GESTURE CONTROL ROBOT

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Abstract— **Now a day's robots are controlled by remote or cell phone or by direct wired connection. Gesture control robot is a robot controlled by hand gestures. Previously controlling the robot with a remote or a switch is quite complicated. So, a new project is developed that is, an accelerometer based gesture control robot. The main goal of this project is to control the movement of the robot with hand gesture using accelerometer. This gesture robot is very useful for physically challenged people. In previously, the physically challenged people using their wheelchair movement by using joysticks. It creates more pressure and stress in their hands. By using this gesture device the movements are very easy to them to operate. In previously gesture devices are using Arduino UNO. But here by using ARDUINO LILYPAD which senses minor movements in their hands. These wireless communications enables the user to interact in a more friendly way.**

Index Terms— **Gesture control, IC, Integrated Development Environment, HT12E, HT12D, RF, Transmitter.**

I. INTRODUCTION

According to the World Health organization (WHO) 285 Million are visually impaired people and 39 million were blind and a nation Estimates approximately 3% of all ages are visually impaired. The leading causes of blindness are Glaucoma, macular degeneration, cataract, optic nerve trophy, diabetic retinopathy. Being a person with visual impairment or partial vision they face great challenges in their everyday life. For those people who are blind may have trouble in finding their way and directions around their places that they don't visit often. Furthermore, they may be limited in terms of what types of extracurricular activities they can take part, thus limiting their social involvement. People with limited or no vision may also struggle with technology, such as use of computer, phone, cell phones etc. To encourage them to actively involve with others, many intelligent systems have been introduced by the researchers to assist visually impaired people in several ways. For Instance, Braille method is used for reading and writing, to recognize colors and face intelligent concepts were used recent innovations on assisting the visually impaired to intelligently choose their wearable items such as dresses, shoes, hair bands, ear rings etc. was discussed in, Also white cane (mechanical device) is the most commonly used as a travel aid to avoid obstacles and to detect uneven surfaces, holes, steeps and other hazards. Although such intelligence systems would provide excellence in achieving their regular tasks, there is no system to assist them in selecting their medicines. According to the survey, the people with visual impairment are facing much difficulty in selecting their medicines. Visually impaired may suffer from different disease of those some may require to take continual medications, or they may need to have medicine for some pains. Hence, it is not possible for them to have manual assistance in choosing and identifying the right medicine in their day today life. Also they are facing difficulty whey they taking medicines nearby.

A Robot is an electro-mechanical system that is operated by a computer program. Robots can autonomous or semi-autonomous. An autonomous robot is not controlled by human and acts on its own decision by sensing its environment. Majority of the industrial robots are autonomous as they are required to operate at high speed and with great accuracy. But some applications require semi autonomous or human controlled robots. Some of the most commonly used control systems are voice recognition, tactile or touch controlled and motion controlled. In future users can use simple gestures to control or interact with devices without physically touching them. Gestures can originate from the any bodily motion or state.

Our motivation to work on this project came from a disabled person who was driving his wheel chair by hand with quite a lot of difficulty. So we wanted to make a device which would help such people drive their chairs without even having the need to touch the wheels of their chairs.

Glove based technique is a well- known means of recognizing hand gestures. It utilizes a sensor attached to a glove that directly measures hand movements.

II. RELATED WORK

Using gesture recognition concept, it is possible to move a robot accordingly. Accelerometers are the main technologies used for human machine interaction which offer very reasonable motion sensitivity in different applications. Motion technology makes easy for humans to interact with machines naturally without any interventions caused by the drawbacks of mechanical devices. Accelerometer-based gesture recognition has become increasingly popular over the last decade compared to vision based technique. The factors that make it an effective tool to detect and recognize the human gestures are its low-moderate cost & relative small size of the accelerometers.
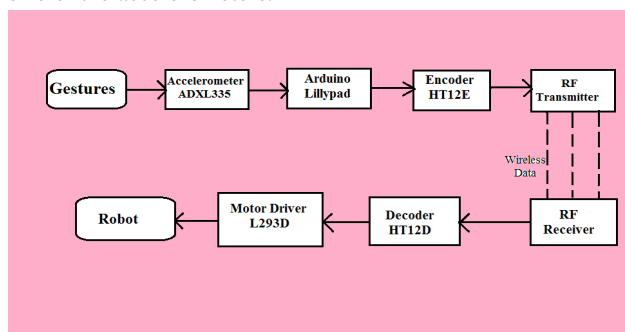

Fig.1. Block Diagram

Our gesture controlled robot works on the principle of accelerometer which records hand movements and sends that data to the comparator which assigns proper voltage levels to the recorded movements. That information is then transferred to a encoder which makes it ready for RF transmission.

These decisions are passed to the motor driver IC which triggers the motors in different configurations to make the robot move in a specific direction.

Gesture Controlled Robot

Gesture recognition technologies are much younger in the world of today. At this time there is much active research in the field and little in the way of publicity available implementation. Several approaches have been developed for sensing gestures and controlling robots. Glove based technique is a well- known means of recognizing hand gestures. It utilizes a sensor attached to a glove that directly measures hand movements.

A Gesture Controlled robot is a kind of robot which can be controlled by hand gestures and not the old fashioned way by using buttons. The user just needs to wear a small transmitting device on his hand which includes a sensor which is an accelerometer in our case. Movement of the hand in a specific direction will transmit a command to the robot which will then move in a specific direction. The transmitting device includes a Comparator IC for assigning proper levels to the input voltages from the accelerometer and an Encoder IC which is used to encode the four bit data and then it will be transmitted by an RF Transmitter module.

At the receiving end an RF Receiver module will receive the encoded data and decode it by using a decoder IC. This data is then processed by a microcontroller and passed onto a motor driver to rotate the motors in a special configuration to make the robot move in the same direction as that of the hand.

Principle of Hand Gesture Controlled Robot

In order to understand the principle of operation of Hand Gesture Controlled Robot, let us divide the project into three parts. The first part is getting data from the ADxl335 Accelerometer Sensor by the Arduino. The Arduino continuously acquires data from the MPU6050 and based on the predefined parameters, it sends a data to the RF Transmitter.

The second part of the project is the Wireless Communication between the RF Transmitter and RF Receiver.

The RF Transmitter, upon receiving data from Arduino (through the Encoder IC), transmits it through the RF Communication to the RF Receiver.

Finally, the third part of the project is decoding the Data received by the RF Receiver and sending appropriate signals to the Motor Driver IC, which will activate the Wheel Motors of the Robot.

III. SYSTEM DESIGN

A. Existing System

Today, a number of robotic arms used in robotics research, many with unique features and design criteria. In this section, a brief of some recent widely-used and/or Influential robotic arms is given. In the robotics field, several research efforts have been directed towards recognizing human hand gestures.

Vision- based gesture recognition – This Recognition system basically worked in the field of Service Robotics and the researchers are finally designed a Robot performing the cleaning task. They designed a gesture-based interface to control a mobile robot equipped with the manipulator. The

interface uses a camera to track a person and recognize the different gestures involving arm motion. A fast, adaptive tracking algorithm enables the robot to track and follow a person reliably through an office environment with changing lighting conditions. Two gesture recognition methods i.e. a template based approach and a neural based approach were compared and combined with the Viterbi algorithm for the recognition of gestures defined through the arm motion. It results in an interactive clean-up task, where the user guides the robot to go to the specific locations that need to be cleaned and also instructs the robot to pick up available trash.

Motion capture sensor recognition - Such recognition technique made it possible to implement an accelerometer based system to communicate with an industrial robotic arm wirelessly. In this particular project the robotic arm is powered with an ARM7 based LPC1768 core. Actually, MEMS is a three dimensional accelerometer sensor which captures gestures of human-arm and produces three different analog output voltages in three dimensional axes.

Accelerometer – based gesture recognition – This Gesture Recognition methodology has become increasingly popular in a very short span of time. The low-moderate cost and relative small size of the accelerometers are the two factors that make it an effective tool to detect and recognize.

Several studies have been conducted on the recognition of gestures from the acceleration data using Artificial Neural Networks (ANNs).

The focuses on the development of the robotic Arm by using Flex Sensor, ZigBee and 3 Servo motor connected to the Arduino Uno which is controlled by processing software and a computer mouse.

These robotic Arms are cheap and easily available which makes it free from unnecessary wire connection, reducing its complexity. But still there is a requirement of adding new ideas and functionality. The central goal is to implement a system through which the user can give commands to wireless Robot using gesture. The command signals are generated from these gestures using image processing and signals are passed to the robot to navigate it in the specified direction. The explanation about the implementation and design of gesture controlled robot by using Flex Sensor, Ultra sonic Sensor, Electronic compass and accelerometer connected to Atmega16 Microcontroller.

B. Implementation

Nowadays, robotics is becoming one of the most advanced in the field of technology. The application of robotics mainly involved in automobiles, Medical, construction, defense and also used as a fire fighting robot to help the People from the fire accidents. But, controlling the robot with a remote or a Switch is quite complicated. So, a new project is developed that is, using an accelerometer based gesture control robot. The main goal of this project is to control the movement of the robot with hand gesture using accelerometer.

Required components

- Accelerometer
- Arduino LILYPAD Board
- RF Transmitter Module
- RF Receiver Module
- Encoder IC
- Receiver IC
- Motor Driver IC
- BO Geared Motors
- Wheels
- Battery

1. *Arduino Lilypad*

The Lily Pad Arduino is a microcontroller board designed for wearable and e-textiles. It can be sewn to fabric and similarly mounted power supplies, sensors and actuators with conductive thread.
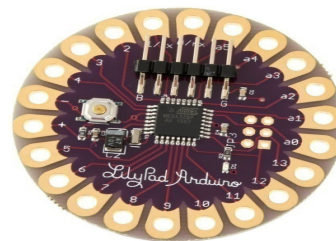

Fig.2. Lilypad Arduino

2. *Accelerometer (ADxl335)*

The most important component is accelerometer. Accelerometer is a 3 axis acceleration measurement device with +3g to -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. 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 an result in form of motion or vibration.
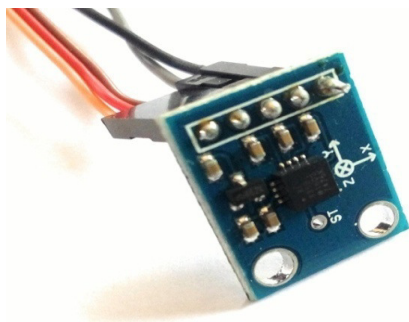

Fig.3. Accelerometer

3. RF433 Module

RF stands for Radio Frequency. This module consists of further two parts: Transmitter and Receiver (Rx). It is a small electronic device used to transmit and receive signal between two devices.

RF Transmitter Module (TX)

In electronics and telecommunications a transmitter or radio transmitter is an electronic device which, with the aid of an antenna, produces radio waves. The transmitter itself generates a radio frequency alternating current, which is applied to the antenna or radio location, such as radar and navigational transmitters.

- The VCC pin is connected to the +terminal in the circuit.
- The data pin is connected to the HT12E (pin no-17) that is transmitted or we can say that encoded data.
- The next pin is shown in figure is GND that is connected to the ground terminal.
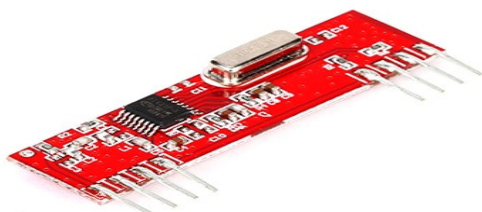- Now the last pin ANT this is connected to a small wire as an antenna.

Fig.4. RF Transmitter

HT12E (Transmitter side)

The encoder has four input lines. These lines are used to give input which we want to encode. In encoding, we are wrapping up the data which means if we want to send a binary signal '1001' to other end, we have to make data pins as '1001'. Now, to make data pin like this, what we need to do is to give high or 5 volts (which in digital means '1') to pins 'D0' and 'D3' while we have to provide pins 'D1' and 'D2' with 0 volt. (Ground).

The input given to data pin is in parallel form which is being transmitted into serial form from the data output pin. The figure below will clear this. The data flows in serial form through the wire and reaches the other end i.e. to the receiver. Receiver now decodes this signal.
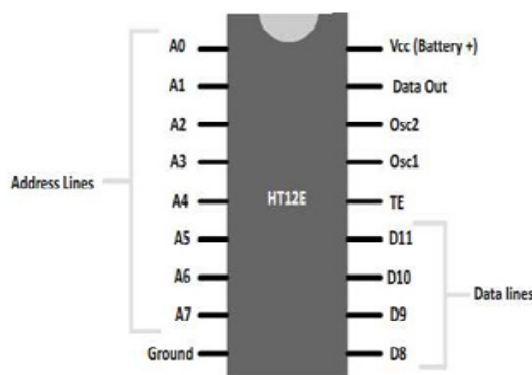

Fig.5. HT12D (Transmitter)

HT12D (Receiver side)

The encoded data which is coming from the transmitter side goes into the Data in (Din) pin. The data which was in serial order gets decoded and the output is generated at the for data line pins in same order as that on transmitter pin.
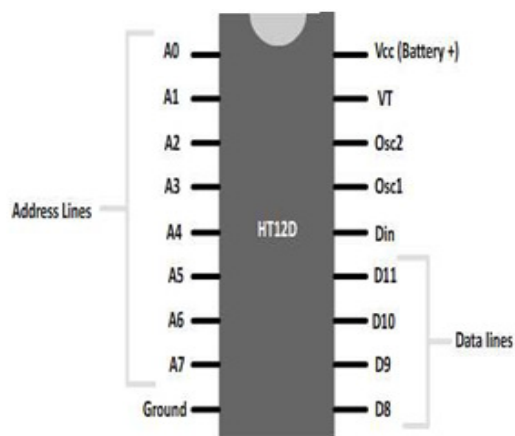
Fig.6. HT12E (Receiver)

IV. SOFTWARE REQUIREMENT

The program is written in Arduino Integrated Development Environment (IDE). Here, the version used is 1.6.1.It connects to the Arduino hardware to upload programs.

But before uploading the program there is a need to select appropriate Microcontroller so, "Arduino Lilypad" from the Tool menu has been chosen.

And for proper communication with computer and Arduino Lilypad boards there is a need to select COM port from the Tool menu.
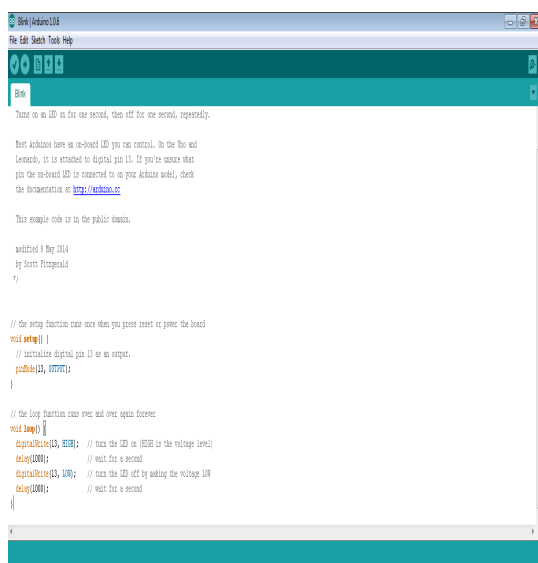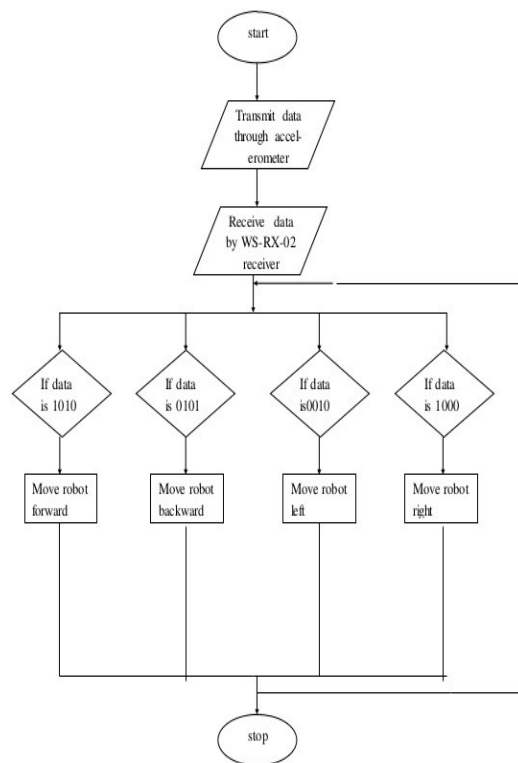
Fig.7. Code in arduino IDE

FLOW CHART

Fig.8. Flow diagram

1010- Forward moment

0101- backward moment

0010- left movement

1000- Right movement

V. METHODOLOGY

A. Methodology for hand motion recognition

The handheld controller is a 3D rigid body that can be rotated about the three orthogonal axes. Yaw, pitch and roll are referred to as rotation.
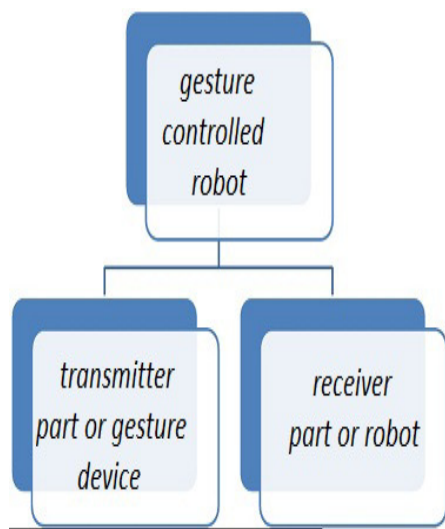
These rotation takes place as Z-axis is called yaw, the next rotation X-axis is called pitch and last rotation about the Y-axis is called roll.

Any orientation can be achieved by the composing those three elemental rotation. In our work, all of the planned hand motions for robot control are simple gestures, each of which contains only one of the three elemental rotations.

Gestures composed of more than one elemental rotation are too complicated for such kind of application.

This paper includes transmitter section and receiver section. The Required components to build this project are Ht12e, Ht12d, L293D, ADxl335 Accelerometer, capacitor, PBT connector, BO Motor, BO wheels, resistor, LED and battery.

The accelerometer is an essential device in this project. Accelerometer or transmitter device depends upon the hand gesture.

Transmitter Part (or) Gesture Device

The Transmitter part contain four module in it,
1. Accelerometer(ADxl335)
2. Comparator IC
3. Encoder (HT12E)
4. RF Transmitter
5. Battery(5V)

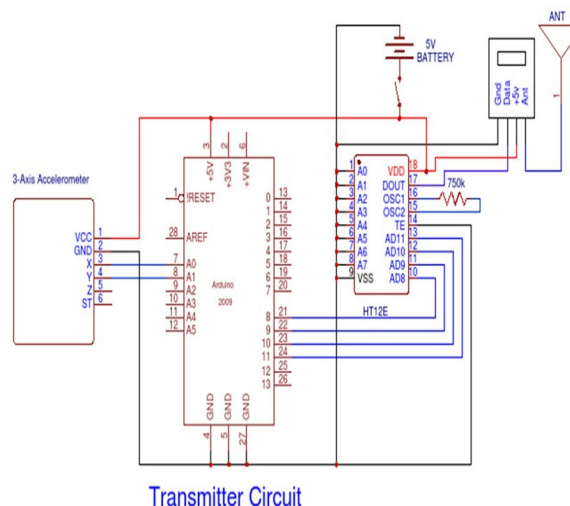### Receiver Part (or) Robot

This part contain four module--
1. RF Receiver(RX433)
2. Decoder(HT12D)
3. Process(microcontroller)
4. Actuator (Motor driver L293D)
5. Battery

1. Transmitter section

The transmitter section of the robot consists of Arduino LILYPAD board, ADxl335 Accelerometer, HT-12E Encoder IC and an RF Transmitter. The communication between Arduino and ADxl335 Accelerometer takes place through I2C Interface. Hence, the SCL and SDA pins of the ADxl335 Accelerometer are connected to A5 and A4 pins of the Arduino LILYPAD. Additionally, we will be using the interrupt pin of the ADxl335 and hence, it is connected to D2 of Arduino LILYPAD. HT-12E is an encoder IC that is often associated with RF Transmitter module. It converts the 12-bit parallel data to serial data. The 12-bit data is divided into address and data bits. A0 to A7 (Pin 1 to Pin8) are the address bits and they are used for secure transmission of the data.

These pins can be either left open or connected to ground (Vss). In this circuit, Pin 1 to Pin 9 (A0 – A7 and Vss) of HT-12E are connected to ground.

Pins 10 to 13 (AD8, AD9, AD10 and AD11) are the data pins of HT-12E. They receive the 4 word parallel data from external source like a microcontroller (Arduino LILYPAD in this case). They are connected to the pins D12, D11, D10 and D9 of Arduino LILYPAD respectively. TE' is the transmission enable pin and it is an active low pin. The data is transmitted as long as the TE' is low. Hence, Pin 14 (TE') is also connected to ground.
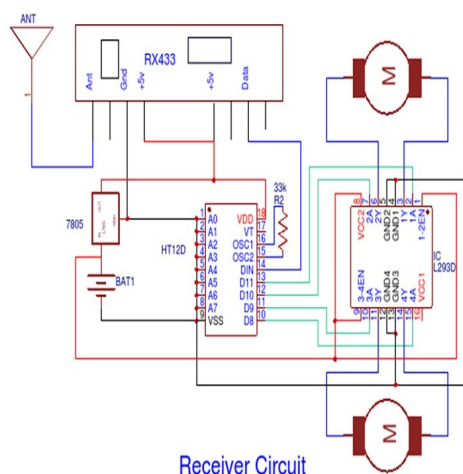

Transmitter Circuit

The encoder IC has an internal oscillator circuit between the pins 16 and 15 (OSC1 and OSC2). A 750KΩ resistor is connected between these pins to enable the oscillator. D out (Pin 17) is the serial data out pin. It is connected to the data in

pin of the RF Transmitter. Both Arduino LILYPAD and ADxl335 have 3.3V Regulator. Hence, all the VCC pins are connected to a regulated 5V Supply.

2. Receiver section

The receiver section of the robot consists of an RF Receiver, HT-12D Decoder IC, L293D Motor Driver IC and a robot chassis with four motors connected to wheels. HT-12D is the decoder IC that is often associated with RF Receiver.

It converts the serial data received by the RF link into parallel data. A0 to A7 (Pin 1 to Pin 8) are the address pins and must be matched with the address pins of the encoder. Since the address pins of encoder (HT-12E) are grounded, the address pins of decoder must also be grounded. Hence, pins 1 to 9 (A0 – A7 and Vss) are connected to ground. The serial data from the RF Receiver is given to Din (Pin 14) of the decoder IC.

Receiver Circuit

HT-12D has an internal oscillator and an external resistor of 33KΩ is connected between OSC1 and OSC2 (Pins 16 and 15). Pin 17 (VT) indicates a valid transmission of data and this pin will be high when a valid data is present on the data pins. An LED in series with a 330Ω resistor is connected to this pin to indicate a valid data transmission.

Pins 10 to 13 (D8, D9, D10 and D11) of HT-12D are the parallel data out pins. They are connected to the input pins of the L293D motor driver IC (Pins 2, 7, 10 and 15 respectively).

L293D motor driver IC is used to provide the necessary current (for both forward and reverse directions) to the motors. Pins 1 and 9 are the enable pins and are connected to VCC (+5v) along with Pin 16 (which is the logic supply).

Pins 3 – 6 and 11 – 14 are the outputs and are connected to the four motors. Pin 8 is the Motor Supply Pin and is connected to a separate power supply. Hence, you will need two batteries in the Receiver Section; one for the Circuit and one for the motors.

VI. SYSTEM DESIGN AND IMPLEMENTATION

This technique is also called as "human machine interaction" Accelerometers are the main technologies used for human machine interaction. Accelerometers offer very reasonable motion sensitivity in different applications. The LilyPad Arduino is a microcontroller board designed for wearable and e-textiles.

Our gesture controlled robot works on the principle of accelerometer which records hand movements and sends that data to the comparator which assigns proper voltage levels to the recorded movements.

That information is then transferred to an encoder.

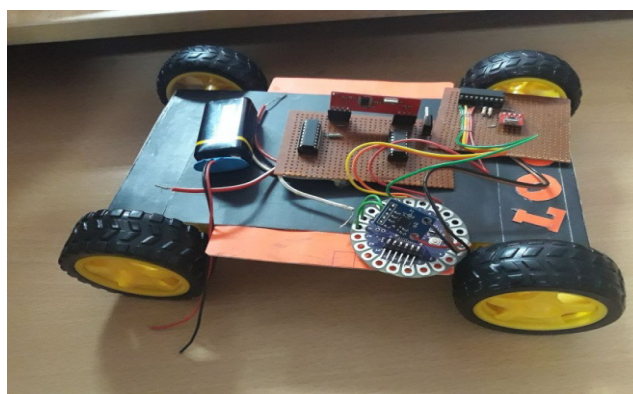Encoder makes that data ready for RF transmission.

Fig.12. Gesture Control Robot

a) Stop condition

When the accelerometer is parallel to the horizontal plane, all the output pins of decoder (13, 12, 11, 10) are set to high which makes the robot in stop mode. Led are connected to the

decoder output pins. Since all the output pins are high, so all the led are glowing.

b) Forward Movement

When the accelerometer is tilted to forward, two output pin of decoder (13, 11) are set to low and other two output pin of decoder (12, 10) are set to high. This condition commands the robot to move in forward direction. Led connected to pin 13 and 11 are not glowing as it is low and led connected to pin 10 and 12 are glowing since, it is high.

Fig.13. Hand Movement of Robot

c) Backward Movement

When the accelerometer is tilted towards backward direction, two output pin of decoder (12, 10) are set to low and other two output pin of decoder (13, 11) are set to high. This condition commands the robot to move in backward direction.

Led connected to pin 13 and 11 are glowing as it is high and led connected to pin 10 and 12 are not glowing since, it is low

d) Moves Towards Right

When the accelerometer is tilted towards right, two output pin of decoder (12, 11) are set to low and other two output pin of decoder (13, 10) are set to high. This condition commands the robot to move towards right.

The output can be seen in the above picture. Led connected to pin 13 and 10 are glowing as it is high and led connected to pin 11 and 12 are not glowing since, it is low

e) Moves Towards Left

When the accelerometer is tilted towards left, two output pin of decoder (12, 11) are set to high and other two output pin of decoder (13, 10) are set to low. This condition commands the robot to move towards left. Led connected to pin 13 and 10 are not glowing as it is low and led connected to pin 11 and 12 are glowing since, it is high.

These are the main hand movements present in our gesture control robot.

VII. CONCLUSION

In spite of lot of improvements in Hand Gesture Controlled Robot using Accelerometer Module, there are many things which can be done.

First improvement can be made is Camera Interfacing, which will be used to detect the position of the Robot, when it is out of eye sight or if any obstacle comes in front of the Robot.

Also, we can increase the operating range of the Robot by introducing a GPS. Due to this, the range will be increased by worldwide.

A gesture controlled communication aid for elderly and disabled people can be a significant task for future. The two important aims will be to identify the different gestures of elderly and disabled people for communication and to design a rich augmented-reality interface for communication via ubiquitous device such as a television set.

Touch less user interface is an emerging type of technology in relation to gesture control. TUI is the process of commanding the computer via body motion and gestures without touching a keyboard, mouse, and screen.

Applications
- Through the use of gesture recognition, remote Control with the wave of a hand of various devices is possible.
- Gesture controlling is very helpful for handicapped and physically disabled people to achieve certain tasks, such as driving a vehicle.
- Wireless controlled robots are very useful in many applications like remote surveillance, military etc.
- Hand gesture controlled robot can be used by physically challenged in wheelchairs.

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