ELITE PROJECT REPORT

On

Gesture Controlled Robot

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CERTIFICATE

This is to certify that the project entitled "GESTURE CONTROLLED ROBOT" has been undertaken under the ELITE scheme of Acharya Narendra Dev College, University of Delhi and is a bonafide work carried out by us in the Electronic Laboratory. This work has not been submitted anywhere earlier, partially or fully.

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Ms. Gauri Ghai

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Date: -_____

ABSTRACT

Today's world is surrounded with technology. Advancement in technology and making it more accessible for efficient interaction has become a very crucial part in the human development. Gesture control enable us to control machines by hands just as we can control our body parts. The ability to control machines with gestures eliminates complicated steps one needs to perform while operating a machine. Moreover, it does not require proper training to operate machine which works on complicated algorithms. Gestures provide the user with a new form of interaction that mirrors their experience in the real world. They feel natural and require neither interruption nor an additional device. Furthermore, they do not limit the user to a single point of input but instead offer various forms of interaction. It provides immense aid for people for whom mobility is a great challenge. This paper deals with the design and implementation of an accelerometer-based hand gesture-controlled robot, operated wirelessly using a small low cost, 3-axis accelerometer. A novel algorithm for gesture identification has been developed to replace the approach of conventional controlling mechanism of robots via buttons by an innovative hand gesture-based controlling.

INTRODUCTION

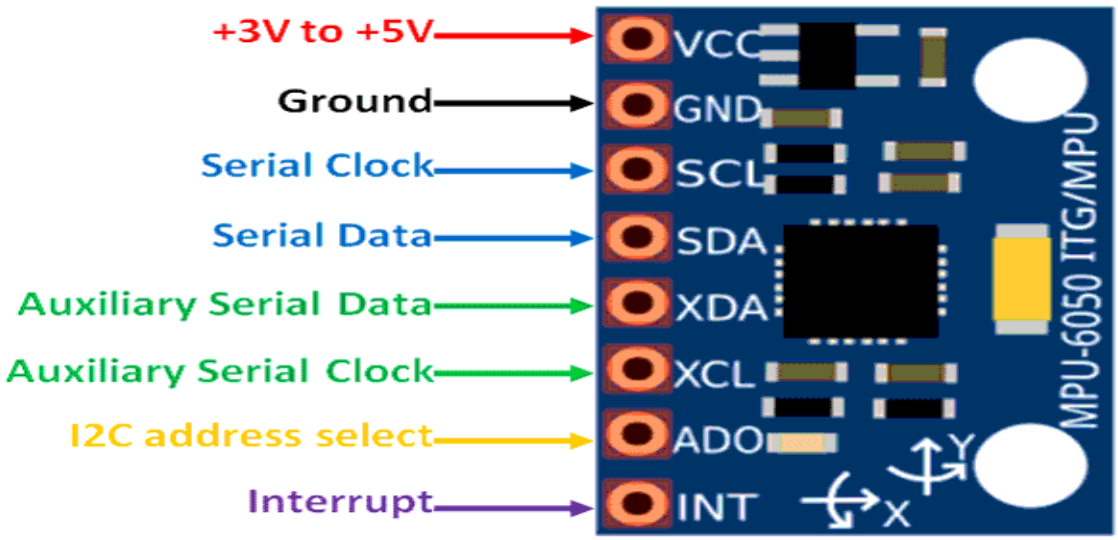
The current emerging technology in the field of science is Robotics. It is the new emerging booming field of great use to people in the coming years. These days a number of wireless robots are being developed and put to various applications and uses. In order to enhance the contribution of robot in our daily lives we need to find an effective way of communicating with robots. For this purpose, there have been certain developments in area of human-machine interaction. One common form of communication is gestures that are not only limited to face, body and fingers but also hand gestures. In order to increase the use of robot in places where conditions are not certain like rescue operations, robots can be made to follow the instructions of human operator and perform the task accordingly. This proposes an integrated approach of tracking and recognition of hands which is intended to be used as human-robot interaction interface.

COMPONENTS USED IN THE PROJECT

Accelerometer: -

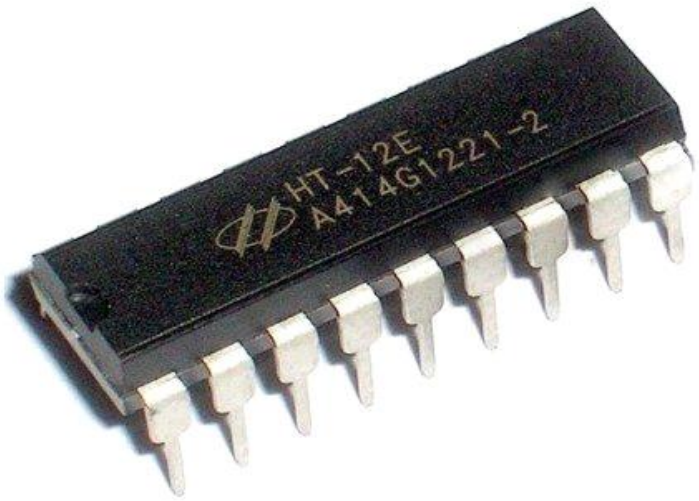
An accelerometer is a one type of sensor and it gives an analog data while moving in the direction of X, Y and Z. These directions depend on the type of sensor. The diagram of accelerometer is shown below. This sensor consists of arrow directions, if the sensor is tilt in one direction, then the data at the particular pin will change in the form of analog. The accelerometer consists of six pins, where the function of each pin is discussed below.

*Pin configuration of accelerometer MPU6050 is in Appendix I.



Encoder

The HT 12E Encoder ICs are series of CMOS LSIs for Remote Control system applications. They are capable of Encoding 12 bit of information which consists of N address bits and 12-N data bits. Each address/data input is externally trinary programmable if bonded out. This encoder is used to encode the 4-bit data and transmits by using an RF transmitter module.



RF Module

Radio Frequency (RF) module consists of two parts: Transmitter (Tx) and Receiver (Rx). It is a small electronic device used to transmit and receive signal between two devices. It is available in different operating frequencies with different operating range. An encoder Circuit & a decoder circuit is used along with the Transmitter & Receiver respectively in order to transmit & receive the message/signal. As shown in figure below, the RF Module operates at the frequency of 315MHz with an operating range of 400-500 meters. RF transmission is better than IR because signals through RF can travel through larger distances while IR mostly operates in line-of-sight mode and also RF signals can travel even when there is an obstruction between transmitter & receiver. Moreover, RF transmission is stronger and more reliable than IR transmission.

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The major components used in the receiving section include receiver, decoder, microcontroller and motor driver.

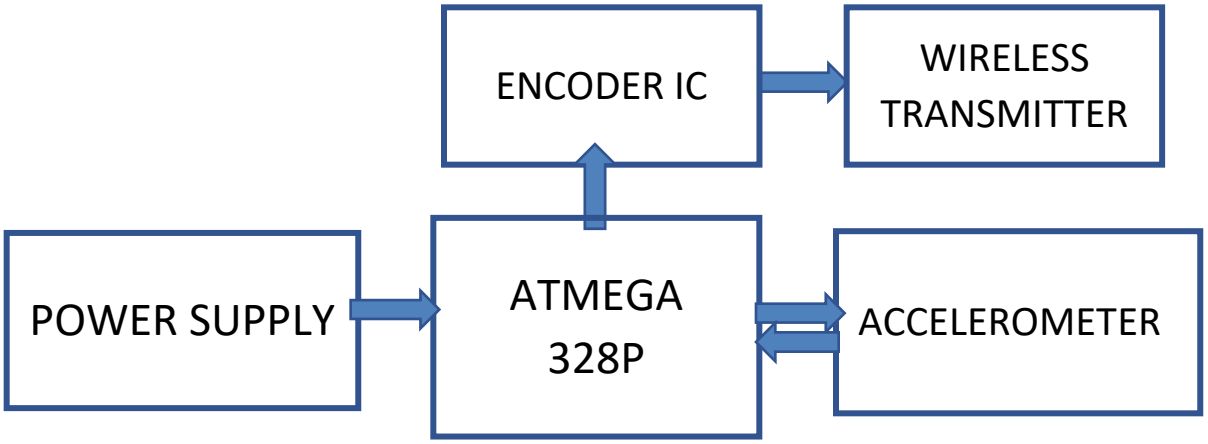


Fig 1. Block Diagram of Transmitting Section

Decoder

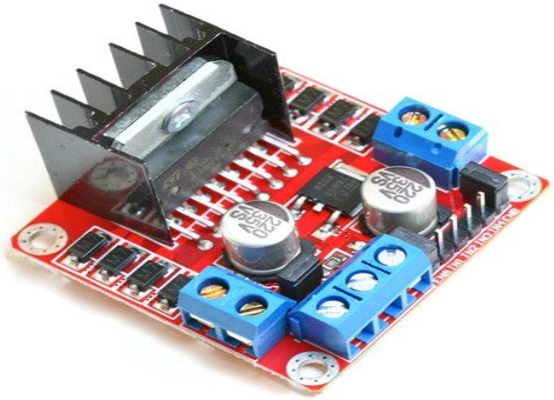
The HT 12D ICs are series of CMOS LSIs for remote control system applications. For proper operation a pair of encoder/decoder with the same number of address and data format should be selected. The Decoder receive the serial address and data from its corresponding decoder, transmitted by a carrier using an RF transmission medium and gives output to the output pins after processing the data. The decoder is used to change the serial data into parallel data which is received from the receiver circuit.

Microcontroller

The Atmel 8-bit AVR RISC-based microcontroller combines 32 kB ISP flash memory with read-while-write capabilities, 1 kB EEPROM, 2 kB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. The device achieves throughput approaching 1 MIPS per MHz the microcontroller is the most essential part of the robot. An AT328P family microcontroller is used in the circuit to give a decision capacity.

Motor Driver

The primary purpose is to supply current to the motors as it cannot be done through the microprocessors. The L298D is a 16-pin IC dedicated to control the motor. It can take input voltage between the range 6-18 Volts.



At the receiver section, an RF receiver module receives the data from the transmitter. The received data can be decoded by an IC HT12D. The received data can be processed by AT328P microcontroller and motor driver is used to control the motor.

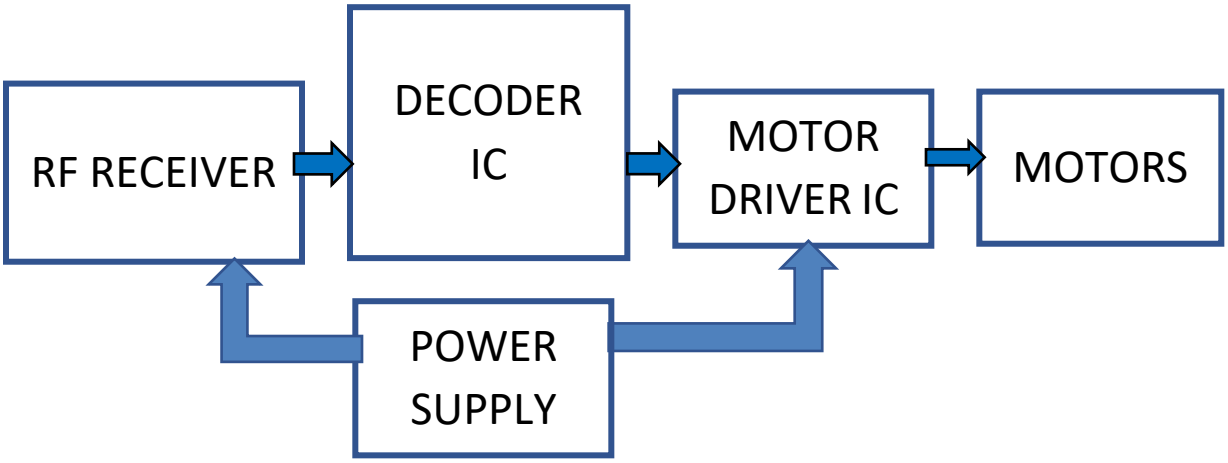


Fig 2. Block Diagram of Receiver Section

Gesture Control Robot Working

A hand Gesture Control Robot is a kind of robot which is controlled by the hand gestures and not by using buttons. The robot is equipped with two sections- Transmitting section and Receiving section. In the Transmitting section, an accelerometer is mounted on hand of the user capturing its gesture and moving the robot accordingly. For assigning proper levels to the input voltages from the accelerometer, comparator IC is used. Encoder IC is then used to encode the four-bit data which will later be transmitted by a RF Transmitter module. In the receiving section, the received encoded data by RF receiver module is then decoded using a decoder IC which is then processed by a microcontroller and passed onto a motor driver to rotate the motors in a special configuration to move the robot in the same direction as that of the hand. So, the primary basic aim of design is to make the robot move as soon as the operator makes any gesture. The goal of this project is to develop methods that helps user to control & program a robot with high level of abstraction from robot specific language.

Working Code for AT328P

```
#include <MPU6050_tockn.h>
#include <Wire.h>

MPU6050 mpu6050(Wire);

long timer = 0;

void setup() {

  pinMode(4, OUTPUT);
  pinMode(5, OUTPUT);
  pinMode(6, OUTPUT);
  pinMode(7, OUTPUT);



  Serial.begin(9600);
  Wire.begin();
  mpu6050.begin();

}

void loop() {
  mpu6050.update();
```

```
  Serial.print("accX : ");Serial.print(mpu6050.getAccX());
  Serial.print("\taccY : ");Serial.print(mpu6050.getAccY());
  Serial.print("\taccZ : ");Serial.println(mpu6050.getAccZ());

 if (mpu6050.getAccX() >= 0.70)
 {                              //FORWARD
  digitalWrite(4, LOW);
  digitalWrite(5, HIGH);
  digitalWrite(6, HIGH);
  digitalWrite(7, LOW);
}
else if(mpu6050.getAccX() <= -0.60)
{                                   //BACKWARD
  digitalWrite(4, HIGH);
  digitalWrite(5, LOW);
  digitalWrite(6, LOW);
  digitalWrite(7, HIGH);
}
else if(mpu6050.getAccY() >= 0.60)
{                                     //LEFT
  digitalWrite(4, LOW);
  digitalWrite(5, HIGH);
  digitalWrite(6, LOW);
  digitalWrite(7, HIGH);
```

```
  }
  else if(mpu6050.getAccY() <= -0.60)
  {                                  //RIGHT

    digitalWrite(4, HIGH);
   digitalWrite(5, LOW);
   digitalWrite(6, HIGH);
   digitalWrite(7, LOW);

  }

  else{
   digitalWrite(4, LOW);
   digitalWrite(5, LOW);
   digitalWrite(6, LOW);
   digitalWrite(7, LOW);
  }
}
```

Applications

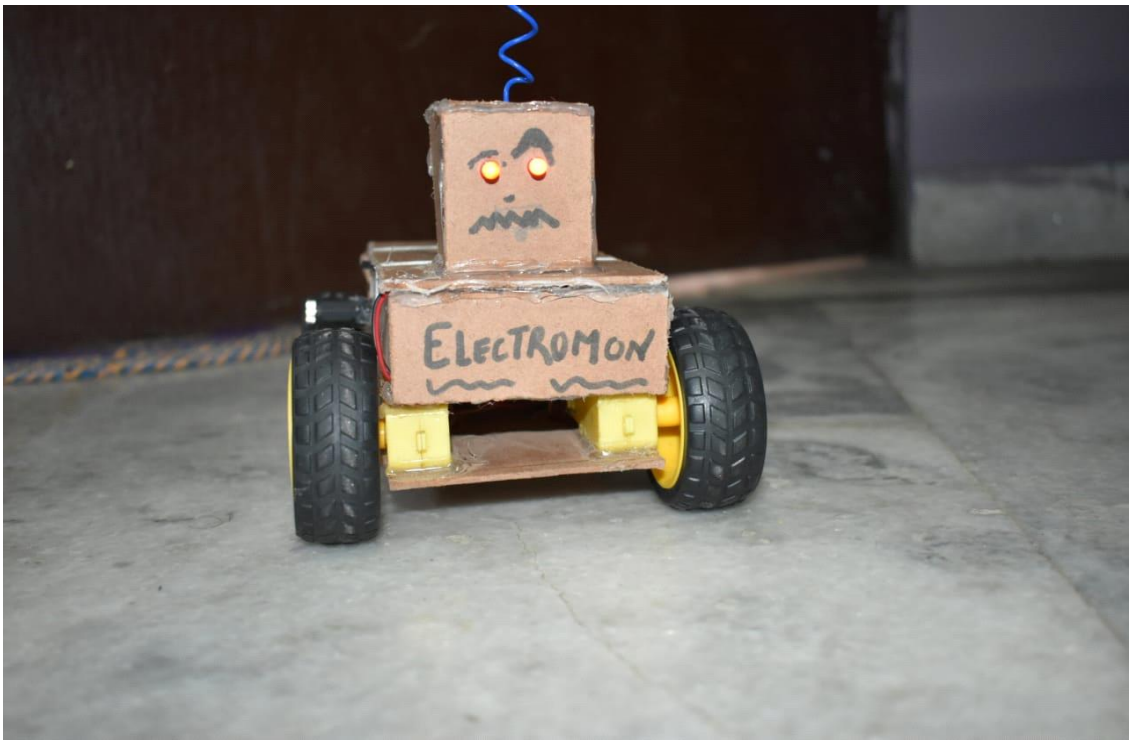
The application of accelerometer-based gesture-controlled robot include

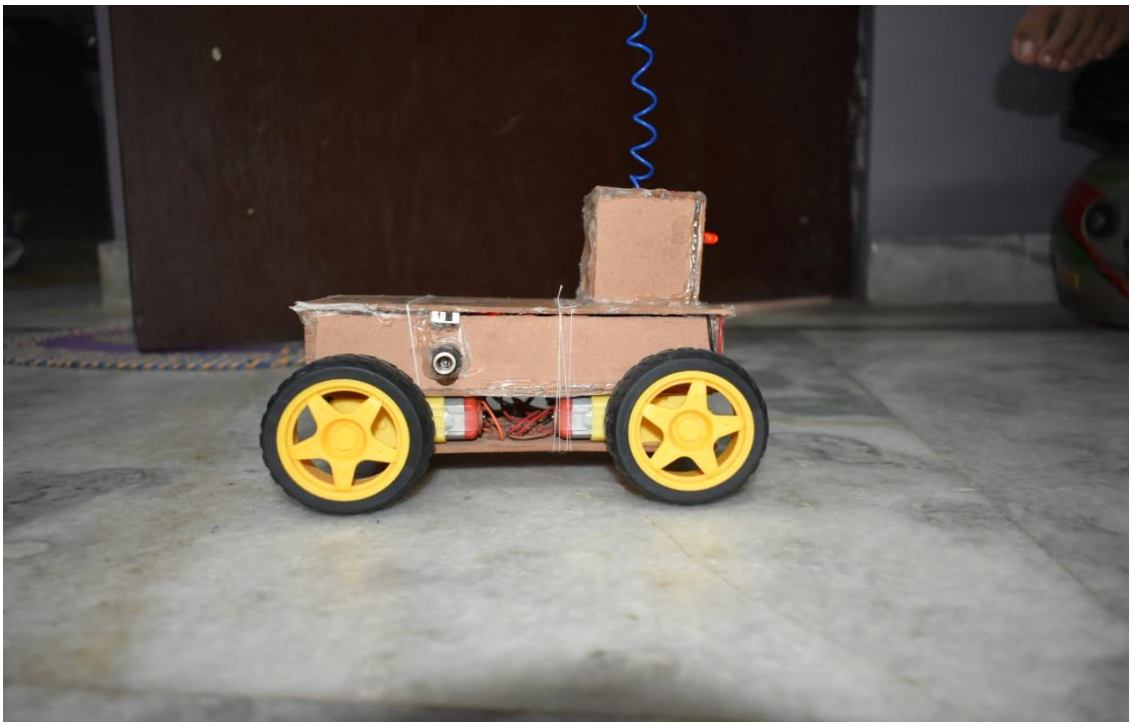
- These robots are used in military applications to operate robots
- These robots are used in medical applications for the purpose of surgery
- This robotics are used in the construction field
- This robotics are used in industries to control trolley and lift.

Result

There are total five conditions for Gesture Control that has been studied. Specific inputs are to be fed to the analog port of the Arduino and the digital output from Arduino is fed to the transmitter circuit. These inputs are given in the following table

Movement of hand				Input to the Arduino ports			
	Angle of tilt	**Direction**	Gesture Code	D3	**D2**	**D1**	**D0**
Stable	180°	Stop		0	0	0	0
Tilt right	34.37°	Turn Right		0	0	0	1
Tilt left	34.37°	Turn Left		0	0	1	0
Tilt back	34.37°	Backward		1	0	0	0
Tilt front	40.10°	Forward		0	1	0	0






ELECTROMON

Conclusion

Hand gesture control is an example of companionship between man and machine in the race of man vs machine, further enhancing the technology to the next level from speech recognition and wired connections to wireless hand gestured controlled technology. There is rapid growth in application development in the field of gesture recognition system. So, in this project, we propose a model of robot based on 'Hand Gesture Recognition utilizing hand gestures to communicate with the robot.' The low price and short setup time are some of the advantages of the system but an important limitation is limited accuracy of the system. Physical hardship is avoided through the use of accelerometer as with the twist of hand. The user gets the ability and freedom to turn the robot to desired direction

Future work will build upon accurate recognition of desired gestures. There are two possible ways to achieve the desired accuracy. Firstly, by implementation of a gyroscope in the system, in order to separate the acceleration due to gravity from inertial acceleration. Secondly, by installing a GPS in the system to track the position of ROBOT. The use of more accelerometers to the arms is another possibility.

References

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Appendix I

Accelerometer MPU6050 Pin Configuration

Pin Number	Pin Name	Description
1	Vcc	Provides power for the module, can be +3V to +5V. Typic ally +5V is used
2	Ground	Connected to Ground of system
3	Serial Clock (SCL)	Used for providing clock pulse for I2C Communication
4	Serial Data (SDA)	Used for transferring Data through I2C communication
5	Auxiliary Serial Data (XDA)	Can be used to interface other I2C modules with MPU6050. It is optional
6	Auxiliary Serial Clock (XCL)	Can be used to interface other I2C modules with MPU6050. It is optional
7	AD0	If more than one MPU6050 is used a single MCU, then this pin can be used to vary the address
8	Interrupt (INT)	Interrupt pin to indicate that data is available for MCU to read.

MPU6050 Features

- MEMS 3-aixs accelerometer and 3-axis gyroscope values combined
- Power Supply: 3-5V
- Communication: I2C protocol
- Built-in 16-bit ADC provides high accuracy
- Built-in DMP provides high computational power
- Can be used to interface with other IIC devices like magnetometer
- Configurable IIC Address
- In-built Temperature sensor