

# Hand-gesture Based Wheelchair with Emergency Message system using Arduino Microcontroller

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**Abstract:** In this project, a different approach is used to drive a hand gesture based wheelchair with the help of Arduino Microcontroller. Gesture is a most natural, expressive way of communication between human and computer in real system. We naturally use various gestures to express our own intension in everyday life. Hand gesture is one of the important methods of non-verbal communications of the human being. Based on hand gesture, output is generated by RF Transmitter Arduino. This output serves as an input to RF Receiver Arduino. This Microcontroller runs the DC motor accordingly. The output of DC motor is used to run the wheelchair.

**Keywords:** Gestures; Arduino Uno; ADXL335 Accelerometer; GSM Module.

## I. INTRODUCTION

In the present world, there is continuous increase of human dependency on the electrical applications, appliances, in infrastructure and manufacturing. Therefore, with increase of users, the need for optimization of designs has also increased. As per observations, we find many electrical applications based on one such electrical equipment that is DC motor. In the DC motor, the power supply directly connects to the field of the motor and causes a precise voltage control which is essential for the applications which need to control speed and torque. Because of various advantages such as simplicity, ease of application, reliability and favorable cost, DC drives have long been a backbone of industrial applications. In comparison with AC drives systems DC drives are less and are normally cheaper for low horsepower rating [1]. DC motor can be used to drive many applications such as bang-bang control, Robotics, machinery, inline bottle filling etc. There exists many ways to drive a DC motor, one among them is driving DC motor by using Arduino microcontroller. Based on hand gestures motor is used to run a wheelchair.

## II. TECHNOLOGY USED

### A. Gestures

Gestures are an important aspect of human interaction, both interpersonally and in the context of man-machine interfaces. A gesture is a form of non-verbal communication in which visible bodily actions communicate particular messages, either in place of speech or together and in parallel with words. Gestures include movement of the hands, face, or other parts of the body. Military air marshals use hand and body gestures to direct flight operations aboard aircraft carriers. Hand gesture recognition way to create a useful, highly adaptive interface between machines and their users. Hand gesture recognition technology would allow for the operation of complex machines using only a series of finger and hand movements, eliminating the need for physical contact between operator and the machine.

### B. Arduino UNO



Fig. 1 Arduino UNO

Arduino (Fig. 1) is an open source microcontroller board, electronics prototyping platform based on flexible, easy to use hardware and software. It is intended for artists, designers, hobbyists are interested in creating interactive objects or environments [2]. Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The Microcontroller on the board is programmed using the Arduino projects can be stand-alone or they communicate with software running on a computer.

**C. RF RECEIVER AND RF TRANSMITTER**

RF Transmitter circuit is a radio transmitter which when connected to an antenna produces an electromagnetic signal such as in radio and television broadcasting two way communication [4]. Transmitter will help us to transmit the gesture signals to the receiver circuit. Here we have two circuits, the transmitter circuit and the receiver circuit. They mutually communicate with each other and exchange the signals. Accelerometer senses the gestures and send output to the RF transmitter via RF receiver. RF Receiver is composed of one or more frequency amplifiers followed by a detector circuit to extract the signals. It receives the programmable inputs from the arduino and gives its output to the receiver circuit.

**D. ADXL335 ACCELEROMETER**

An accelerometer is a device that measures proper acceleration. Proper acceleration is not the same as coordinate acceleration. Accelerometers have multiple applications in industry and science. Highly sensitive accelerometers are components of inertial navigation systems for aircraft and missiles [5]. Accelerometers are used to detect and monitor vibration in rotating machinery. Accelerometers are used in tablet computers and digital cameras so that images on screens are always displayed upright. Accelerometers are used in drones for flight stabilisation. ADXL335 Accelerometer is a small low powered 3 axis device whose information is furnished by the analog devices. It is accurate and reliable. It is used to sense the gesture of the user and the output of this is sent to the RF Transmitter.

**C. GSM MODULE (SIM900)**

A GSM Module (Fig. 2) is basically a GSM Modem connected to a PCB with different types of output taken from the board – say TTL Output (for Arduino, 8051 and other microcontrollers) and RS232 Output to interface directly with a PC (personal computer). The board will also have pins or provisions to attach mic and speaker, to take out +5V or other values of power and ground connections. Insert the SIM card to GSM module and lock it. Connect the adapter to GSM module and turn it ON. Now wait for some time (say 1 minute) and see the blinking rate of status LED once the connection is established successfully, the status/network LED will blink continuously every 3 seconds and messages can be sent the contacts.



Fig. 2 GSM Module SIM900

**III. DESIGN AND IMPLEMENTATION**

**A. Hardware Design**

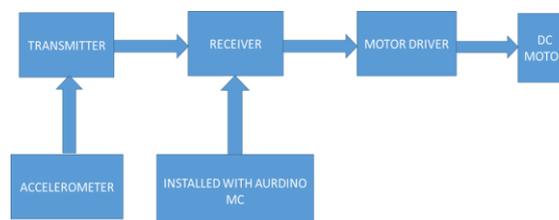


Fig. 3 Interfacing Transmitter and Receiver with the arduino

Accelerometer sensor is used to sense the tilt and movement of the hand, and send the same to the transmitter. Transmitter then transmits the received signals from accelerometer to the receiver. Receiver is present within the wheelchair circuit. The wheelchair consists of arduino microcontroller which is been programmed accordingly [3]. The programmed value is compared with the receiver value and the direction of movement is decided. The direction is sent to the motor driver which in turn helps in the movement of DC motor. Fig. 3 represents Interfacing Transmitter and Receiver with the arduino.

**B. Interfacing ADXL335 with Arduino UNO**

Mount the ADXL335 on the breadboard.

The connections to Arduino should be as follows:

- VCC of accelerometer is given to 3.3 V
- GND of accelerometer is connected to
- GND of Arduino.
- X pin in accelerometer is given to A0 pin of Arduino.
- Y pin in accelerometer is given to A1 pin of Arduino.

**C. Interfacing RF Transmitter and Arduino**

Fig. 4 shows the connection between the rf transmitter and Arduino. ADXL335 Accelerometer is connected to Arduino with 3.3V. Mount the RF transmitter on the breadboard make connections as follows:

- GND of transmitter to GND of Arduino.
- DATA pin of transmitter to D12 of Arduino.
- VCC of transmitter is given 5V in Arduino

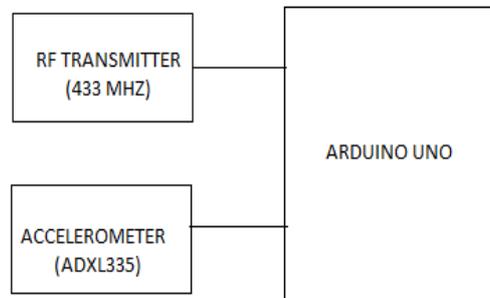


Fig. 4 Interfacing Arduino UNO with ADXL335 and RF Transmitter

**D. Interfacing RF Receiver with Arduino UNO**

Fig. 5 shows the connection between the RF receiver and the Arduino. Mount the RF receiver on the breadboard. Ground of the receiver is connected to the ground of the Arduino with VCC 5V. Data pin of the receiver is connected to D11 pin of the Arduino and the Arduino is programmed accordingly.



Fig. 5 Interfacing RF Receiver with Arduino

**IV. GSM TECHNOLOGY**

We are implementing Emergency Message System using GSM Technology. It helps in sending messages or calls at cases of emergency.

Steps to start a GSM Module:

- Insert the SIM card to GSM module and lock it.
- Connect the adapter to GSM module and turn it ON.
- Now wait for some time (say 1 minute) and see the blinking rate of ‘status LED’ .
- Once the connection is established successfully, the status/network LED will blink continuously every 3 seconds.

**A. GSM Interfacing**

Connect GSM Transmitter to Arduino Receiver (Fig. 6). Then, GSM Receiver to Arduino Transmitter and the Ground pin of Arduino to ground pin of GSM module.

When the person sitting on the wheelchair needs any assistance or help he pushes a button whose signal is fed into the arduino and based on the programmable logic stored in the arduino, the inbuilt message is sent to the stored contacts of the SIM which can include the doctor and his close relatives.

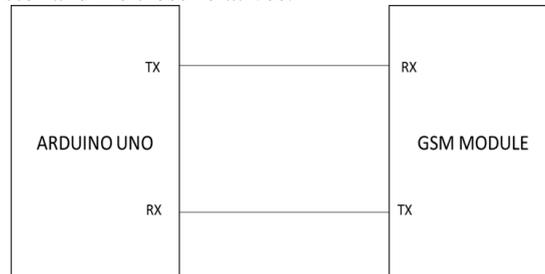


Fig. 6 Interfacing Arduino and GSM Module

**V. RESULT**

As shown in the Fig. 7, Using Arduino as microcontroller, we can create a wheelchair that will move based on the gestures. Accelerometer sensor senses the directions and gestures, and this is transmitted to the Receiver circuit which in turn sends the signal to the Motor Driver. The motor driver moves only if it gets the opposite inputs. Inputs are in the form of low and high voltage. If the inputs supplied are same, it does not move in any direction. The motion also depends on the pin numbers of accelerometer. Threshold values are compared with the originally programmed values and the wheelchair is moved accordingly. GSM Technology is used to send inbuilt messages to those contacts which are loaded into the SIM. GSM Technology is implemented using GSM Module. When the emergency button on the wheelchair is pressed by the patient, it alerts the message receiver with the inbuilt messages.

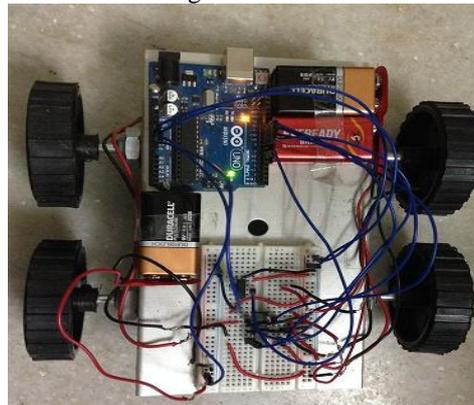


Fig. 7 Hardware Implementation

**VI. CONCLUSION**

The importance of gesture recognition lies in building an efficient human-machine interaction. Its applications ranges from the sign language recognition through medical rehabilitation to virtual reality. Almost all consumer electronic equipments that are used today controls the user interfaces. This project helps to control the wheelchair motion for the disabled person using the hand gestures and the person can send a rescue request during emergency. Some training is essential to use the accelerometer as it's quite sensitive. But in the end there could be a better use of technology for an individual who is deprived of the same physical strength.

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