Robotic Vehicle Controlled By Hand Gesture Using PIC

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ABSTRACT

Robotic vehicle constrained by the hand movement fundamentally benefits the handicapped individual, as those individual with the hand gestures moves to the direction while not pressing any buttons.

This system incorporates a glove that incorporates a receiver circuit which is able to be mounted on the top with Atmega microcontroller interfaced to the accelerometer and it ought to be worn by the person whereas utilizing this machine. The circuit on the vehicle incorporates RF collector, PIC microcontroller and Driver IC to operate the motors. The commands that are received by the IC on the circuit are sent to the RF transmitter that forwards the command to the RF receiver. The command from RF receiver then gets transmitted to the PIC microcontroller which decodes the command and makes the vehicle move in the direction specified by the user.

KEYWORDS: Robotic Vehicle, Hand Gesture, RF Module, PIC Microcontroller.

INTRODUCTION

In recent days, most of the industries are equipped with machine-controlled devices to extend the productivity and potency. These days, robotics is getting to be a standout amongst the most progressive in the field of innovation. A Robot is an electro-mechanical framework that is worked by a computer program. Robots can be self-sufficient or semi-self-ruling.A self-ruling robot isn't constrained by human and follows up on its own choice by detecting its

environment. Majority of the modern robots are self-governing as they are required to work at rapid and with incredible precision. But a few of applications require semi-self-ruling or human controlled robots. Some of the most normally utilized control frameworks are voice acknowledgment, material or contact controlled and movement controlled. A Gesture Controlled robot is a sort of robot which can be constrained by your hand signals not by old buttons. You simply need to wear a little transmitting gadget in your grasp which included an acceleration meter. This will transmit a fitting order to the robot with the goal that it can do anything we desire.

The transmitting device includs33 FR receiver, PIC microcontroller and Driver IC to operate the motors. The commands that are received by the IC on the circuit are sent to the RF transmitter which forwards the command to the RF receiver.

At the receiving end a receiver circuit which will be mounted on the top with Atmega microcontroller interfaced to the accelerometer and it is supposed to be worn by the user while using this machine. In this way, another undertaking is built up that is, an accelerometer based motion control robot. The primary objective of this venture is to control the movement of the robot with hand signal utilizing accelerometer.

Presently its opportunity to break the task in various module's to make the task simple and straightforward any venture turn out to be simple or blunder free in the event that it is done in various modules. As our undertaking is as of now separated into two distinctive part transmitter and receiver.

The fundamental objective of this project is to control the development of the robot with hand gesture utilizing accelerometer. The robot is normally an electro-mechanical machine that can perform tasks automatically.

LITERATURE REVIEW

Robotic vehicle controlled by hand gesture is being performed since a long time in both the spatial as well as the transform domain. A few methods have been reviewed in this section.

Archika et al.[1] proposed a technique hand gesture recognition based robot using accelerometer sensor, in this 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 simple for humans to act with machines naturally with none interventions caused by the drawbacks of mechanical devices. 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.

Shamsheer Verma[2] presented a hand gestures remote controlled robotic arm. In this author has explained the development of a robotic arm, prepared by him, which is operated &

controlled wirelessly with the help of hand gestures. It's a category 5 robot. The complete robotic assembly is formed into 2 components via a transmitter assembly placed on the gloves comprising of APC-220 Module, Arduino Board, Gyroscope, Accelerometer and a receiver (Robotic Arm) comprising of APC-220 Module, Arduino Board, ServoMotors and arms mounted on circular revolving base made of acrylic sheets.

Chirag Gupta and NitinGarg[3] has proposed a technique Gesture Controlled Car, in this a Gesture Controlled robot could be a kind of robot which may be controlled by hand gestures and not the old fashioned method by using buttons. The user simply must wear a little transmitting device on his hand which has a sensor that is an accelerometer in our case. Movement of the hand in a very specific direction can transmit a command to the robot which can then move in a very specific direction. The transmitting device includes a Comparator IC for distribution correct levels to the input voltages from the accelerometer and an Encoder IC that's used to encode the four bit data so it'll be transmitted by an RF Transmitter module.

Prajwal Ashwin Jawalekar[4] proposed Robot control by using human hand gestures. This paper describes about the gesture control robot which can be controlled by your normal hand gesture. The accelerometer controls the movement of the car. Accelerometers are used to measure the angular displacement of human hand motion. It consists of primarily 2components, one is transmitter half and another is receiver half. The transmitter will transmit the signal consistent with the position of accelerometer attached on your hand and also the receiver will receive the signal and make the robot move in individual direction. Here, the program is intended by using Arduino. Any robot can be controlled by using Arduino, and not only we can control it, but we can use it to do minimum 256 different functions

Ms. Asmita Jadhav et al.[5] presented Hand Gesture Controlled Robot Using Arduino. This paper presents a Hand Gesture Controlled Robot using Arduino, which can be controlled by simple hand gesture. According to the movement of the person hand, the accelerometer start moves. It is based on 3axis of accelerometer and robot move in four direction forward, backward, left and right. For sensing Human motion, we use infrared sensor, it's range is 790nm wavelength from human body. This type of robot widely used in military application, industrial robotic, construction field. In such a field, it is very risky and complicated to handle the machines through switches or remote, sometimes operator may be confused so this new concept introduces to control the machine with the movement of hand which is able to at the same time control the robot.

Prof. P.G. Kale et al.[6] proposed technique of hand gesture recognition for operational

behaviour of the robot. The Hand gesture recognition is a simpler and more natural way of human computer interaction. The goal of this paper is to notice the continual gestures and use them to convey info for the robot movement control. Therefore the hand gesture recognition needs quick and intensely robust. Navigating and controlling a robot in an indoor and outdoor environment by using the range of body-worn sensor is becoming an increasingly interesting research area in the robotic community.

Ashutosh Zagade et al.[7] presented study on gesture control arduino robot. Gesture Controlled car may be a robot which may be controlled by easy human gestures. The user simply must wear a gesture device within which a sensor is included. The sensor can record the movement of hand during a specific direction which is able to lead to the motion of the robot within the individual directions. The robot and also the Gesture instrument are connected wirelessly through radio waves. User will interact with the robot during additional friendly manner because of the wireless communication.

Soubagya Nayak et al.[8] said that the diffusion of unstoppable juggernaut of computational innovations and artificial intelligence into our lives makes human-computer interaction (HCI) as the most emphasizing field for the current researchers and scientists. But the orthodox usage of mouse and keyboards for HCI makes our life tedious and stereotyped. After all to prosper the quality of life of elderly and physically challenged people, the improvisation of gesture control technology is a burning urgency. Thus with a sublime goal to create a modernized environment for HCI exterminating all the undesired-age old-orthodox communicating peripherals like keyboard, mouse, etc.; our paper steps forward. It portrays how to control a robot using hand gesture control technique with a 3-axis accelerometer sensor. The working of the sensor is based on the concept of acceleration due to gravity at different positions with its varied orientations. It is placed between any two fingers of the hand. The output of the accelerometer sensor is directly fed to the microcontroller and depending on the hand movement, the robot is controlled. The robot uses differential drive for movement and gets power from motor driver board attached to the chassis. The hand gestured device and the robot is connected through wireless RF (radiofrequency) communication using zigbee module.

Xing-Han Wu et al.[9] introduced a hand-gesture-based control interface for navigating a car-robot. A 3-axis accelerometer is adopted to record a user's hand trajectories. The trajectory data is transmitted wirelessly via an RF module to a computer. The received trajectories are then classified to one of six control commands for navigating a car-robot. The classifier adopts the dynamic time warping (DTW) algorithm to classify hand

trajectories. Simulation results show that the classifier could achieve 92.2% correct rate.

Mithileysh Sathiyanarayanan et al.[10] said in spite of the fact that there are numerous controlled robots using commands from user or self-controlled that uses GPS and sensors, the requirement for gesture controlled robots are on ascent for military purposes, which is called as Unmanned ground vehicles (UGVs). These robots are utilized to increase the warrior's capacity in an open territory. In the last few years, tremendous research is going on in various parts of the world to develop robots for military purposes. This inspiration helped us fabricate a prototype gesture controlled robot (called as UGV) to embrace missions like border patrol, reconnaissance and in dynamic battle both as a standalone unit (automatic) and as well as in co-ordination with human soldiers (manual). Like, command controlled mode and self-controlled mode, we use another specific mode called, gesture control mode or hand wave mode. In this mode, UGV is manoeuvred using commands sent based on hand movements mapped by the IMU unit and the UGV is capable of travelling from one point to another point.

Riyaz Mansuri et al.[11] they introduced a hand-gesture-based Control interface for navigating a car-robot. A 2-axis accelerometer is adopted to record a user's hand trajectories. The trajectory data is transmitted wirelessly via an RF module. The received trajectories are then classified to one of four commands for navigating a car-robot and two control commands for claw/robotic arm.

PROPOSED METHOD

The system consists of two parts:

- Hardware
- Software

Hardware:

Hardware is made up of two parts: Transmitter and Receiver

Transmitter

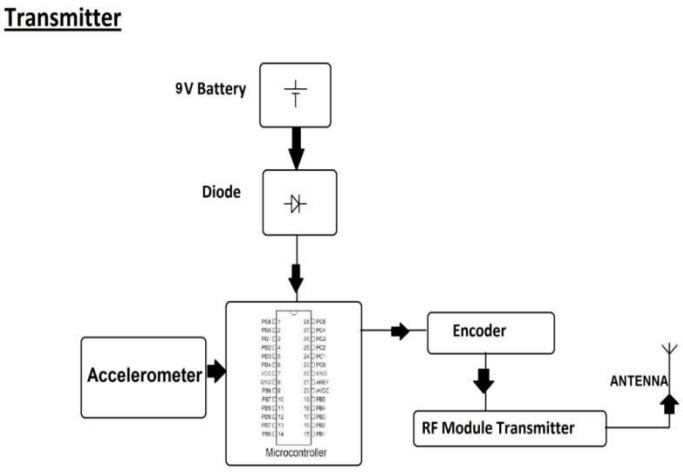

Figure1. Circuit Diagram of Transmitter

Transmitter mainly contains 5 modules:

- ❖ Battery
- ❖ Accelerometer
- ❖ Microcontroller
- ❖ Encoder
- ❖ RF Module Transmitter

Battery

A battery may be a device that converts energy on to voltage. It comprises of various voltaic cells; every voltaic cell comprises of two half cells associated in arrangement by a conductive electrolyte containing anions and cation particles. One half-cell incorporates electrolyte and the terminal to which anions (negatively charged particles) move, for example the anode or negative cathode; the other half-cell incorporates electrolyte and the terminal to which cation particles (positively charged particles) relocate, for example the cathode or positive terminal.

Accelerometer

Accelerometers are used to sense both static (e.g. gravity) and dynamic (e.g. sudden starts/stops) acceleration. One of the more generally utilized applications for accelerometers is tilt-detecting. Because they are affected by the acceleration of gravity, an accelerometer can tell you how it's oriented with respect to the Earth's surface.

Microcontroller

The Atmel ATmega328P is a 32K 8-bit microcontroller dependent on the AVR engineering. Numerous directions are executed in a single clock cycle giving a throughput of very nearly 20 MIPS at 20MHz. The ATMEGA328-PU arrives in a PDIP 28 stick bundle and is reasonable for use on our 28 stick AVR Development Board. There are a number of prominent groups of microcontrollers that are utilized in various applications according to their capacity and plausibility to play out the ideal undertaking, most normal of these are 8051, AVR and PIC microcontrollers.

Features include:

- High Performance, Low Power Design
- 8-Bit Microcontroller Atmel® AVR® advanced RISC architecture
  - 131 Instructions most of which are executed in a single clock cycle
  - Up to 20 MIPS throughput at 20 MHz
  - 32 x 8 working registers
  - 2 cycle multiplier
- Memory Includes
  - 32KB of programmable FLASH
  - 1KB of EEPROM
  - 2KB SRAM
  - 10,000 Write and Erase Cycles for Flash and 100,000 for EEPROM
  - Data retention for 20 years at 85°C and 100 years at 25°C

Encoder

The RF encoders are a progression of CMOS LSIs for remote control systems and applications. They are equipped for encoding data which comprises of N address bits and 12_N information bits. Each location/information can be set to one of the two logic states. The customized addresses/information is transmitted together with the header bits through an RF or an infrared transmission medium. The capacity to choose a TE trigger on the HT12E or a

DATA trigger on the HT12A further improves the application for the adaptability of the 2^12 arrangement of encoders. The HT12A also gives a 38 kHz transporter to infrared systems.

RF Module Transmitter

The ST-TX01-ASK is an ASK Hybrid transmitter module. ST-TX01-ASK are designed by the Saw Resonator, with an effective low cost, small size, and simple-to-use for designing.

Frequency Range: 315 / 433.92 MHZ.

Supply Voltage: 3~12V.

Output Power: 4~16dBm

Circuit Shape: Saw

The output of the power supply which is 5v is connected to 20th pin of MC and GND is connected to its 10th pin. Pin 1-3 of MC is connected to set of push buttons. Pins 7, 8, 9, 3, 12 of MC are connected to Backward, Stop, Forward, Left, Right push buttons. Pins 19, 18, 16, 15 of MC are connected to 10,11,12,13 Pins of encoder HT12E. Pins 1 to 9 of HT12E encoder are connected to GND.

Receiver

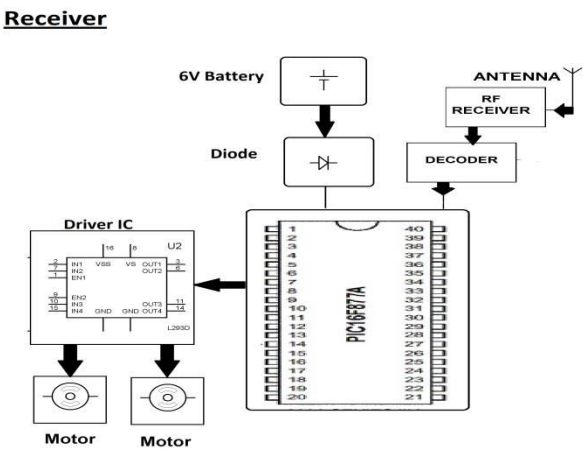

Figure2. Circuit Diagram of Receiver

Receiver mainly contains 6 modules:

- Battery
- RF Receiver
- Decoder
- PIC
- Driver IC
- Motor

RF Receiver

The ST-RX02-ASK is an ASK Hybrid receiver module. An effective low cost solution for using at 315/433.92 MHZ. The circuit shape of ST-RX02-ASK is L/C. Receiver Frequency: 315 / 433.92 MHZ Typical sensitivity: -105dBm Supply Current: 3.5mA IF Frequency: 1MHz

Features:

- Low power consumption
- Easy for application
- Operation temperature range: -20°C ~ + 70°C
- Operation voltage: 5 Volts.
- Available frequency at: 315/434 MHz

Decoder

The 212 decoders are a progression of CMOS LSIs for remote control system applications. They are matched with Holtek's 212 arrangement of encoders (allude to the encoder/decoder cross-reference table). For legitimate tasks, a couple of encoder/decoder with a similar number of addresses and information arrangements should be picked. The decoders get sequential locations and information from a customized 212 arrangement of encoders that are transmitted

by a bearer utilizing a RF or an IR transmission medium. They think about the sequential info information multiple times constantly with their local locations. In the event that no mistake or unmatched codes are discovered; the info information codes are decoded and after that exchanged to the output pins. The VT stick additionally goes high to show a substantial transmission. The 212 arrangement of decoders is equipped for interpreting data that comprises N bits of location and 12_N bits of information. Of this arrangement, the HT12D is orchestrated to give 8 address bits and 4 information bits, and HT12F is utilized to disentangle 12 bits of location data.

PIC

The PIC16F87XA devices have a 13-bit program counter capable of addressing an 8K word x 14 bit program memory space. The PIC16F876A/877A devices have 8K words x 14 bits of Flash program memory, while PIC16F873A/874A devices have4Kwords x 14 bits. Accessing a location above the physically implemented address will cause a wrap around.The Reset vector is at 0000h and the interrupt vector is at 0004h.

Driver IC

L293D is a double H-connect engine driver coordinated circuit (IC). Engine drivers go about as flow speakers since they take a low-momentum control signal and give a higher-ebb and flow signal. This higher current sign is utilized to drive the engines. L293D contains two inbuilt H-connect driver circuits. In its basic method of activity, two DC engines can be driven at the same time, both in forward and turn around bearing. The engine activities of two engines can be constrained by information rationale at pins 2 and 7 and 10 and 15. Information logic 00 or 11 will stop the comparing engine. Logic 01 and 10 will turn it in clockwise and anticlockwise headings, separately.

Motor

A DC motor is an electric engine that keeps running on direct flow (DC) power. In any electric engine, activity depends on basic electromagnetism. A current-conveying conductor creates an attractive field; when this is then put in an outside attractive field, it will encounter a power relative to the current in the conductor, and to the quality of the outer attractive field. As you are very much aware of from playing with magnets as a child, inverse (North and South) polarities draw in, while like polarities (North and North, South and South) repulse. The inner setup of a DC engine is intended to outfit the attractive cooperation between a current-conveying conductor and an outer attractive field to create rotational movement.

Pin's 1 to 4 of MC is connected 13 to 10 of HT12D Decoder. Pin 10 of MC is connected to 17th pin of HT12D Decoder. 14th pin of HT12D Decoder is connected to DATA pin of Receiver. Pin's 28 & 27 of MC are connected to 7 and 2 Pin's of L293D. Pin's 26, 23, 28, 21 of MC are connected to 1, 9, 10, 15 pin's of

L293D Motor Driver. Pin's 3, 6, 11, 14 of L293D are given to Motor 1 and 2.

HARDWARE COMPONENTS:

1. Battery
2. Voltage regulator
3. Micro controller
4. Push buttons
5. L293d
6. Dc motor
7. Rf module
8. Accelerometer
9. BC547
10. 1n4007
11. Resistor
12. Capacitor

Battery

An electrical battery could be a combination of 1 or additional electrochemical cells, used to convert stored chemical energy into electrical energy. The battery has become a typical power supply for several home and industrial applications. Batteries is also used once and discarded, or recharged for years as in standby power applications. Miniature cells are used to power devices like hearing aids and wristwatches; larger batteries offer standby power for telephone exchanges or pc data centres.

Voltage Regulator 7805

The LM78XX/LM78XXA series of three-terminal positive regulators are available in the TO-220/D-PAK package and with several fixed output voltages, making them useful in a Wide range of applications. Each type employs internal current limiting, thermal shutdown and safe operating area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output Current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents.

Micro Controller Pic16F877A

High-Performance RISC CPU:

- Only 35 single-word instructions.
- All single-cycle instructions except for program branches, which are two cycle.
- Operating speed: DC – 20MHzclockinput DC– 200nsinstruction cycle
- Up to 8Kx14 words of Flash Program Memory, Up to 368x8 bytes of Data Memory (RAM), Up to 256x8 bytes of EEPROM Data Memory.
- Pin out compatible to other 28-pin or 40/44-pin, PIC16CXXX and PIC16FXXX microcontrollers.

Push Buttons

A push-button (also spelled pushbutton) or simply button is a simple switch mechanism for controlling some aspect of a machine or a process. Buttons are typically made out of hard

material, usually plastic or metal. The surface is usually flat or shaped to accommodate the human finger or hand, so as to be easily depressed or pushed. Buttons are most often biased switches, though even many un-biased buttons (due to their physical nature) require a spring to return to their un-pushed state. Different people use different terms for the "pushing" of the button, such as press, depress, mash, and punch.

Motor Driver (L293d)

L293D is a dual H-bridge motor driver integrated circuit (IC). Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors.

L293D contains two inbuilt H-bridge driver circuits. In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction. The motor operations of two motors can be controlled by input logic at pins 2 & 7 and 10 & 15. Input logic 00 or 11 will stop the corresponding motor. Logic 01 and 10 will rotate it in clockwise and anticlockwise directions, respectively.

DC Motor

A DC motor is an electric motor that runs on direct current (DC) electricity. In any electric motor, operation is based on simple electromagnetism. A current-carrying conductor generates a magnetic field; when this is then placed in an external magnetic field, it will experience a force proportional to the current in the conductor, and to the strength of the external magnetic field. As you are well aware of from playing with magnets as a kid, opposite (North and South) polarities attract, while like polarities (North and North, South and South) repel. The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor and an external magnetic field to generate rotational motion.

RF Communication

RF communication works by creating electromagnetic waves at a source and being able to pick up those electromagnetic waves at a particular destination. These electromagnetic waves travel through the air at near the speed of light. The wavelength of an electromagnetic signal is inversely proportional to the frequency; the higher the frequency, the shorter the wavelength.

Frequency is measured in Hertz (cycles per second) and radio frequencies are measured in kilohertz (KHz or thousands of cycles per second), megahertz (MHz or millions of cycles per second) and gigahertz (GHz or billions of cycles per second). Higher frequencies result in shorter wavelengths. The wavelength for a 900 MHz device is longer than that of a 2.4 GHz device.

BC 547

The BC547 transistor is an NPN Epitaxial Silicon Transistor. The BC547 transistor is a general-purpose transistor in small plastic packages. It is used in general-purpose switching and amplification BC847/BC547 series 45 V, 100 mA NPN general-purpose transistors.

1N4007

Diodes are used to convert AC into DC these are used as half wave rectifier or full wave rectifier. Three points must he kept in mind while using any type of diode.

- Maximum forward current capacity
- Maximum reverse voltage capacity
- Maximum forward voltage capacity

Resistors

A resistor is a two-terminal electronic component designed to oppose an electric current by producing a voltage drop between its terminals in proportion to the current, that is, in accordance with Ohm's law:

$$V = IR$$

Resistors are used as part of electrical networks and electronic circuits. They are extremely commonplace in most electronic equipment. Practical resistors can be made of various compounds and films, as well as resistance wire (wire made of a high-resistivity alloy, such as nickel/chrome).

Capacitors

A capacitor or condenser is a passive electronic component consisting of a pair of conductors separated by a dielectric. When a voltage potential difference exists between the conductors, an electric field is present in the dielectric. This field stores energy and produces a mechanical force between the plates. The effect is greatest between wide, flat, parallel, narrowly separated conductors.

Accelerometers

Accelerometers are used to sense both static (e.g. gravity) and dynamic (e.g. sudden starts/stops) acceleration. One of the more widely used applications for accelerometers is tilt-sensing. Because they are affected by the acceleration of gravity, an accelerometer can tell you how it's oriented with respect to the Earth's surface. For example, Apple's iPhone has an accelerometer, which lets it know whether it's being held in portrait or landscape mode. An accelerometer can also be used to sense motion. For instance, an accelerometer in Nintendo's Wii Mote can be used to sense emulated forehands and backhands of a tennis racket, or rolls of a bowling ball. Finally, an accelerometer can also be used to sense if a device is in a state of free fall. This feature is implemented in several hard drives: if a drop is sensed, the hard drive is quickly switched off to protect against data loss.

SOFTWARE:

MPLAB IDE is a software program that runs on a PC to develop applications for Microchip

microcontrollers. It is called an Integrated Development Environment, or IDE, because it provides a single integrated environment to develop code for embedded microcontrollers.

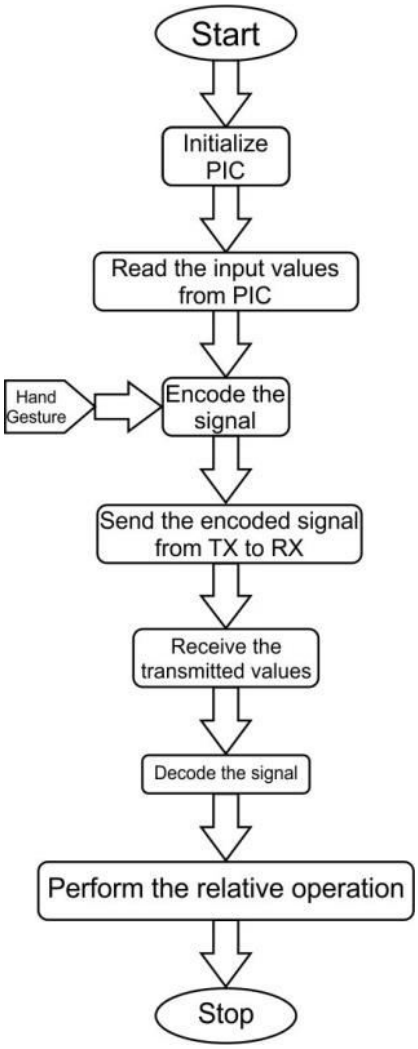

Figure3. Flowchart of program

EXPERIMENTAL RESULTS

Transmitter:

The output of the power supply which is 5v is connected to 20th pin of MC and GND is connected to its 10th pin. Pin 1-3 of MC is connected to set of push buttons. Pins 7, 8, 9, 3, 12 of MC are connected to Backward, Stop, Forward, Left, Right push buttons. Pins 19, 18, 16, 15 of MC are connected to 10,11,12,13 Pins of encoder HT12E. Pins 1 to 9 of HT12E encoder are connected to GND.

Receiver:

Pin's 1 to 4 of MC is connected 13 to 10 of HT12D Decoder. Pin 10 of MC is connected to 17th pin of HT12D Decoder. 14th pin of HT12D Decoder is connected to DATA pin of Receiver. Pin's 28 & 27 of MC are connected to 7 and 2 Pin's of L293D. Pin's 26, 23, 28, 21 of MC are connected to 1, 9, 10, 15 pin's of L293D Motor Driver. Pin's 3, 6, 11, 14 of L293D are given to Motor 1 and 2.

Results:

In this project transmitter and receiver both will take part continuously as transmitter will give the instructions to the receiver and then according to gestures receiver and transmitter will work. When we tilt hand with an accelerometer before the robot, at that point the robot begins pushing ahead until the successive movement is given. When we tilt hand in reverse direction, then the robot changes its direction and state. At that point it begins moving in reverse direction until the following sign is given. When we tilt hand on left side, at that point the robot moves into left side until the following sign is given. In similar way, when we tilt hand in right side, at that point the robot moves right side.

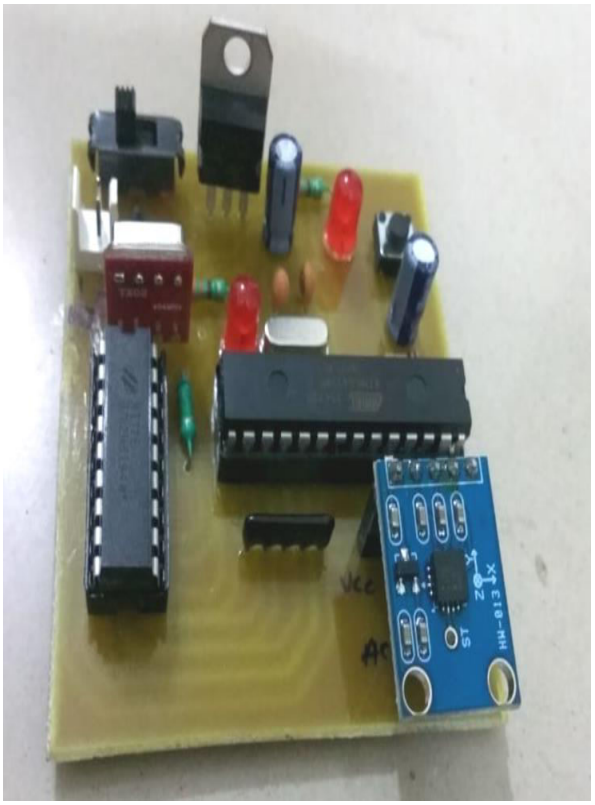

Figure4. Circuit image of Transmitter

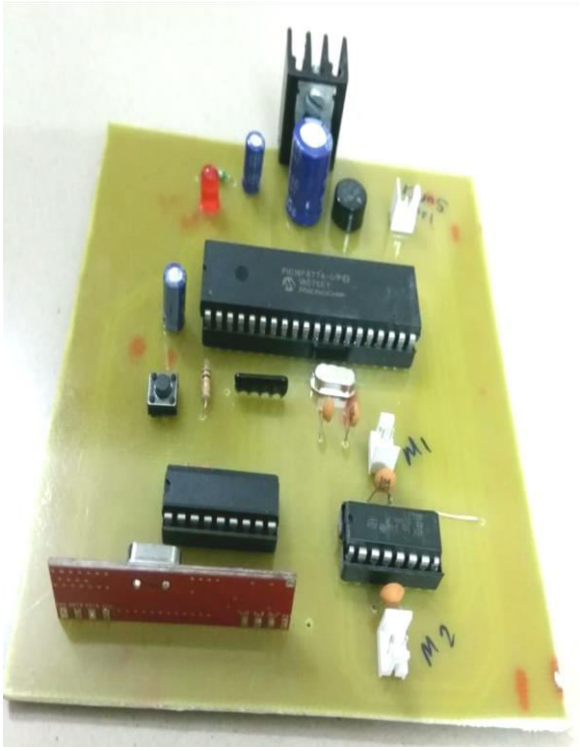

Figure5. Circuit image of Receiver

This robot is meant for recognizing 5 sets of gestures: forward, backward, left, right and stop.

- When we tilt our hand in front side then the robot will move in forward direction.

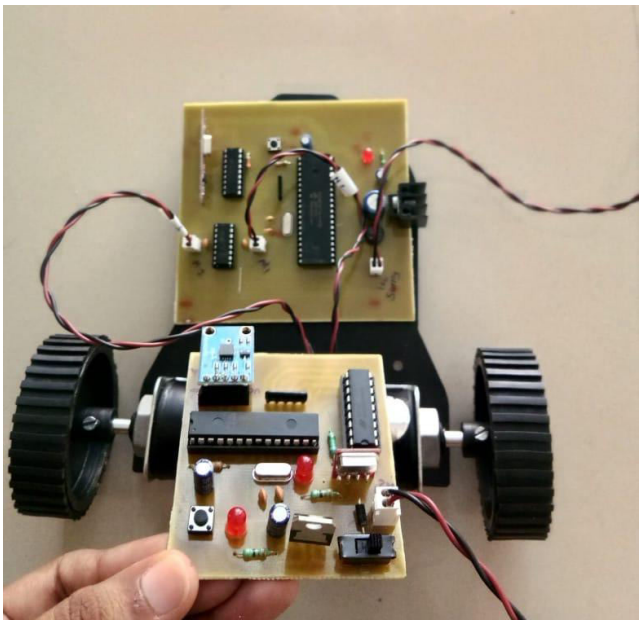

Figure6. When vehicle is moving in forward direction

- When we tilt our hand in back side then the robot will move in backward direction.
- When we tilt our hand in left side then the robot will move in left direction.

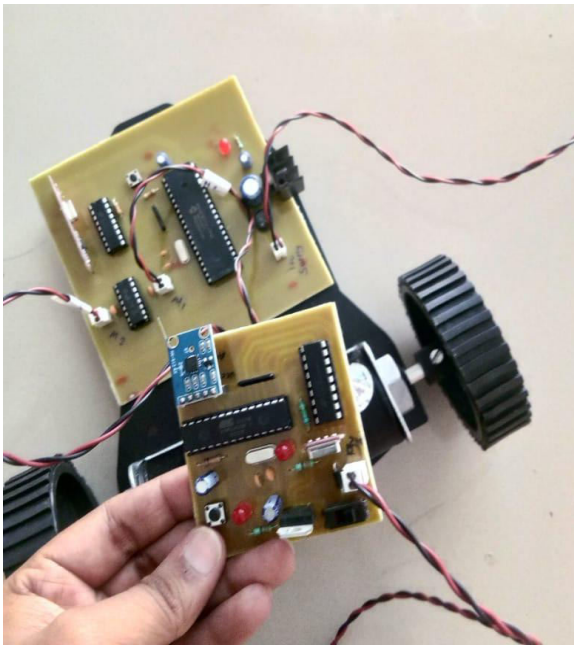

Figure7. When vehicle is moving in left direction

- When we tilt our hand in right side then the robot will move in right direction.

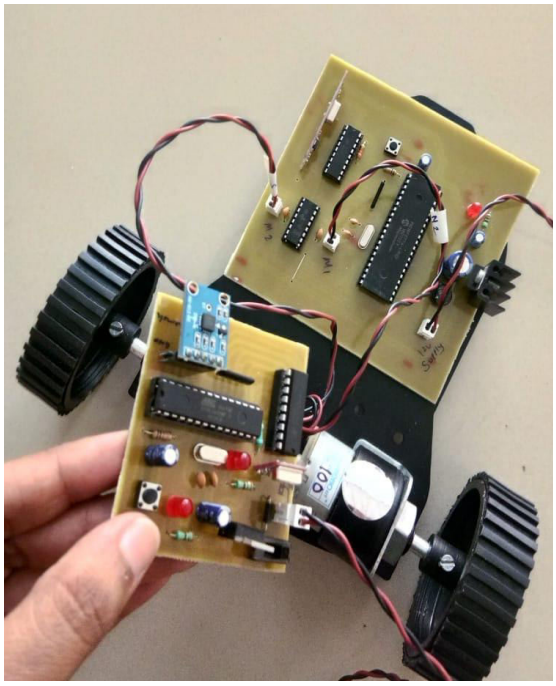

Figure8. When vehicle is moving in right direction

- When we will keep our hand still then the robot will stop.

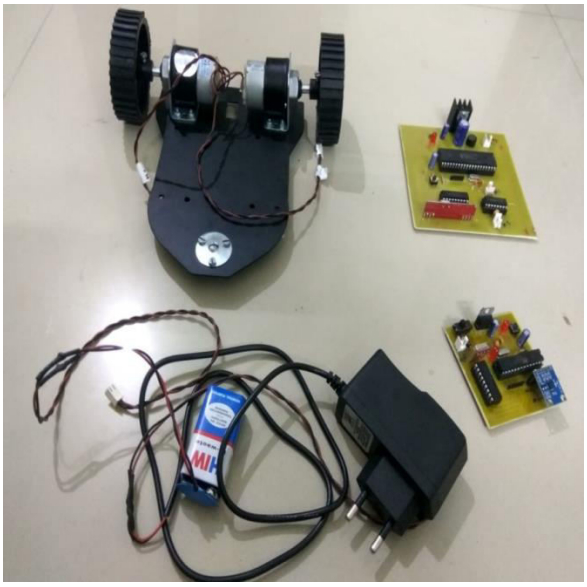

Figure9. Unassembled image of robotic vehicle

CONCLUSION

The point of our proposed system is to build an accelerometer based Hand Gesture Controlled Robot. As its name suggests it will be a productive robot, which can be moved toward any path by influencing simple gestures and the system's affectability to motions can be effectively balanced as for each our preferring. After concentrated on this system we can conclude when a person moves his/her hand Left, Right , Down , Up then accelerometer will detect variations and send that specific signal to the microcontroller and that signal will sent to the receiver part of the system then based on transmitted signal robot will move. The hand gesture robot utilizing Microcontroller will demonstrate to work satisfactorily by using the accelerometer.

The on board batteries occupy a lot of space and are also quite heavy. We can either use

some alternate power source for the batteries or replace the current DC Motors with ones which require less power.

The proposed system is applicable in hazardous environment where a camera can be attached to the robot and can be viewed by the user who is in his station. This system can also be employed in medical field where miniature robot are created that can help doctors for efficient surgery operations For more efficient response, threshold values can be used to detect gesture and advanced features such as finger counts that provide different functional commands can be used.

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