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E-Mail :
editor.ijasem@gmail.com
editor@ijasem.org

www.ijasem.org

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GESTURE CONTROLLED WIRELESS ROBOT USING MEMS

B.Sumalatha [1], R.Varalaxmi [2] , S.Sudha [2]

ABSTRACT

The project describes a robustness of MEMS based Gesture Controlled Robot is a kind of robot that can be by our hand gestures rather than an ordinary old switches or keypad. In Future there is a chance of making robots that can interact with humans in a natural manner. Hence our target interest is with hand motion based gesture interfaces. An innovative Formula for gesture recognition is developed for identifying the distinct action signs made through hand movement. A MEMS Sensor was used to carry out thisconvinced operation. In order to full-fill our requirement a program has been written and executed using a microcontroller system. Upon noticing the results of experimentation proves that our gesture formula is very competent and it's also enhance the natural way of intelligence and also assembled in a simple hardware circuit.Based on hand movement the robot is controlled in different directions with the help of MEMS which is a accelerometer sensor. Here we control forward, backward, left, right and stop. The MEMS sensor is connected with a medium of wires to the microcontroller to communicate and it is controlled with the help of Microcontroller.

INTRODUCTION

Objective of The Project:

The project describes a robustness of MEMS based Gesture Controlled Robot is a kind of robot that can be by our hand gestures rather than an ordinary old switches or keypad. In Future there is a chance of making robots that can interact with humans in a natural manner. Hence our target interest is with hand motion based gesture interfaces. An innovative Formula for gesture recognition is developed for identifying the distinct action signs made through hand movement. A MEMS Sensor was used to carry out this convinced operation. In order to full-fill our requirement a program has been written and executed using a microcontroller system. Upon noticing the results of experimentation proves that our gesture formula is very competent and it's also enhance the natural way of intelligence and also assembled in a simple hardware circuit.Based on hand movement the robot is controlled in different directions with the help of MEMS which is a accelerometer sensor. Here we control forward, backward, left, right and stop. The MEMS sensor is connected with a medium of wires to the microcontroller to communicate and it is controlled with the help of Microcontroller.

[1,2]Assistant Professor, Department of ECE ,MEGHA INSTITUTE OF ENGINEERING & TECHNOLOGY FOR WOMEN, Hyderabad, Telangana, India.

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HARDWARE ASPECTS

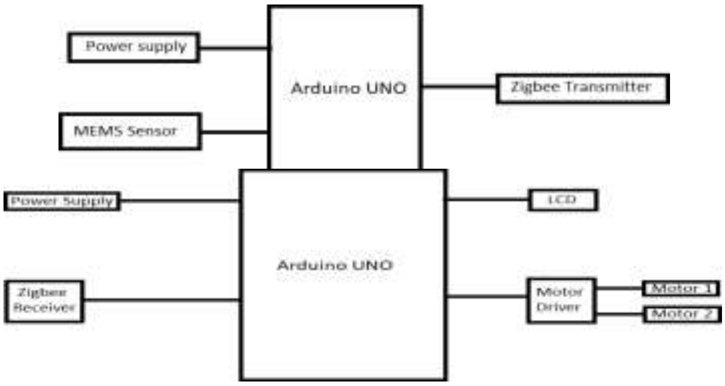

Fig: 2.1 Block Diagram of gesture controlled wireless ROBOT using MEMS.

POWER SUPPLY:

The input to the circuit is applied from the regulated power supply. The a.c. input i.e., 230V from the mains supply is step down by the transformer to 12V and is fed to a rectifier. The output obtained from the rectifier is a pulsating d.c voltage. So in order to get a pure d.c voltage, the output voltage from the rectifier is fed to a filter to remove any a.c components present even after rectification. Now, this voltage is given to a voltage regulator to obtain a pure constant dc voltage.

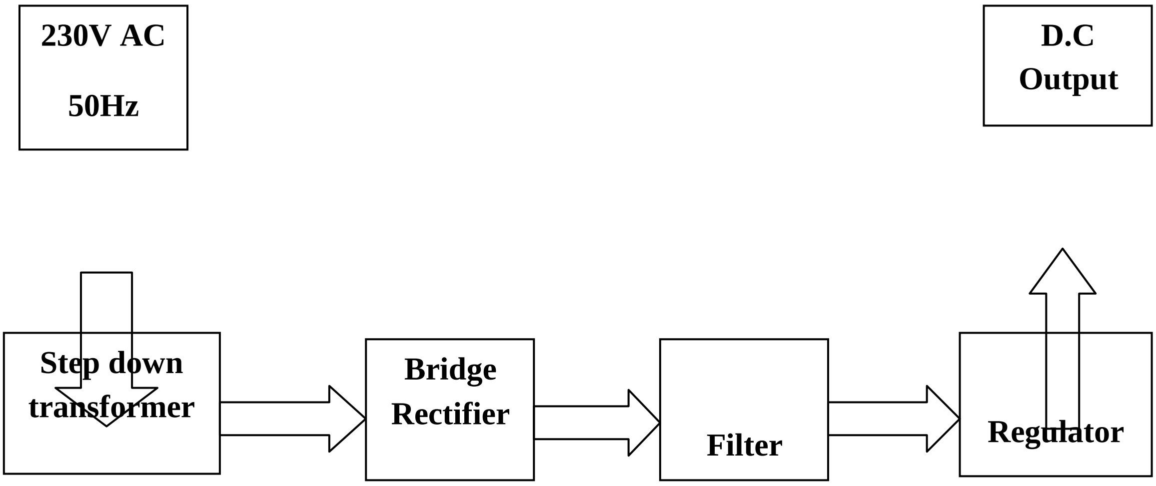

Fig: 2.1.1 Block diagram of power supply

TRANSFORMER:

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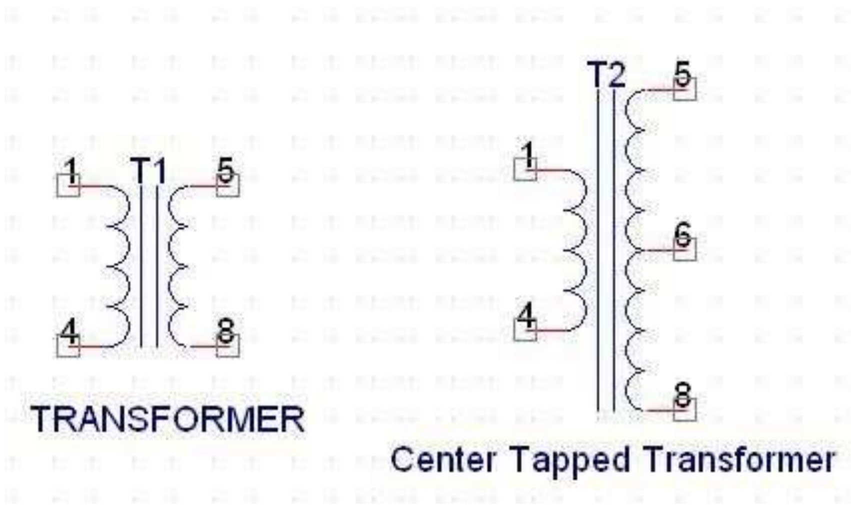

Fig 2.1.2 Transformer

A transformer consists of two coils also called as "WINDINGS" namely PRIMARY & SECONDARY.

They are linked together through inductively coupled electrical conductors also called as CORE. A changing current in the primary causes a change in the Magnetic Field in the core & this in turn induces an alternating voltage in the secondary coil. If load is applied to the secondary then an alternating current will flow through the load. If we consider an ideal condition then all the energy from the primary circuit will be transferred to the secondary circuit through the magnetic field.

So

$$P_{primary} = P_{secondary}$$

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

Rectifier

A rectifier is a device that converts an AC signal into DC signal. For rectification purpose we use a diode, a diode is a device that allows current to pass only in one direction i.e. when the anode of the diode is positive with respect to the cathode also called as forward biased condition & blocks current in the reversed biased condition.

Rectifier can be classified as follows:

1) **Half Wave rectifier**

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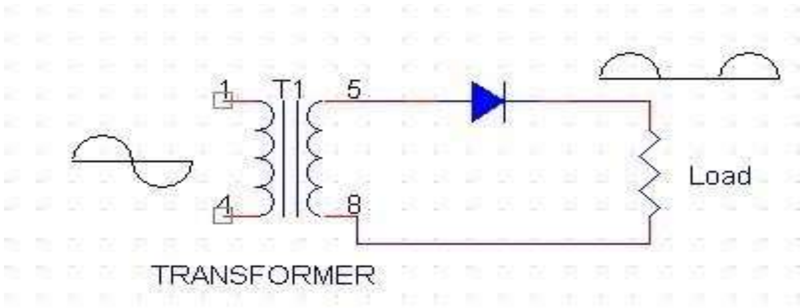

Fig.2.1.3 Half Wave Rectifier

This is the simplest type of rectifier as you can see in the diagram a half wave rectifier consists of only one diode. When an AC signal is applied to it during the positive half cycle the diode is forward biased & current flows through it. But during the negative half cycle diode is reverse biased & no current flows through it. Since only one half of the input reaches the output, it is very inefficient to be used in power supplies.

2) Full wave rectifier

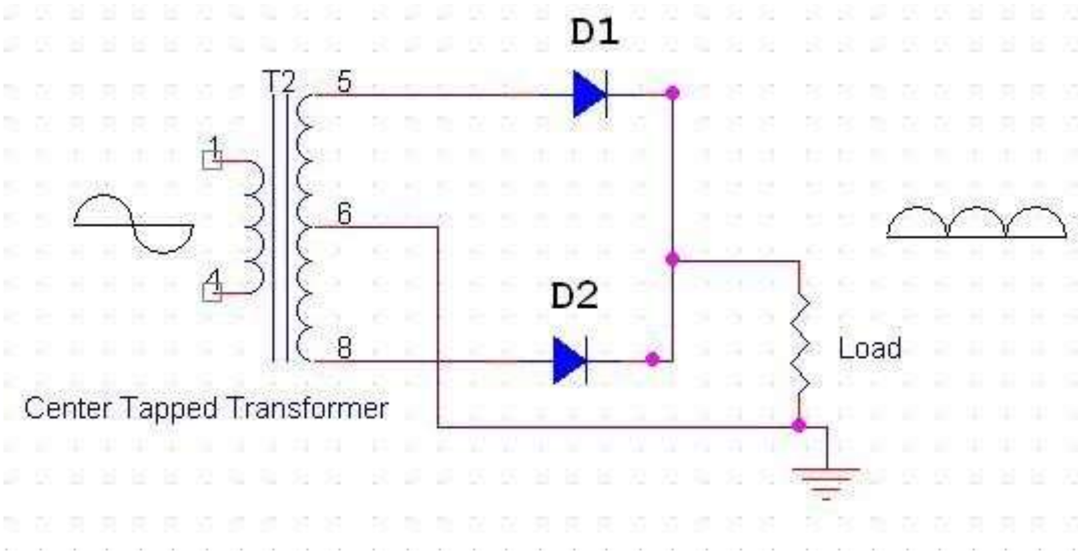

Fig.2.1.4 Full Wave Rectifier

Half wave rectifier is quite simple but it is very inefficient, for greater efficiency we would like to use both the half cycles of the AC signal. This can be achieved by using a center tapped transformer i.e. we would have to double the size of secondary winding & provide connection to the center. So during the positive half cycle diode D1 conducts & D2 is in reverse biased condition. During the negative half cycle diode D2 conducts & D1 is reverse biased. Thus we get both the half cycles across the load.

One of the disadvantages of Full Wave Rectifier design is the necessity of using a center tapped transformer, thus increasing the size & cost of the circuit. This can be avoided by using the Full Wave Bridge Rectifier.

FILTER CAPACITOR

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Even though half wave & full wave rectifier give DC output, none of them provides a constant output voltage. For this we require to smoothen the waveform received from the rectifier. This can be done by using a capacitor at the output of the rectifier this capacitor is also called as “FILTER CAPACITOR” or “SMOOTHING CAPACITOR” or “RESERVOIR CAPACITOR”. Even after using this capacitor a small amount of ripple will remain.

We place the Filter Capacitor at the output of the rectifier the capacitor will charge to the peak voltage during each half cycle then will discharge its stored energy slowly through the load while the rectified voltage drops to zero, thus trying to keep the voltage as constant as possible.

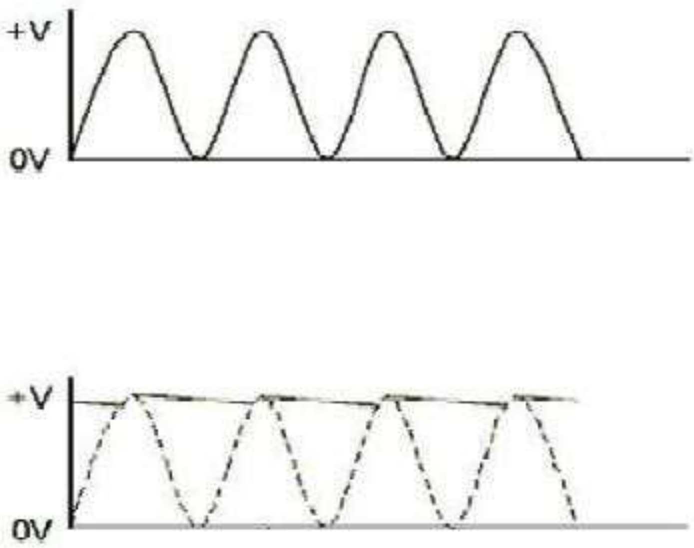

Fig 2.1.5 Waveforms of Filter Capacitor

If we go on increasing the value of the filter capacitor then the Ripple will decrease. But then the costing will increase. The value of the Filter capacitor depends on the current consumed by the circuit, the frequency of the waveform & the accepted ripple.

$$C = \frac{V_r F}{I}$$

Where,

Vr = accepted ripple voltage.(should not be more than 10% of the voltage)
I = current consumed by the circuit in Amperes.
F = frequency of the waveform. A half wave rectifier has only one peak in one cycle so F =25hz
Whereas a full wave rectifier has Two peaks in one cycle so F =100 Hz.

2.1.2 VOLTAGE REGULATOR

A Voltage regulator is a device which converts varying input voltage into a constant regulated output voltage. Voltage regulator can be of two types:

1) Linear Voltage Regulator:

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Also called as Resistive Voltage regulator because they dissipate the excessive voltage resistively as heat.

2) Switching Regulators:

They regulate the output voltage by switching the Current ON/OFF very rapidly. Since their output is either ON or OFF it dissipates very low power thus achieving higher efficiency as compared to linear voltage regulators. But they are more complex & generate high noise due to their switching action. For low level of output power switching regulators tend to be costly but for higher output wattage they are much cheaper than linear regulators.
The most commonly available Linear Positive Voltage Regulators are the 78XX series where the XX indicates the output voltage. And 79XX series is for Negative Voltage Regulators.

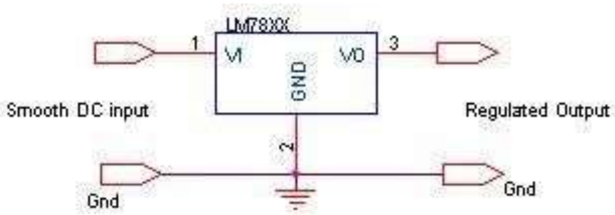

Fig.2.1.6 Pin diagram of voltage regulator

After filtering the rectifier output the signal is given to a voltage regulator. The maximum input voltage that can be applied at the input is 35V.Normally there is a 2-3 Volts drop across the regulator so the input voltage should be at least 2-3 Volts higher than the output voltage. If the input voltage gets below the Vmin of the regulator due to the ripple voltage or due to any other reason the voltage regulator will not be able to produce the correct regulated voltage.

Circuit diagram:

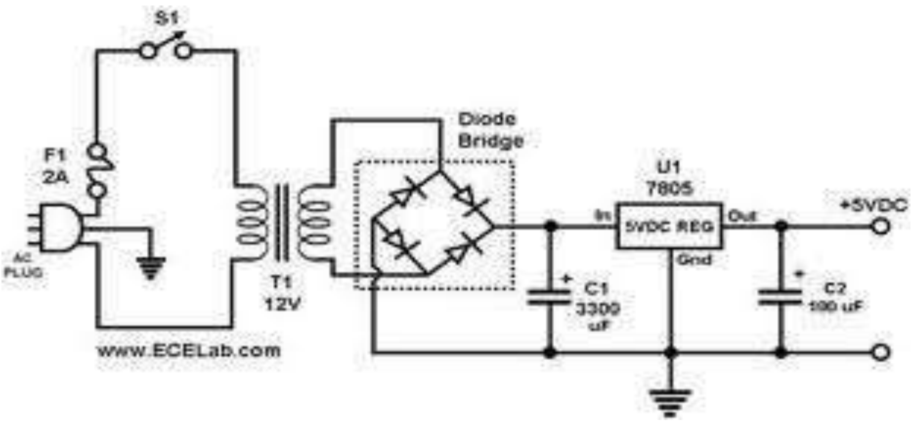

Fig Circuit Diagram of power supply

- **IC 7805:**

7805 is an integrated three-terminal positive fixed linear voltage regulator. It supports

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an input voltage of 10 volts to 35 volts and output voltage of 5 volts. It has a current rating of 1 amp although lower current models are available. Its output voltage is fixed at 5.0V. The 7805 also has a built-in current limiter as a safety feature. 7805 is manufactured by many companies, including National Semiconductors and Fairchild Semiconductors.

The 7805 will automatically reduce output current if it gets too hot. The last two digits represent the voltage; for instance, the 7812 is a 12-volt regulator. The 78xx series of regulators is designed to work in complement with the 79xx series of negative voltage regulators in systems that provide both positive and negative regulated voltages, since the 78xx series can't regulate negative voltages in such a system.

The 7805 & 78 is one of the most common and well-known of the 78xx series regulators, as it's small component count and medium-power regulated 5V make it useful for powering TTL devices.

SPECIFICATIONS	**IC 7805**
V_{out}	5V
V_{ein} - V_{out} Difference	5V - 20V
Operation Ambient Temp	0 - 125°C
Output I_{max}	1A

Table: Specifications of IC7805

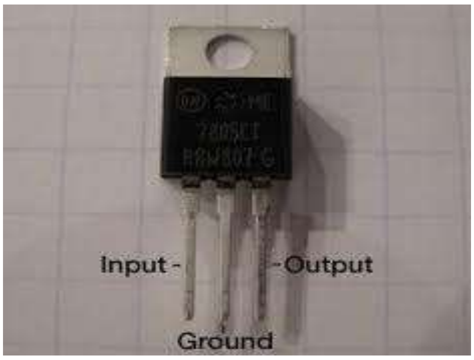


Fig 2.1.8 Pin diagram of 7805

General Characteristics of Zigbee Standard:

1) Low Power Consumption
2) Low Data Rate (20- 250 kbps)
3) Short-Range (75-100 meters)
4) Network Join Time (~ 30 msec)
5) Support Small and Large Networks (up to 65000 devices (Theory); 240 devices (Practically))
6) Low Cost of Products and Cheap Implementation (Open Source Protocol)
7) Extremely low-duty cycle.
8) frequency bands with 27 channels.

Operating Frequency Bands (Only one channel will be selected for use in a network):

1. **Channel 0**: 868 MHz (Europe)
2. **Channel 1-10**: 915 MHz (the US and Australia)
3. **Channel 11-26**: 2.4 GHz (Across the World)

Features of Zigbee:

1. Stochastic addressing: A device is assigned a random address and announced. Mechanism for address conflict resolution. Parents node don’t need to maintain assigned address table.
2. Link Management: Each node maintains quality of links to neighbors. Link quality is used as link cost in routing.
3. Frequency Agility: Nodes experience interference report to channel manager, which then selects another channel
4. Asymmetric Link: Each node has different transmit power and sensitivity. Paths may be asymmetric.
5. Power Management: Routers and Coordinators use main power. End Devices use batteries.

LCD:

To display any character on LCD micro controller has to send its ASCII value to the data bus of LCD. For e.g. to display 'AB' microcontroller has to send two hex bytes 41h and 42h respectively.LCD display used here is having 16x2 size. It means 2 lines each with 16 characters.

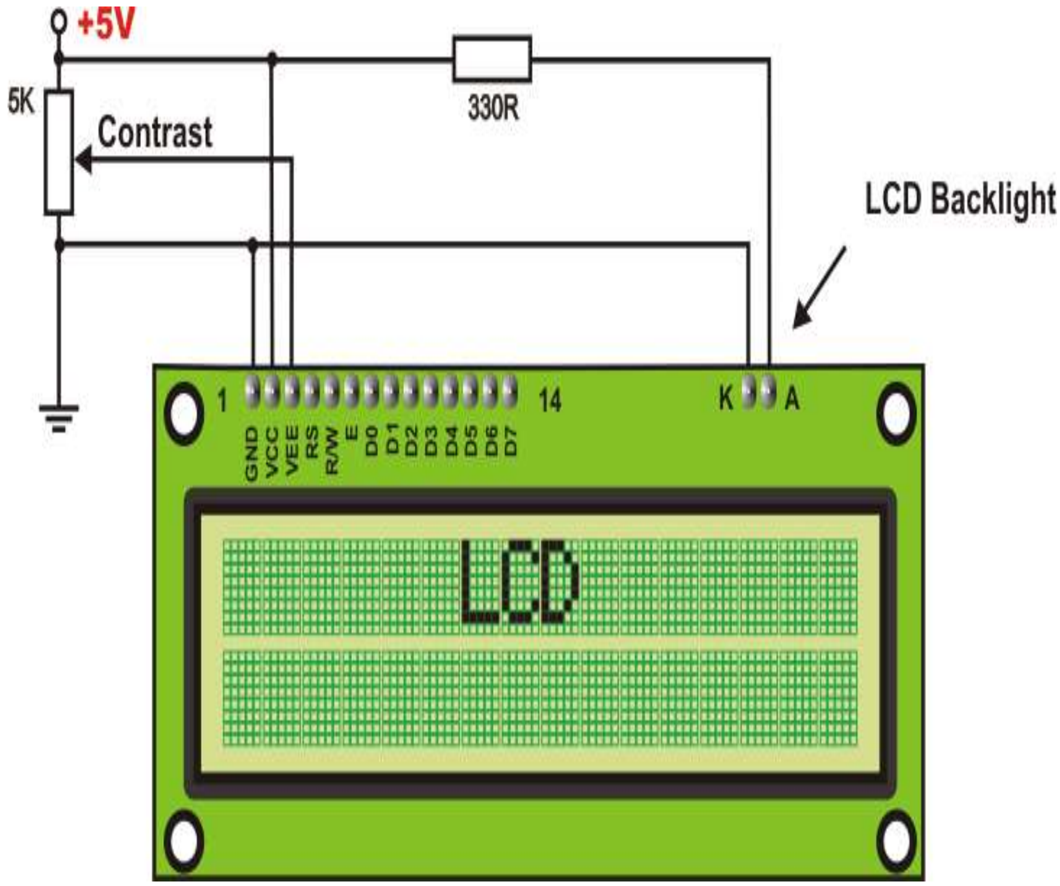


Fig:2.7.1 LCD

Pins Functions:

There are pins along one side of the small printed board used for connection to the microcontroller. There are total of 14 pins marked with numbers (16 in case the background light is built in). Their function is described in the table below:

Function	Pin Number	Name	Logic State	Description
Ground	1	Vss	-	0V
Power supply	2	Vdd	-	+5V
Contrast	3	Vee	-	0 – Vdd
Control of operating	4	RS	0 1	D0 – D7 are interpreted as commands D0 – D7 are interpreted as data
	5	R/W	0 1	Write data (from controller to LCD) Read data (from LCD to controller)
	6	E	0 1 From 1 to 0	Access to LCD disabled Normal operating Data/commands are transferred to LCD
Data / commands	7	D0	0/1	Bit 0 LSB
	8	D1	0/1	Bit 1
	9	D2	0/1	Bit 2
	10	D3	0/1	Bit 3
	11	D4	0/1	Bit 4
	12	D5	0/1	Bit 5
	13	D6	0/1	Bit 6
	14	D7	0/1	Bit 7 MSB

Table:2.7.1 Pin Functions of LCD

Algorithm to send data to LCD:

1. Make R/W low

2. Make RS=0; if data byte is command

    RS= 1; if data byte is data (ASCII value)

3. Place data byte on data register

4. Pulse E (HIGH to LOW)

5. Repeat the steps to send another data byte

LCD Initialization:

This is the pit fall for beginners. Proper working of LCD depend on the how the LCD is initialized. We have to send few command bytes to initialize the LCD. Simple steps to initialize the LCD

1. Specify function set: Send 38H for 8-bit, double line and 5x7 dot character format.

2. Display On-Off control: Send 0FH for display and blink cursor on.

3. Entry mode set: Send 06H for cursor in increment position and shift is invisible.

4. Clear display: Send 01H to clear display and return cursor to home position.

Addresses of cursor position for 16x2 HD44780 LCD

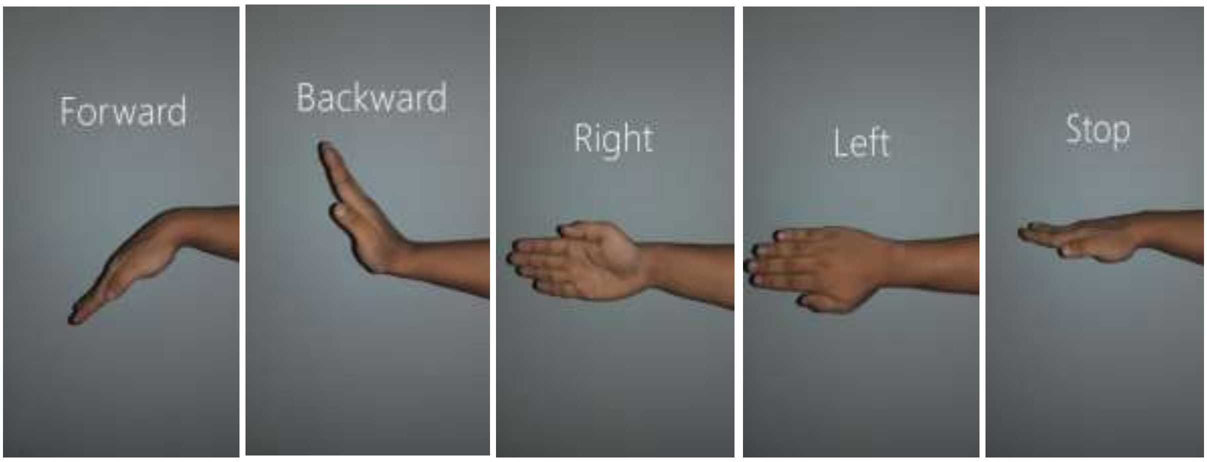
line1	80H	81H	82H	83H	84H	85H	86H	87H	88H	89H	8AH	8BH	8CH	8DH	8EH	8FH
line2	C0H	C1H	C2H	C3H	C4H	C5H	C6H	C7H	C8H	C9H	CAH	CBH	CCH	CDH	CEH	CFH

RESULT

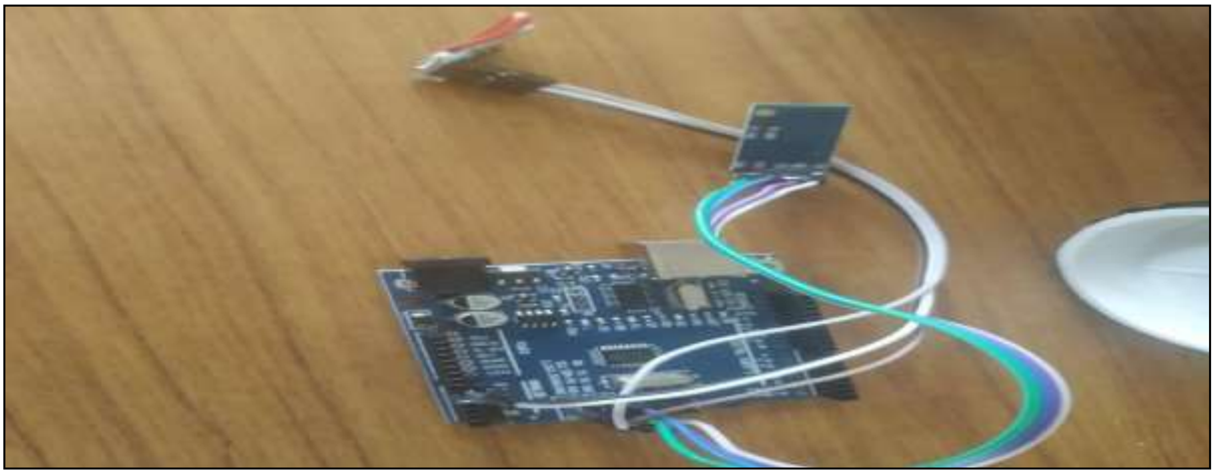
When the robot is powered on, the transmitter part which consists of Arduino, MEMS sensor and Zigbee transmitter will continuously sends the gesture movements.

Based on the data received from transmitter to receiver, according to that Robot will operate.

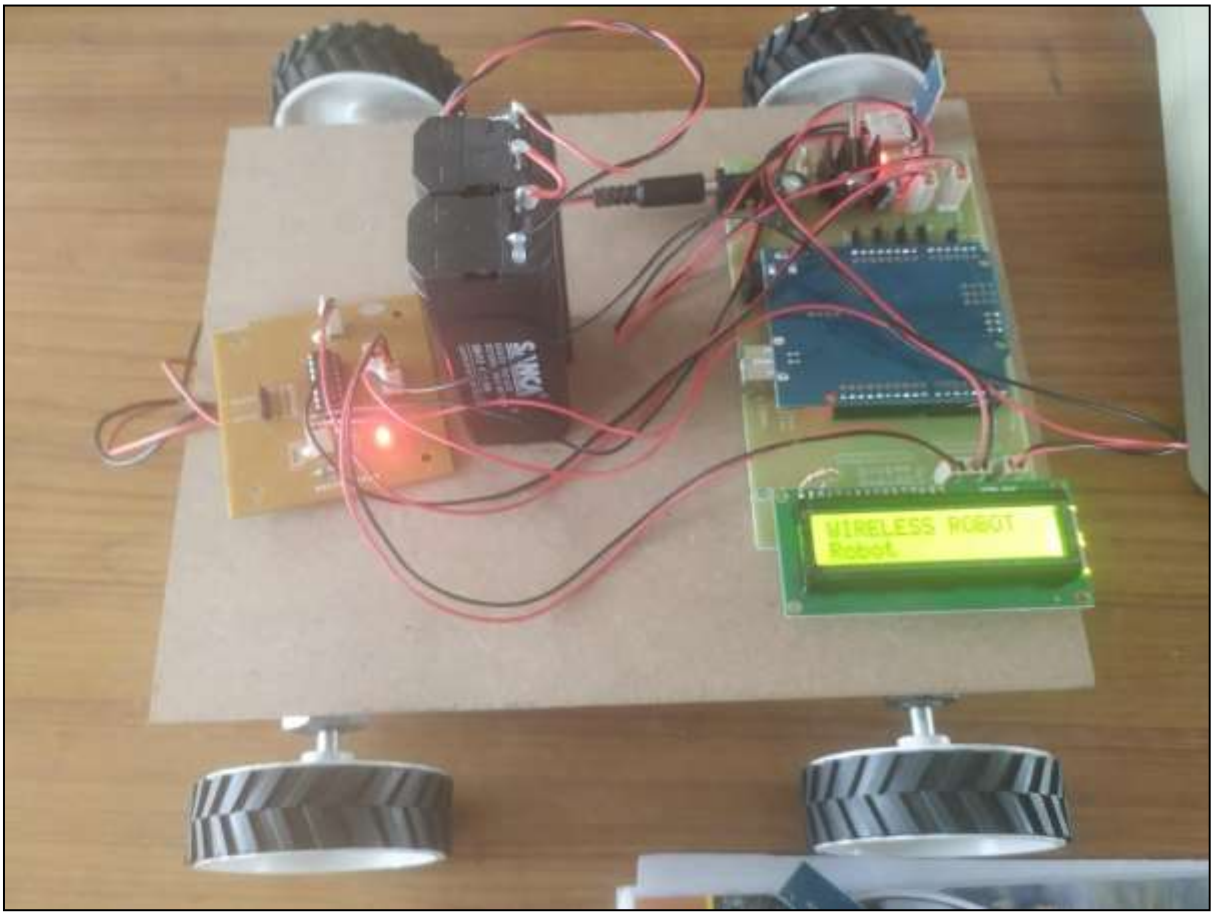
This Robot is designed for recognizing five sets of gesture:Forward,Backward,Right,Left and Stop.



Five sets of gesture.



Transmitter section of gesture controlled wireless ROBOT using MEMS



Receiver section of gesture controlled wireless ROBOT using MEMS

ADVANTAGES AND APPLICATIONS

ADVANTAGES:

1) It has low cost of manufacturing.
2) The microcontroller can be reprogrammed if any modification is required.
3) Due to wireless communication data rate is faster.
4) Wireless makes ease of operation.
5) Power consumption is less.

APPLICATIONS:

6) Military application.
7) Medical application.
8) Construction application.
9) Commercial application.

CONCLUSION AND FUTURESCOPE

CONCLUSION:

By using MEMS sensors,the Robot can be controlled effectively and efficiently.MEMS are very useful because,all the individual sensors can be integrated on a single chip.Moreover,the power consumption of MEMS is low.

MEMS are made up of components that are of 0.001 to 0.1mm in size and this is the main advantages of MEMS sensors for choosing them to control the ROBOT using hand gestures.

FUTURESCOPE:

1) By adding camera, we can live stream.
2) By adding GPRS and GPS, we can track the location details.
3) By adding temperature sensor, we can measure temperature.
4) By connecting bomb detector or metal detector, we can detect the bomb or metal.

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