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LANDMINE DETECTION ROBOT

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ABSTRACT

The system proposed is a solution for landmine detection in war fields. We are proposing a robot that has the aptitude to detect the buried mines and lets user control it wirelessly to avoid human casualties. The robot is equipped with special wheels controlled by H-Bridge module, allowing it to move in all possible directions. In this paper we focus on the safety of human life by employing robot to indicate the position of landmines to the humans. The robot is enhanced with the wireless capability to send alert messages. The robot is completely powered by using Li-Po batteries and hence it can last more time in the field. Microcontroller provides the commands to the robot. This technique has the practical benefit of reducing the number of casualties, after the implementation of the technique, the robot can be controlled efficiently and it robustly determines the position of the obstacle.

Keywords: Mines detection, Lithium-polymer (Li-Po), wireless control, H-Bridge

INTRODUCTION

The mines detection has been implemented before in many robotic applications. Robotics is bringing innovatory changes in the world by introducing new technologies. The basic aim to employ a robotic method is to ascertain human safety and lessen human efforts. Countries like India require an up-to-date and competent technology, therefore, to remove these mines the manual methods are being used that brings disaster to human life and property According to ICBL (International conference to ban Landmines) report, there were 5700 casualties in 2006 in different countries [2].The detection of mine helps a lot in saving human life in war fields. These robot plays an important role in reducing the risk in areas where the mines have been buried. The robot is designed by using PIC microcontroller families. The wireless capabilities for the robot is given using the GSM and the robot controls are implemented using H-Bridge IC (L293D).

L293D QUADRUPLE HALF-H DRIVERS

The L293 and L293D devices are quadruple high-current half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. These devices are designed to drive inductive loads such as relays, solenoids, DC and bipolar stepping motors, as well as other high-current/high-voltage loads in positive supply applications. Each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo- Darlington source. Drivers are enabled in pairs, with drivers 1 and 2 enabled by 1,2EN and drivers 3 and 4 enabled by 3,4EN.The L293 and L293D are characterized for operation from 0°C to 70°C.The L293D IC is used to implement the locomotive control of the robot by receiving the signal from the microcontroller.

Figure 1: L293D DC Motor Driver IC

MICROCONTROLLER -PIC16F877A

The PIC16F877A is a 8-bit controller with RISC architecture. The controller consist of 32 general purpose pins, t also has hardware UART support which helps to interface the system with GSM module. It has a programmable flash memory of 8K x 14 words and 368 x 8 bytes of Data Memory (RAM) . The system can be clocked maximum at the rate of 20 MHz and executing the instruction at the rate of 200ns.These configuration would be sufficient to run the program in the controller.

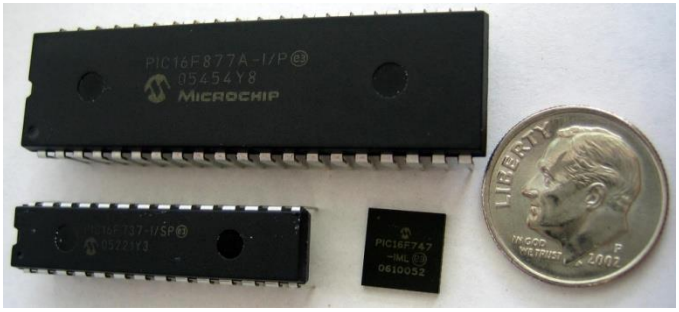

Figure 2: PIC16F877A Microcontroller

IR SENSOR ARRAY

The IR sensor array is used to guide the robot in an preplaned path.The IR sensor will detect the travelling path by detecting the black line drawn on the ground.The IR sensor works by sending an IR light ray to the target and reads the reflected ray from the target.If the target is black in color then the reflected intensity of the ray will be very less hence the digital output of the IR sensor will be '0' and if the target is white in color the incident IR ray will be completed reflected back to the photodiode then the sensor output would be '1'.The IR sensor array is a group of IR sensors together grouped in a single PCB.

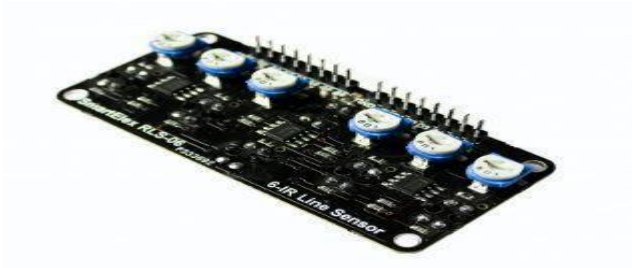

Figure 3: IR Sensor Array

BATTERY CIRCUIT

The complete system is powered by using Lithium Polymer batteries. The circuit is also used to charge the Li-Po batteries. The Li-Po battery charging circuit is implemented by using TP4056. The TP4056 is a standalone Li-Po charging IC with very less BOM. The TP4056 is a complete constant-current/constant-voltage linear charger for single cell lithium-ion batteries. Its SOP package and low external component count make the TP4056 ideally suited for portable applications. Furthermore, the TP4056 can work within USB and wall adapter. No blocking diode is required due to the internal PMOSFET architecture and have prevent to negative Charge Current Circuit. Thermal feedback regulates the charge current to limit the die temperature during high power operation or high ambient temperature. The charge voltage is fixed at 4.2V, and the charge current can be programmed externally with a single resistor. The TP4056 automatically terminates the charge cycle when the charge current drops to 1/10th the programmed value after the final float voltage is reached. TP4056 other features include current monitor, under voltage lockout, automatic recharge and two status pin to indicate charge termination and the presence of an input voltage.

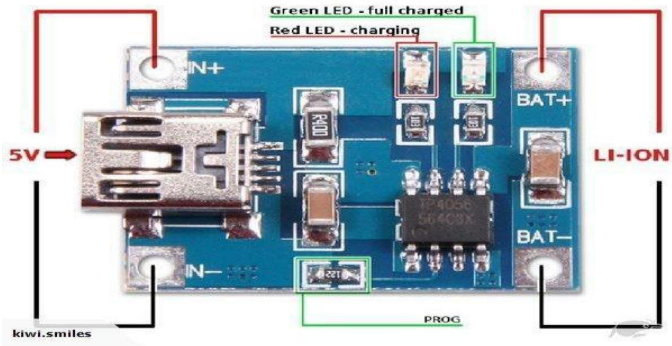

Figure 4:TP4056 Module

INDUCTIVE PROXIMITY SENSOR

The Inductive proximity sensor is used to detect the landmines buried in ground. The range of the sensor depends on its sensitivity. The sensitivity of the sensor can be increased by no of winding in the inductive coil. The output of the sensor is an analog value which is the converted into digital value by using an comparator circuit and fed to the microcontroller .

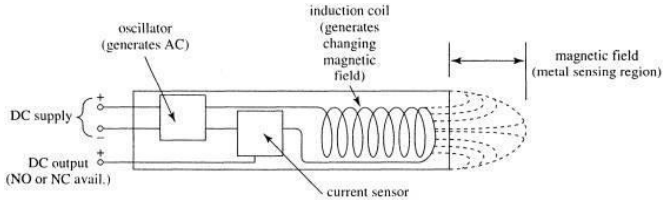

Figure 5: Inductive Proximity Sensor Working

FRAMEWORK (CHASSIS)

The typical chassis with two wheels in back and a castor wheel at front is used in the robot . The chassis and the body is completely made up of plastic and DC motors are mounted in both the sides of the chassis.

ARCHITECTURE

The various different parts are wired with the controller.The complete working of the system is divided into various steps.

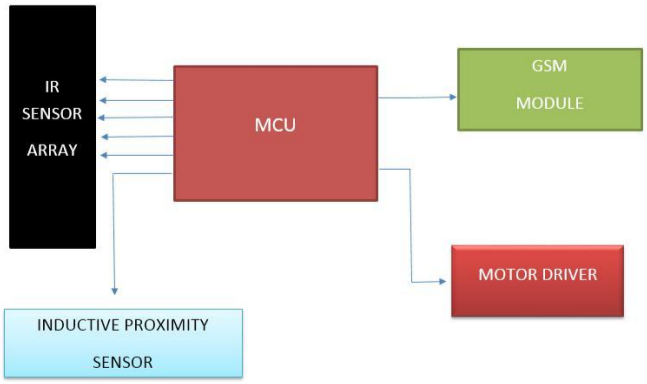

Figure 6: System Architecture

Initially the travelling path of the robot is detected using the IR sensor, which then sends the signal to the microcontroller.

Mainly three IR sensors are used to find the black line in the ground [3].The dots in fig 9 represents the sensors and dark line represents the black colour line in the ground. If the sensor in middle's output is zero the robot moves forward, if the sensor in left output is zero the robot moves in left direction and if the sensor in right output is zero the robot moves in right direction. The direction values are sent to the motor driver which controls the movement of the robot.

The metal detector is used to find the metal from a specific distance [6]. It is employed to find the concealed and buried metal. The metal detector which we used uses an oscillator to generate an AC current. When this AC current passes from a coil, it generates an alternating magnetic field that helps in detecting the metal [4]. Fig.5 shows the operating principle of metal detector showing electromagnet field lines and eddy currents. If a portion of metal is in the range of the coil, the eddy current will be induced and make a magnetic field of its own. The difference of the magnetic field caused by metal is used to detect metal [4]. If there is any metal, the robot will stop and update the operator about the presence of mine through SMS and metal in the field. The SMS is sent by using GSM module [5] followed by a buzzer alarm. The robot will again function normally after the removal of the landmine.

PROGRAMMING

The code for the robot is completely written in the embedded C language. The Microchip's MPLAB IDE is used for programming the robot. The programming involves register level addressing to accomplish the required task.

CONCLUSION

The human effort has reduced by the Robot. The robot is designed with high accuracy in movement section .All the objectives of the project were accomplished with high accuracy. The execution time is very very less compared to previous projects and it is fully free from mistakes. The project was implemented with all the mentioned objectives.

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