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Design and Implementation of Intelligent Lawn-Mower Robot

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Abstract:- **The objective of this project is to design and implement all terrain lawn mower robotic vehicle that can be used to remove grass from lawns and play grounds intelligently and precisely. The controller uses intelligent approach to work in dynamic, unstructured and unknown terrain without having any inaccuracy. A set of concurrently running behaviors are defined to perform mowing operation. Various accelerometers are utilized to obtain the dynamics of the terrain. There will be a master controller which uses information from the sensors and modify the mechanics of the mower to cut away the lawn precisely. The controller will be pretty much user friendly so that any ordinary human users can control it. Effective utilization of energy will be a prime concern for design.**

Keywords:- *AVR microcontroller, ADXL 355 accelerometer, Atmega 328p,Servo Motor.*

I. INTRODUCTION

Use of robots is increasing nowadays. An application where lot of human effort is required is being replaced by robots. Lawn mowing is such an application where lot of human effort is required. There are some lawn mowers that can be operated by using remote control. But the problem with these lawn mowers is that it cuts the grass unevenly. Since the ground is having irregular shape, we cannot maintain the blade of lawn mower always parallel to ground. This will lead to uneven cutting of grass. By adjusting the blades, so that it always remains parallel to ground, we can solve this problem. The robot is controlled by remote control. Height adjustment is done automatically. This robot is more user friendly, so that common people can easily use this. The system is entirely powered by batteries. So we can make this fully solar powered in the future. This will make the system more economical. Behavior-Based approach is employed for robot controllers in order to perform the desired task in outdoor environment, which is normally dynamic and unstructured. The conventional approach for mobile robot, i.e. hierarchical approach is reliant on uncertain symbolic information about the world model. This approach stipulates that the world should not be dynamic and unstructured, which is only probable in fixed indoor environments with static objects. The controller designed using this approach works in sequential fashion to process the information acquired from the environment and to decide the appropriate actions. Behavior based controller overcomes all of these deficiencies by using sense-act methodology in parallel fashion. The field of lawn mower robot is still immature and necessitates a lot of investigation for mowing patterns intelligently

II. BLOCK DIAGRAM & FLOW CHART DESCRIPTION

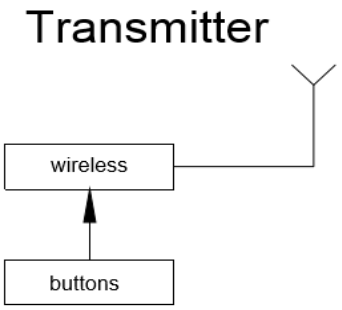

Fig 1:-Transmitter Block Diagram

Transmitter section consists of switches to give input by human user, which is encoded by means of an encoder and transmitted via radio frequency transmitter. Four switches are used for controlling the movement of the lawn mower vehicle that is for forward, backward and sideways motion. A switch is used to switch on/off the lawn mower blade. Combinations of two switches are used for height adjustment purpose of the blade. LEDs are used to indicate the inputted height on the remote. A 9V battery is used to supply the whole transmitter module.

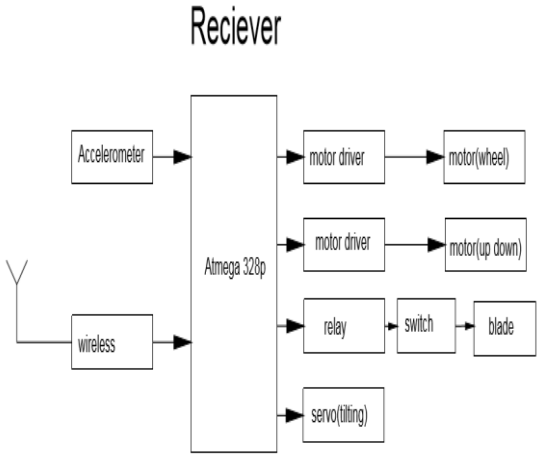

Fig 2:-Receiver Block Diagram

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The transmitted signal is received by means of radio frequency receiver. The received signal is decoded by means of a decoder and is given to a master controller. A low rpm motor is used to adjust the height of the cutting tool. A servo motor is used to tilt the cutting mechanism with respect to the accelerometer reading.. Driver 2 is for controlling the motion. The height adjustment is done by the remote input and the input is fixed for a required height. The height is maintained throughout, until the next command for height adjustment is given by user.

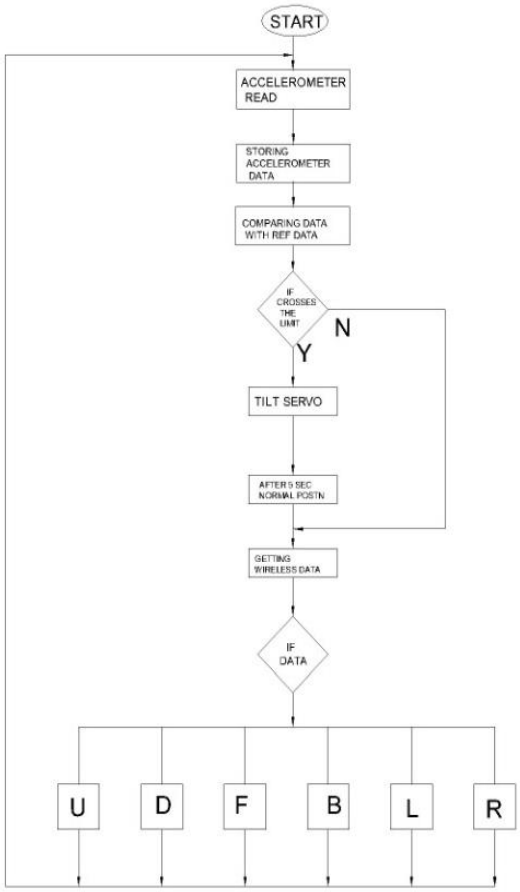

Fig 3:- Flow Chart

III. PROPOSED SYSTEM AND METHODOLOGY

Transmitter section consists of switches to give input by human user, which is encoded by means of an encoder and transmitted via radio frequency transmitter. Four switches are used for controlling the movement of the lawn mower vehicle that is for forward, backward and sideways motion. The transmitted signal is received by means of radio frequency receiver. The received signal is decoded by means of a decoder and is given to a master controller. Various ultrasonic sensors for height measurement are also connected to this controller. Two servo motors are used to adjust the blades via a gyroscope. DC motor 3 is used for height adjustment of the blade. Driver 2 is for controlling the motion. The height adjustment is done by the remote input and the input is fixed for a required height. The The height is maintained throughout, until the next command for height adjustment is given by user.

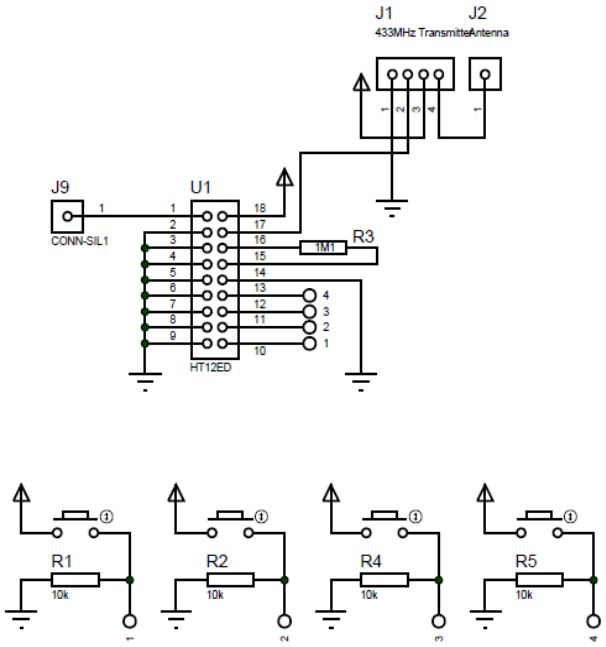

Fig 4:-Proposed Design

A. *HT12E*

HT12E is a 2^{12} series encoder IC is used for remote control purposes. This IC is mainly used for radio frequency applications. By pairing HT12E encoder and HT12D decoder we can easily transmit and receive 12 bit data. HT12E encoder converts 12 bit data in to serial output which is easily transmitted through a RF transmitter. These 12 bit parallel data is divided in to 8 address bits and 4 data bits. The address pin provides a 8 bit security code for transmission of data. Multiple receivers can be addressed using the same transmitter.

B. *RF Transmitter-Receiver Module*

As the robot is remote controlled, it must be controlled to a distance visible to the user. So for medium range transmission, we use RF module. The corresponding frequency range is varied between 30 kHz and 300 GHz. This modulation used in this case is amplitude shift keying (ASK).

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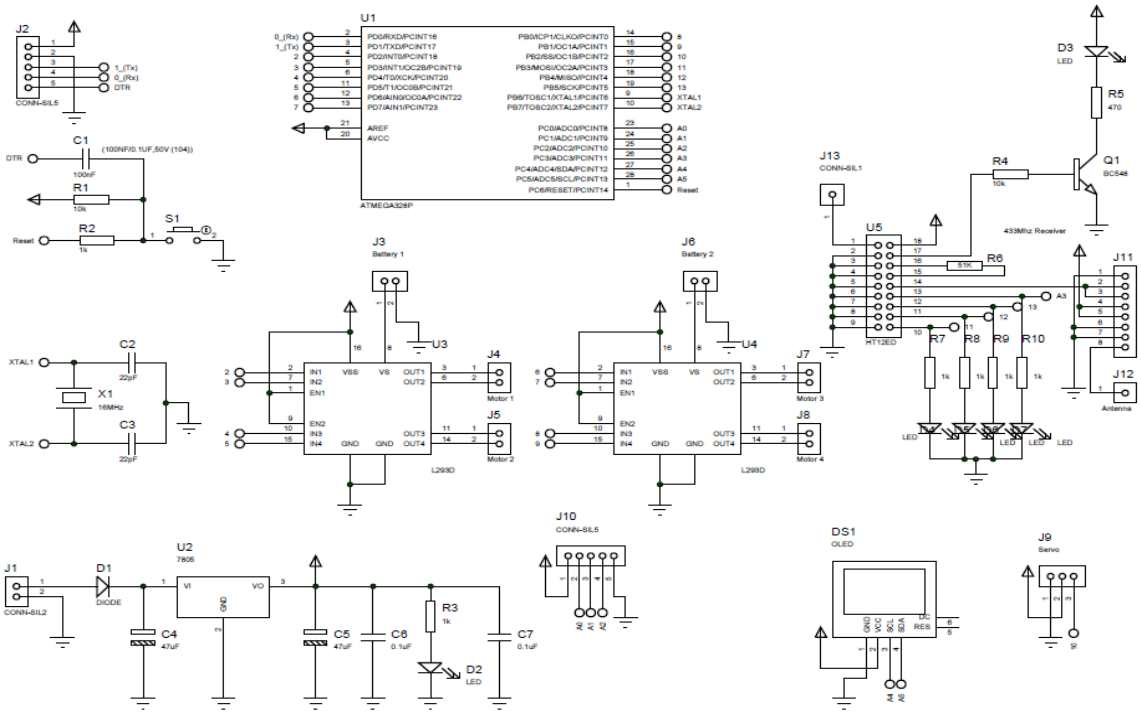

Fig 5:- RF Transmitter-Receiver Module

C. 7805 Voltage Regulator

This unit provides a constant 5V power supply to the microcontroller.The current sensor is also provided with 5V supply through the voltage regulator.

D. Atmega 328p Processing unit

The proposed system uses Atmega328p arduino as the processing unit.This unit controls the entire working of the system through the use of both hardware and software.

E. ADXL 355 Accelerometer

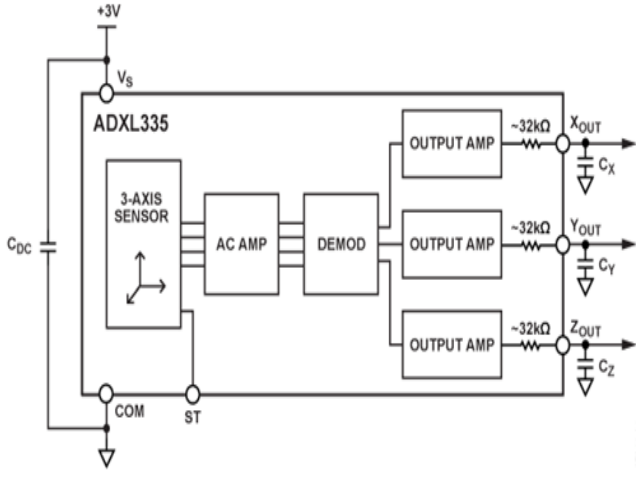

Fig 6:- *ADXL 355 Accelerometer*

The ADXL335 is a 3-axis accelerometer which gives conditioned signal voltage outputs. It measures acceleration with a full-scale range of ±3 g. Static acceleration of gravity is measured by the product so that it can be used in tilt sensing applications. Dynamic acceleration also can be measured resulting from motion, shock, or vibration.

F. HT12D

HT12D is a decoder IC that belongs to 2^{12} line of decoders. Remote control system applications, like burglar alarm, car door controller, security system etc uses this line of decoders. They can be easily paired with 2^{12} series of encoders in order to transmit and receive data wirelessly. The number of address and data pin should be same for the chosen pair of encoder and decoder.

G. HT12D

converts the serial input into parallel outputs. It decodes the serial addresses and data received by RF receiver, into parallel data and sends them to output data pins. The input data is compared with the local addresses three times successively. The input data code is decoded when no error or unmatched codes are found.

H. L293D

L293D is a Motor driver which allows DC motor to drive in both directions. L293D has 16 pins and can control a pair of motor in both directions simultaneously. It works on the principle of H-bridge. H-bridge is a circuit designed in order to obtain bi directional flow of voltage to a single DC motor.In a DC motor as the direction of voltage flow changes, the direction of the rotation of the motor also changes. Hence, H-bridge is the most appropriate concept for this project.

IV. HARDWARE IMPLEMENTATION

A low rpm motor is used to adjust the height of the cutting mechanism. This low rpm motor is connected to a gear

which is in turn is coupled to a gear teeth rod. When the height input is given to the controller, the controller sends the required signal to the motor. The low rpm motor moves according to the received signal. Anticlockwise motion of the motor will decrease the height between the cutting tool and the ground and Clockwise motion will increase the height.The tilting of the cutting mechanism is achieved using a servo motor. Once the lawn mower approaches an uneven terrain, a dual axis accelerometer mechanism is used to sense how much tilt the motor should achieve in order to make the cutting tool parallel to the ground. This tilting is done using a servo motor. Once the blade is parallel to the ground the motor used to cut the grass is switched on.

V. CONCLUSION

An analysis is required for the controller design of the robotic lawn mower vehicle because any deviation cannot be tolerated. Development and implementation of a user-friendly controller interface with an optimized programming scheme for the convenience of the human user. The main challenge is to maintain the height of the lawn to be cut precisely. Mechanical design of the height adjustment system is more complicated. Same time controller has to act accordingly. A mechanical design and a controller design has to be interlinked together to get this condition done. With some enhancements, the performance of the robot controller can be excelled.

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