# Gesture Control Surveillance Robot (GESBOT)

**J. Karthikeyan[1] A. Birose Begam[2] R. Jothimani[3] M. Mythili[4]**
[1]Assistant Professor
[1,2,3,4]Department of Information Technology
[1,2,3,4]K.L.N. College of Engineering, India

*Abstract*— This paper proposes a method to controlling a wireless robot (GESBOT) for surveillance using gesture control. Wireless controlled robots are playing a vital role in automation across all the sectors and very useful in many applications like military, construction, autonomous car, medical, manufacturing, etc. The GESBOT proposed the implementation of smart surveillance monitoring system using raspberry pi. We have developed gesture controlled robot by using accelerometer and Arduino UNO. In this research we have used hand motion to move the robot, which can follow the commands made by hand gestures. A transmitting device is used in hand which contains accelerometer and RF Transmitter. This will transmit command to GESBOT, so that it can do the required task like moving forward, backward, turn right, turn left and stop. The GESBOT uses wireless technology and acts as a spy tool for the places where human feels difficult to go and it also used to detect the relative direction of human movement. The raspberry pi camera is used to monitor and capture images and also feeds live video. The pi cam initiates recording when the motion is sensed.

***Key words:*** GESBOT

## I. INTRODUCTION

Robotics is the current pinnacle of technical development. Gestures can originate from any bodily motion. Gesture recognition can be seen as a way for robot to begin to understand human body language. The video surveillance has played vital role in the research of last few decades. The different kind of cameras is used for surveillance like fixed cameras, pan and tilt cameras. Those kinds of cameras are generally used for indoor security which are mounted on wall with different angels to detect or track objects. These types of systems need a computer or laptop for monitoring.

Now a day most of the system uses a mobile robot with a camera for surveillance. The camera mounted on the robot can move to different locations. These types of robots are more flexible than the fixed cameras.

An Arduino is an open-source microcontroller development board. Figure:1 shows Arduino Uno board. We can use the Arduino to read sensors and control things like motors and lights. This allows you to upload programs to this board which can then interact with things in the real world. With this, you can make devices which respond and react to the world at large. Some people think of the entire Arduino board as a microcontroller, but this is inaccurate. The Arduino board actually is a specially designed circuit board for programming and prototyping with Atmel microcontrollers.

Raspberry pi is a world's most inexpensive and powerful single board computer. Figure:2 Shows Raspberry Pi 3 Model B development board. This is world's cheapest microprocessor units specially build for planner and makers. It has a huge community and plenty of online resources which make learning smooth. Raspberry pi can run as OS (Linux Distribution).

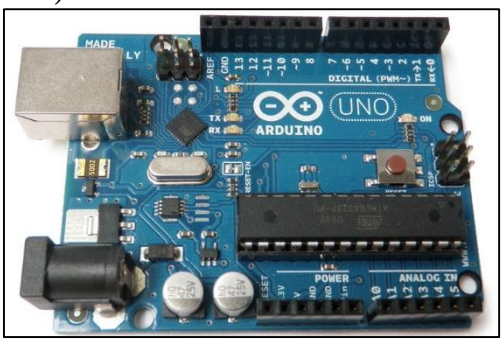


Fig. 1: Arduino UNO

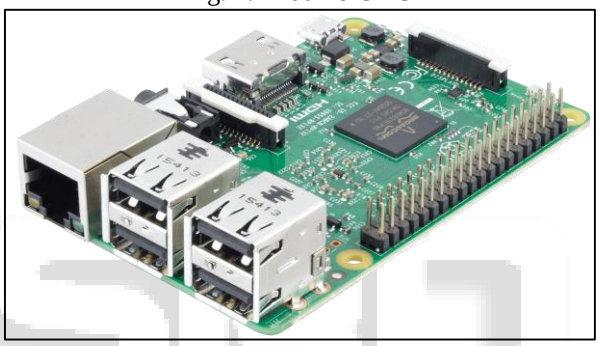

Fig. 2: Raspberry Pi 3 Model B

## II. PIR SENSOR

The PIR (Passive Infra-Red) Sensor is a pyroelectric device that detects motion by measuring changes in the infrared levels emitted by surrounding objects. This motion can be detected by checking for a high signal on a single I/O pin A PIR detector combined with a fresnel lens are mounted on a compact size PCB together with an analog IC,SB0081, and limited components to form the module. High level output of variable width is provided. The PIR sensor detects the infrared radiation emitted or reflected from an object.

The PIR sensors are used with Fresnel lenses to enhance and shape their FoV (Field of View) (Fig 3). Fresnel lenses are moulded out of inexpensive plastic and have a small form factor when compared to the regular lenses. Fresnel lenses are good energy collectors.

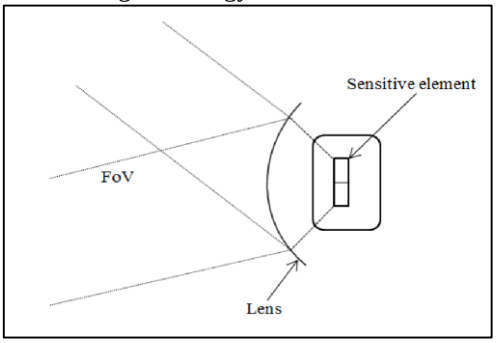


Fig 3: Schematic of typical PIR sensor

 

Typically, an array of Fresnel lenses is used to divide the FoV into several separate fields to improve the sensitivity and efficiency of the sensor.

## III. ACCELEROMETER

An accelerometer is a three-axis acceleration measuring device. The accelerometer used here is ADXL335 and it has 3 axis (X Y Z). Almost all smart phones now have accelerometers. Accelerometer is a 3 axis acceleration measurement device with +-3g range. This device is made by using polysilicon surface sensor and signal conditioning circuit to measure acceleration. The output of this device is Analog in nature and proportional to the acceleration. This device measures the static acceleration of gravity when we tilt it. And gives a result in form of motion or vibration.

According to the datasheet of adxl335 polysilicon surface-micromachined structure placed on top of silicon wafer. Polysilicon springs suspend the structure over the surface of the wafer and provide a resistance against acceleration forces. Deflection of the structure is measured using a differential capacitor which incorporate independent fixed plates and plates attached to the moving mass. The fixed plates are driven by 180° out-of-phase square waves. Acceleration deflects the moving mass and unbalances the differential capacitor resulting in a sensor output whose amplitude is proportional to acceleration. Phase-sensitive demodulation techniques are then used to determine the magnitude and direction of the acceleration. Most accelerometers are Micro-Electro-Mechanical Sensors (MEMS).

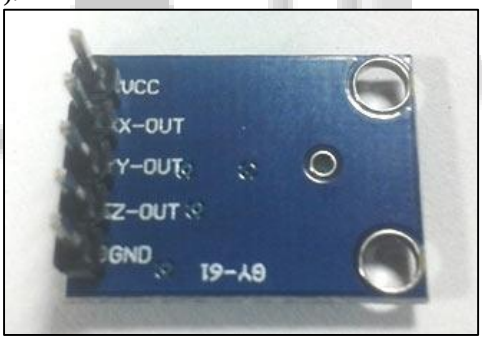


Fig. 4: Accelerometer

### A. *Pin Description of accelerometer*

| | |
|---|---|
| Vcc | 5 volt supply should connect at this pin. |
| X-OUT | This pin gives an Analog output in x direction. |
| Y-OUT | This pin give an Analog Output in y direction. |
| Z-OUT | This pin gives an Analog Output in z direction. |
| GND | Ground |

## IV. ULTRASONIC SENSOR

This HC-SR04-Ultrasonic Range Finder is a very popular sensor which is found in many applications where it requires to measure distance and detect the objects. The module has two eyes like projects in the front which forms the Ultrasonic transmitter and Receiver. This sensor uses sonar to determine the distance to an object like bats or dolphins do.

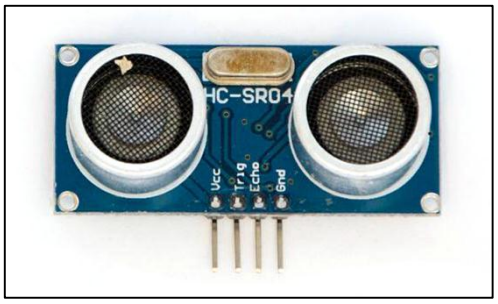


Fig. 5: Ultrasonic sensor

It offers excellent range accuracy and stable readings in an easy-to-use package. Its operation is not affected by sunlight or black material like Sharp rangefinders are (although acoustically soft materials like cloth can be difficult to detect).

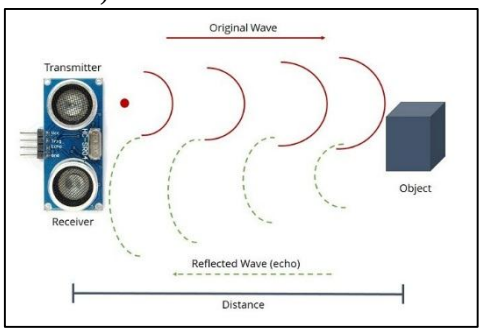


Fig. 6: Ultrasonic sensor working principle

The *Trigger* and the *Echo* pins are the I/O pins of this module and hence they can be connected to the I/O pins of the Arduino. When the receiver detects return wave the *Echo* pin goes high for a particular amount of time which will be equal to the time taken for the wave to return back to the sensor.

## V. PROPOSED SYSTEM

In this project, to build a real-time live streaming and monitoring an interaction robot using raspberry pi and Arduino. It records and saves the video whenever it detects motion or any disturbance in the view area. Accelerometer based gesture controlled robot moves according to the movement of hand as we place the accelerometer on your hand. When we tilt hand with an accelerometer in front of the robot, then the robot starts moving forward until the next movement is given. When we tilt hand in backward direction, then the robot changes its direction and state. Then it starts moving in backward direction until the next signal is given. When we tilt hand on left side, then the robot moves into left side until the next signal is given. In the same way, when we tilt hand in right side, then the robot moves right side.

 

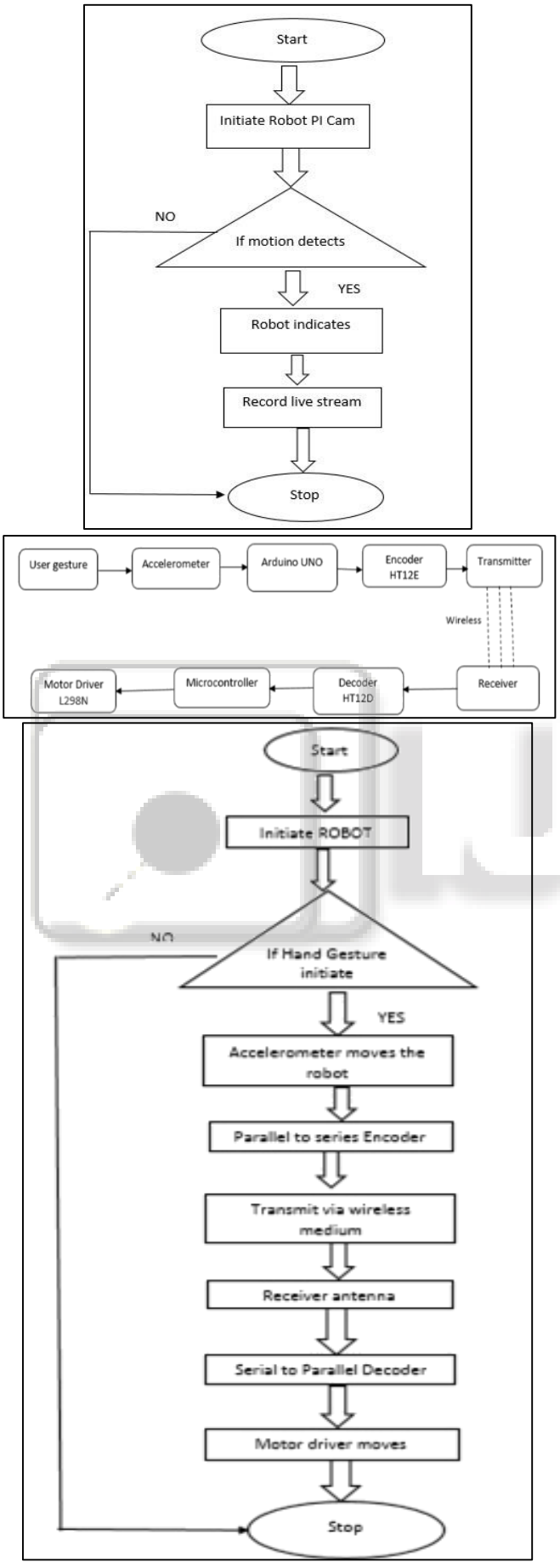


Fig. 7: Dataflow Diagram of GESBOT

### *A. Software Module*

Robot Navigates through desired route. A Gesture is used to control the movement of GESBOT. The test programs are loaded onto the microcontroller and then microcontroller send a direction signal. After issuing the signal from microcontroller, the bot moves to any direction such a left, right, forward and backward. A pi cam is used to capture the images and videos when the motion is detected. The captured images and videos will be saved for future use.

### *B. Hardware Module*

To detect the motion, we use PIR motion sensor in our design. The Figure shows the block diagram of a general PIR motion sensor. The PIR sensing element senses the change in infrared radiation and is fed to the sensing IC which amplifies the signal. The delay and sensitivity control circuit is used to adjust the delay and the sensitivity of the sensor. The output is directly fed to the MCU digital input pins. The output of the sensor will be either 0 or 1. 1 represents the motion detection and 0 represents the normal idle state.

## VI. MODULES

A. Design of GESBOT
B. GESBOT navigation and control using Accelerometer
C. Obstacle avoidance using sensors
D. Capture and upload images and videos

### *A. Design of GESBOT*

The GESBOT is designed with robot chassis of two wheels. Motor driver L298N is used to control motor of the wheels. This gesture controlled robot uses Arduino, Raspberry pi, ADXL335 accelerometer, Ultrasonic sensor, PIR sensor and RF transmitter-receiver pair. A webcam is fixed at the top of the bot with the help of stand holding it. The rechargeable battery is used for the movement of bot.

### *B. GESBOT Navigation and Control Using Accelerometer*

The test program is loaded onto the microcontroller that will send a direction signal. When issued a command from the microcontroller, the bot will move a specified direction such as left, right, forward and backward.

Here the accelerometer reads the X Y Z coordinates when we make gestures by hand and send the X Y Z coordinates to the Arduino. The Arduino checks the values of coordinates and sends a 4 bit code to the Encoder IC. The Encoder passes the data to RF transmitter and the transmitted data is received by the RF receiver. The receiver sends the 4 bit code to the Decoder IC and the decoder passes it to Motor Driver IC. Later the motor driver makes the decision to turn the two motors in the required direction.

### *C. Obstacle Avoidance Using Sensors*

ULTRASONIC Sensor is used for obstacle avoidance. It is used to sense certain characteristic of its surroundings by either emitting and/or detecting infrared radiation.

### *D. Capture and Upload Images and Videos*

A raspberry pi camera is used to capture the images and videos when the motion is detected. The captured images and videos will be saved in a web page for future use.

 

## VII. CONCLUSION

This proposed system has successfully implemented the working of the wireless GESBOT for exploration and monitoring purposes. The robot can be easily controlled with the help of an accelerometer. It can monitor the environment and send the live video of the place. The user can have the live view of the surroundings.

## VIII. FUTURE ENHANCEMENT

In future, this methodology can be applied to other problem domains such as military applications to operate robots (mine detector), medical applications for the purpose of surgery. It has to improve the security regarding false rating to add new sensors and make it completely autonomous.

## REFERENCES

[1] A. H. Sanoob, j. roselin, and p.latha –Smartphone Enabled Intelligent Surveillance System||IEEE Sensors journal,VOL.16,NO.5,PP.1642-1649 MARCH 2016.
[2] Jaeseok Yun , and Min-Hwan Song_Detecting Direction of Movement Using Pyroelectric Infrared Sensors|| IEEE Sensors.,VOL.14,NO.5,PP.1482-1489 MAY 2014.
[3] Ren C.Luo,and Ogst Chen_Wireless and Pyroelectric Sensory Fusion System for Indoor Human/Robot Localization and Monitoring|| IEEE/ASMATrans.Mechatronics,VOL.18,NO.3.PP.1542-1549,JUNE 2013.
[4] Xin Jin,SournalyaSarkar, Asok Ray,Shalabh Gupta,and Thyagaraju Damarla,"Tarket Detection and classification Using Seismic and PIR Sensors",IEEE Sensors.,VOL.12,NO.6,PP.132-138,JUNE 2012.
[5] Ying-Wen Bai,Zi-Li Xie and Zong –Han Li,"Design and Implementation of a Home Embedded Surveillance System With Ultra-Low Alert Power", IEEE Trans.Consum Electron ,VOL.57,NO.1,PP.153-158,FEBRUARY 2011.
[6] PieroZappi,ElisabettaFarella,and Luca Benni,"Tracking Motion Direction and Distance with Pyroelectric IR Sensors", IEEE Sensors., VOL.10,NO.9,PP.1486-1494,SEPTEMBER 2010
[7] Ying-Wen bai,Zong-Han Li and Zi-Li Xie,"Enhancement of the complement of an Embedded Surveillance System with PIR Sensorsand Ultrasonic Sensors",The 14th IEEE International Symposium on Consumer Electronics Braunschweing, Germany ,PP.1-6,JUNE 2010.
[8] Suryadevara,N.k.,Mukhopadhyay, S.C., "Wireless Sensor Network Based Home Monitoring System for Wellness Determination of Elderly ", IEEE Sensor., VOL.12, Issue6,PP.1965-1972,JUNE 2012.
[9] Ying-Wen Bai,Li-SihShen and Zong-Han Li,"Design and implementation of an Embedded Home Surveillance System by Use of Multiple Ultrasonic Sensors", IEEE Trans.Consum.Electron, VOL.56,No.1, PP.564-569,FEBRUARY 2010.
[10] Jun Zhang Guangming Song,GuifangQiao, TianhuaMeng, and Hongtao Sun,"An Indoor Security System with a Jumping Robot as the Surveillance Terminal", NOVEMBER 2011.

 