# ACCELEROMETER BASED WIRELESS GESTURE CONTROLLED ROVER

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***Abstract*—Here, in this project we have demonstrated the working of accelerometer based gesture controlled rover using arduino. Here the movement and the path of rover is controlled using simple gestures, with help of accelerometer. The systems sensitivity is defined and adjusted using the Arduino coding as per the requirement. Here we have used RF transmitter and receiver systems to attain maximum efficiency in real time applications. The hand gestures are transmitted through transmitter section that contain accelerometer and voltage level corresponds to movement of robot along X and Y axes are compared by a pre instruction, following which corresponding instructions are transmitted through the RF transmitter to control robot. The robot receives the instructions. The motor driver IC drives motors corresponding to instructions received and changes the path of the rover**

***Keyword: Arduino Nano, RF Transmitter, RF receiver, Hand Gesture***

## *I.* INTRODUCTION

Developments in field of robotics offer greater opportunities and provide various applications for domestic, industrial and defense, etc. In current scenario, wireless controlled 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. Wireless communication systems play a vital role for communication between human and robot. Though low range wireless transmission systems like ZigBee and Wi-Fi are established for low range rover applications, they cannot be used for long range transmission applications. Here, we propose a rover model using RF transmission systems and the motion of the rover is controlled using MEMS based accelerometer that can be mounted anywhere as desired. The accelerometer is an electromechanical device that converts the gestures to electrical signals which are used to control path of the rover along the desired directions [1].

The movement of gesture transmitter section is sensed by accelerometer and voltage level corresponds to movement of robot along X and Y axes are compared by an Arduino, following which corresponding instructions are transmitted through the RF transmitter to control robot [2]. The robot receives the instructions. The Arduino drives motors corresponding to instructions received.

Fig 1: Input gesture to be given

Advantages are unmanned robotics and gesture controlled robotic devices are being actively developed for both civilian and military use to perform a variety of dull dirty and dangerous activity [2].

In many applications of controlling robotic gadget it becomes quite hard and complicated when there comes the part of controlling it with remote or many different switches. The concept of using gestures to control machine with the movement of hand which will simultaneously control the movement of robot [2], which is a benefit. Cost of production is very cheap, Circuit is simple, Low power consumption. Advantages are we are using RFTransmitter; only four combination of

movement is Possible.So, either REVERSE or STOP condition has to be avoided. For higher application, circuit designing can be simplified use upgraded components. If we are using a rechargeable battery hardware section is more complex. The user has a huge device on his hand which obstructs the user do normal hand movement. Since there is no force feedback, the user won't know what he is working on. But we can add feedback system in newer projects. Since there is no force feedback, the user won't know what he is working on.Fine movement is difficult to achieve when working with bigger objects or controlling machines are bigger in size.

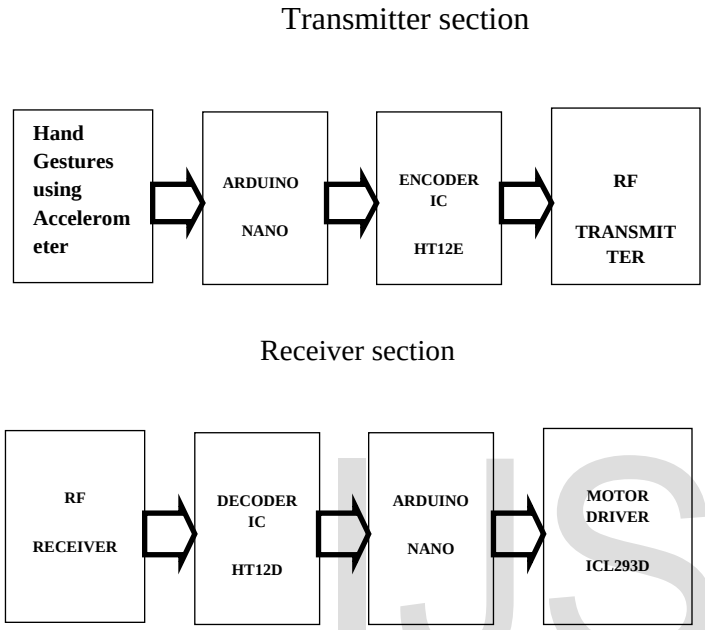


Fig.2: Block diagram of transmitter and receiver section

In the above diagram, for transmitting section consists of accelerometer for input purpose and command compared within Arduino Nano and then it transmitted with the help of RF transmitter the signal is transmitted. In RF transmitter the digital are converted into radio signal using encoder IC(HT12E) and then it transmits. Receiver section consist of RF receiver to receive the signal, the received RF signal are decoded into digital by decoder IC(HT12D) and then it given to Arduino Nano, here the signal is processed and instruction are given to motor driver IC(L293D)to drive the motors in given directions

## II. PROPOSED SYSTEM

### *A. Systems Description*

#### *ACCELEROMETER MODULE*

An Accelerometer is an electromechanical device that can measure the acceleration of anything that is mounted on [10]. The accelerometer module used here is based on ADXL335 triple-axis accelerometer from Analog devices. The sensor has a full sensing range of +3g or -3g. MEMS means micro electromechanical system common name for Accelerometer. A 2-axis accelerometer module is shown below [5]. Fig.3 shown below is the Accelerometer

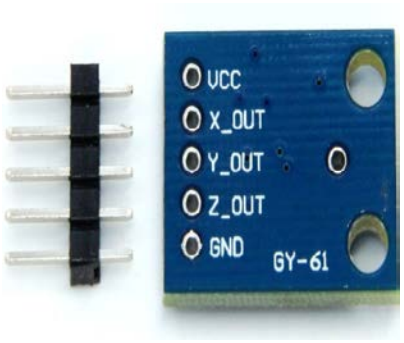


Fig.3: Accelerometer module

#### *RF MODULE*

An RF module (radio frequency module) is a (usually) small electronic circuit used to transmit and/or receive radio signals on one of a number of carrier frequencies. RF modules are widely used in electronic design owing to the difficulty of designing radio circuitry. Good electronic radio design is notoriously complex because of the sensitivity of radio circuits and the accuracy of components and layouts required for achieving operation on a specific frequency. Design engineers will design a circuit for an application which requires radio communication and then "drop in" a radio module rather than attempt a discrete design, saving time and money on development.

RF modules are most often used in medium and low volume products for consumer applications such as garage door openers, wireless alarm systems, industrial remote controls, smart sensor applications, and wireless home automation systems. They are sometimes used to replace older infra red communication designs as they have the advantage of not requiring line-of-sight operation. Several carrier frequencies are commonly used in commercially-available RF modules, including 433.92 MHz, 315 MHz, 868 MHz and 915MHz.
These frequencies are used according to national and international regulations governing that use radio frequencies for communication.

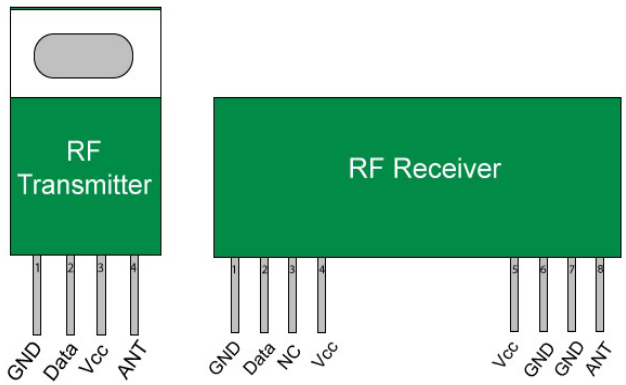


Fig3. Block Diagram of RF transmitter and receiver

TYPES OF RF MODULES

The term RF module can be applied to many different types, shapes and sizes of small electronic sub assembly circuit board. It can also be applied to modules across a huge variation of functionality and capability. Most standard, well known types are covered here:

- Transmitter module
- Receiver module
- Transceiver module.

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**Transmitter module**

An RF transmitter module is a small PCB sub-assembly capable of transmitting a radio wave and modulating that wave to carry data. Transmitter modules are usually implemented alongside a micro controller which will provide data to the module which can be transmitted. It is also a part of trans receiver.

**Super heterodyne& super-regenerative modules**

There are two types of RF receiver modules: Super heterodyne receivers and super-regenerative receivers. Super-regenerative modules are usually low cost and low power designs using a series of amplifiers to extract modulated data from a carrier wave. Super-regenerative modules are generally imprecise as their frequency of operation varies considerably with temperature and power supply voltage. Superheterodyne receivers have a performance advantage over super-regenerative; they offer increased accuracy and stability over a large voltage and temperature range. This stability comes from a fixed crystal design which in turn leads to a comparatively more expensive product.

**RF signal modulation**

There are three types of signal modulation methods commonly used in RF transmitter and receiver modules:

- ASK
- FSK
- OOK

Main Factors of effecting RF module Performance

As with any other radio-frequency device, the performance of an RF module will depend on a number of factors. For example, by increasing the transmitter power, a larger communication distance will be achieved. However, this will also result in a higher electrical power drain on the transmitter device, which will cause shorter operating life for battery powered devices. Also, using a higher transmit power will make the system more prone to interference with other RF devices, and may in fact possibly cause the device to become illegal depending on the jurisdiction.

Correspondingly, increasing the receiver sensitivity will also increase the effective communication range, but will also potentially cause malfunction due to interference with other RF devices.

The performance of the overall system may be improved by using matched antennas at each end of the communication link, such as those described earlier.

Finally, the labelled remote distance of any particular system is normally measured in an open-air line of sight configuration without any interference, but often there will be obstacles such as walls, floors, iron construction to absorb the radio wave signals, so the effective operational distance will in most practical instances be less than specified.

***Encoder***

Encoder IC (HT12E) receives parallel data in the form of address bits and control bits. The control signals from remote switches along with 8 address bits constitute a set of 12 parallel signals in fig 5. The encoder HT12E encodes these parallel signals into serial bits. Transmission is enabled by providing ground to pin14 which is active low. The control signals are given at pins 10-13 of HT12E. The serial data is fed to the RF transmitter through pin17 of HT12E.Transmitter, upon receiving serial data from encoder IC (HT12E), transmits it wirelessly to the RF receiver. The receiver, upon receiving these signals, sends them to the decoder IC (HT12D) through pin2. The serial data is received at the data pin (DIN, pin14) of HT12D. The decoder then retrieves the original parallel format from the received serial data.HT12E is an encoder integrated circuit of 212 series of encoders. They are paired

with 212 series of decoders for use in remote control system applications. It is mainly used in interfacing RF and infrared circuits. The chosen pair of encoder/decoder should have same number of addresses and data format. Simply put, HT12E converts the parallel inputs into serial output. It encodes the 12 bit parallel data into serial for transmission through an RF transmitter. These 12 bits are divided into 8 address bits and 4 data bits. HT12E has a transmission enable pin which is active low. When a trigger signal is received on TE pin, the programmed addresses/data are transmitted together with the header bits via an RF or an infrared transmission medium. HT12E begins a 4-word transmission cycle upon receipt of a transmission enable. This cycle is repeated as long as TE is kept low. As soon as TE returns to high, the encoder output completes its final cycle and then stops.

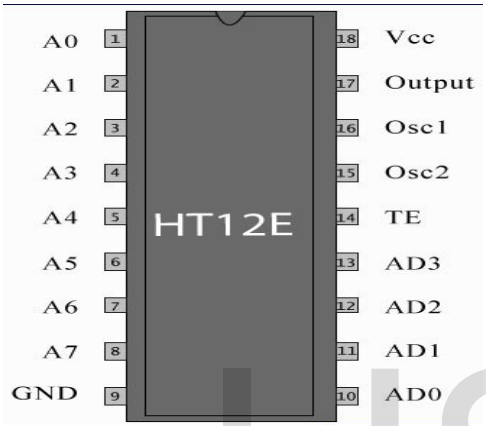
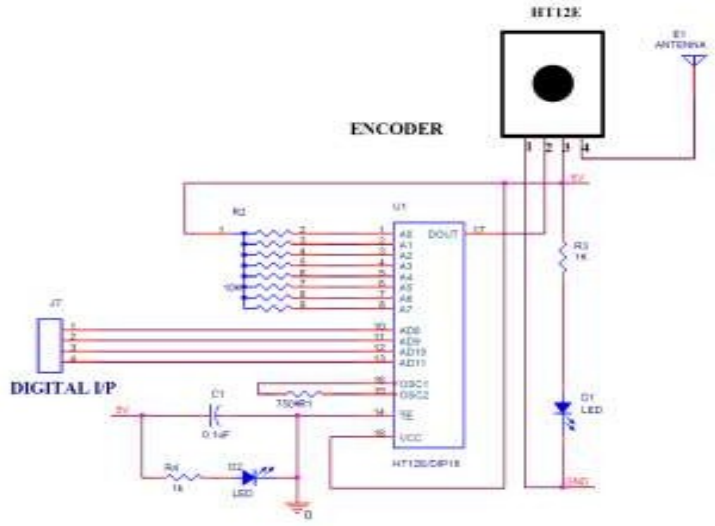



Fig.4: Pin Diagram of Encoder ICHT12E




***HT12D decoder with RF Receiver***

HT12D IC comes from HolTek Company. HT12D is a decoder integrated circuit that belongs to 2 12 series of decoders. This series of decoders are mainly used for remote control system applications, like burglar alarm, car door controller, security system etc. It is mainly provided to interface RF and infrared circuits. They are paired with 2 12 series of encoders. The chosen pair of encoder/decoder should have same number of addresses and data format. In simple terms, HT12D converts the serial input into parallel outputs. It decodes the serial addresses and data received by, say, an RF receiver, into parallel data and sends them to output data pins. The serial input data is compared with the local addresses three times continuously. The input data code is decoded when no error or unmatched codes are found. A valid transmission in indicated by a high signal at VT pin. HT12D is capable of decoding 12 bits, of which 8 are address bits and 4 are data bits. The data on 4-bit latch type output pins remain unchanged until new is received.

This circuit utilizes the RF module (Tx/Rx) for making a wireless remote, which could be used to drive an output from a distant place. RF module, as the name suggests, uses radio frequency to send signals. These signals are transmitted at a particular frequency and a baud rate. A receiver can receive these signals only if it is configured for that frequency. A four-channel encoder/decoder pair has also been used in this system. The input signals, at the transmitter side, are taken through four switches while the outputs are monitored on a set of four LEDs corresponding to each input switch, connected to any household appliance.

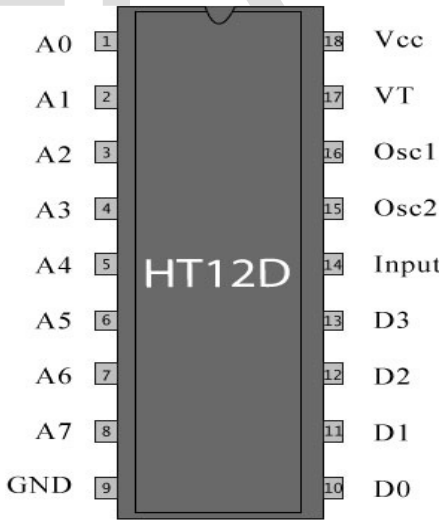



Fig.6: Pin Diagram of Decoder IC HT12D

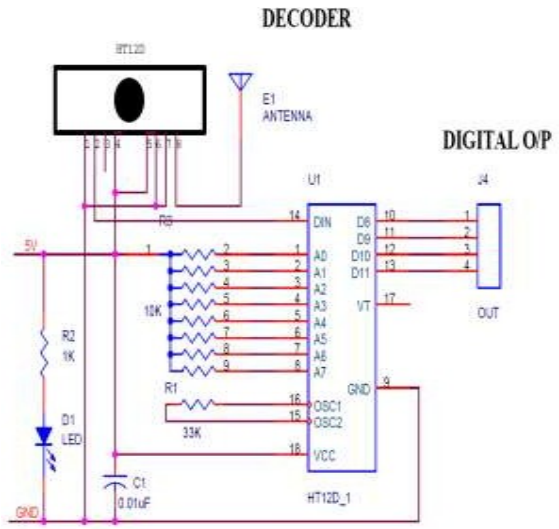



Fig.7: circuit diagram of decoder circuit

## Working of Accelerometer

Accelerometer is used to detect the device angle which it mounted on it. the angle can be of x, y and z axis. for every coordinate some values are assigned from $0^0$ to $360^0$. Let us consider X-axis from 0 to $90^0$ degrees, Y-axis from $90^0$ to $270^0$ and Z-axis from $270^0$ to $360^0$ degree as shown in Fig.8 .

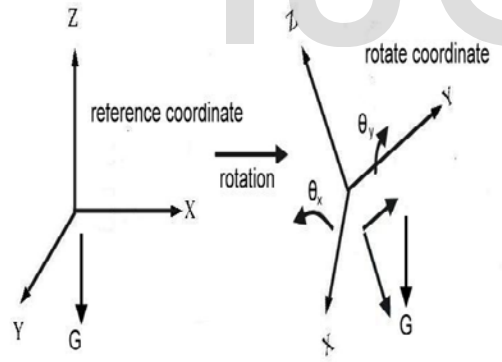



Fig. 8: Reference coordinate axis of accelerometer

In our recognition module, for each hand gesture, we randomly select one trajectory as the corresponding template trajectory for the gesture as shown in Fig. The resulting test trajectory is then compared to the template sequence for each handgesture. The two trajectories to be compared are dynamically time aligned and the resultant alignment path of maximum similarity is computed. Finally, the test trajectory is claimed to be the class with the largest similarity. After the trajectories have been classified, the corresponding command is then transmitted to the car-robot.

### MOTOR DRIVER IC L293D

L293D two h-bridges are present. Four transistors are present in each h-bridge. If we give logic bits 1, 0 then current flow is Vcc to motor positive after that motor positive to negative and then flows to ground. Then motor rotates in one direction. We change the logic bits as 0, 1 then current flow is Vcc to motor negative after that motor negative to positive and then flows to ground. Then motor rotate in opposite direction. If we give logic bits 1, 1 then Vcc and ground are short. So motor does not rotate. If we give logic bits 0, 0 then motor does not start. Because two pins are given to zero.

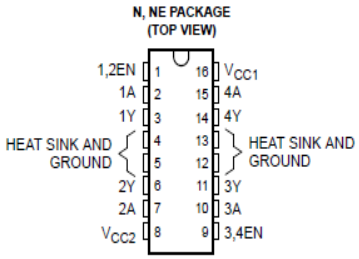



Fig.9: Pin Diagram of Motor Driver ICL293D

The Fig.9 shows the pin diagram of motor Driver IC(l293D). we are using this IC because its low costs and efficient to run two motor simultaneously. We can move motors oppositely, because we have to give command whenever we want to change the direction if two motor takes a same instructions it is difficult to drive the robot. So, in this case we are using L293d IC, they are other for four input instructions.

### *IR Proximity sensor*

when any object is brought nearer to the IR LED, Photo-Diode pair, the amount of IR rays from IR LED which reflects and falls on the IR photodiode increases and therefore voltage at the resistor increases. We compare this voltage change (nearer the object, more is the voltage at 10K resistor / IR photodiode) with a fixed reference voltage (Created using a potentiometer).

Here, LM358 IC (A comparator/OpAmp) is used for comparing the sensor and reference voltages. The positive terminal of photodiode (This is the point where the voltage changes proportion to object distance) is connected to non-inverting input of OpAmp and the reference voltage is connected to inverting input of OpAmp. The OpAmp functions in a way that whenever the voltage at non-inverting input is more than the voltage at inverting input, the output turns ON. When no object is near the IR proximity sensor, we need LED to be

turned off. So we adjust the potentiometer so as to make the voltage at inverting input more than non-inverting.

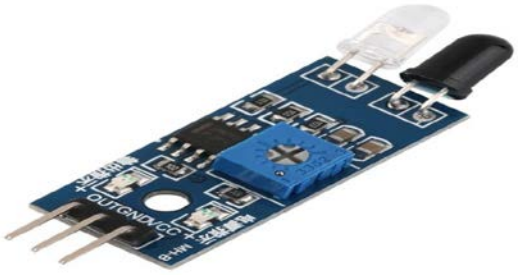



Fig. 9: IR Proximity Sensor

The above shown fig.9 is proximity sensor used to detect obstacles infront of it by using the ir rays. If obstacle is detected ir rays are reflected from the obstacle which is received by photo diode in the circuit. Then it send the command to Arduino board to stop the robot.

## III. RESULT AND DISCUSSION

We completed our project "Accelerometer Based Gesture controlled Robot", which is an efficient circuit(robot), which can be moved in any direction by making simple Gestures. Since the circuit is wireless, it is very user friendly and cost effective. we used Arduino to realize the circuit because it has some additional features when compared to microcontroller, pulse with modulation feature ,high resolution etc. In this project, we used rechargeable battery so that the robot is very reliable. In many applications of controlling robotic gadget it becomes quite hard and complicated when there comes the part of controlling it with remote or many different switches. The concept of using gestures to control machine with the movement of hand which will simultaneously control the movement of robot, which is a benefit of our project.

Fig.10: Final Hardware Design of This System

The figure of hardware model is shown in Fig.10.It consist of both transmitting section and receiving section along with the accelerometer module. In transmitter section we use Arduino Nano and RF transmitter to send data upto2km theoretically. But in real time we can get upto500m range when more amount obstacles along with noise in atmosphere as well as circuit noise efficiency decrease,if less amount of noise is present the range varies between 1km to 5km .they are other condition to be consider.

## IV CONCULSION

In conclusion, we have constructed a low cost gesture controlled rover using RF transmitter and receiver sections where the path of the rover is controlled with hand gestures using accelerometer. RF wireless modules used consume very low power and are best suited for wireless, battery driven devices. The gesture controlled robots can further be extended in applications in fields of Construction, Hazardous waste disposal, exploration, defense applications, medical surgeries, etc.

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