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DESIGN AND IMPLEMENTATION OF ADVANCED ROBOTIC LAWN CUTTER

S. ARIVOLI

Department of Electrical and Electronics Engineering, V.S.B College of Engineering Technical Campus, Coimbatore, Tamil Nadu, India

ABSTRACT

An automatic lawn cutter helps the user to cut the grass in their lawn with less effort. The different sensors are used to detect and avoid objects obstacles and humans intervention while moving. The objective of automatic lawn cutter is that the user can specify the area that is to be cut down with a machine and the height of grass to be cut as per the requirement is done by using the keypad. The design of automatic lawn cutter is done by using an AT mega microcontroller, RF module, IR sensors, motors, LCD Display and Keypad. This grass cutter can work in any of two modes i.e. ―Automatic and Manual. All hardware and software operations are controlled by AT mega microcontroller. The wireless communication between remote (manual mode) and robot is performed by the RF modules which covers a range of 50 meters. For obstacle detection, the robot is developed with IR sensor. Four motors are used, one for grass cutting and two for wheels. Driver IC L293D used to drive the motors. The entire circuitry is connected with 12V battery. All the operations are controlled by robot themselves in automatic mode and in case of hurdle detection, they change the lane and moves back. By using the keypad the expected task is performed In the manual mode to operate the robot. For transmission and reception of the information between remote and robot, RF module is used and to display the fetched information related to the detection of hurdle, LCD is used. And also the blade is attached with front bottom of the robot which is used for cutting the grass.

KEYWORDS: Automatic Lawn Cutter, IR Sensors, Microcontroller, RF Module, Robot

INTRODUCTION

Pollution is a major threat for entire world because of increasing demand in automobile sector. Pollution starts from our own homes and it was generated by us. The conventional lawn cutter is power by gas which pollutes the environment. Since the cost of fuel usage is increasing day by day it is not an efficient method to go with gas powered lawn cutter. Hence the Solar powered lawn cutters were introduced for eliminating the occurrence of pollution. Solar energy is utilized to power an electric motor for rotation of a blade which in turn cuts the grass in the lawn. But the design cost increases. So an automatic lawn cutter was proposed which consist of a rechargeable battery. To eliminate the environmental hazardless which has occurred in Hydrogen gas powered lawn cutter, we here propose an alternative solution with automatic lawn cutting machine. The most of the commercial running lawn cutter machines uses gasoline with small adjustments in the design of the carburetor and a hydrogen reservoir which contains solid-state metal hydrides. Periodically check up is done and annual maintenance is performed by changing the lubricating oil of the engine, and thereby passing inlet of air into the reservoir for reactivating the metal hydride powder. Periodically check up is done and annual maintenance is performed by changing the lubricating oil of the engine, and thereby passing inlet of air into the reservoir for reactivating the metal hydride powder. Hence as an alternative solution, automatic lawn cutter is designed

and implemented using rechargeable battery for economical reasons. The sensors play a vital role and are considered as the eyes for lawn cutter. Automatic lawn cutter can perform the operation of cutting the grass in specified area by feeding input from the keypad. The height of grass to be cut is controlled by adjusting the height of blades. Thus the idea of this lawn mower is to cut the grass in the lawn with less effort. Also to cut the grass of particular area as per user requirement this automatic robotic lawn cutter is used.

LAWN CUTTER BLOCK DIAGRAM

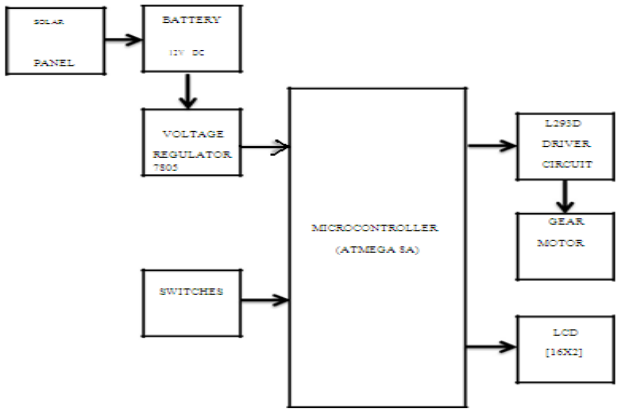

Figure 1: Block Diagram of Lawn Cutter

MICROCONTROLLER – ATMEGA8

Features

- High-performance, Low-power AVR® 8-bit Microcontroller
- Advanced RISC Architecture
- High Endurance Non-volatile Memory segments

Peripheral Features

- Special Microcontroller Features
    - Power-on Reset and Programmable Brown-out Detection
    - Internal Calibrated RC Oscillator
    - External and Internal Interrupt Sources
    - Five Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, and Standby
- Power Consumption at 4 MHz, 3V, 25°C

PIN CONFIGURATION

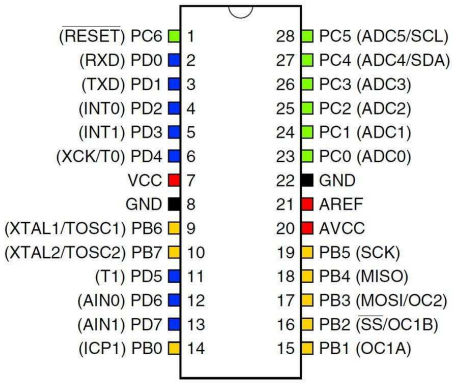

Figure 2: Pin Configuration of Atmega 8 Microcontroller

L293D Dual H-Bridge Motor Driver

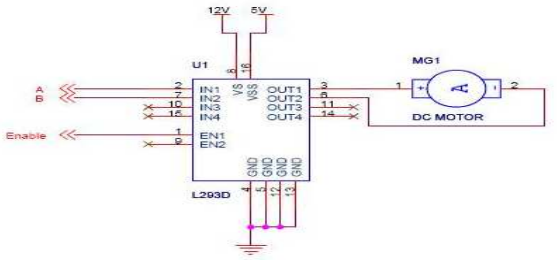

Figure 3: A Simple Schematic for Interfacing A DC Motor Using L293D

The IC L293D is used to drive the motor, which is a dual H-Bridge motor driver. The interfacing of two DC motors is done by using one IC L293D and is used to control the direction of rotation in both clockwise and counter clockwise direction. Per channel the output current is 600mA and its peak output current is 1.2A. Output diodes have been connected within the IC to protect the circuit from the flow of back EMF. The output supply ranges from 4.5V to 36V, which makes L293D as a best selection as DC motor driver. Figure 3 represents a simple schematic for interfacing a DC motor using L293D. Table 1 represents the operation of motor.

Table 1: Operation of Motor

Truth Table

A	B	Description
0	0	Motor stops or Breaks
0	1	Motor Runs Anti-Cloclwise
1	0	Motor Runs Clockwise
1	1	Motor Stops or Breaks

The “H-Bridge" controls the motion of the motor and is derived from the actual shape of the switching circuit. It is also termed as "Full Bridge". H-Bridge consists of four switching elements as shown in the figure 4 below.

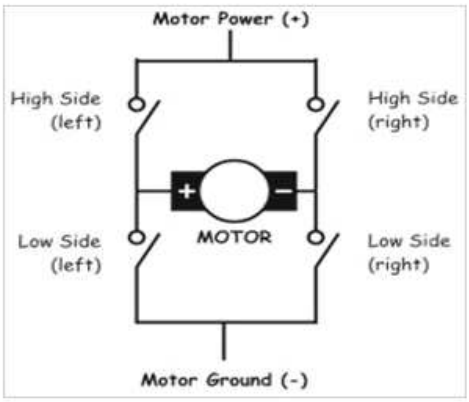

Figure 4: Four Switching Elements in the H-Bridge

In the figure 4 there are four switching elements namely (i) High side left (ii)High side right (iii)Low side right(iv)Low side left. The motor changes its direction according to the position of switches being turned ON. For Example if High side left switch and Low side right switch are ON, then motor will rotate in forward direction since the current flows through the motor coil via switch low side right from Power supply to ground This flow of current is shown in the figure 5 below.

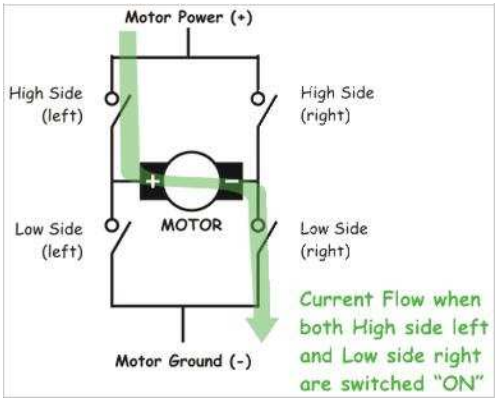

Figure 5: Flow of Current when both High Side Left and Low Side Right are Switched ON

Correspondingly when a low side left switch and high side right switch are turned ON, the current will flow in opposite direction and motor will rotate in backward direction. We can also make a small truth table According to the switching operations of H-Bridge truth table is formulated as shown in Table 2.

Table 2: Truth Table Showing the Operation of H-Bridge

High Left	High Right	Low Left	Low Right	Description
On	Off	Off	On	Motor runs clockwise
Off	On	On	Off	Motor runs anti-clockwise
On	On	Off	Off	Motor stops or decelerates
Off	Off	On	On	Motor stops or decelerates

With the usage of transistors and MOSFET's, H-Bridge are constructed and designed with the consideration of power handling capacity of the circuit. If motors are needed to run with high current then lot of dissipation is there. So head sinks are needed to cool the circuit. So by simple switching elements make our own H-Bridge, or other option we have is using an IC based H-bridge driver.

LCD

A liquid crystal display is a device which is made up of pixels arranged in front of a light source or reflector. Each pixel consists of liquid crystal molecules which are suspended in columns between two transparent electrodes and two polarizing filters and the axes of polarity of them are perpendicular to each other. Light passing through one filter would be blocked by the other filter when there is absence of crystal between them. The liquid crystal is responsible for twisting the polarization of light getting entered in one filter for allowing it to pass through the other filter and the Pin Diagram of LCD is as shown in figure 6 and the pin configuration is shown in table 2.

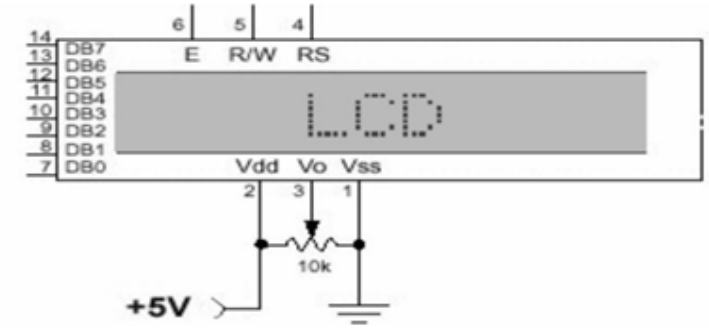

Figure 6: Pin Diagram of LCD

Pin Configuration

Table 3: Pin Configuration of LCD

PIN CONNECTIONS			
PIN	**Symbol**	**Level**	**Function**
1	VSS	-	GND(OV)
2	VDD	-	Supply Voltage for Logic(+5V)
3	VO	-	Power supply for LCD
4	RS	H/L	H: Data; L: Instruction Code
5	R/W	H/L	H: Read; L: Write
6	E	H/L	Enable Signal
7	DBO	H/L	Data Bus Line
8	DB1	H/L	
9	DB2	H/L	
10	DB3	H/L	
11	DB4	H/L	
12	DB5	H/L	
13	DB6	H/L	
14	DB7	H/L	
15	BL1	-	Backlight Power(+5V)
16	BL2	-	Backlight Power(0V)

Three pins namely A, B and Enable are needed for interfacing a DC motor. By connecting Enable to VCC, the output can be enabled and to make the motor work only two pins are required. It is easy to program with the microcontroller. The programming will be same for BJT circuit and L293D by allowing the appropriate combinations of A and B. The programming is done by using C language. In making a robot, the first thing is to make move on the ground. Either DC motor or a stepper motor can be selected for making the movement of robot. Dc motors are preferred in case of consideration of factors such as speed, weight, size, and cost. The speed of motor can be easily controlled, the direction control of rotation, encoding of the rotation is made easily by using a DC motor. To interface a DC motor with a microcontroller H-bridge is selected. L293D IC an H-bridge motor driver is available for interfacing. H-bridge can also be made by using transistors and MOSFETs.

CONCLUSIONS

The environmental production and low cost of operation with no cost for fueling has been the major advantage of the proposed work and it had been designed and implemented for cutting the grass with desired height. An Automatic lawn cutting machine was developed for the use of cutting grass in residential area and is established as an alternative replacement in place of tractor driven grass cutting machines. This machine provides good replacement for the gasoline powered lawn mowers also. Thus Automatic Lawn Cutter was developed by using keypad, LCD display, AT mega microcontroller, RF module, IR sensors, motors and battery and was made to automatically work successfully.

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