RF Controlled Robotic Vehicle with Metal Detection Project

Sunita Kumari,Sonali Pareek ,Nagma Parveen, Rajesh kr. Jangid,Pushpendra Singh Gurjar, Prof. Jitendra Sharma

Department of Electrical Engineering,SKIT College,Jaipur, India

Abstract— *The project is intended to cultivate a robotic vehicle that can sense metals ahead of it on its path similar to detecting land mines. The robot is controlled by a remote using RF technology. It consists of a metal detector circuit interfaced to the control unit that alarms the user behind it about a doubted land mine ahead. An 8051 series of microcontroller is used for the preferred operation.*

For controlling the movement of robot either to forward, backward & right or left commands are sent to the receiver by using push buttons of the transmitter. At the receiving end two motors are interfaced to the microcontroller where they are used for the movement of the vehicle. The RF transmitter acts as a RF remote control that has the advantage of sufficient range (up to 200 meters) with proper antenna, while the receiver decodes before serving it to another microcontroller to drive DC motors via motor driver IC for necessary work. A metal detector circuit is attached on the robot body and its operation is carried out automatically on sensing any metal underneath. The instant the robot senses this metal it produces an alarm sound through buzzer. This is to aware the operator of a probable metal (eg: land mine) ahead on its path.

Further the project can be enhanced by mounting a wireless camera on the robot so that the operator can govern the movement of the robot remotely by observing it on a screen.

Keywords— Buzzer, Land mines, Microcontroller, Metal Detector circuit, RF Technology.

I. INTRODUCTION

The project is intended to cultivate a robotic vehicle that can sense metals ahead of it on its path similar to detecting land mines. The main purposes of this project are to use radio frequency bands for remote control of robot using Radio Frequency technology. It comprises of a control unit along with a metal detector circuit that produces alarm sound to warn the user behind it about a doubted land mine ahead. An 8051 series of microcontroller is used for the preferred operation. As this uses radiofrequency signals for the movement of robot, transmitter circuit transmit signals through air and the receivercommunicate to the transmitter through these signals from the air. This robotic vehicle makes use of the transmitter and receiver at 433MHz i.e.at radiofrequency that is available at low cost hence making it very beneficial. The Radio Frequency based control is more useful as compared to the Infrared based control that limits the operating range to only a few meters of distance.

Commands for controlling the movement of the robot either to move forward, backward and left or right etc. are sent to the receiver circuit by using push buttons of the transmitter circuit.For the movement of the vehicle,at the receiving end two motors are interfaced to the microcontroller. The RF transmitter acts as a RF remote control that has the advantage of sufficient range (up to 200 meters) with proper antenna, while the receiver decodes before serving it to another microcontroller to drive DC motors via motor driver IC for necessary work. A metal detector circuit is attached on the robot body and its operation is carried out automatically on sensing any metal beneath. The instant the robot senses this metal it produces an alarm sound through buzzer. This is to aware the operator about a probable metal (eg: land mines or presence of metals) onward on its path.

Further the project can be enhanced by mounting a wireless camera on the robot so that the images around the robot will be transmitted to remote place and user can monitor the images and metal detection alarms on Television.

II. WORKING PRINCIPLE & FEATURES

2.1 Working Principle:

This robotic vehicle works on radiofrequency based transmitter and receiver circuit. The commands required to operate the robot is transmitted by the transmitter circuit and the receiver circuit receives these instructions through radio frequency communication channel present between them and moves the robot conferring to the received commands. A metal detector circuit is placed to the receiver side interfaced to the controller. Thus the robot's movement stops and buzzer starts ringing whenever any metal is detected.

The working of metal detector circuit is as, when the electromagnetic field is transmitted from the search coil into the earth, metals in the electromagnetic field will become fortified& resend an electromagnetic signal of their own. The metal detector consists of a search coil which receives the re-transmitted field &aware the user by producing a reaction of the metal. Mine lab metal detectors are accomplished by discriminating between dissimilar types of targets and can be fixed to ignore unwanted metal objects.

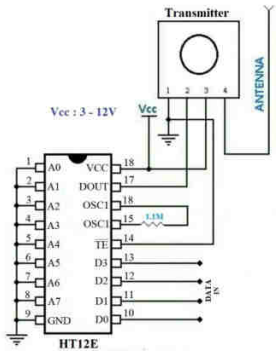

Fig. 1: Block diagram of RF Transmitter

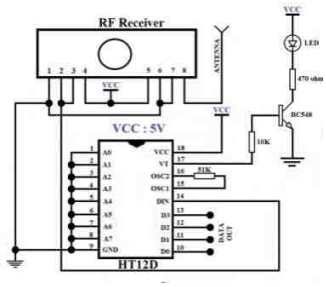

Fig. 2: block diagram of RF Receiver

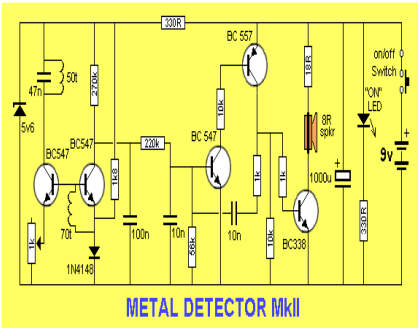

Fig. 3: circuit diagram of Metal Detector

2.2 Features:

A. *ATMEL 89C51 Microcontroller:*

The AT89C51 is a microcontroller having low-power, high-performance CMOS 8-bit microcomputer with 4K bytes of Flash programmable and erasable read only memory (PEROM). The device is mass-produced using Atmel's high-density nonvolatile memory technology and is harmonious with the industry-standard MCS-51 instruction set and pin out. The program memory is permitted to be reprogrammed in-system or by a conventional nonvolatile memory programmer by the on-chip flash. By uniting a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C51 is a powerful microcomputer which offers a highly-flexible and cost-effective solution to many embedded control applications.

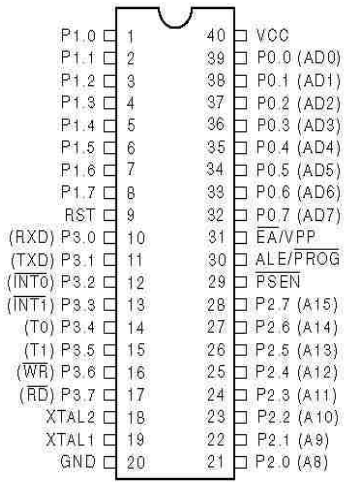

Fig. 4: Pin diagram of AT89S51Microcontroller

Pin Description of ATMEL 89C51 Microcontroller

- V_{CC}:This pin 40 provides supply voltage of +5 V to the chip.
- GND:-This Pin 20 is the ground pin.
- XTAL1 and XTAL2: XTAL1 and XTAL2 are the input and output respectively, of an inverting amplifier that can be configured for use as an on-chip oscillator and for this purpose either a quartz crystal or ceramic resonator may be used. XTAL2 should be left unconnected while XTAL1 is drivento drive the device from an external clock source. Since the input to the internal clocking circuitry is through a divide-by-two flip-flopso there are no requirements on the duty cycle of the external clock signal,but minimum and maximum voltage, high and low time specifications must be observed.
- RESET: The Pin 9 is the reset pin of microcontroller. It is an active high and an input pin. The microcontroller will reset and terminate all the activities by applying a high pulse to this pin. This is often stated to as a power-on reset.

***B.RF Receiver STR-433 MHz*:**

The data available on the data pins are received by the radio frequency receiver from the antenna pin. There are two data pins are provided in the receiver module. Thus, this data can be used for useful applications.

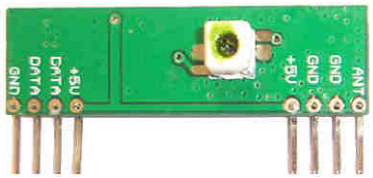

Fig .5: RF Receiver

C.RF Transmitter STT-433MHz

About the Transmitter:

1. The STT-433 is ideal RF transmitter for remote control applications where low cost and longer range is requisite.
2. The transmitter operating supply voltage ranges from 1.5-12V, making it ideal for battery-powered applications.
3. The transmitter employs a SAW-stabilized oscillator, which ensures accurate frequency control for best range performance. The STT-433 is suitable for high volume applications because of its manufacturing-friendly SIP style package and low-cost.

D. Metal Detector Circuit:

The metal detector consists of an oscillator which produces an alternating current that passes through a coil producing an alternating magnetic field and it is the simplest form of a metal detector. If a piece of electrically conductive metal comes close to the coil, eddy currents will be induced in the metal, and this develops an alternating magnetic field of its own. The change in the magnetic field due to the metallic object can be detected by using another coil to measure the magnetic field (acting as a magnetometer).

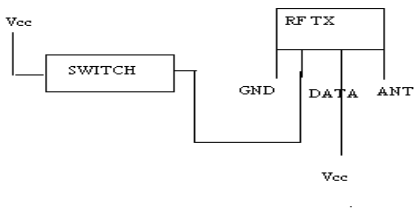

Fig. 6 : Metal detector circuit.

E. *DC motor:*

It is a class of electrical machines that converts direct current electrical power into mechanical power. The common types of DC motor rely on the forces produced by magnetic fields. To periodically change the direction of current flow in part of the motor nearly all types of DC motors have some internal mechanism which are either electromechanical or electronics. Most types of DC motor produce rotary motion; a linear motor unswervingly produces force and movement in a straight line.

Since DC motors could be powered from existing direct-current lighting power distribution systems so they were the first type widely used in robotic vehicle. By using either a variable supply voltage or by changing the strength of current in its field windings the speed of DC motor can be controlled over a wide range. Small DC motors are used in tools, toys, and many other appliances.

Fig. 7: DC motor

F. *Push Buttons*:

A push-button or simply button is a simple switch mechanism for controlling some feature of a machine or a process. Buttons are usually made out of hard material, usually plastic or metal. The surface is generally flat or shaped to hold the human finger or hand, so as to be easily depressed or pushed. Buttons are generally of two types. The most often are biased switches, though even many un-biased buttons (due to their physical nature) require a spring to return back to their un-pushed state. Different terms are used by different people for the "pushing" of the button, such as press, depress, mash, hit, and punch. These pushbuttons are mandated by the electrical code in many jurisdictions for increased safety and are called emergency stop buttons.

Fig. 8: Push buttons

III. METHODOLOGY

This robotic vehicle uses HT12E Encoder which converts 4 bit data to serial output which is then fed to the radio frequency transmitter module for transmitting the same to be received by the receiver radio frequency module the output of which is fed to HT12D the serial decoder IC, the output of which is fed to microcontroller pin 1-4.The transmitting end of controller is attached to a set of

pushbutton switches. When a fastidious button is pressed the program executed delivers consequent 4-bit data which are then transmitted consecutively .The data so received at the receiver end of port 1 control the motor through motor driver IC L293D as required being interfaced from the Microcontroller output port 2.The transmitter is supplied by a 6v battery in series with a silicon diode to finally develop required voltage for microcontroller circuit. The receiver is power-driven by a 12v battery in series with a silicon diode to guard the circuits from unintentional reverse battery connection. 5V DC out of the 12V available from regulator IC 7805 is fed to the controller, decoder, and the motor driver IC L293D pin 8 for operation of the motor. A metal detector circuit is used that uses a tuned circuit comprising of a coil. Two capacitor's C_2 and C_3 determining a specific resonant frequency of oscillator by Q_4. The sensitivity of which is familiar by a potentiometer of 5k. The output of this resonant circuit is fed to Q_2 which quarter in emitter follower configuration with appropriate filtering to forward bias Q_3 that forces Q_4 to be not in condition stage thus the buzzer associated from positive supply to the collector of Q4 does not get any power so doesn't sound.

While any metal object is come across by the coil the resonance frequency drifts away that removes the drive voltage to Q3 which in turn switches on the Q4 for the buzzer to get power and sound consequently in cooperation with the L, LED growing to indicate the presence of the metallic object.

IV. SOFTWARE REQUIRED

- Keil is an ARM Company that makes C compilers, real-time kernels, simulators, debuggers, integrated environments, macro assemblers evaluation boards, and emulators for ARM7/ARM9/Cortex-M3, XC16x/C16x/ST10, 251, and 8051 MCU families.
- Compilers are programs which are used to convert a High Level Language to object code. Desktop compilers produce an output object code for the fundamental microprocessor, but not for other microprocessors.

V. APPLICATION

- These robots are used in identify landmines.
- Robots are used for sense the minerals present in the ground.
- These robots are used for detect the bombs.
- These can be used in construction industry for situate steel bars present in concrete.
- They are used in airports and building security to detect the artillery.

VI. CONCLUSION

This project presents a metal detecting robot using radio frequency communication with wireless audio transmission and it is designed and put into maneuver with Atmel 89C51 MCU in embedded system field. The robot is moved in finicky track using switches and the Beeping sound is generated .Experimental work has been carried out cautiously. The outcome shows that higher effectiveness is indeed achieved using the embedded system. The proposed method is demonstrated to be highly favorable for the security intention and industrial purpose.

The mine sensor endeavor at a constant speed without any problem notwithstanding its extension, meeting the specification required for the mine recognition sensor. It contributes to the enhancement of detection rate, while upgrading the operability as verified by completion of all the detection job as scheduled. The tests confirmed that the robot would not pretense any performance problem for setting up of the mine detection sensor.

REFERENCES

Text Books:

[1] Raj Kamal, "Embedded Systems", Pearson Education Publications.

[2] Mazzidi, "8051 Microcontroller and Embedded Systems", Prentice Hall Publications, 2nd Edition, 2005.

[3] Edwin S.Grosvenor and Morgan Wesson,"Alexander Graham Bell: The Life and Times of the Man Who Invented the Telephone ", New York, Abrams, 1997 .

Web portal:

[4] www.howstuffworks.com.

[5] http://www.atmel.com/dyn/resources/prod_documents/doc0265.pdf

[6] www.intechopen.com/download/pdf/pdfs_id/68.pdf