NEW HORIZON
COLLEGE OF ENGINEERING

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"DTMF BASED ROBOTIC CAR"

A MINIPROJECT REPORT

Submitted by

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CERTIFICATE

Certified that the mini project work entitled "**DTMF Based Robotic Car**" carried out by **Rahul M R(1NH18EC090)**bonafide student of Electronics and Communication Department , New Horizon College of Engineering, Bangalore.

The mini project report has been approved as it satisfies the academic requirements in respect of mini project work prescribed for the said degree.

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Rakesh M (1NH18EC091)

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ABSTRACT

In this project, the robotic toy car can be controlled using Dual Tone Multi Frequency (DTMF) technology. This project deals with the operation of a simple toy car that can be controlled by a cell phone (sender). The controller has to make a call to the cell phone (receiver) stacked to the toy car. In this duration of the call if any number key is pressed a DTMF tone corresponding to the key pressed is heard on the other end of the call (receiver).This tone is called as Dual Tone Multi Frequency. The reason it is called multi frequency because every key in cell phone is assigned to two frequencies high and low frequency. The car receives the tone through the 3.5 mm audio jack connected and processed with the help of the DTMF decoder. The DTMF decoder IC has low pass and high pass filter. It separates both high and low frequency signal and later it is given to digital detection algorithm. The IC MT8870 decodes the received tone into equivalent binary digit (For eg if key 5 is pressed the decoder decodes to 0101).This binary value is sent to Motor driver L293D based on the input received this prompts the motor driver in order to move forward direction or backward direction or left or right direction. The phone which is used to make call acts as remote to control the car. In addition to this this project does not require any extra circuitry part such as transmission and receiver units.

CHAPTER 01

INTRODUCTION

DTMF is an acronym of **DUAL TONE MULTI FREQUENCY**. **Dual-tone multi-frequency signaling** (**DTMF**) is a telecommunication signaling system using the voice-frequency band over telephone lines between phone equipment and other communications devices and switching centers.

In a DTMF based robotic bot, the motor is controlled by mobile phone that makes a call to another mobile phone which is attached to robotic bot. During the ongoing call whenever a button is pressed on the keypad, a DTMF tone of corresponding button is heard at the other end of the call depending upon the button pressed a robotic car either moves forward, backward, or take right or left turn.

The hardware used for this project includes a DTMF receiver (MT8870), Motor driver IC (L293D), a cell phone, car chassis, breadboard etc.

The data is sent typically through a voice call, whenever someone press the button on a phone generates two tone of different frequencies is generated one is higher frequency and other is lower frequency. The DTMF receiver receives the corresponding signal and gives the decoded output and this output is given to motor driver IC to increase the current. And the output from motor driver IC is given to motors of the DTMF robotic car, which drives the motors.

Conventionally, wireless-controlled robots make use of RF circuits, use of this technology can overcome the drawbacks of limited frequency, limited working range and the limited control over the device. It provide the advantage of robust control, large working range and up to twelve output control options.

CHAPTER 02

LITERATURE SURVEY

PAPER NO	TITLE OF THE PAPER	AUTHOR AND YEAR OF PUBLICATION	OUTCOME	LIMITATION
1	Dual-Tone Multiple Frequency (DTMF) Detector Implementation	Guner Arslan March 1998	simulations in MATLAB, for ITU and Bellcore compatibility	Problem in determining N
2	DTMF based surveillance robot	G Pragathi Reddy March 2016	Was able to make aware of new place using robot	Difficulty in moving robotic parts using signals
3	A real time analysis of service based using mobile phone controlled vehicle using DTMF for Accident prevention	C K Gomathy, V Geetha 2016	design a practical and opstimized communication mechanism for direct phone-to-phone data transfer to the driver's phone	Slight complexity
4	Automatic wheelchair using DTMF technology	Guruprasad R, CSakthivel 2018	Using DTMF and MOTOR DRIVER executed working model	Movement of model was slightly rigid

Table 2.1:Literature survey list

CHAPTER 03

EXISTING SYSTEM

- **CALL CENTRES**

  The best day to day example is whenever a person or individual calls to any call center an automated menu is heard asking us to press 1 for English , 2 for Hindi and 3 for Telugu etc.
  How does they know what are we pressing it is based on this DTMF technology.
  Where in these call centers have DTMF receivers which receives the signals depending upon the button pressed on keypad these call centers redirect the calls to respective person.

- **HOME AUTOMATION**

  These days many people are making use of this DTMF technology in home automation. It can be used to control various home appliances from a very large distance to a very short distance range.
  DTMF dual tone frequencies can be set ie press 1 for switching on the MOTOR , press 2 for turning on a speaker, press 3 for turning on a TV and henceforth twelve such controls can be set without any interference of the signals.

PROBLEM STATEMENT

Most of the wireless robotic cars make use of RF circuits and microcontrollers, with the use of DTMF technique we can overcome the drawbacks of complexity of the circuit design, limited frequency and limited working range. It provide the advantage of robust control, large working range and up to twelve output control options.

CHAPTER 04

PROPOSED METHODOLOGY

The block diagram of the project is shown below where in the project is divided into three stages

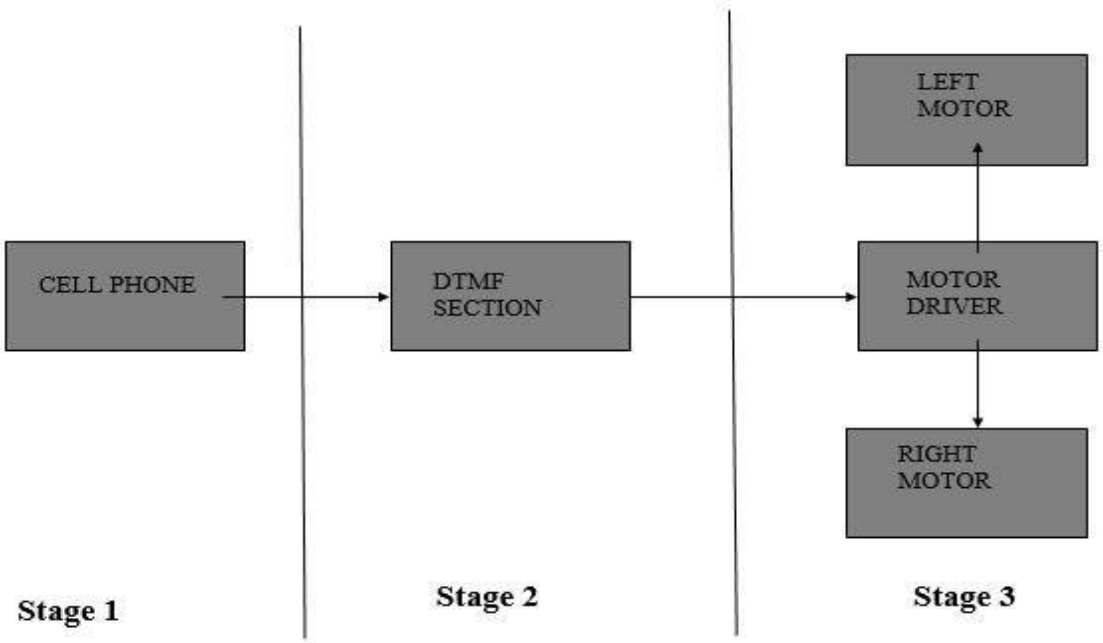

Fig 4.1:Block diagram

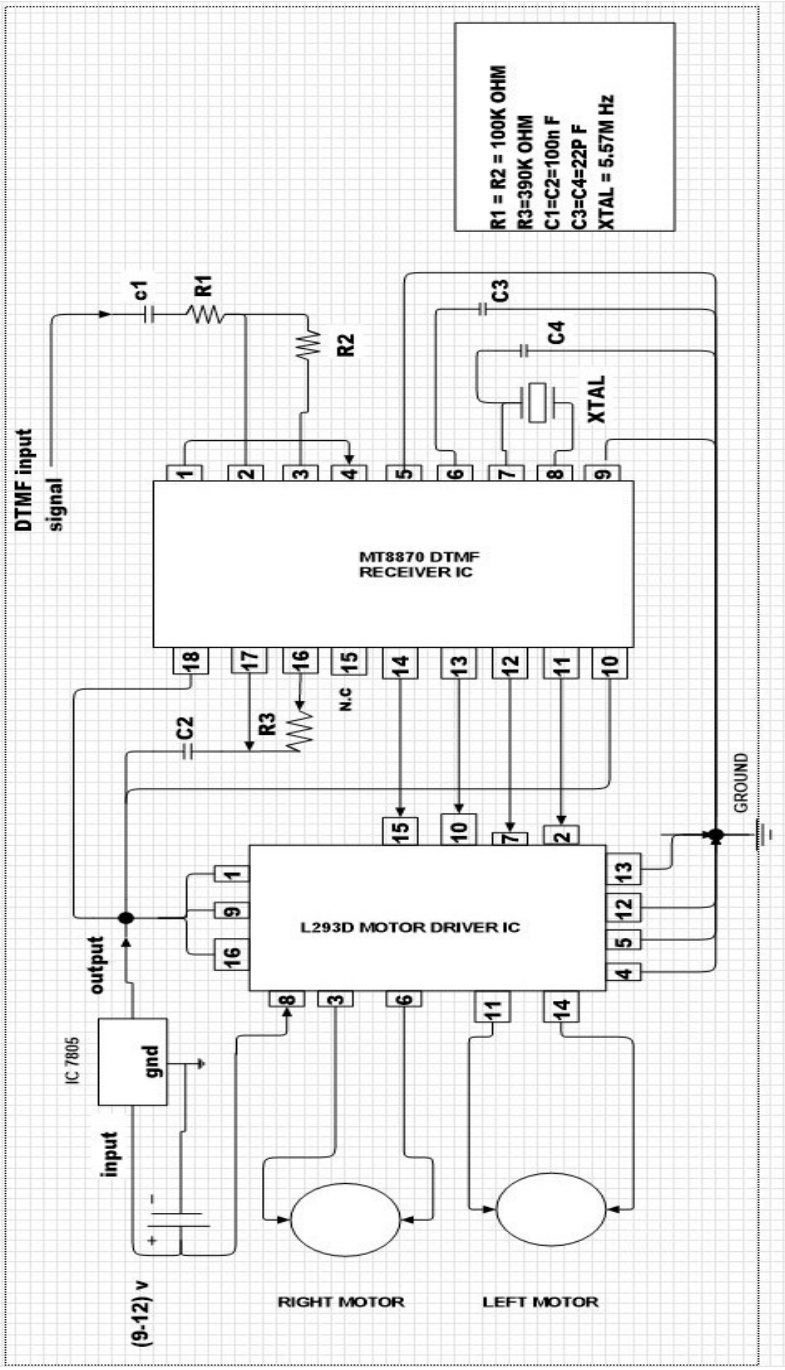

Fig 4.2:Schematic of DTMF based robotic car

WORKING

The working of this model is very simple. All the hardware components are powered by the battery. At the first, call is made to the mobile phone which is stacked to the robotic car. On the receivers end the phone is to be picked. In the course of call if any button is pressed on the keypad a corresponding DTMF tone is observed.

Each and every key on keypad has a dual frequency, which is a combination of the low frequency and high frequency signal. And the dual frequency of each key differ from each other which is shown as in the below figure.

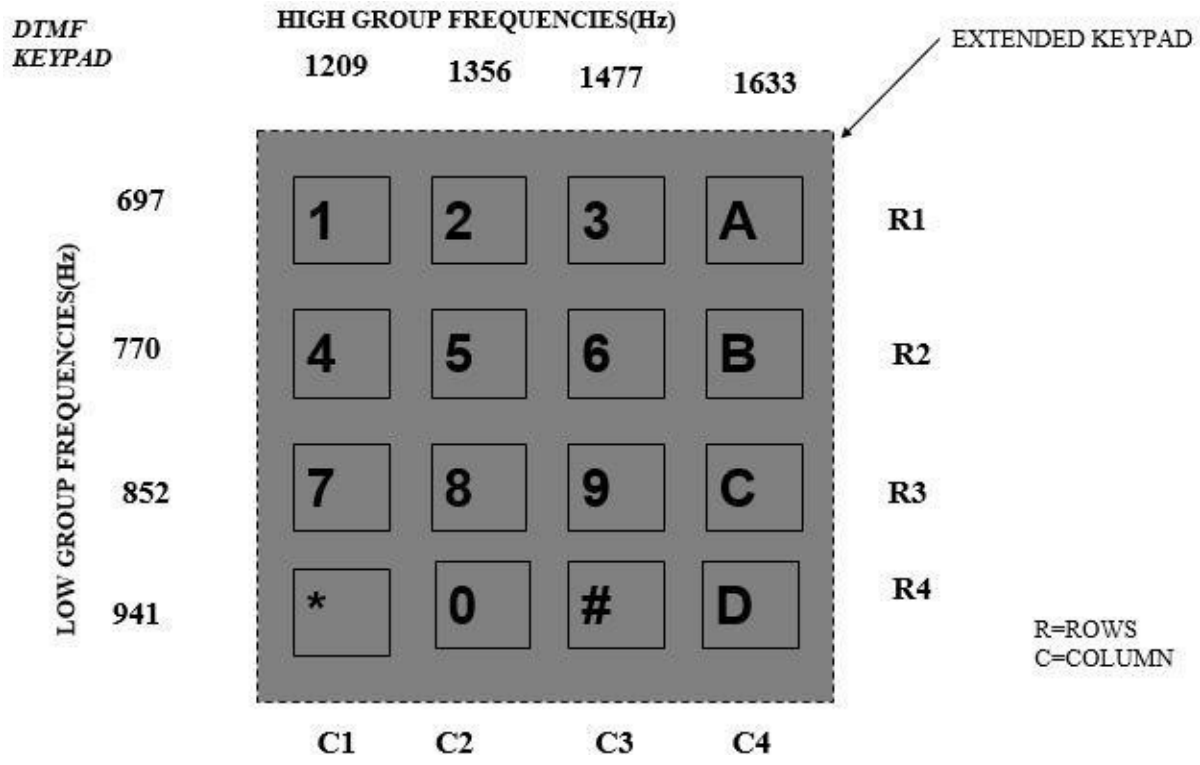

Fig 4.3:DTMF Keypad

Depending on the number pressed on keypad a DTMF tone is heard over the other side of the call. The same DTMF tone acts as input for the DTMF decoder IC (MT8870).

The MT8870 is a complete DTMF receiver integrating both the band split filter and digital decoder functions. Depending upon the button pressed corresponding output is observed at across the output terminals of the IC (Q1,Q2,Q3,Q4).

Button	Low DTMF Frequency (Hz)	High DTMF Frequency (Hz)	Q4	Q3	Q2	Q1
1	697	1209	0	0	0	1
2	697	1336	0	0	1	0
3	697	1477	0	0	1	1
4	770	1209	0	1	0	0
5	770	1336	0	1	0	1
6	770	1477	0	1	1	0
7	852	1209	0	1	1	1
8	852	1336	1	0	0	0
9	852	1477	1	0	0	1
0	941	1336	1	0	1	0
*	941	1209	1	0	1	1
#	941	1477	1	1	0	0
A	697	1663	1	1	0	1
B	770	1663	1	1	1	0
C	852	1663	1	1	1	1
D	941	1663	0	0	0	0

Table 4.1:Functional decode table

The above tables shows, the output across the (Q1,Q2,Q3,Q4) when the corresponding button is pressed on the keypad.

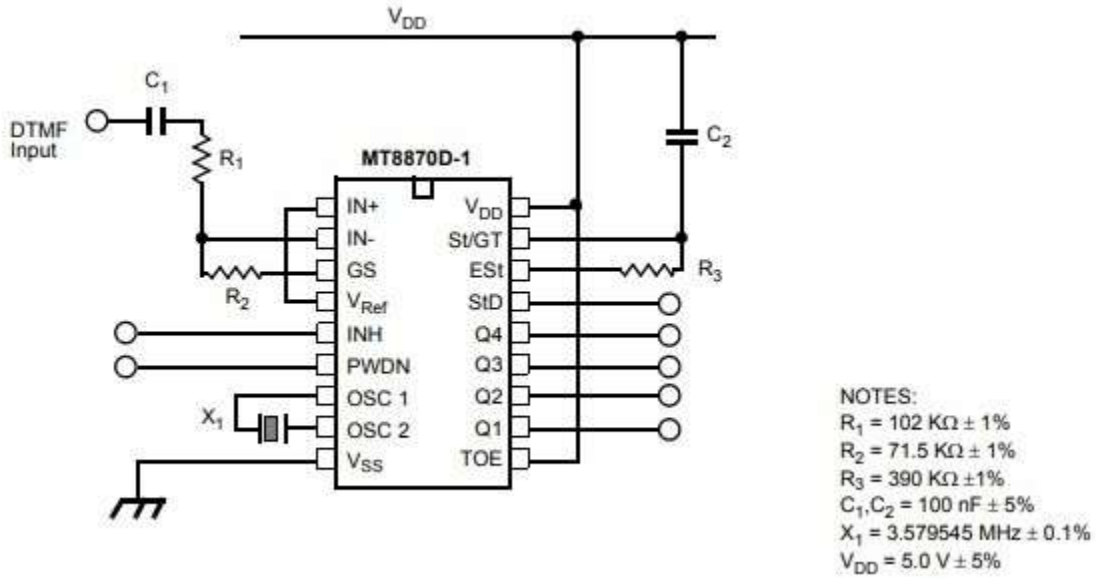

Fig 4.4:DTMF to IC connections

The outputs are binary in nature which can be observed by connecting the LEDs across the outputs. The outputs of the IC (Q1,Q2,Q3,Q4) acts as input for the motor driver IC. The outputs of DTMF receiver cannot be directly connected across the motors as the output current from the decoder IC is very small, it will not be able to drive the load (motors). The minimum current required for the motors to drive is around 250 mill ampere.

So the motor driver IC (L293D) is used which increases the current. It amplifies the current.

The connections to the motor driver IC is given as below circuit diagram.

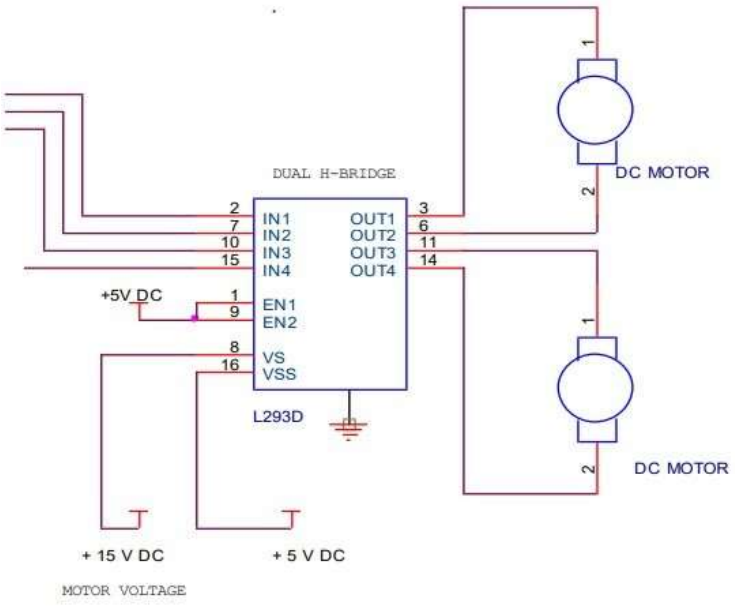

Fig 4.5:Motor driver connections

Depending upon the potential applied to the motors the motor turns either clockwise or anticlockwise. For example if the outputs of Q1,Q2 are connected to the motor 1.

Input 1(Q2)	Input 2 (Q1)	Result
0	0	No rotation
0	1	anticlockwise rotation
1	0	clockwise rotation
1	1	No rotation

Table 4.2:Truth table for connection of motor

Hence from these above data a flow chart can be created which shows when does the robotic car moves front, back, turns left, turns right or stops.

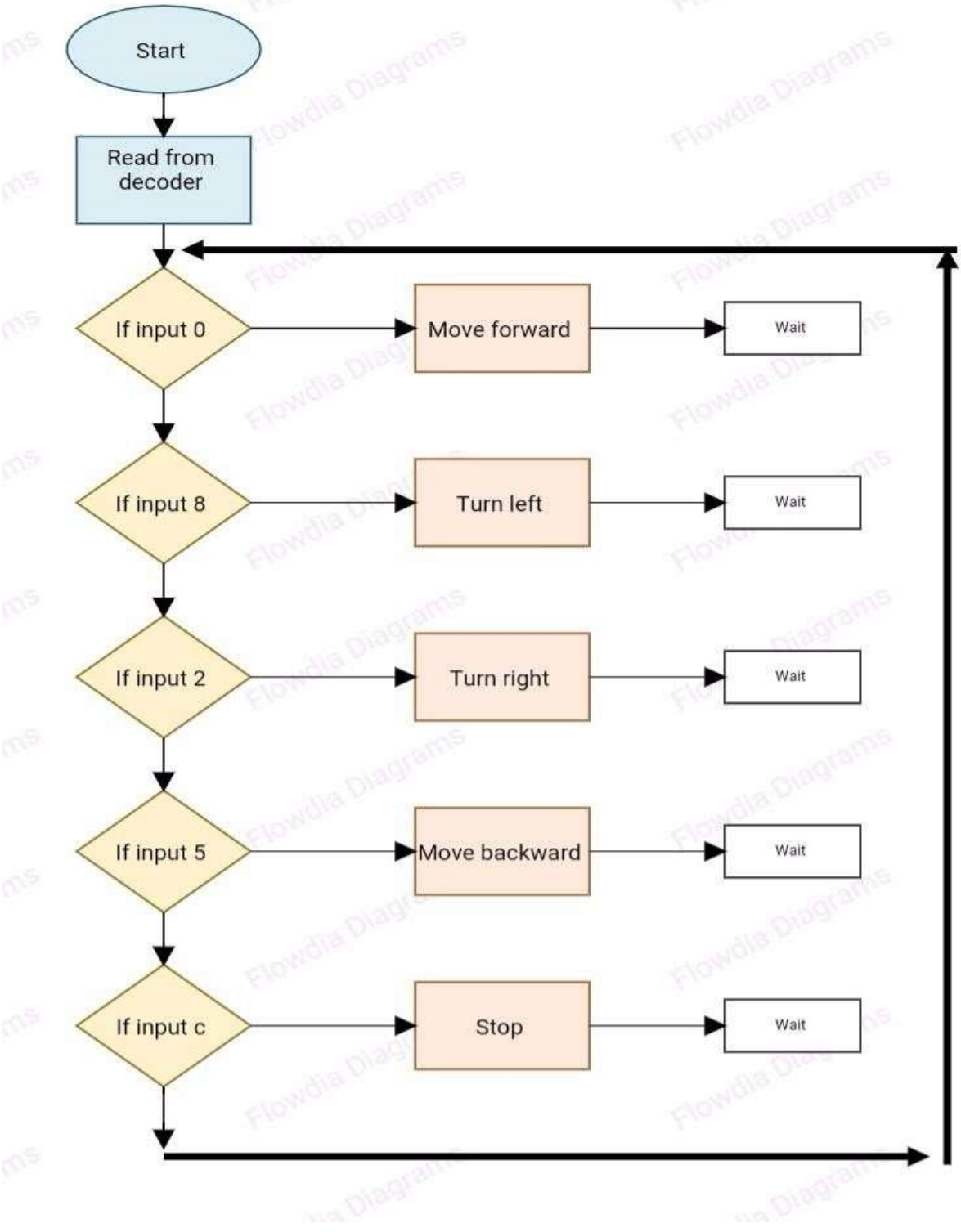

Fig 4.6:Flow Chart

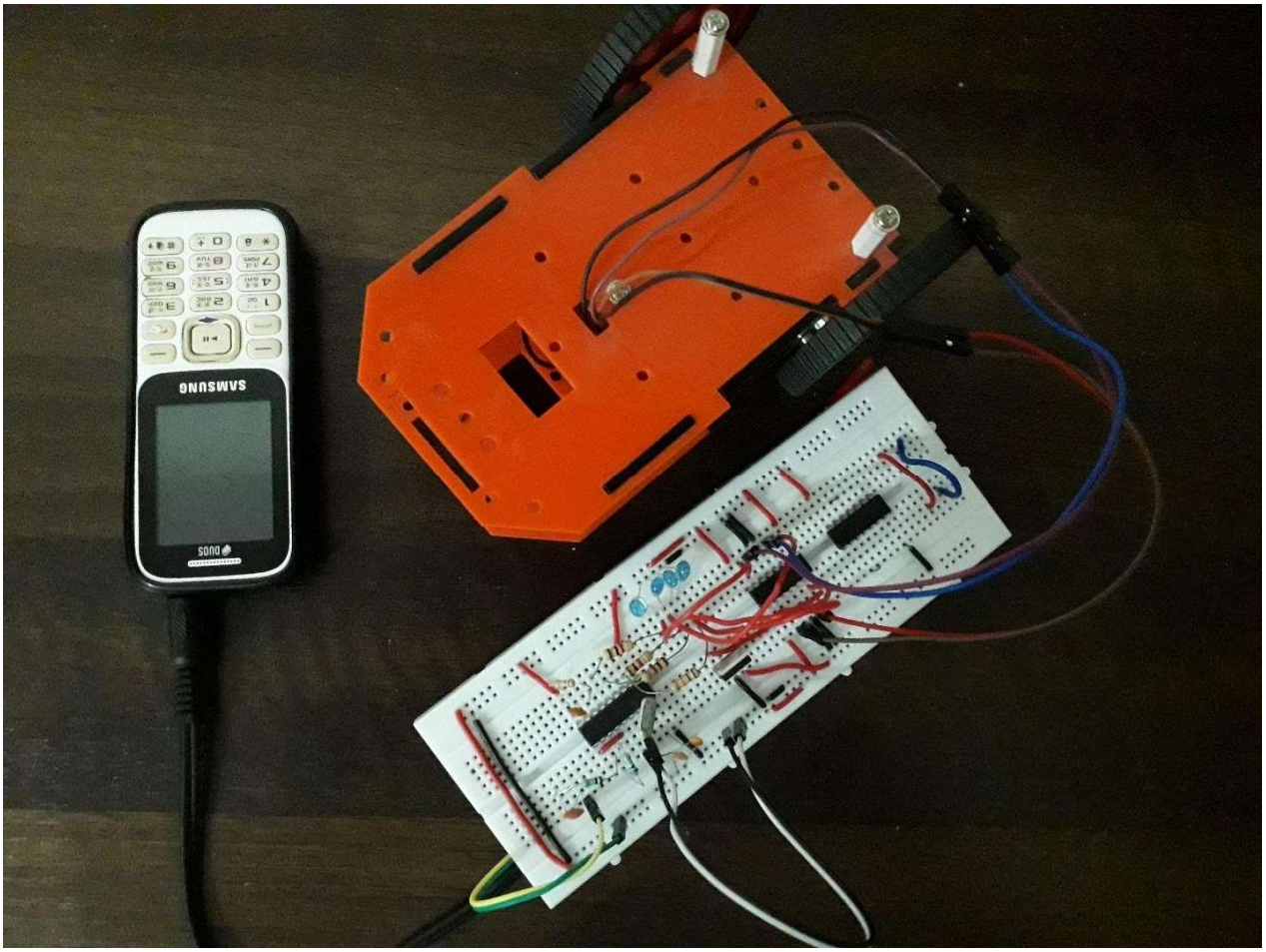

Fig 4.7:hardware connections of the DTMF robotic car

CIRCUIT DESCRIPTION

Robot car can be controlled wirelessly with many methods like remote, Wi-Fi, Bluetooth and many more. But the controls of these method are restricted to small areas and it is also little complicated to design these communication gadgets .It is possible to overcome these kind of difficulties by designing mobile controlled robots as it can be accessed from anywhere in the world

In this project the robotic car is controlled by a mobile phone that makes a call to the mobile phone attached to the robot in the duration of the call, if any key is pressed on keypad. The control corresponding to the key pressed is heard at the other end of the call. . Robot receives this DTMF tone with the help of a phone stacked in the robot.

The received tone is processed by DTMF decoder MT8870 decoder, decodes the DTMF tone into its equivalent binary digit and this binary number is sent to the motor drivers in order to drive the motors either forward or backward motion or a turn depending upon the button preseed.

The mobile that makes a call to the mobile phone which is stacked to the robotic bot acts as a remote for controlling the robotic car.

The circuit was designed using the required equipment and the output were checked using LEDs before mounting on the car model. 3.5 mm jack was used to connect the phone stacked with the model and the setting was made in the phone to auto answer.

CHAPTER 05

HARDWARE AND SOFTWARE SPECIFICATIONS

The hardware required for the project are as follows:

Description	Quantity
· **Bread board**	**1**
· **IC MT8870D (DTMF receiver)**	**1**
· **IC L293D (Motor driver IC)**	**1**
· **Crystal oscillator of 3.57Mhz**	**1**
· **9v battery**	**1**
· **Resistors of(100KΩ,300KΩ,1KΩ)**	**(2,1,1)**
· **Capacitors of (100nf ,22pf)) ceramic capacitor**	**(2,2)**
· **Bi-directional DC motors**	**2**
· **Car chassis**	**1**
· **IC 7805 (Voltage regulator)**	**1**
· **IC 7404 (inverter)**	**2**

Table 6.1:Components required

1. IC MT8870 DTMF Receiver

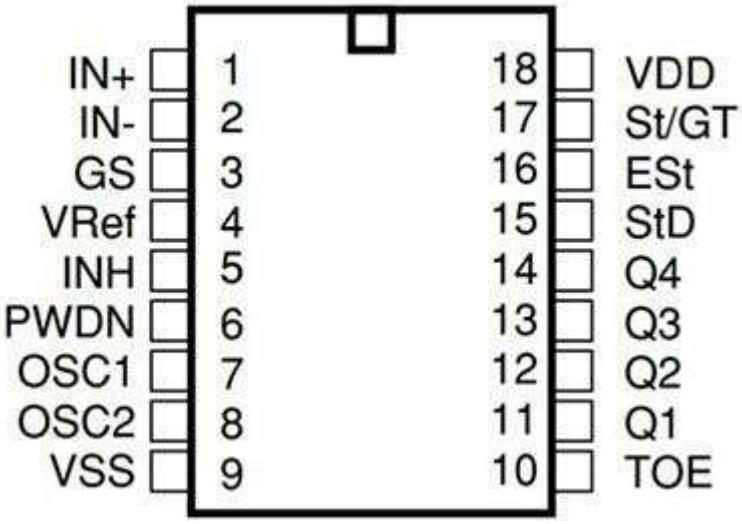

Fig 6.1:Pin diagram of IC MT8870

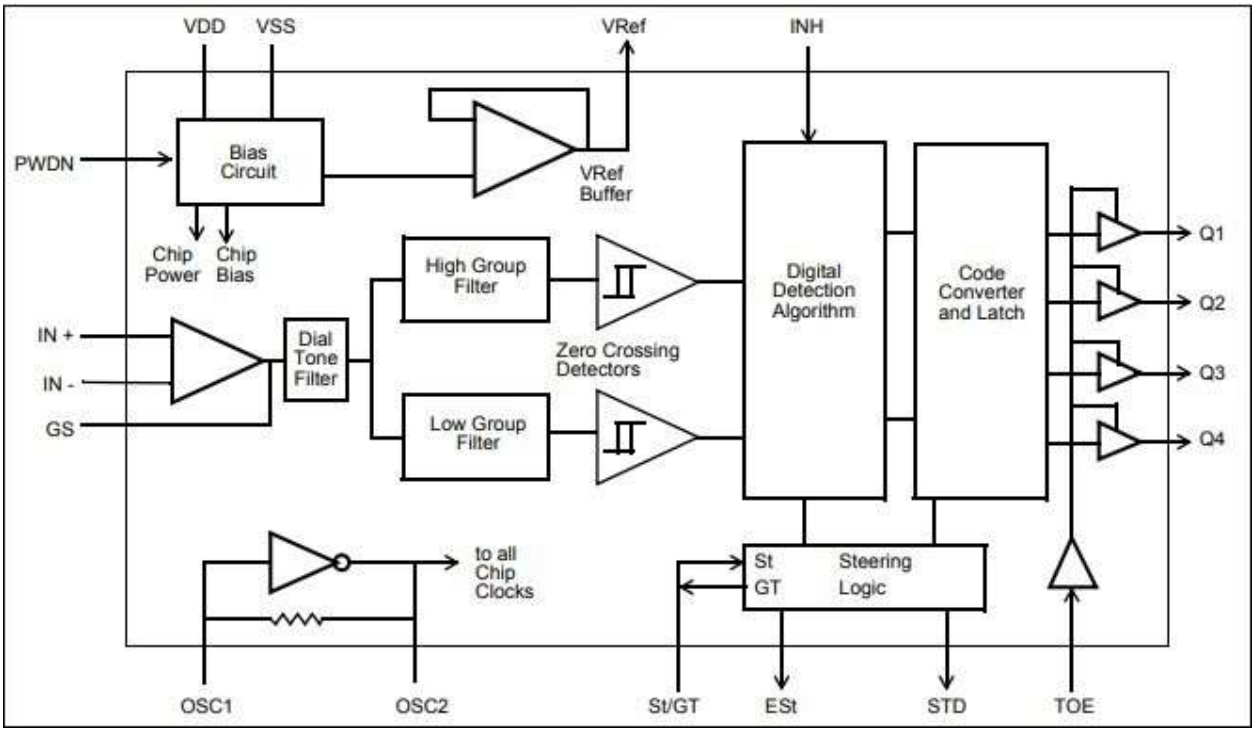

Fig 6.2:Internal block diagram of IC MT8870 (DTMF receiver)

Table 6.2:PIN DESCRIPTION

18 pin IC MT8870	Name of the pin	Description
1	IN+	Non-Inverting Op-Amp (Input).
2	IN-	Inverting Op-Amp (Input).
3	GS(Gain select)	Gives access to output of front end differential amplifier for connection of feedback resistor
4	V ref	Reference Voltage (Output): Nominally VDD/2 is used to bias inputs at mid-rail
5	INH	Inhibit (Input): Logic high inhibits the detection of tones representing characters A, B, C and D. This pin input is internally pulled down
6	PWDN	Power Down (Input): Active high. Powers down the device and inhibits the oscillator. This pin input is internally pulled down
7	OSC1	Clock (Input)
8	OSC2	Clock (Output): A 3.579545 MHz crystal connected between pins OSC1 and OSC2 completes the internal oscillator circuit.
9	Vss	Ground(Input):0V
10	TOE	Three State Output Enable (Input). Logic high enables the outputs Q1-Q4. This pin is pulled up internally
11-14	Q1-Q4	Three state data (Output). When enabled by TOE, provide the code corresponding to the last valid tone-pair received (see Table 1). When TOE is logic low, the data outputs are high impedance
15	StD	Delayed Steering (Output).Presents a logic high when a received tone-pair has been registered and the output latch updated; returns to logic low when the voltage on St/GT falls below VTSt
16	EsT	Early Steering (Output). Presents a logic high once the digital algorithm has detected a valid tone pair (signal

The IC MT8870 is a DTMF receiver that integrates both band split filter and decoder functions .

It is a dual inclined dip IC with 18 terminals. It is manufactured using complementary metal oxide semiconductor process technology. This IC MT8870 offers low power consumption and handles the data precisely. Its decoder uses digital counting techniques to detect and decode all 16 DTMF tone pairs into a 4-bit code.

C1, R2 and R1 have been designed in such a way that it can control gain of the input signal. Resistance R3 and capacitor C2 has been used to set the "guard time ‟ which is a time duration through which a valid DTMF tone must be present for its recognition.

2. MOTOR DRIVER IC L293D

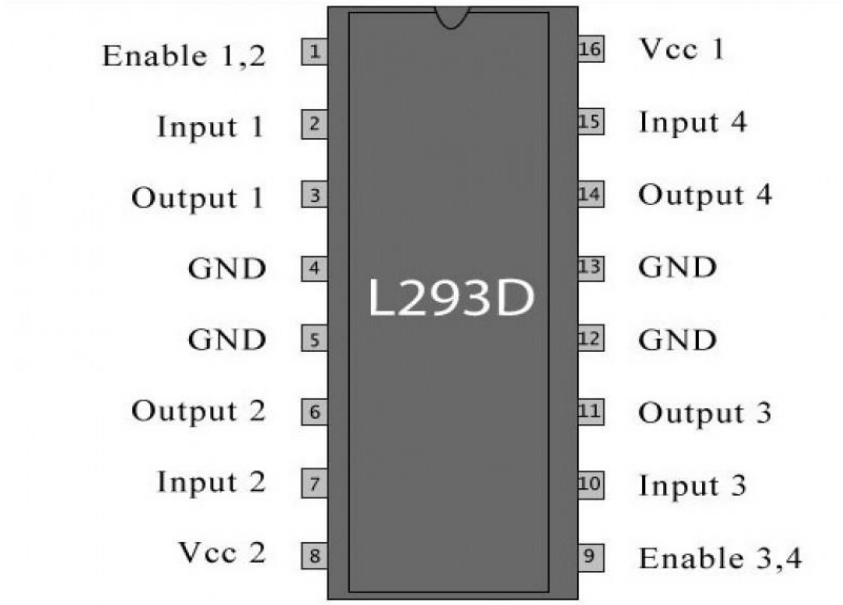

Fig 6.3:PIN DIAGRAM OF IC L293D

16 PIN IC	NAME	DESCRIPTION
1	ENABLE-1-2	When this part of enable is high the left part works and the other part remains inactive
2	INPUT-1	When input is high current flows through output-1
3	OUTPUT-1	Connected across one terminal of motor
4,5	GND	Ground pins
6	OUTPUT-2	Connected across one terminal of motor
7	INPUT-2	When input is high current flows through output-2
8	VCC2	Voltage supplied across the motor
9	ENABLE-3,4	When this part of enable is high the right part works and the other part remains inactive
10	INPUT-3	When input is high current flows through output-3
11	OUTPUT-3	Connected across one terminal of motor
12,13	GND	Ground pins
14	OUTPUT-4	Connected across one terminal of motor
15	INPUT-4	When input is high current flows through output-3
16	VCC1	Power source to IC usually 5V

PIN DESCRIPTION OF MOTOR DRIVER IC

Table 6.2:PIN DESCRIPTION OF MOTOR DRIVER IC

DC motor is electromechanical device that converts electrical energy into mechanical energy that can be used to do many works. It can produce mechanical movement to moving the wheels of the robot. DC motor has two wires, we can say them positive terminal and negative terminal, when these wires are connected with power supply the shaft rotates. We can reverse the direction of the rotation. L293d chip is very safe to use for DC motor control. This L293D is 16bit chip. Chip is design to control four DC motor, there are two inputs and two outputs for each motor.

There are two enable pins on motor driver IC L293D. Pin no 1 and pin 9, in order to enable the IC the pin 1 and 9 is connected to Vcc (high). For driving the motor to the left we need to enable

pin 1 to high. And for right we need to make the pin 9 to high. If anyone of the either pin1 or pin9 goes low then the motor in the corresponding section will suspend working. It's like a switch.

There are 4 input pins for this IC L293D, pin no 2,7 on the left side and pin no 15,10 on the right side of the IC as show in the pin diagram. Left input pins will regulate the rotation of motor connected across left side and right input for motor on the right hand side. The motors are rotated on the basis of the inputs provided across the input pins as LOGIC 0 or LOGIC 1 the motor.

3. CRYSTAL OSCILLATOR OF 3.57MHz

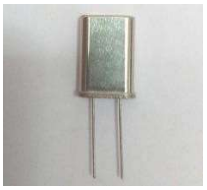

Fig 6.4:Crystal Oscillator

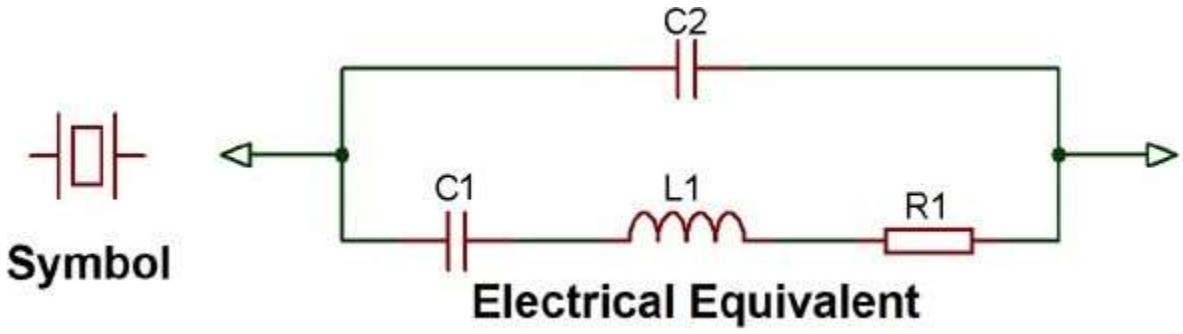

Fig 6.5:Internal structure of oscillator

Crystal oscillator works on the principle of the Inverse Piezoelectric Effect, the applied electrical field will generate a mechanical distortion across some material. Therefore, it utilizes the vibrating crystal's mechanical resonance, which is made through a piezoelectric material for generating an electrical signal of a certain frequency.

The internal clock circuit is completed with the addition of an external 3.579545 MHz crystal and is normally connected (Single-Ended Input Configuration). However, it is possible to configure several MT8870D device employing only a single oscillator crystal. The oscillator

output of the first device in the chain is coupled through a 30 pF capacitor to the oscillator input (OSC1) of the next device. Subsequent devices are connected in a similar fashion. The problems associated with unbalanced loading are not a concern with the arrangement shown, i.e., precision balancing capacitors are not required.

4. IC 7805 (voltage regulator)

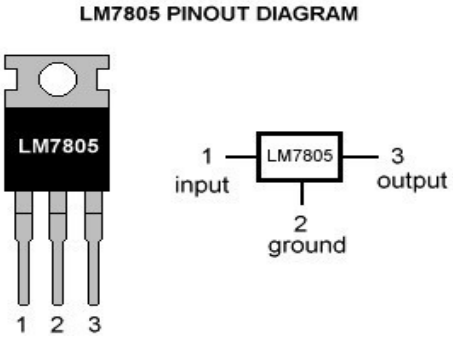

Fig 6.6:IC 7805

IC 7805 is to produce a stable DC voltage for powering the electronic circuits. It is used to get regulated DC current from unregulated DC current. The output observed at the IC is stable, it can be used to get a low DC voltage from high DC voltage. (for eg there are IC 7805, IC7812)

There are 2 types of voltage regulators available in market

1. Fixed voltage regulators with series number (78XX, 79XX)
2. Variable voltage regulators with series number (LM317)

5. CAR CHASSIS

Fig 6.7:Car Chassis

A chassis is the basic framework of your vehicle. Sometimes the chassis is only the frame, while other times it includes the wheels, transmission, and sometimes even the front seats.

A chassis is onse of the most important components of a vehicle, without which the car would have no structure. It is the canvas in which the final construction of the vehicle is placed upon.

6. DC MOTORS

Fig 6.8:DC Motors

DC motors are used for the movement of the robotic car. These motors can be operated at the 12V DC power supply. These motors are bidirectional, which means it can rotate both clockwise and anticlockwise direction. The minimum current required for these types of motors to rotate is greater than 250mA. The rotation of the motor depends upon the potential applied to the terminals of the motor. The motors are arranged in H-bridge fashion.

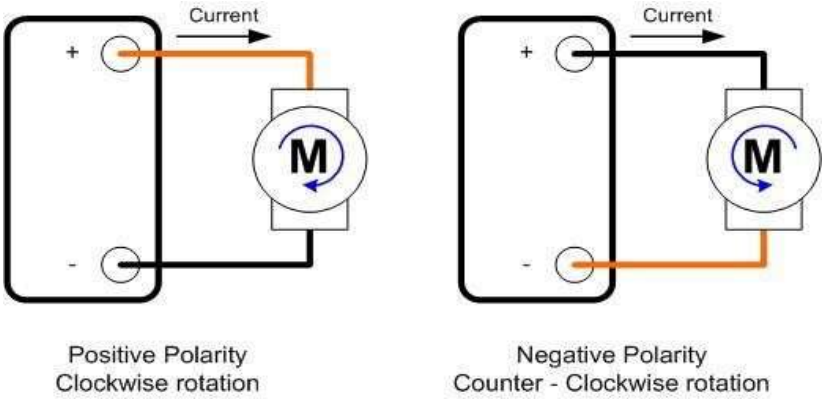

Fig 6.9:Connections to DC Motors

7. BREADBOARD

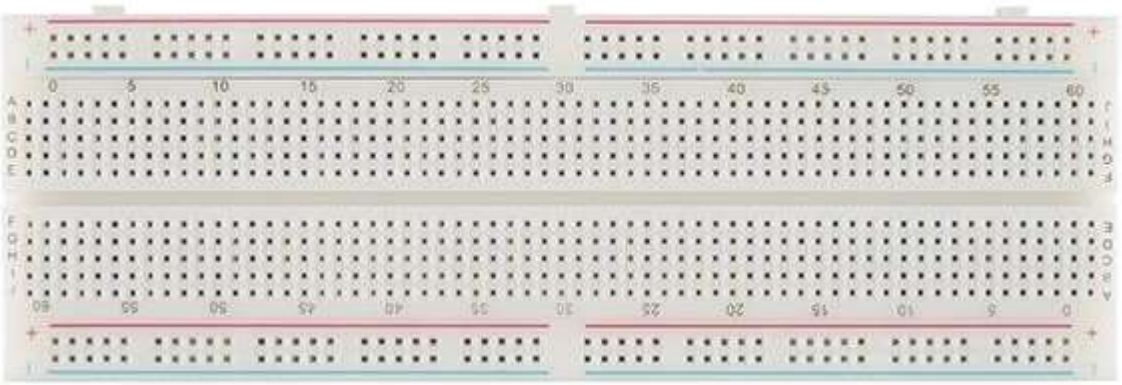

Fig 6.10:Breadboard

The breadboard represented in fig is a base used for constructing circuits on the base. This breadboard that the picture depicts is a solderless breadboard also called as the terminal array board.These are the boards that are required for the prototyping of various electronic systems ranging from analog to digital circuits and also complete CPU. These are made white plastic, solderless material. Since it is a board that does not require soldering (solderless) it is a reusable board and it becomes much easy to use for circuit design,for the creation of temporary prototypes and for the purpose of experimenting. On usage of other boards like stripboard, pcb with similar prototyping , the boards cannot be used for experimenting as it is not reusable. And this is one of the reasons why these solderless boards are popular amongst the students in usages pertaining to circuits and technological constructions. In this project, breadboard serves as a base to house the various equipments used such as resistors, 555 ic, capacitors.

CHAPTER 06

RESULT AND DISCUSSION

From the confirmed output we have obtained that DTMF technology works the best at very large distances and provides a good range of communication.

DTMF technology thoroughly makes us understand the working of the relevant components inside the decoder if ie, the working of the decoder, the working of the op-amp the inverting and non-investing terminals which makes us understand it's basic principle and the use of the filter (high and low), the code convertor latch and where the 4 bit output is passed. The crystal oscillator we understand its basic working and on how it generates its clock pulse based on the mechanical resonance.

Next up we have the motor driver, which drives the motor attached on both sides of the IC considering the enable and input/output pins we understand motor driver IC can be used to drive motors with higher power ratings.

Based on the decoded output we have a control over the car ie 2 for right, 8 for left and henceforth we can move forward or backward ie clockwise and anticlockwise, based on the assigned values the output is verified and the specific operation is performed.

Expected output

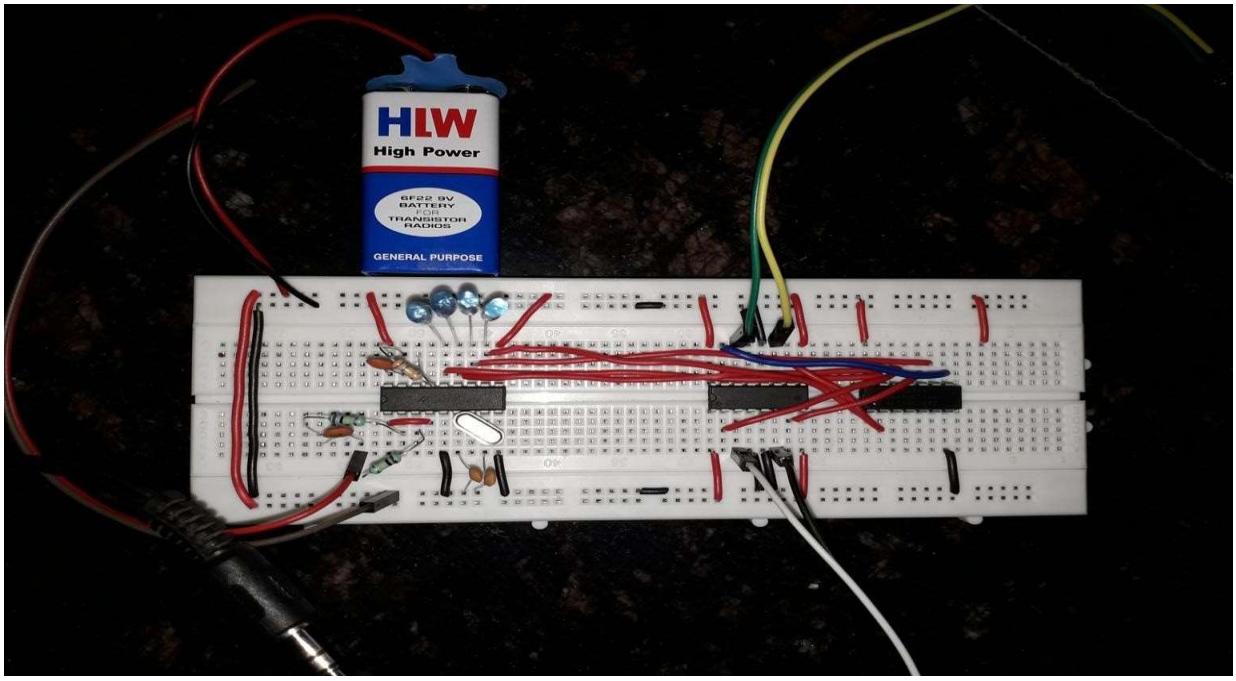

Fig 6.11; Expected output when the no 3 is pressed

ADVANTAGES

- Power consumption is less
- Quick responses of input
- Large range
- Expenses are less
- It can be used for various applications such as home automation, call center etc
- Provides higher security to user and doesn't let any intruder use it

LIMITATIONS

- The robotic car might not work properly, if the stacked phone or controller phone does not have proper network connection.

CHAPTER 07

CONCLUSION

On the rise such a robotic surface vehicle and AI, we have to overcome the drawbacks of the typically used RF circuits. This DTMF technology includes advantages such as robust control, minimal interference and a large working range. In these project with the use of a mobile phone for controlling the BOT can overcome these limitations. It provides the advantages of easy control, working range as large as the coverage area of the service provider, no interference with other controllers and up to twelve controls. The car requires five commands for motion control. The remaining controls are available internal circuitry. In this way the cost involved in training people to use such DTMF can also be saved to serve purposes dependent on the area of application of the DTMF. We have tried to reduce the circuit complexity and improve upon the human machine interface. The cost analysis of the research described clearly indicates a huge improvement in the cost expenditure of the production of these unmanned vehicles. Moreover handling these DTMF does not require much skill on the part of the user. Even an ordinary person can maneuver these DTMF without having to know much about the.

FUTURE SCOPE

- An IR sensor or ultrasonic sensor can be used to detect the obstacles in the pathway of the robotic car.
- Different sensors for the car can be used to detect a particular line to follow ie line following robotic cars.
- A camera module can be attached, so that the user can correctly move the robotic car.

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