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## Snake robot for metal detection

Sasanka Pavani Somarouthu

[somarouthupavani09@gmail.com](mailto:somarouthupavani09@gmail.com)

Andhra University College of Engineering for Women,  
Visakhapatnam, Andhra Pradesh

Siraparapu Renuka

[renukasiraparapu@gmail.com](mailto:renukasiraparapu@gmail.com)

Andhra University College of Engineering for Women,  
Visakhapatnam, Andhra Pradesh

Sasanapuri Sameera

[sasanapurisameera555@gmail.com](mailto:sasanapurisameera555@gmail.com)

Andhra University College of Engineering for Women,  
Visakhapatnam, Andhra Pradesh

Shaik Sharifa

[shaiksharifa375@gmail.com](mailto:shaiksharifa375@gmail.com)

Andhra University College of Engineering for Women,  
Visakhapatnam, Andhra Pradesh

### ABSTRACT

*Robots have been and will always be a research topic. This paper illustrates the working of a Snake robot which is constructed by chaining together a number of independent segments which makes it hyper redundant. Snake robot can manoeuvre through thin spaces due its shape and hence very helpful at places where human reachability is difficult. This robot moves by avoiding the obstacles in its path. In this project work, we have included a metal detection sensor in this robot so that it can be used in variety of applications like landmine detection for military purposes. The communication to robot is done via Bluetooth and operated from android phone. With further innovations the snake robot can be used in large number of applications.*

**Keywords**— Snake Robot, Object detection, IR sensor, Metal detection, Bluetooth module

### 1. INTRODUCTION

Robotics is mainly to design and control the robots. It also plays a role in sensory feedback and information processing. Robots are mainly for replacing humans and their activities. Robots are designed with mechanical parts and they can be operated with the help of software program. Most of the robots are controlled by humans and they work according to the instructions given to them. They can be moved with the help of wheels provided to them or by walking with legs designed for them. The energy to the robots can be provided with solar energy, electrical energy or by using battery.

Using robots in dangerous environments increases the efficiency of the work and also increases the safety level. Robots work in sensitive environments like deactivation of bombs and bomb detection. In our project Snake Robot, we have designed a snake robot with mechanical parts that is, by attaching sensors, motors and segments. This Snake robot detects the obstacles in its path by the use of an obstacle sensor and changes its path accordingly. It also detects the metals in its path and indicates us

by ringing a buzzer sound. The Snake robot in our project can be operated by connecting to the android phone through the Bluetooth module.

### 2. RELATED WORK

In [1], the author has presented a handheld metal detector which is used for landmine detection. The standard metal detector gives high rate of false alarm on unco-operative soil. Hence, in [1] image processing and visualization techniques are used to gather more information about the object present so that the false alarm rate decreases and works well on unco-operative soil. But this system does not provide safety as it is handheld and there are high chances of risk.

The author in [2] proposed a robotic vehicle which can detect metals and is operated by android phone through Bluetooth. This system can be used in landmine detection without harming humans. But the drawback of this robot is that it does not provide high degrees of freedom like snake robot.

### 3. PROPOSED WORK

In our proposed system, a snake robot is being used for metal detection and it provides more degrees of freedom compared to a simple robotic vehicle. Also, it provides safety over standard hand held metal detectors. The components used in this robot are as follows:

#### 3.1 Arduino Nano Microcontroller

Arduino Nano is a compact microcontroller board based on ATmega328p/Atmega168p. The operating voltage is 5V and it has 14 digital pins, 8 Analog pins, 6 power pins, 2 reset pins. The digital and Analog pins are configured to act as input pins when sensors are used and as output pins when a load is to be driven. It is programmed using Arduino IDE. Many variations of Arduino boards are present but the small size of Arduino Nano makes it a perfect fit for those applications where size of its components is of great concern.

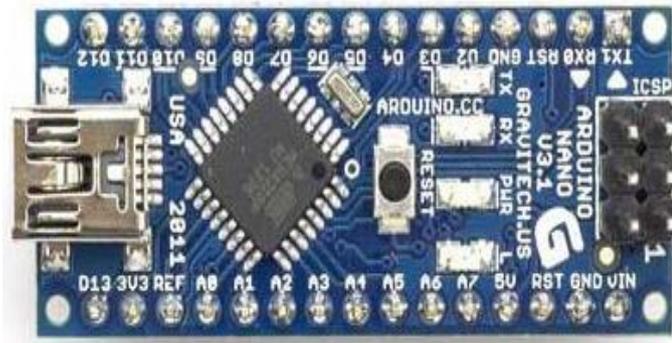


Fig. 1: Arduino Nano Microcontroller

it is dropped to +5V by using a regulator. The benefits for using servo motors are high angular precision, consume low power, less weight and user friendly.



Fig. 4: Servo Motors

### 3.2 Infrared (IR) Sensor

IR sensor uses infrared radiation to detect its surroundings. There are passive and active IR sensors. We used active IR sensor.

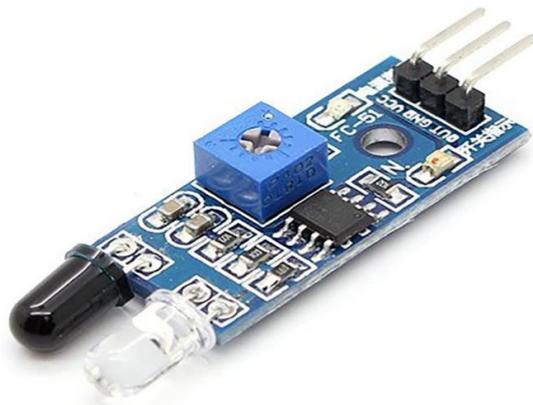


Fig. 2: IR Sensor

A transmitter generally an LED emits IR rays and when the are reflected back from an object, the receiver generally a photodiode detects these reflected rays.

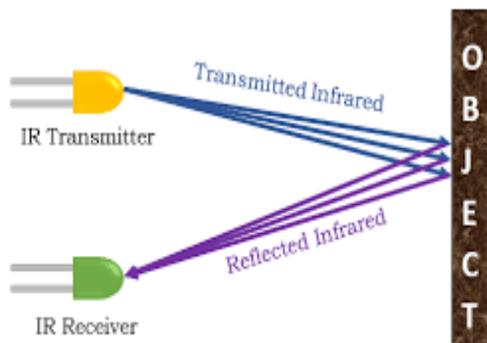


Fig. 3: IR sensor working

### 3.3 Servo Motors

Servo motors are used for automation technology. It rotates and moves the parts of a machine with efficiency and precision. It is a self-contained electrical device. Servo motors are used for controlling angular position. It also gives feedback of position by pairing a regular motor with a sensor. It works on the principle of pulse width modulation (PWM). The angle of rotation can be controlled by applying a pulse duration to the control pin. The input given to its control pin is either the analog or the digital signal which represents the position for output shaft.

In our project Snake Robot, we have used servo motors for the angular position. The main reason behind using these is, the servo motors moves as long as we want and waits for the next signal for further proceeding. The power given to it is +7.2V and

### 3.4 Metal Detection Sensor

Metal detection sensor is used for detecting the hidden metals and the metals near to its path. It works by producing eddy currents. In general, it consists of an oscillator which generates a high electrical field. Due to the electric field, a magnetic field is produced around the sensor. When the sensor comes closer to a metal, it induces the electrical current which is known as the eddy currents. Due to these electrical currents, a magnetic field is developed around the metal which in turn interferes the original magnetic field of the sensor. These rings the buzzer indicating the presence of a metal.

Metal detection sensor consists of 3 pins: Power pin, Out pin and Ground pin. +5v supply is given through the power pin. The Output pin gives the digital output either 0 or 1. Based on this the buzzer rings. This sensor is mainly used in airports for security purposes and in archaeology. It is also used in industries for detecting blockages in pipes.

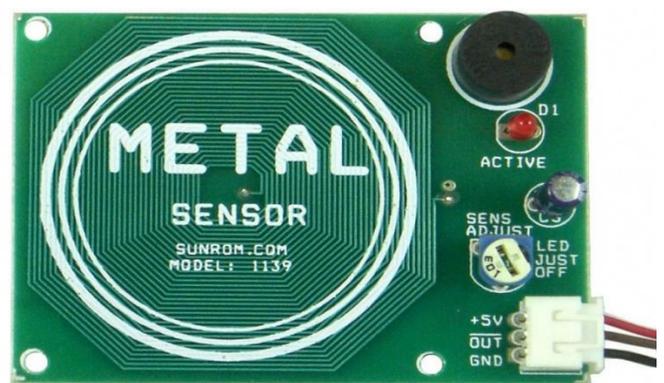


Fig. 5: Metal detection Sensor

### 3.5 Bluetooth Module

Bluetooth module plays a major role in wireless communication between the electronic devices. It operates at a frequency of 2.4GHZ. It is perfect for short range, lower power and low-cost transmission of data between the devices. Its range is up to 10m. The Bluetooth module consists of 6 pins namely STATE, RXD, TXD, GND, VCC and EN. The pin descriptions are provided below.

1. EN: Generally, the Bluetooth module is in data mode. By enabling this key, it is set to command mode.
2. VCC: +5V power is given to this pin.
3. GND: Ground pin.
4. TXD: Transmitter

5. RXD: Receiver

6. STATE: It indicates whether the Bluetooth module is connected to a device or not.

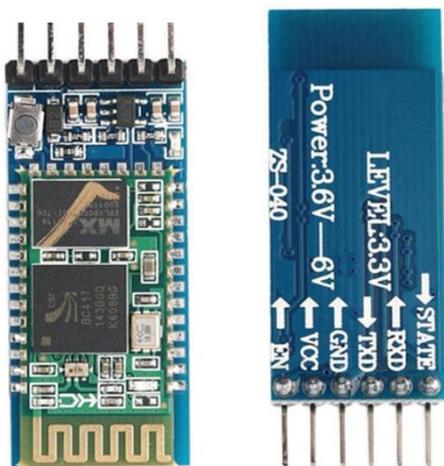


Fig. 6: Bluetooth Module pin diagram

The working of the Snake Robot is explained briefly below:

The robot contains 6 segments motivated by servo motors and joined with mechanical links. The servos are controlled by an Arduino Nano and powered by a +7.2V DC which is brought down to +5V by a regulator. It is operated with android phone by installing HC-05 Bluetooth automation app. Bluetooth module is fixed on the robot.

It has an IR Sensor which detects the obstacles in its path by using LED transmitter and a receiver. The robot changes the direction of its movement accordingly. The metal detection sensor detects the metals in its path. It gives the digital output. If the output is 1, it rings the buzzer sound which indicates metal is detected. If the output is 0, it continues moving. The angular precision for the movement of the robot is provided with the use of servo motors. Due to this the robot can move in narrow places and remote locations where it is difficult for humans to enter.

The block diagram is provided below:

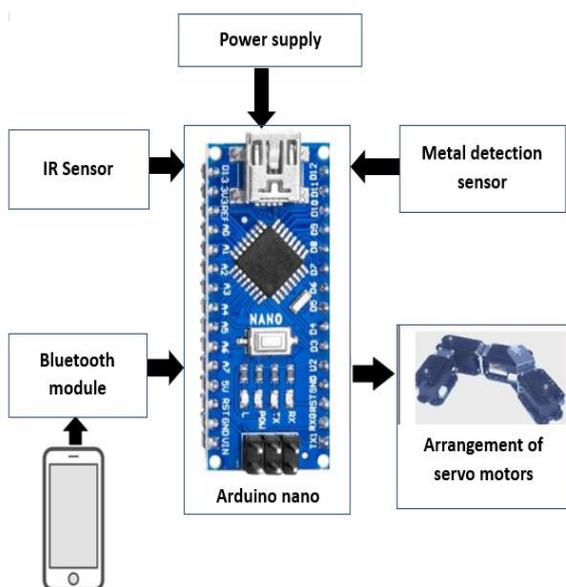


Fig. 7: Block Diagram

#### 4. CONCLUSION

This project Snake Robot, have been designed for detecting the metals. The snake bot can move in remote locations. The components used for constructing it are IR sensor, metal detection sensor, servo motors, dc motors and Bluetooth module makes it work effectively. It is monitored by using a android phone through Bluetooth connection which is cost effective and can be easily operated from android phone. It can be used in the search and rescue operations.

The future scope of this project is that we can fix a camera to the snake bot and can monitor its live location and obstacles in its path through the android. Its applications include landmines detections which is mainly used during military operations and wars. By this it reduces the deaths and saves the lives. And also, it plays a role in industries by detecting the blockages in the pipes.

#### 5. ACKNOWLEDGMENT

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