

AMPHIBOT AS A METAL DETECTOR

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ABSTRACT

In this paper a wireless controlled automated vehicle capable of moving on land and on under water has been proposed. This proposed design is basically inspired from the biological structure of amphibians that can live on terrestrial and aquatic region. This prototype is built using combination of microcontroller, dc motors and RFID for serial communication for safe and better handling from longer distance. This prototype also consist of metal detector which uses VLF (very low frequency) technique to detect the metal and is very useful in many applications. The system has been designed and implemented in a cost effective way so that if our project is commercialized user in developing countries will benefit from it.

KEYWORDS: *Wireless, Aquatic and Terrestrial, Animal Locomotion, Metal Detection, RFID*

I. INTRODUCTION

There has been many significant interest towards the development of robots which are capable of autonomous amphibious operation on turbulent ocean zones. There are many potential operations for such type of robots include: mine clearing, terrain mapping, metal detection and scouting potential approach for amphibious naval operations. Terrestrial and aquatic mobility, control, navigation, communication, obstacle avoidance, and sensor payload remain critical issues to be resolved for successful operation.

An Amphibian Bot or Amphibot represents an amphibious robot which has the following features:

- A robot which can move on land as well as on (or under) water.
- A robot which uses the principle of buoyancy to vary its depth while in water.
- It is made up of Acrylic body.
- Its wheels are made up of plastic having aluminum angles on them.
- It works wirelessly controlled by remote.
- It also contain wireless camera.
- It also consist of metal detector.

ORGANISATION: Section (1) deals with the introduction of the research paper. Section (2) gives a brief description of the proposed design, which includes the basic principle, algorithm, block diagram and circuit diagram.

II. PROPOSED DESIGN

2.1 Basic Principle

The main objective of this project is to make an amphibian robot, which can travel on land, on water and inside water. The part where we need to build a robot that can transverse on land is quite easy. But as we need it to float on water, we design the bot in such a way that it is slightly positive buoyant.

The metal detector work on the principle that when a current passes through the coil, it produces a magnetic field around it.

2.2 Block Diagram of Amphibot

Figure 1 depict the block diagram of the transmitter and receiver part of the Amphibot

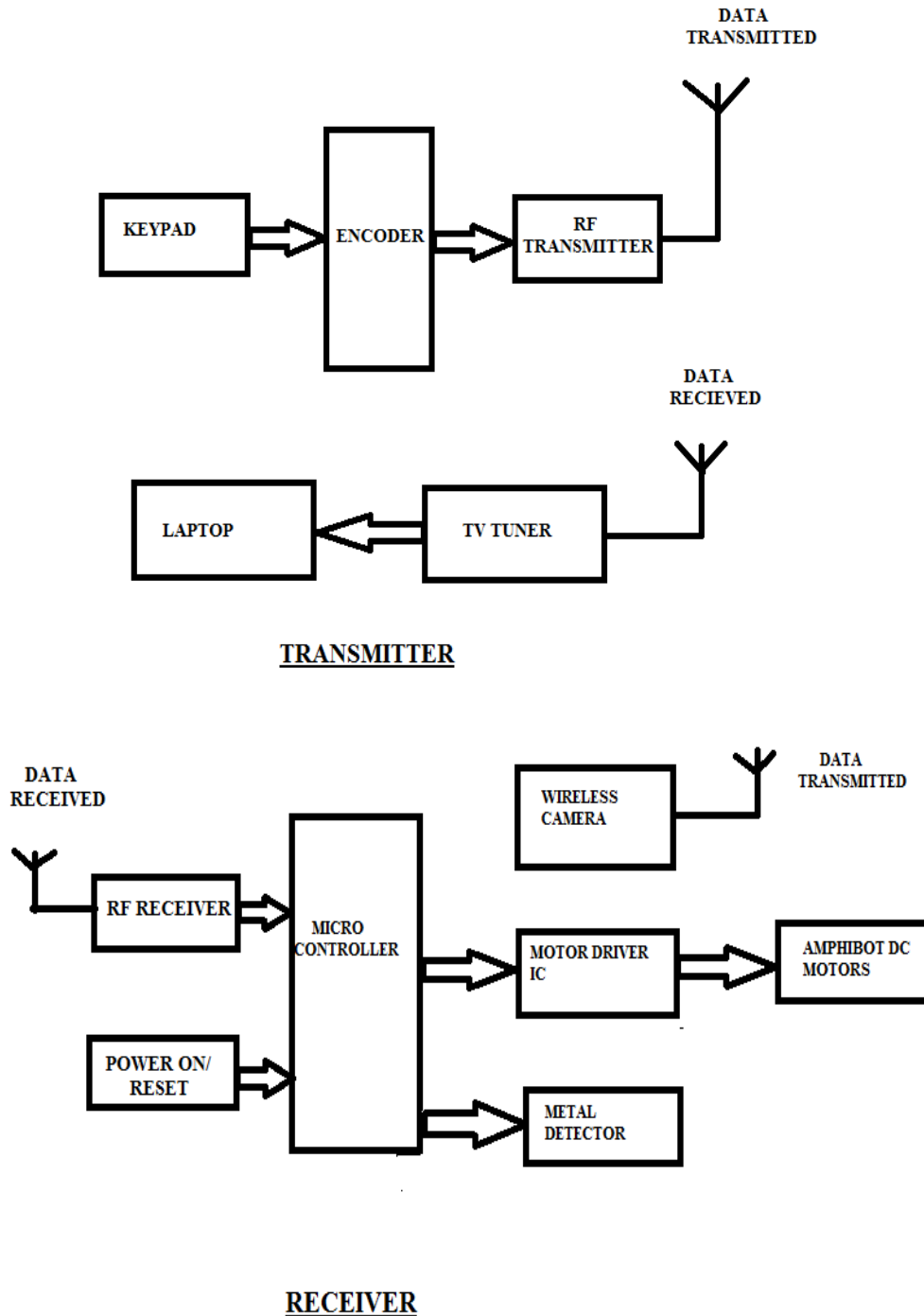


Figure 1 Overview Block Diagram of the System

2.2.1 Microcontroller: PIC16F877A is used to receive and transmit the amplified signal and convert this amplified signal to digital signal. Microcontroller controls the driver circuit that starts a motor and helps in movement of bot. Microcontroller also controls the propellers for movement in water.

2.2.2 Driver Circuit: Motor driver circuit consists L293D IC, which supplies essential power to drive the motor. This isolates the PIC and ICs from electrical problems.

2.2.3 Motor: DC motor of 500, 300 RPM, 12 volts, 1A is used to move the bot. It is connected to PIC through a driver circuit. The driver circuit protects PIC from back EMF.

2.2.4 Acrylic body: The main objective of this project is to make an amphibian robot, which can travel on land, on water and inside water. The part where we need to build a robot that can transverse on land is quite easy. But as we need it to float on water, we design the bot in such a way that it is slightly positive buoyant.

The robot's body is made of acrylic, as we need to make it positively buoyant, so a light weight material like acrylic, having density of 1.18g/cm^3 , is best. Acrylic sheet is cut into different parts of the robot using water jet or laser cutter.

2.2.5 Wheels: The wheels are made of plastic, having a diameter of 16 cm. Wheels of large radius are needed for better ground clearance, so that bot can travel in rough terrain without damaging any of its parts. The wheels have aluminum angles screwed to it. They help the robot to push water effectively.

2.2.6 Battery: The battery is used to supply power to all the motors present in the robot. It has maximum voltage of 13.5 volts. The robot can remain active, with all its motors working, for about 20 to 25 minutes.

2.2.7 Back Propellers: There are two propellers present at the rear of the robot, made of plastic and having a diameter of 11cm. They help in locomotion on the water surface. As the ground clearance is small we are not able to use large diameter propellers at back, otherwise they will get strike the ground, thus harming the bot.

2.2.8 RF Tx/Rx: The RF Tx/Rx works on the radio frequency range. Here we use the radio frequency of 433 MHz. These use for wireless communication between remote controller and the receiver of the bot.

2.2.9 HT 12E: It is also known as encoder ic. It is an encoder ic of 2^{12} series of encoders. They have to pair with 2^{12} decoder to work as remote control.

2.3 Circuit Diagram

Figure 2 depict the circuit diagram of transmitter.

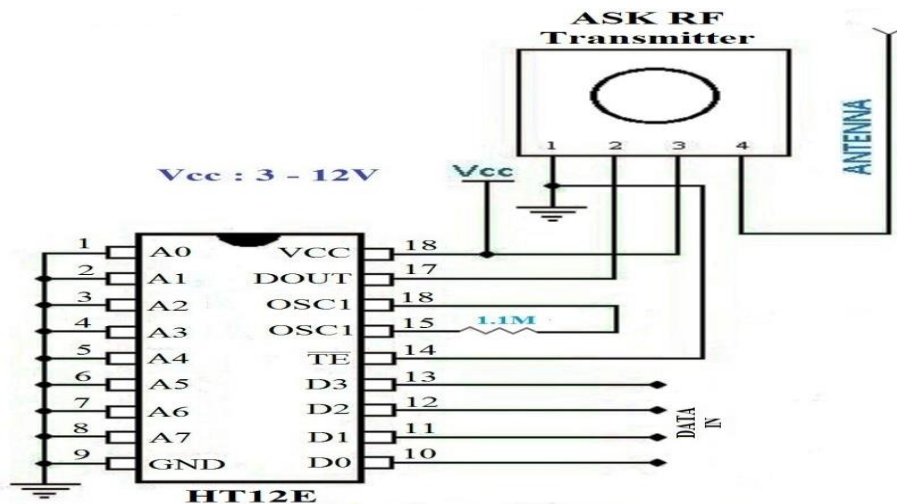


Figure 2 Circuit Diagram of Transmitter

Figure 3 depict the circuit diagram of receiver.

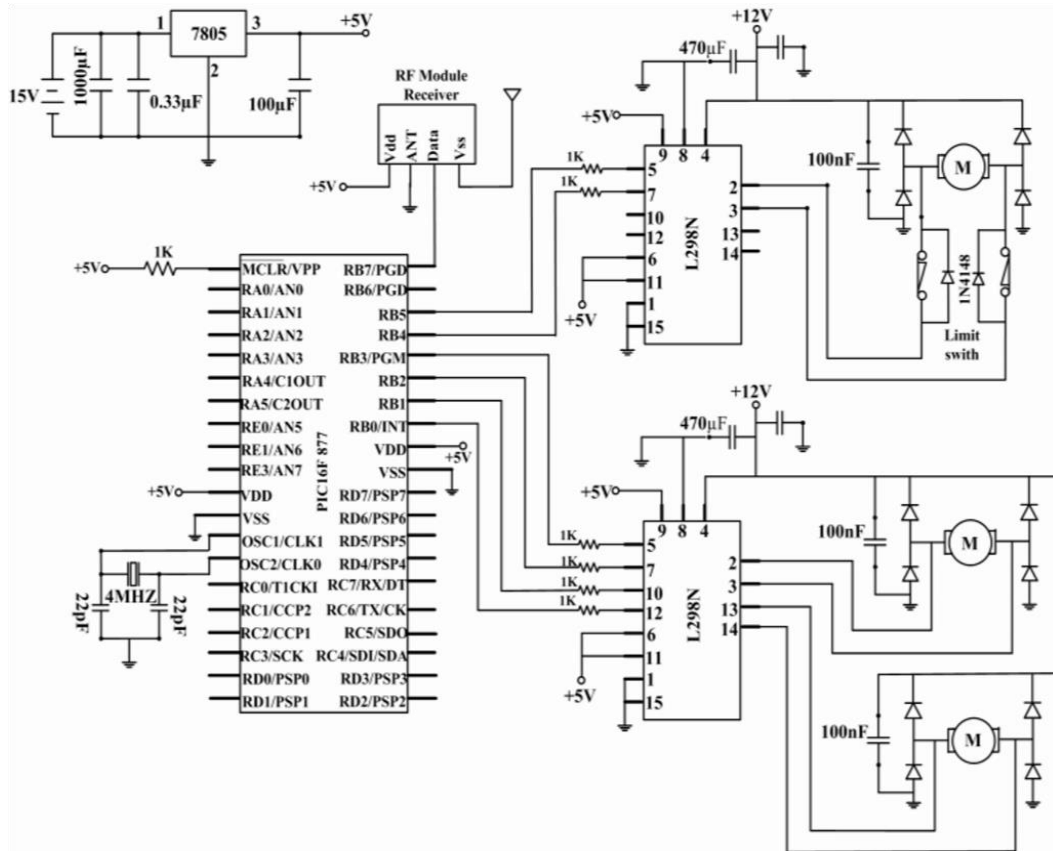


Figure 3 Circuit Diagram of Receiver

2.4 Concepts of Metal Detector

Metal detectors work by transmitting an electromagnetic field from the search coil into the ground. Any metal objects within the electromagnetic field will become energized and retransmit an electromagnetic field of their own. The detector coil receives the retransmitted field and alerts the user by producing a target response.

2.4.1 Control Box: The control box contains the detector's circuit. This is where the transmit signal is generated and the received signal processed and give response.

2.4.2 Search Coil: The detector's search coil use to transmit the electromagnetic field into the ground and receive the change in the return electromagnetic field.

2.4.3 Transmit Electromagnetic Field: It is use to energize the metal to make them to be detect.

2.4.4 Receive Electromagnetic field: The receive electromagnetic field is generated by the metal to be detect into the receiver coil.

2.4.5 Target Response: When a good or best conductive metal is detected the metal detector will produce an audible response, such as a beep or change in tone. Many Mine lab detectors also provide a visual display of target information

2.5 Block Diagram of Metal Detector

Figure 4 depict the block diagram of metal detector.

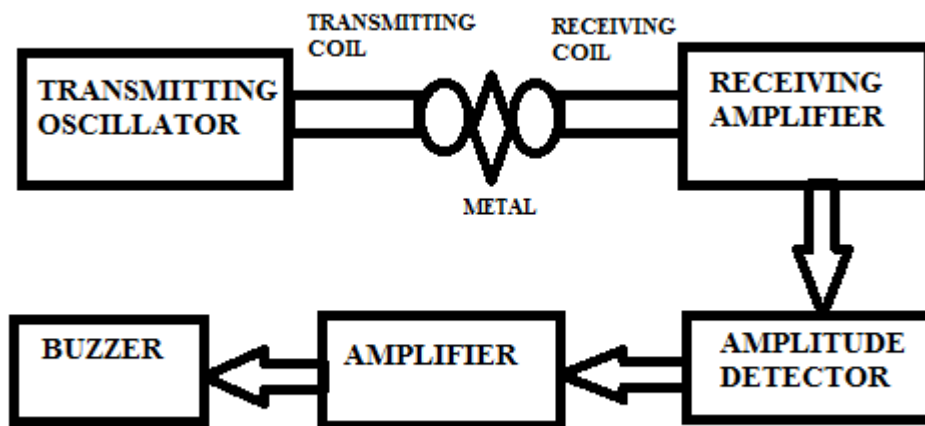


Figure 4 Block Diagram of metal detector

2.5.1 Circuit Diagram of Metal Detector

Figure 5 depict the circuit diagram of metal detector

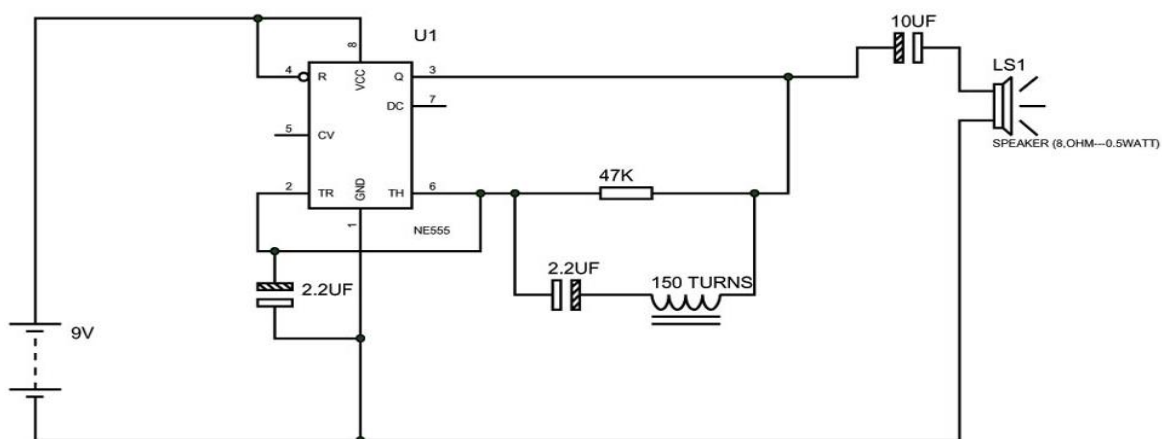


Figure 5 Circuit Diagram of Metal Detector

2.5.2 working of metal detector

The 555 IC timer here acts as a square wave generator and it generate pulses with frequencies audible to human. The capacitor between pin2 and pin1 should not be changed as it is need to generate audible frequencies.

In the circuit there is an RLC circuit formed by 47K resistor, 2.2µF capacitor, and 150turn inductor. This RLC circuit is the metal detection part. Now as mentioned earlier in previous section, a metal core inductor has a high inductance value over an air cored one.

Remember the coil wound here is an air cored one, so when a metal piece is brought near the coil, the metal piece acts as a core for the air cored inductor. By this metal acting as a core, the inductance of the coil changes or increases considerably. With this sudden increase in inductance of coil the overall reactance or impedance of the RLC circuit changes by a considerable amount when compared without the metal piece.

At first when there is no metal piece the signal fed to speaker causes some audible sound. Now with the reactance change around the RLC circuit the signal sent to speaker will no longer be the same as before, because of this the sound produced by the speaker will be of different to the first one.

So whenever a metal is brought near the coil, the impedance of RLC changes making the signal to change resulting in variation to sound generated in speaker.

III. RESULT & DISCUSSION

The proposed design is working properly but there is problem with metal detector and battery charging. The problem of metal detector can be solved by increasing the sensitivity of coil and putting it away from water as it does not wet. And the problem of battery charging can be solved by making the charging stations or by using the solar panels.

IV. CONCLUSION

These design innovations will allow to navigate on rough terrain and on water to accomplish tasks with little or no low-level control. This will greatly simplify the autonomous control problem and give the vehicle a versatility that no amphibious robot has yet enjoyed. This design is very useful for the purpose of defense as it is user-friendly and automated so as the loss of life in defense can be reduced as it can be operated from safer distance. This design is very economically best.

V. FUTURE WORK

This system can be enhanced with more features like GPS handling, obstacle detection, mine detector, bomb diffusing, for more better and safe handling in defense operations.

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