

## Thermal Motion Detecting Spider Robot for Surveillance and Observation Using Thermal Imaging Camera

Priyadarshi Priyesh<sup>1</sup>

<sup>1</sup>Student, Department of Electronics and Telecommunication SKNCOE, SPPU Pune, India  
<sup>1</sup>priyeshpriyadarshi1600@gmail.com

### Abstract

*This paper presents the model of a thermal imaging motion detecting spider robot. With the incorporation of sensor and microcontroller, the four legged spider robot will be able to monitor the unwanted movement of intruders near the national boundaries, detect any mishap like forest fire (in forest regions), and even gather some secret information of the enemy required to execute any mission by the security forces. Since the robot being of average size by putting a furry material on the robot, the robot would easily camouflage with the environment. The size of the robot can be remodified according to the region/country, as there are big sized spider very commonly present in other nations, and these big spiders can have additional four dummy legs to support the body of the robot and also distract any kind of suspicion. These spider robots can be used in such places where there is no human surveillance. These spiders can be controlled by RC transceivers, if any suspicious activity is noticed then appropriate actions can be taken accordingly. The movement of the robot is controlled by the help of Arduino nano and the thermal imaging camera used to monitor the surrounding is connected to an Arch mix board.*

**Keywords**— Arduino Nano, Arch Mix, IR Thermal Sensor, Servo motors, Robotic

### I. INTRODUCTION

Spiders are creatures which are almost found in all most every surroundings. Using this advantage of spiders, a robotic spider (the size of the robot will be 80mm \* 85 mm) can be used for patrolling and gathering intel from areas inaccessible. This robot uses an Arduino nano to drive the spider which is interfaced with the servo motors<sup>[2]</sup> (micro RC servo motor) so as to move the spider and Arch mix microcontroller to interface the MLX90640 IR Array: Thermal Imaging Camera. This Camera can detect the movement of human beings as well other things by forming a thermal image of the object. The power to this robot will be supplied by a 9V battery. If any such movement is noticed near the national borders then someone can be sent to see what the situation is. This robotic spider can be of immense use to the defence sector. A fur will be put on the bot so as to make it look real. In this project the spider bot will be having 4 legs with 3servo motors in each leg. The Arduino nano used will be used to connect the motors to it. As we are going to control the robot using RC controller, the receiver of the controller will be connected to the Arduino nano's pins. As we are using the thermal imaging camera which is connected to the arch mix. Using I2C pins we connect the arch mix and the Arduino nano (the I2C pins in the Arduino nano are A4 and A5). Then the thermal camera is connected to the Arch mix. Arch mix is a light weight development board with preinstalled RT Thread Real Time Operating System and built in micro python.<sup>[1]</sup>



Fig. 1Sample image of a Spider Robot with 4 legs.<sup>[3]</sup>

## II. CONNECTIONS AND WORKING

### A. Connections

The setup of the spider robot will have 4 legs with 3 servo motors in such an arrangement so as to let the spider move in all possible directions.

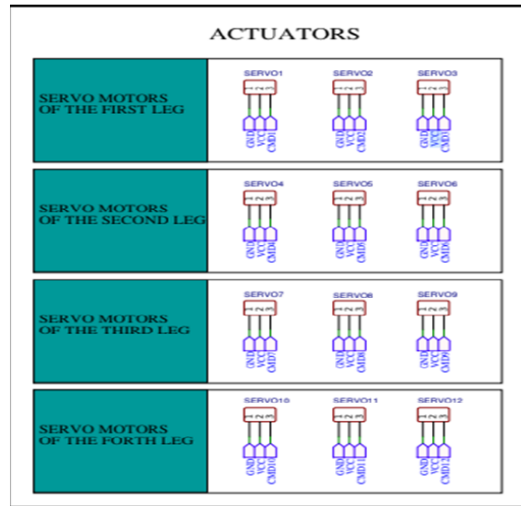


Fig. 2 Pinout diagram of servo motors.<sup>[4]</sup>

These pins of the servo motors<sup>[2]</sup> are connected to the Arduino nano as shown in fig. 2.

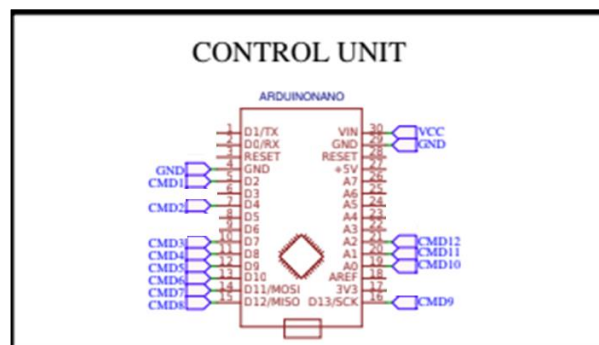


Fig. 3 Connection of servo motors with Arduino nano.<sup>[4]</sup>

As here two development boards are used so they need to be connected to each other. This connection is done using I2C pin, in Arduino nano A4 and A5 are the I2C pins. The MLX90640 IR Array: Thermal Imaging Camera is connected to the Arch Mix by connecting it to one of the I2C port of the Arch mix. After doing the same we connect this board to the computer and write the appropriate programme in it. This spider is being controlled by a RC controller so the receiver needs to be connected to the Arduino. The receiver has 3 array like pins 1<sup>st</sup> array is for signal, 2<sup>nd</sup> array is for  $V_{cc}$  and 3<sup>rd</sup> array is for ground. The connection is shown in Fig .3.

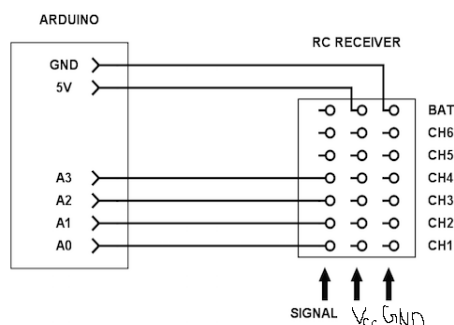


Fig. 4 Connection of RC receiver with the Arduino nano.<sup>[5]</sup>

The Arduino nano is being programmed in the Arduino IDE to make proper movement of the servo motors. The Arch mix is programmed in python using the command prompt.

#### B. Working

This spider robot consists of a total of 12 Servo Motors (Micro RC servo motor), Arduino Nano, Arch Mix, MLX90640 IR Array: Thermal Imaging Camera, 9V battery and FS-T6 6CH Transmitter and FS-R6B Receiver. The body has 4 legs, having 3 servo motors in each of them which is connected to Arduino nano and the FS-R6B receiver is also connected to the Arduino nano this Arduino nano is connected to the Arch mix through I2C pins. This Arch mix is connected to the MLX90640 IR Array: Thermal imaging camera. When the robot and the controller is switched on then the signal will be sent from the controller which will be received by the receiver. This will start the Servo motors and movement will be controlled by the controller. The movements noticed by the thermal imaging camera will be visible on the screen present on the controller. As the range of the controller is near about 1.2 km which can be increased by using a bigger antenna so this robot can be controlled from the nearest control room.

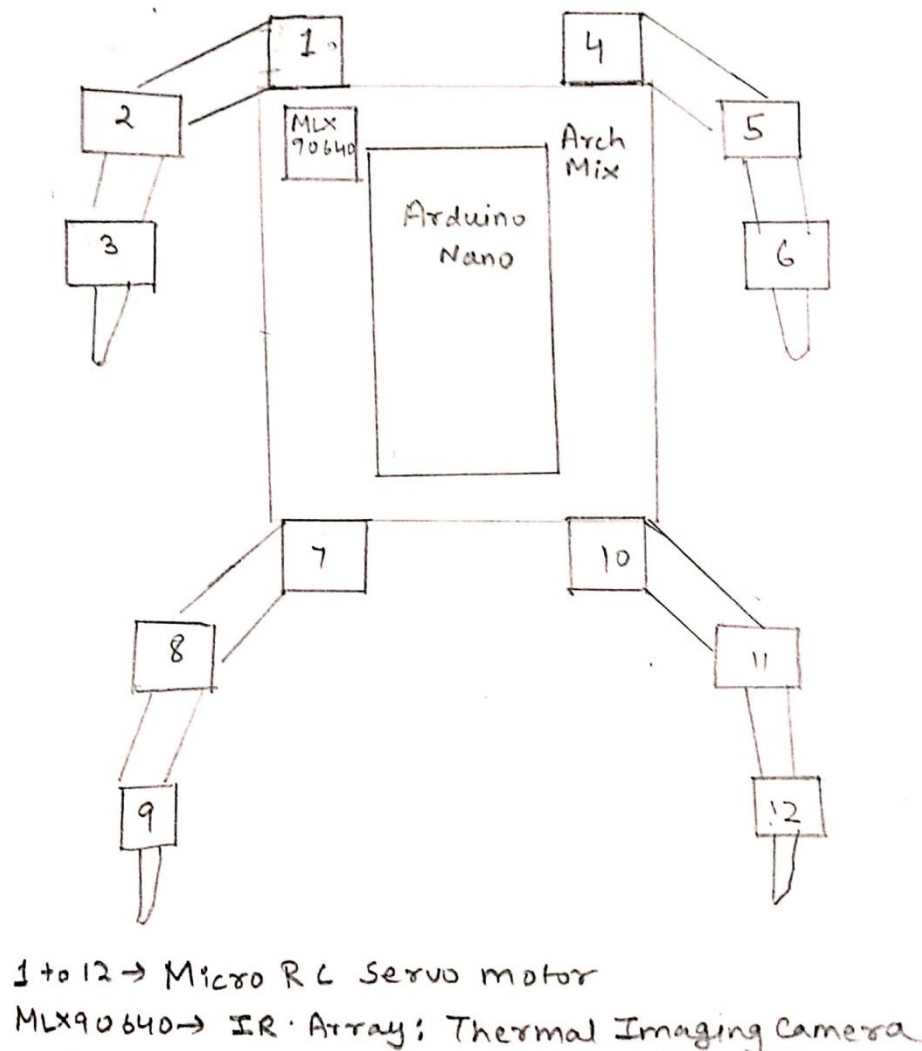


Fig. 5 Block diagram of spider robot.

### III. ADVANTAGES AND LIMITATIONS

#### A. Advantages

This robot has many advantages like

- 1) The robot will help detect the movement of intruders.
- 2) This can also be used to gather intelligence like what is the man power or other things.
- 3) The biggest advantage is that as this bot will have a fur on it which will make it look real, so it won't be suspicious for others.
- 4) The thermal imaging camera has a very good capability in detecting the surrounding temperature, so it will easily detect human temperature.
- 5) The power consumption by the components is less so battery backup is also good.
- 6) The spider robot can easily camouflage in the environment.

#### B. Limitations

- 1) The movement speed is slower than the natural spiders.

### IV. CONCLUSIONS

Hence, from this study paper this can be concluded that spider robots being small and of light weight can be used for surveillance and other purposes required by different security agencies majorly by the armed forces. This robot could be a lot of help for keeping an eye on the intruders near the national boundaries so as to keep the country safe. The weight of the components used is less for example the micro RC servo motor used is only 30 grams. The spider robot can easily blend into the nature and give wonderful results.

### V. ACKNOWLEDGMENT

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