Hand Gesture controlled Wheelchair with Health Monitoring System

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ABSTRACT-*:* . Relying on others for the movement is the prime obstacle encountered by the disabled persons. Constant care on health is needed, which further needs external aid. Thus, the main motivation of the paper is to evolve and implement a prototype of hand gesture controlled wheelchair which is accompanied by the real-time health monitoring system. The proposed model is examined by a motion sensor and the health monitor, which is mounted on hand gloves. This model thus helps the differently-abled to move without external aid. This model aims to control the automaton of the wheelchair through hand gestures and keeps a track on health by embedding sensor modules. A device is used to identify the hand movement, the temperature, pulse rate and sends an indication to Arduino Uno. The hand gestures are thus detected and enforced along with the health parameters.

Keywords: Arduino Uno, Accelerometer, Gyroscope, Hand Gesture, Pulse Rate, Physically Challenged, Temperature, Obstacle Detection, Wireless Sensor

I. INTRODUCTION

Humans interact in the physical world employing the five senses. Efforts have been carried out to develop intelligence and natural interfaces between the users and the computer system based on gestures. Gestures provide an innate connection between the living brain and the electronic brain. Hence they not only take the place of conventional equipment but also be second-handed to expand the functioning. Maintaining good health is necessary to carry out any task in our life. Any abnormality in our body should be reported and treated properly, failing which may result in the death of the person, so a regular check should be ensured for the proper functioning of the body. Our proposed system is one such machine that takes the gestures of differently-abled humans as input along with the body temperature and heart rate to keep a check on their health and make their life better. It is a kind of semi-autonomous or human-controlled robot controlled by hand gestures. The project has two major parts: The transmitter and the Receiver. We program the transmitter circuit to be able to give its outputs to Arduino, which processes it and sends the signal to the receiver. In the receiver, a controller is used to identify the gestures, health records, and act accordingly.

II. RELATED WORKS

The system comprises two major parts.

1. WheelChair movement and
2. A real-time health monitoring system, both of which accompanied by the wireless transmission system.

The paper “Robot Control by Accelerometer Based Hand Gesture using Arduino Microcontroller” published in International Journal of Recent Technology and Engineering-Volume 7, Issue 4, November 2018 by Pankaj Kumar Gautam, Sudhanshu Pandey, Vishwajeet Kumar Nanda, represents the framework of an automated wheelchair which

moves by the control of hand gesture. Here an accelerometer is used to sense the direction of the hand and move the robot accordingly. In our model, we are using the accelerometer ability along with the gyroscope to have precise information about the orientation.

The paper "Design of Hand Gesture Controlled Robot using Arduino Lilypad" published in International Journal of Engineering and Advanced Technology, Volume 8, Issue 6S, August 2019 by Balaji Sivakumar, Pravin Kumar, Bhuvaneswari Balachander, presents the model of wheelchair controlled by hand gestures. Here, an encoder and decoder are used to deliver the data, and different forms of hand gestures are defined. We are using the encoder and decoder in our model so that the data is transferred securely to the receiver from the transmitter.

The paper "Gesture Controlled Robot Using Arduino and Android" published in International Journal of Advanced Research in Computer Science and Software Engineering, Volume 6, Issue 6, June 2016 by Premangshu Chanda, Pallab Kanti Mukherjee, Subrata Modak, Asoke Nath, represents a model of hand gesture controlled robot, Here the gestures are controlled by an Android operated application and transmitted via Bluetooth. In our model, we use an RF module, as the range of Bluetooth is generally short compared to an RF module.

The paper "A hand gesture-based wheelchair for a physically handicapped person with the emergency alert system" published in International Research Journal of Engineering and Technology, Volume 3, Issue 4, April 2016 by Prof. Chitte p.p., Miss: Khemnar S.B., Miss: Kanawade A.A. Miss: Wakale S.B, represents a model of hand gesture controlled wheelchair with the alert system. Here, the IR sensor is used to control the movement of the wheelchair and to detect the obstacle, and an alert system is designed in case of an emergency. In our model, we make use of an ultrasonic sensor to detect the obstacle, and an alert system is used for health monitoring.

The paper "Automated Gesture-Based Wireless Wheelchair Control by Means of Accelerometer" published in International Journal of Engineering and Advanced Technology, Volume 9, Issue 1, October 2019 by V Sridevi, P. Ishwarya, P. Surya Chandra, N. Suresh Kumar, presents a model of the hand gesture controlled wheelchair. Here the ultrasonic sensor is used for obstacle detection.

The paper "Tongue Operated Wheelchair for Physically Disabled People" published in the International Journal of Latest Trends in Engineering and Technology, Volume 4, by Monika Jain and Hitesh Joshi, presents a model of tongue controlled technology for people with a severe disability. Here a permanent magnet is placed on the tongue whose magnetic field is measured by the magnetic sensors. The sensor signal is transmitted and processed to control the wheelchair but it is really painful as the permanent magnet is pierced on the tongue.

The paper " A Survey on Health Monitoring System by using IoT" published in the International Journal for Research in Applied Science and Engineering Technology, Volume 6, Issue 3, March 2018 by M.Saranya, R.Preethi, M.Rupasri, Dr.S.Veena, gives us a basic understanding and information about heath detection and monitoring of patients and various forms of performing them.

The paper " E-health monitoring system" published in International Conference on Applied Internet and Information Technology June 2016 by Aleksandar Kotevski, Natasha Koceska, and Saso Koceski, gives us an insight on using our electronic gadgets to monitor our health by regularly maintaining the records of the patients and alert when an emergency arises by intimating the doctor. In our model, we are storing the records of the patient in a nearby remote device.

The paper "Raspberry-Pi Based Health Monitoring System" published in the International Journal of Advanced Research in Electrical, Electronics, and Instrumentation Engineering, Volume 4, Issue 8, August 2015 by Chetan T.Kasundra and Prof.A.S.Shirsat, focuses on the measurement of important parameters. Here, the wireless transmission of the data takes place through the Bluetooth module and Raspberry acts as a controller. It also presents a health care system that is more flexible.

The paper "Healthcare Monitoring for Physically Challenged People in Wheelchair using IoT" published in the International Journal of Science Technology & Engineering, Volume 4, Issue 9, March 2018 by Dr. K. Muthulakshmi, Ms. R. Indhu, Mr. E. Abishake, Mr. R. Kishore Kumar, Ms. D. Lavanya, explains how a wheelchair can be controlled by head gesture with help of Tilt sensor and records of the patient are stored and the database is sent to the doctor using IoT. The last two papers serve as the inspiration for a health monitoring system via wireless transmission.

III. PROBLEM DEFINITION

In the Existing System, the wheelchair is controlled using the button or joystick which makes it difficult to handle for the disabled. Moreover, the transmitter and receiver sections are fixed and they cannot be adjusted. Any health monitoring can only be done externally with the help of others which makes it all the more difficult for the disabled.

IV. PROPOSED SYSTEM

In our proposed model, We are designing a wheelchair whose direction of motion is controlled by hand gesture, which is accompanied by a system to keep track of the health condition persistently.They have a check on the specifications like heartbeat, temperature and transmit the data to a remote device for a future purpose. Usually, we find these ideas as individuals, but we are combining them into a single unit. During an abnormal or emergency, the doctor is notified. Here Arduino, which forms the central part, takes various inputs and acts accordingly to it.

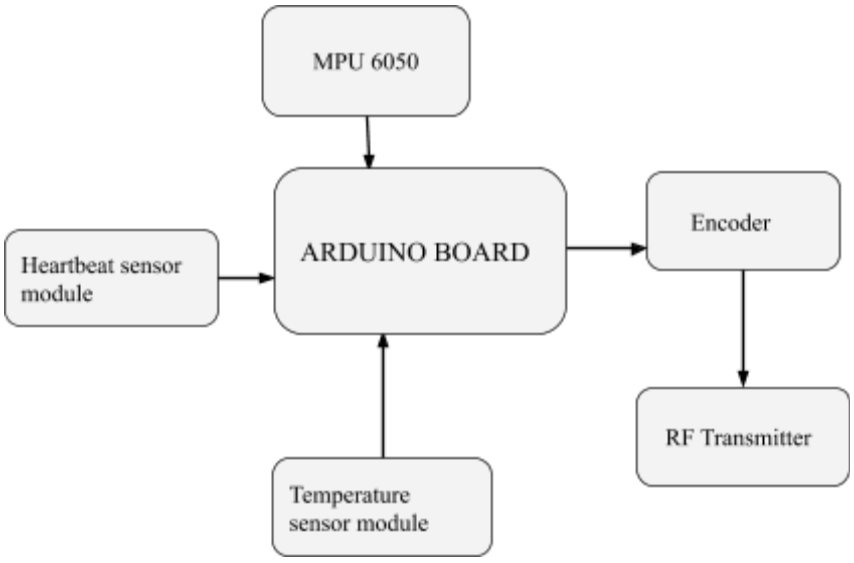

Fig 1. Block Diagram of Transmitter

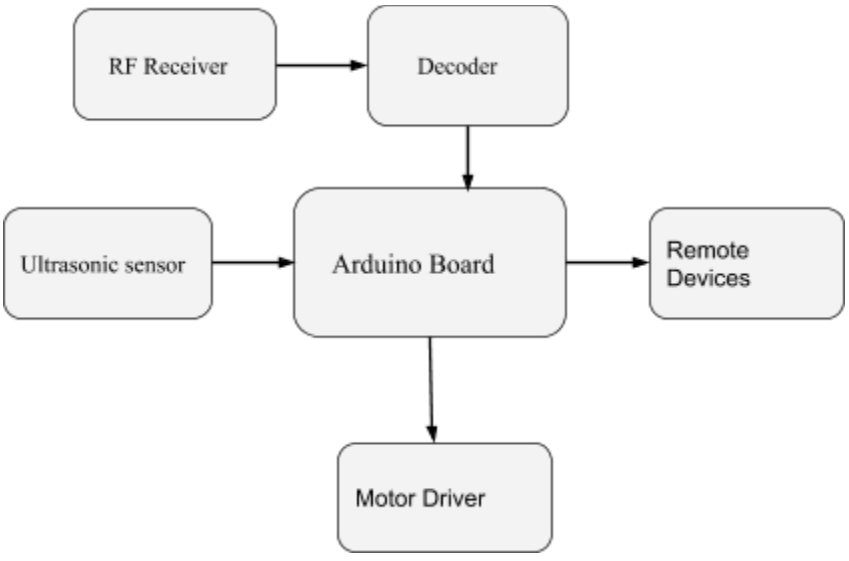

Fig 2. Block Diagram of Receiver

V. OPERATION OF COMPONENTS INVOLVED

HARDWARE :

1. MPU6050 Sensor

An electromechanical device is used to measure the acceleration. It is termed an Accelerometer. Acceleration is the rate of change of velocity, which may be constant as gravity or dynamic by vibrating an object.

The MPU6050 is a 3axis based accelerometer, and gyroscope. It calculates the acceleration and position with a minimum full-scale range. It measures the acceleration, constant with time or dynamic with precise measurements and finds the angular position by integrating the output of the gyroscope with angular velocity, obtained from acceleration.

The device has 8 pins such as VCC, GND, SCL, SDA, XDA, XCL, ADO, and INT.Vcc is connected to the 5V supply of the controller. The SCL AND SDA pins are connected to the A4 and A5 pins of the controller.

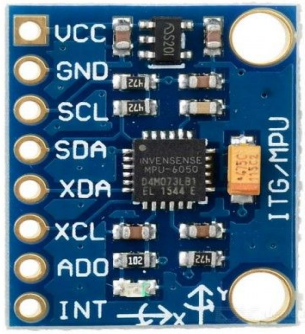

Fig 3.

2. Arduino Uno

Arduino Uno is the microcontroller board based on the chip ATmega328p.It is the first ancestor for all the USB based boards.It served the heart for the development of the other advanced boards. It has several components embedded in it. It consists of 14 digital I/O pins,6 analog pins,16MHZ crystal oscillator, a power jack, USB, and button for reset.It is programmed by connecting the USB cable to the computer and providing power supply by battery or any other DC device source.

3. Encoder HT12E & Decoder HT12D

HT12E is an integrated encoder circuit consisting of 2^12 series of encoders. The main function of the encoder is to convert the input data from a parallel combination to an output data transmitted serially. It takes 12bit parallel data as the input, in which 8 bits refer to the address and the remaining 4 bits refer to the data. The transmission of the program address/data takes place through an RF medium only when the 14th pin, the transmission enable, is set to low. The encoder begins the 4-word transmission cycle and is repeated as long as the enable is low. As the enable returns to high, it marks the stopping condition.

The encoder pins 10,11,12,13 are connected with the pins of 8,9,10,11 of the controller. A pullup resistor of value 47k ohm is placed between the 15 and 16 pins of the encoder. The 17th pin of the encoder is connected to the RF transmitter.The power supply of 5V is given through the VDD.

HT12D is an integrated decoder circuit consisting of 2^12 series of decoders. The main objective of this is to decode the data and addresses obtained serially from the RF receiver, into parallel outputs and send the data to output pins. It decodes the 12 bits, in which 8 bits are the address and 4 bits are data. The data is decoded only if there are no errors in the codes.

The decoder pins 10,11,12,13 are connected to the pins 2,7,10,15 of the motor driver IC.A pullup resistor of value 10k ohm is connected between the pins 15 and 16 of the decoder.The 14th pin is connected with the data pin of the receiver and the 18th pin to the power supply.

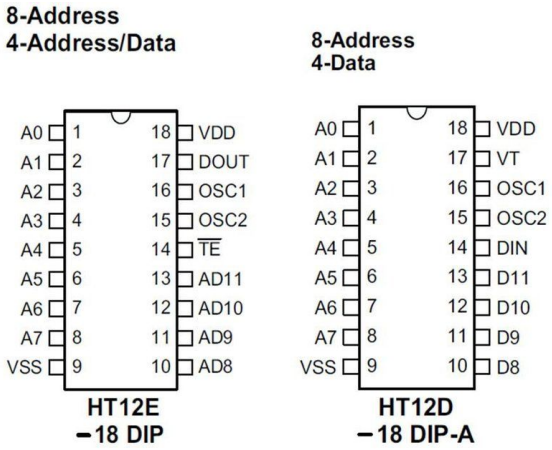

Fig 4.

4. HC-SR04 Sensor

SR04 is an ultrasonic sensor that detects the presence of obstacles in the movement of a wheelchair. It blocks the movement of the wheelchair completely when an obstacle is detected and needs to be reset to operate again.

Fig 5.

It consists of 4 pins namely Vcc, Gnd, Trig, Echo. It can measure up to a distance of 4m with an accuracy of 1cm. It sends a signal and then picks up its echo to compute the period from which distance can be calculated as a period is proportional to distance. The trigger and echo pin is connected to the D10 and D11 pin of the controller.

5. Temperature Sensor DS18B20

The main advantage of this sensor is that it is a programmable digital sensor. It consists of 3 pins namely Vcc,Data,Gnd, where the value can be read from a data pin using the method of one-wire.It ranges from minus 55 degree to plus 125 degree, with plus or minus 0.5 degree accuracy . The output resolution ranges from 9-bit to 12-bit.

6. Pulse/Heartbeat Sensor

The pulse sensor determines the variation in the blood volume to determine the heartbeat. It has 3 pins namely VCC,Signal,Gnd,where the signal pin pulsates the output. The sensor has two faces, one face consists of the LED, which is placed along with a photodiode(detector), and on the other face, we have some circuitry, which is responsible for amplification and noise cancellation. The Led is placed on the fingertip, the light from the Led falls on the vein in the finger. The blood in the vein absorbs a part of the light and the light reflected by the blood is received by the photodiode, which sends its output(electrical signal) to the Arduino, which determines the heartbeat, which is corresponding to the pulse rate,through frequency of the signal

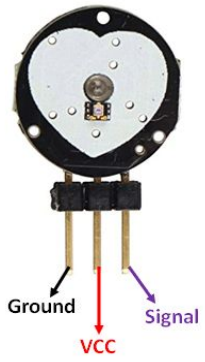

Fig 6.

7. RF transmitter & RF receiver

Radiofrequency (RF) waves are electromagnetic waves whose oscillation ranges between 3kHz and 300GHz and it is relative to the wave frequency, and the alternating currents that transfer the signals. It describes the use of wireless communication, in opposition to the communion via electric wires. Here, We are utilizing a 433 MHz RF module which has a range of about 50-80m.

The TX module comprises 4 pins namely, Ground, Vcc, Data, and Antenna. The data pin of the transmitter is associated with the 17th pin of the encoder through which it receives the data to be transmitted. The transmitting unit of length 17cm is used to send and receive the RF sign connected with the transmitter antenna. The signs are sent remotely to the receiver.

The Receiver module consists of 8 pins, 3 Ground, 2 Vcc, 2 Data, and 1 Antenna pins. The data pin of the receiver is connected to the 14th pin of the decoder.

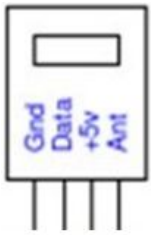

Fig 7.

The RX module consists of 8 pins, 3 Ground, 2 Vcc, 2 Data, and 1 Antenna pins. The data pin of the receiver is connected to the 14th pin of the decoder. The receiving wire of length 17cm is used to send and receive the RF sign connected with the receiver antenna. The signs are transmitted virtually to the recipient using this wire.

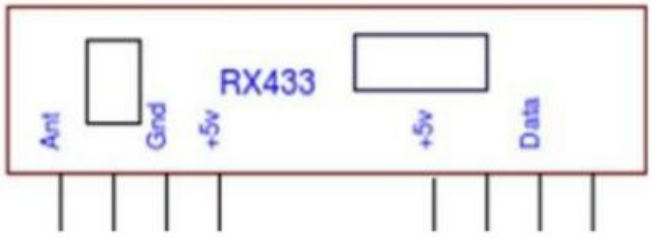

Fig 8.

The length of the transmitting and the receiving apparatus is determined by the RF module recurrence.

8. L293D driver

The motor driver IC L293D is implemented for the functioning of the motors. It consists of 16 pins namely, four output pins, four data pins, two Vcc pins, two Enable pins, and four ground pins. All the 4 data pins are connected to the output pins of the decoders. Also, four output pins are connected to the motor of the wheelchair. Each of the 2 VCC pins is connected to a power supply of 5V.

SOFTWARE:

1. **Arduino IDE**

The Arduino Integrated Development Environment is a platform where the codes are written in any of the programming languages. They are saved as a text file with the extension .ino. It contains a lot of examples which make even the beginners to work with ease. The hexadecimal text file is encoded into the board by the bootloader program in the board.

2. **PLX-DAQ**

Parallax Data Acquisition tool software gets the information from 26 channels from any Parallax controllers and drops the data into the column when they are received.The examination of the spreadsheets grouped in the field area is done in a trouble-free way due to this tool. The transmitted data is recorded in the computer and then plotted and used for analysis.

VI. WORKING

Flowchart

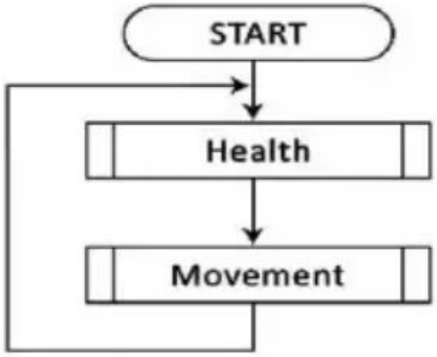

Fig 9.

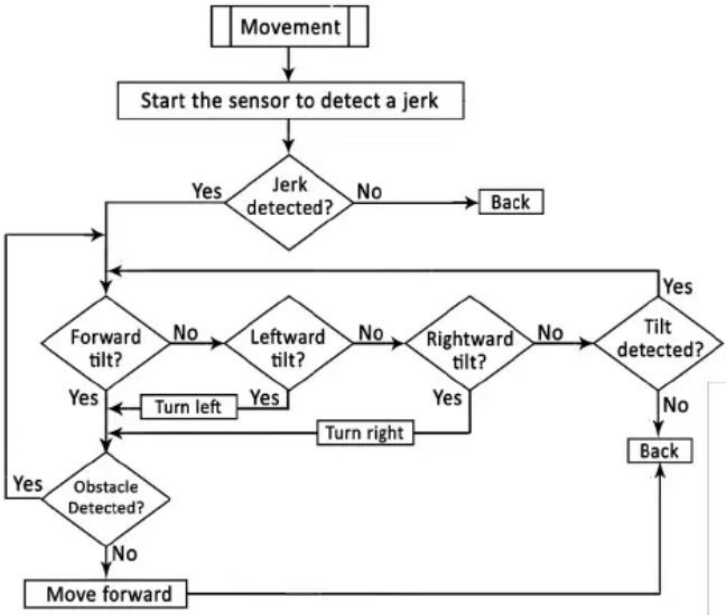

Fig 10. Movement of the WheelChair

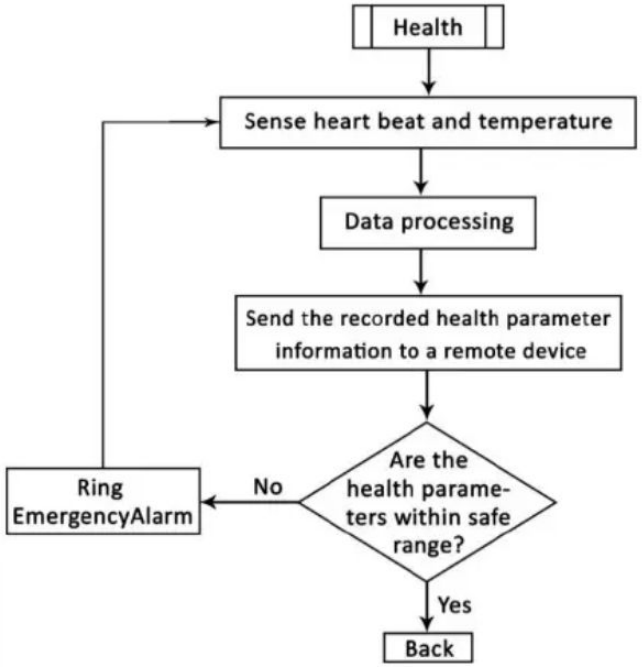

Fig 11. Health monitoring system

MPU6050 consists of an accelerometer and gyroscope, which detects the tilt of the hand.

The gyroscope measures the rate of change of the angular position, along the three axes The outputs of the gyroscope are measured in degrees per second. To obtain the angular position, we have to intermingle the angular velocity which is obtained from the acceleration. On the other side, the accelerometer of MPU6050 measures acceleration. So, if we merge the data of the accelerometer and gyroscope we would get exact information about the orientation of the sensor. The data is transmitted to the Arduino by interfacing the MPU6050 with the Arduino. The

pulse sensor determines the variation in the blood volume through the LED and changes it to an electrical signal from the reflected light signal, which is done by the photodiode. These electrical signals are sent to the Arduino where they are processed. The signal pin of the pulse sensor is interfaced with the A2 pin of the controller. The temperature sensor measures the temperature of the body, the data pin of the sensor is interfaced with the D2 pin of the controller.

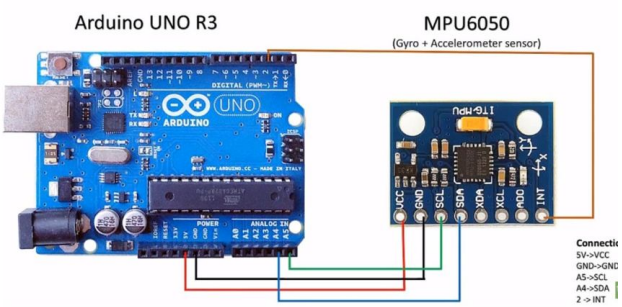

Fig 12.

The data is collected by the Arduino from the MPU6050, pulse, temperature sensor. The signal is encoded using the HT-12E encoder and then transmitted to the RF transmitter. The RF module is interfaced with the Arduino. The encoder encodes the input data which is given parallelly and sends the output data, serially and after which the data is transmitted through the RF transmitter.

The RF receiver receives the signal and passes it to the decoder HT-12D, which decodes the data. The decoded signal is given to the Arduino from which the controls are given to the respective modules for actions. The L293D receives the control from the controller and the driver controls the functioning of the motors by considering the pre-established parameters and checks for the obstacle using the sensor which is interfaced with the controller. The data of temperature and pulse sensor received from the controller is stored in a remote device. When the threshold conditions of the parameter are exceeded, then there is an emergency alert in the device.

VII.RESULTS

Prototype and Functioning

The section of transmitter is placed on hand gloves or the palm depending on the convenience of the person and the receiver section is placed near the beneficiary part of the vehicle(wheel) that moves according to the gesture. This section depicts the five commonly used distinct motions of the hand. They are ‘stop’ ‘forward’ ‘reverse’ ‘right’ and ‘left’.

1. Gesture to Stop

When the position of the accelerometer is evenly placed on the axes, the output of the decoder becomes high, which marks the stopping condition. Pins 10,11,12,13 of the decoder are set to 1(high) and make the wheelchair to halt.

2. Gesture to Forward

When the position of the accelerometer makes an angle to move forward, the output of the decoder,whose two pins 11 and 13 becomes 0 and other output pins 10 and 12 becomes 1 which makes the wheelchair to move forward.

3. Gesture to Reverse

When the position of the accelerometer makes an angle to move in backward, the output of the decoder,whose two pins 10 and 12 becomes 0 and other output pins 11 and 13 becomes 1 which makes the wheelchair to move in backward direction.

4. Gesture to Right

When the position of the accelerometer makes an angle to move in right, the output of the decoder,whose two pins 11 and 12 are calibrated to 0 and other output pins 10 and 13 are calibrated to 1 which makes the wheelchair to move in right.

5. Gesture to Left

When the position of the accelerometer makes an angle to move in left, the output of the decoder,whose two pins 10 and 13 are calibrated to 0 and other output pins 11 and 12 are calibrated to 1 which makes the wheelchair to move in left.

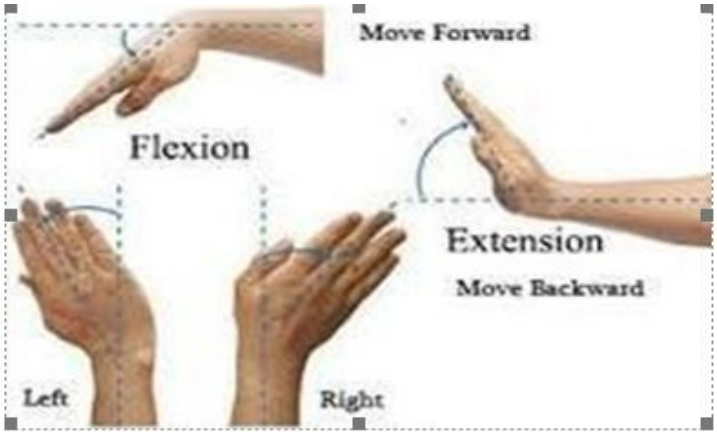

Fig 13.

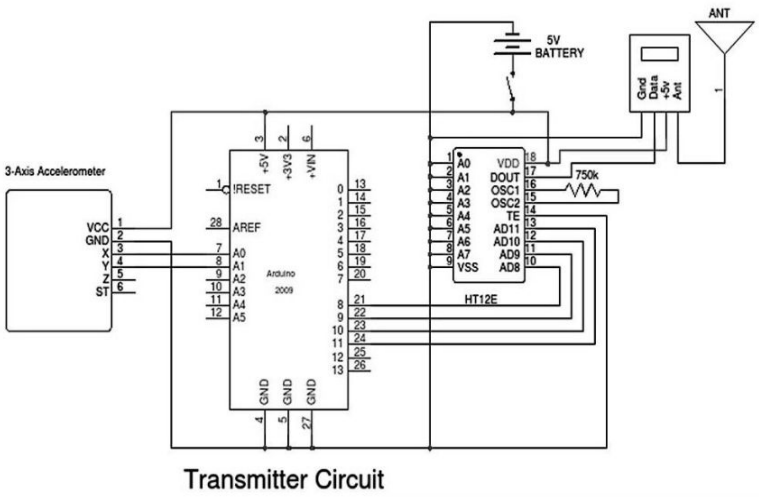

Fig 14. Transmitter circuit for the wheelchair system

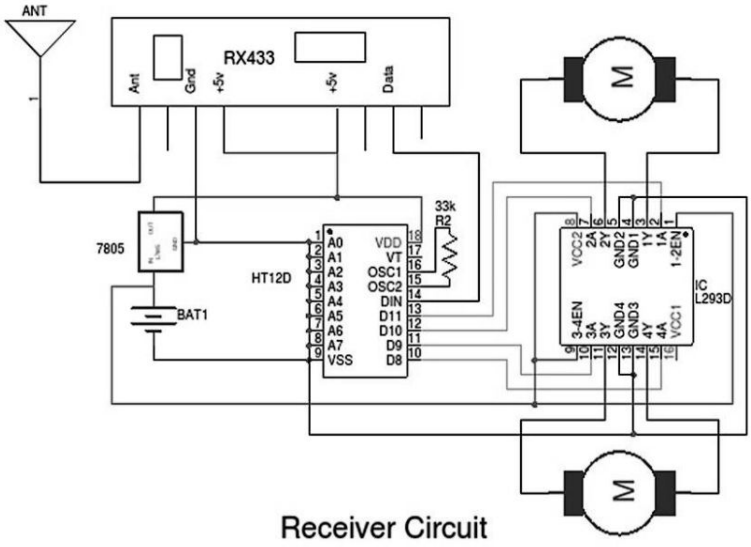

Fig 15. Receiver circuit for the system

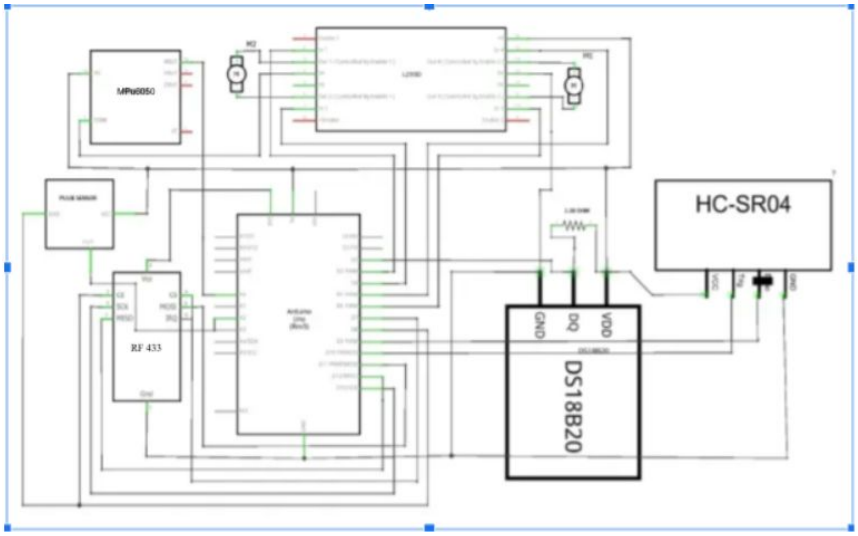

Fig 16. Overall circuit of the system

6. Circuit Elements

Fig 14 comprises a transmitter circuit of the wheelchair that includes the components which has been discussed in the section V and Fig 15 comprises a receiver circuit that has components which aids in receiving the unique sign from the transmitter .Fig 16 comprises the overall circuit of the system.

7. Result

The sign transmission through the radio recurrence segment has a better capacity in contrast with IR (infrared). The superiority exerted by the RF , that can send the sign for long separation, these aches extend the application, and the sign can travel even if there is any obstacle between the transmitter and receiver. The working of the recurrence of the transmitter and the receiver is 433MHz. The consecutive data is sent via the radio wires and the receiver obtains the data and converts it as an uncommon sign and moves it to the controller from where the commands are moved to the engine driver and the remote device. The motor driver makes the motor of the wheel

work according to the movement of the hand and the data are stored in the remote devices and alerted in case of emergency. Fig 17 shows the overall implementation of the system.

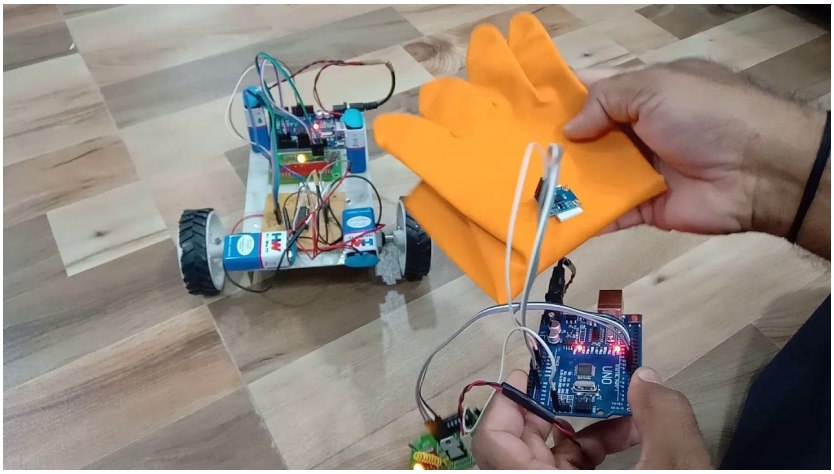

Fig 17.

VIII. CONCLUSION

The design and implementation of the Gesture Controlled Robot are presented and developed using an Arduino microcontroller. A modification to the existing system is provided and the functioning of the device is detailed. As the world keeps updating day by day, the improvisation of this system is kept has future work.

The system's productivity can be increased by using additional sensors or cameras. The shortcomings of the hardware in the existing system have been reduced to a great extent and the health monitoring system is made as a single unit. It provides a way for humans to command which bridges the gap between the real and digital world in a more intuitive way.

IX. FUTURE WORKS

We have implemented the hand gesture controlled wheelchair. To improve this project further,

1. We can use eye retina using an optical sensor to move the wheelchair accordingly.
2. We can use voice command IC's to interface our voice signal with a microcontroller.
3. We can send the alert message raised from the device to a defined person by adding a call log facility.
4. We can also send the data directly to our mobile or watch using the cloud services
5. The development of wheelchair for disabled,which operates according to the nervous system of humans has yet to be explored.

There are various other fields in which the gesture plays a major role. Some of them are

1. They are employed in defense, security surveillance, etc.
2. Hand gesture controlled industrial-grade robotic arms can be developed.

X. REFERENCES

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