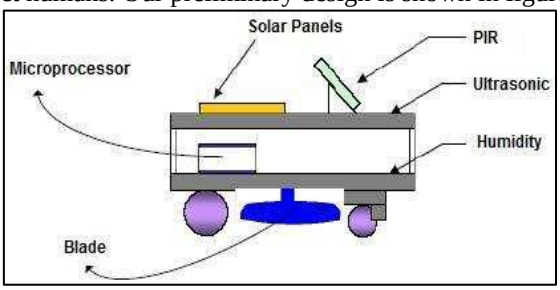

Fig. 2: Preliminary Design

III. HARDWARE REQUIREMENT

A. *Why DTMF is used?*

Conventionally, Wireless-controlled robots use RF circuits, which have the drawbacks of limited working range, limited frequency range and the limited control. Use of a mobile phone for robotic control can overcome these limitations. It provides the advantage of robust control, working range as large as the coverage area of the service provider.

Although the appearance and the capabilities of robots vary vastly, all robots share the feature of a mechanical,

movable structure under some form of control. The Control of robot involves three distinct phases: perception, processing and action. Man has come long way In terms of development over a period of time we would use the RF modules for the purpose wireless after that we overcome with the techniques of GSM modems and we use the DTMF in wireless system. The DTMF technology has overcome the problem of limitation which we can work only in limited range or limited area was in RF technology by using cell phone (DTMF).

Figure 3: DTMF Component

B. DTMF Working Frequency Table

Frequency	1209	1336	1477	1633
697	1	2	3	A
770	4	5	6	B
852	7	8	9	C
941	*	0	#	D

Table 1: DTMF Working Frequency Table

C. Quadruple Half-Driver

To control the DC motors, an H-bridge was used for both microcontroller protection and efficiency. Even though each chip can handle two bi directional DC motors, we went with one chip per motor for heating concerns.

Fig. 4: Quadruple Half-Driver

D. Bi-Directional Motor

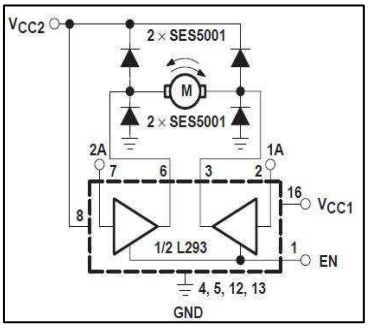

Fig. 5: Bi-directional motor control with L293DNE

IV. SOFTWARE REQUIREMENT

A. Simulation Tool: Proteus 8.6

Proteus PIC Bundle is the complete solution for developing, testing and virtually prototyping our embedded system designs based around the Microchip Technologies series of microcontroller. This software allows us to perform schematic capture and to simulate the circuits you design. A demonstration on the use of PROTEUS will be given to you on this lab session, after that; you are encouraged to learn to use the software interactively.

The DTMF has 4 Pulse Width Modulation (PWM) channels, we used only 2: one for eachmotor. The PWM will control the speed of each motor. Essentially, the PWM is a square function with a DC offset that repeats every cycle. 'The 'ON' time determines how much of the voltage is being applied to the motors. The higher the voltage the faster the motor moves. Figure 16 shows two different PWM signals. The top PWM signal will move the motors slower than the lower PWM signal. Coding is done on turbo C which is burn in microcontroller.

V. WORKING OF SOLAR GRASS CUTTER

Coming to the working of solar powered grass cutter, it has panels mounted in a particular arrangement at an angle of 45 degrees in such a way that it can receive solar radiation with high intensity easily from the sun. Now this electrical energy [6] is stored in batteries by using a solar charger. The main function of the solar charger is to increase the current from the panels while batteries are charging. The motor is connected to the batteries through connecting wires and a switch is provided between the two mechanical circuit breakers. It starts and stops the working of the motor. From this motor, the power transmits to the mechanism [7] and this makes the blade to slide on the fixed blade and this makes to cut the grass.

A. Basic operation of the prototype design

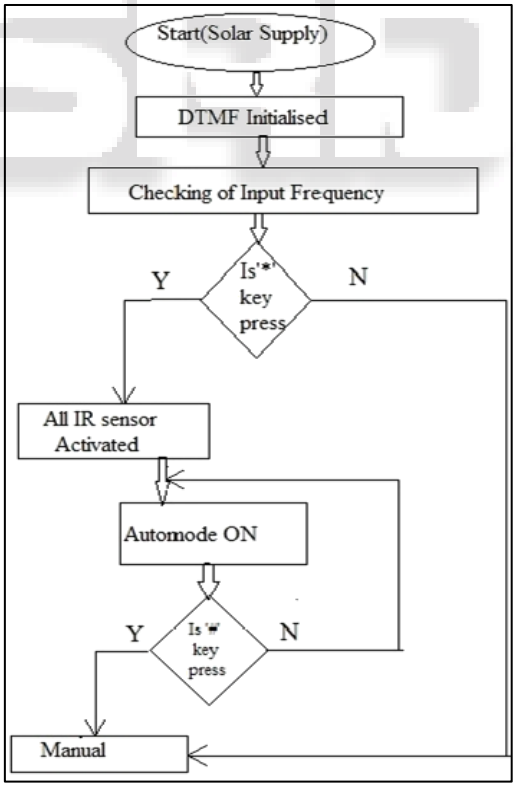

Fig. 6: Flow chart

B. Manual operation of the prototype design

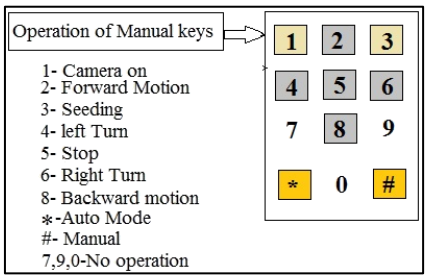

Fig. 7: Key description of remote mobile

VI. CALCULATIONS AND RESULT

$$P = 2\pi NT / 60 \text{ watts}$$

Where, P = power
N =Speed of motor
T = Torque
Then

$$P=V*I$$

Where, V= voltage
I = current

A. With No Load condition

$$P= V*I = 12*25 = 300 \text{ W}$$

We know that, N= 800 RPM
Then

$$P = 2\pi NT / 60$$

$$300 = 2*\pi*800*T / 60$$

$$18000 = 2*\pi*800*T$$

$$T = 3.58 \text{ N-m}$$

B. With Load condition

$$P= V*I = 12*29 = 348 \text{ W}$$

We know that, N= 600 RPM
Then

$$P = 2\pi NT / 60$$

$$348 = 2*\pi*600*T / 60$$

$$20880 = 2*\pi*600*T$$

$$T = 5.53 \text{ N-m}$$

C. Obtained Results

Torque with No Load Conditions = 3.58 N-M
Torque with Load Conditions = 5.53 N-M

D. Comparison of Proposed Model with Previous Model

S. No.	Previous Model	Existing Model
1	Totally polluted	Totally free from pollution
2	Fuel is the important need	No fuel consumption
3	No. of reciprocating parts are more	No. of reciprocating parts are less
4	Speed reduction ratio is less and it does not vary	Ratio of speed reduction more when weight increases very much

Table 2: Comparison of Proposed Model with Previous Model

VII. ADVANTAGES AND LIMITATIONS

A. Advantages

- Compact size and portable
- Easy to move from one place to another place
- Operating principle is simple.
- Non-skilled person also operate this machine

B. Limitations

- Large time required to remove the grass
- Manually operated
- Difficult to operate in rainy seasons

VIII. CONCLUSION

Our project entitled Fabrication [8] of solar powered grass cutter is successfully completed and the results obtained are satisfactory. It will be easier for the people who are going to take the project for the further modifications. This project is more suitable for a common man as it is having much more advantages i.e., no fuel cost, no pollution [9] and no fuel residue, less wear and tear because of less number of moving components and this can be operated by using solar energy. This will give much more physical exercise to the people and can be easily handled.

REFERENCES

[1] Darwin Ramos and Jessie Lucero proposed "Automatic lawn mower" Sanjose state university, electrical dept in 2009,
[2] M. I. Fadhel, Ramez Abdul, B. F. Yousif, Azami Zaharim, K.Sopian (2011), "Thin-Layer Drying Characteristics of Banana Slices in a Force Convection Indirect Solar Drying", Recent Researches in Energy & Environment ,ISBN: 978-960-474-274-5.
[3] Muhammad Wasif proposed "Design and implementation of autonomous lawn-mower robot controller" IEEE 2011transaction paper. in 2011.
[4] Junho Yang and Soon-Jo Chung proposed "vision-based localization and mapping for an autonomous mower" IEEE intelligent robots and systems (IROS) Nov 3-7 Tokyo, Japan. In 2013,
[5] Yan-Fang Li, Saul Harari, Hong Wong, and Vikram Kapila (2004, July). Matlab Based Graphical User Interface Development for Basic Stamp 2 Microcontroller Projects, Proceeding of the 2004 American Control conference 3233-3236. Retrieved on May 6, 2009 from IEEE explore.
[6] Guo-shing Huang and Keng-Chih Lin proposed "Intelligent auto-saving energy robotic lawn mower". IEEE transaction on robotics, Pg 4130 to 4136 in 2010,
[7] Songchai Wiriyaumpai wong, Jindaporn Jamrad-loedluk (2007), "Forced Convection Solar Drying: Experimental Investigation and Mathematical Modeling of Pork Strips", KKU Engineering Journal Vol. 34 No .2 (243 - 250).
[8] Stand-alone solar energy: Planning, sizing and installation of stand-alone photovoltaic systems by Oliver Style Paperback.
[9] Chandrakumar B Pardhi, Jiwanlal L Bhagori (2013), "Development and performance evaluation of mixed-

mode solar dryer with forced convection", International Journal of Energy and Environmental Engineering.

