Visvesvaraya Technological University

BELGAUM, KARNATAKA

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ಬೆಳಗಾವಿ, ಕರ್ನಾಟಕ

A MINI PROJECT REPORT ON

"DTMF BASED MOBILE CONTROLLED ROBOT"

Submitted to Visvesvaraya Technological University in partial fulfillment of the requirement for the award of degree of

Bachelor of Engineering

in

Electronics and Communication Engineering.

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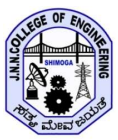

2021

National Educational Society ®

J N N College of Engineering

Department of Electronics and Communication Engineering

CERTIFICATE

This is to certify that the mini project report entitled

"DTMF BASED MOBILE CONTROLLED ROBOT"

Submitted by:

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Toward's the partial fulfillment of the requirement for the award of the Bachelor Degree in Electronics & Communication Engineering as per the University regulations during the year 2021. It is certified that all corrections / suggestions indicated for Internal Assessment have been incorporated and it satisfies the academic requirement in respect of Mini Project (18ECMP68) prescribed.

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Signature of Examiners

Examiner 1: _____ **Examiner 2:** _____

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Thanking you all,

Project Associates,

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ABSTRACT

Cell phone operated Robot is a Robot whose movement can be controlled by pressing the number of cell phone. The robot can move forward, backward, right or left which depends on the numbers you are pressing. The property of Robot to operate by the cell phone helps you to operate the robot from some distance The Cell Phone controlled Robot uses DTMF (Dual tone-multi frequency) module. It is capable of receiving a set of command (instructions) in the form of DTMF (Dual tone multiple frequency) tones and performs the necessary actions. The robot is controlled by making call to the mobile connected to the robot. The robot performs various operations like moving forward, backward etc. if any key is pressed in the course of the call, by hearing at the other end of the call (i.e. at the mobile connected to the robot). Each key corresponds to a particular frequency which is decoded by the DTMF decoder & processed by logic circuit by giving each key a particular operation like moving forward, backward, right, left etc. The benefit is that we can operate the robot by using any mobile with the working range as large as the coverage area of the service provider.

CHAPTER 1

INTRODUCTION

Dual-tone multi-frequency signalling (DTMF) is an in-band telecommunication signalling system using the voice-frequency band over telephone lines between telephone equipment and other communications devices and switching centres. DTMF was first developed in the Bell System in the United States, and became known under the trademark Touch-Tone for use in push-button telephones supplied to telephone customers, starting in 1963. DTMF is standardized by ITU-T Recommendation Q.23. It is also known in the UK as MF4.

Multi-frequency signalling is a group of signalling methods that use a mixture of two pure tone (pure sine wave sounds. Various MF signalling protocols were devised by the Bell System and CCITT

The DTMF system uses a set of eight audio frequencies transmitted in pairs to represent 16 signals, represented by the ten digits, the letters A to D, and the symbols # and *. As the signals are audible tones in the voice frequency range, they can be transmitted through electrical repeaters and amplifiers.

Controlling a robot wirelessly is possible with several methods such as Remote, Bluetooth, Wi-Fi, etc. But, the controls of these communication methods are limited to certain areas, and complicated to design as well. To overcome these difficulties, we have come up with a Mobile Controlled Robot.

A Mobile Controlled Robot is a mobile device, which provides wide-range of wireless control ability to your robot unless your cell phone gets out of signal.

A general concept of mobile controlled robot is that it can be controlled from any part of the world with just an inclusion of a camera. We will definitely offer you the simplest method for developing this kind of robot in the coming days.

Now, we like to introduce the simplest technique of fabricating a Mobile Controlled Robot via GSM. As we have eliminated the use of a microcontroller, it could certainly help the beginners to feel better.

wireless controlled vehicles had been extensively used in a lot of areas like unmanned rescue missions, military usage for unmanned combat and many others. But the major disadvantage of these wireless unmanned robots is that they typically make use of RF circuits for manoeuvre and control. Essentially RF circuits suffer from a lot of drawbacks such as limited frequency range i.e. working range, and limited control. To overcome such problems associated with RF control, few papers have been written, describing methods which make use of the GSM network and the DTMF function of a cell phone to control the robotic vehicle. This paper although uses the same principle technology of the GSM network and the DTMF based mobile phone but it essentially shows the construction of a circuit using only 4 bits of wireless data communication to control the motion of the vehicle without the use of any microcontroller. This improvement results in considerable reduction of circuit complexity and of manpower for software development as the circuit built using this system does not require any form of programming. Moreover, practical results obtained showed an appreciable degree of accuracy of the system and friendliness without the use of any microcontroller.

DTMF Keypad

The DTMF telephone keypad is laid out in a 4×4 matrix of push buttons in which each row represents the low frequency component and each column represents the high frequency component of the DTMF signal. Pressing a key sends a combination of the row and column frequencies. For example, the key 1 produces a superimposition of tones of 697 and 1209 hertz (Hz). Initial pushbutton designs employed levers, so that each button activated two contacts. The tones are decoded by the switching centre to determine the keys pressed by the user.

CHAPTER 2

DTMF ROBOT

In principle, RF (Radio Frequency) can be regarded as the control which deals with the use of radio signals to remotely control any device. A remotely controlled vehicle may be defined as any mobile device which is controlled by means that it does not restrict its motion with an origin external to the device i.e. the possibility of an existence of a radio control device, a cable between the control and the vehicle or an infrared controller. A RCV is always controlled by a human operator and takes no positive action autonomously.

The IR system follows the line of sight approach which involves the process of actually pointing the remote at the device being controlled; this makes communication over obstacles and barrier quite impossible. To overcome such problems, a signalling scheme utilizing voice frequency tones is employed. This is known as Dual Tone Multi-Frequency (DTMF), Touchtone or simply tone dialling.

In this paper, phones making use of the GSM network interfaced directly with the DTMF decoder and the motor driver is used to remotely control an unmanned robotic vehicle thus overcoming the distance barrier problem and communication over obstacles with very minimal or no interference but is solely network dependant. The design of an unmanned vehicle proposed here does not make use of any microcontroller. The transmitter used, is a handheld cell phone.

In this project the robot, is controlled by a mobile phone that makes call to the mobile phone attached to the robot in the course of the call, if any button is pressed control corresponding to the button pressed is heard at the other end of the call. This tone is called dual tone multi frequency tome(DTMF) robot receives this DTMF tone with the help of phone stacked in the robot.

The received tone is processed by the atmega16 microcontroller with the help of DTMF decoder MT8870 the decoder decodes the DTMF tone in to its equivalent binary digit and this binary number is send to the microcontroller, the microcontroller is preprogramed to take a decision for any give input and outputs its decision to motor drivers in order to drive the motors for forward or backward motion or a turn. The mobile that makes a call to the mobile phone stacked in the robot acts as a remote. So this simple robotic project does not

require the construction of receiver and transmitter units. DTMF signalling is used for telephone signalling over the line in the voice frequency band to the call switching centre. The version of DTMF used for telephone dialling is known as touch tone.

DTMF assigns a specific frequency (consisting of two separate tones) to each key s that it can easily be identified by the electronic circuit. The signal generated by the DTMF encoder is the direct al-gebric submission, in real time of the amplitudes of two sine (cosine) waves of different frequencies, i.e. ,pressing 5will send a tone made by adding 1336hz and 770hz to the other end of the mobile.

In this project, the robot is controlled by a mobile phone that makes a call to the mobile phone attached to the robot. In the course of a call, if any button is pressed, a tone corresponding to the button pressed is heard at the other end of the call. This tone is called „dual-tone multiple-frequency" (DTMF) tone. The robot perceives this DTMF tone with the help of the phone stacked in the robot.

DTMF signalling is used for telephone signalling over the line in the voice- frequency band to the call switching centre. The version of DTMF used for telephone tone dialling is known as „Touch-Tone". DTMF assigns a specific frequency (consisting of two separate tones) to each key so that it can easily be identified by the electronic circuit. The signal generated by the DTMF encoder is a direct algebraic summation, in real time, of the amplitudes of two sine (cosine) waves of different frequencies, i.e., pressing „5" will send a tone made by adding 1336 Hz and 770 Hz to the other end of the line

CHAPTER 3

CONSTRUCTION AND WORKING

A DTMF decoder is a device which takes a signal from the headset line of a cell phone and gives a 4 bit output corresponding key pressed in the cell phone. Whenever a key is pressed in the mobile, a sum of two fixed frequency is sent as input to the decoder IC. This IC converts the number into its corresponding binary value for example if 3 is pressed its binary value 0011 is produced at the output.

Conventionally, robots controlled by wireless communication employ radio frequency (RF), which have the drawbacks of limited working range, limited frequency range and the limited control. Use of a mobile phone for robotic control can overcome these limitations. It provides the advantage of robust control, working range as large as the coverage area of the service provider, no interference with other controllers and up to twelve controllers. Although the appearance and the capabilities of robots vary vastly, all robots share the feature of a mechanical, movable structure under some form of control. The control of the robot involves three distinct phases: perception, processing and action. Generally, the preceptors are sensors mounted on the robot, processing is done by the on-board microcontroller or processor, and the action is performed using motors or with some other actuators. When constructing any robot, one major mechanical constraint is the number of motors being used. Either a two wheel drive or a four-wheel drive can be used. Though four-wheel drive is more complex than two-wheel drive, it provides more torque and good control. Two-wheel drive, on the other hand, is very easy to construct. The chassis used in this model is a 10×18cm2 sheet made up of par ax. Motors are fixed to the bottom of this sheet and the circuit is affixed firmly on top of the sheet. A cell phone is also mounted on the sheet as shown in the picture. In the four-wheel drive system, the two motors on a side are controlled in parallel. So a single L293D driver IC can drive the rover. For this robot, beads affixed with glue act as support wheels.

3.1 Hardware Design Framework

The blocks of the receiver model which is seen in fig are explained in detail in this section: However, upon implementation we also found that the proposed method could also be implemented without using a microcontroller, which was one of the key elements in the design of the circuit. In case of motion control as described in these papers, we found that a considerable amount of circuit complexity can be reduced when we omit the use of the microcontroller. And the need for writing any software code is also absent. The main components of the circuit are DTMF decoder IC, motor driver IC and motors. The decoder IC used here is HT9107B IC. The second pin of decoder IC is an inverting pin of the operational amplifier.

Tone is applied to the IC through a series of capacitor and resistor. The output of the Op Amp is feedback through GS pin of the IC. An external crystal is connected to the 7th and 8th pins of the IC.

Motor driver IC used is L293D. It has 16 pins. 2, 7, 10, 15 pins are the inputs of motor driver IC connected from output pins of the decoder IC. The output pins are 3, 6, 11, 14. These pins are connected to the two motors of robotic vehicle. 8th pin is connected to the 5v. Vss is the input voltage with which the motors runs. Motors cannot be driven with 5Vof microcontroller. So, a driver IC is used to amplify this voltage

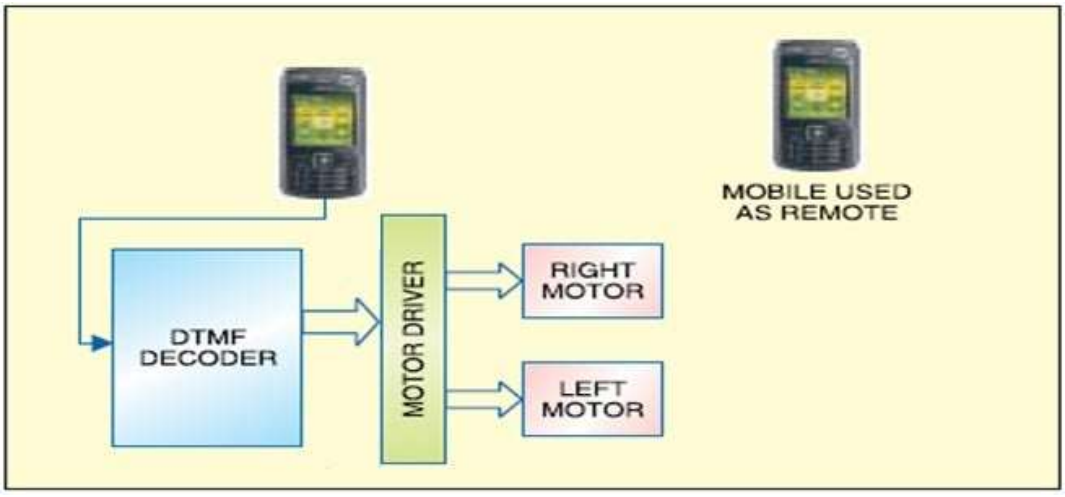

Figure 3.1: Block Diagram of Mobile Controlled Robot

3.2 DTMF Decoder

NEED OF DTMF DECODING:

In the premature days, our telephone systems were operated by human operators in a telephone exchange room. The caller will pick up the phone, giving instruction to the operator to connect their line to the destination. It is a kind of manual switching. As more and more people entered in the telephone technology as useful communication gear, manual switching becomes a time consuming tedious task.

As technology established, pulse or dial tone technique were invented for telephone communication switching. It employs electronics and computers to support switching operations. DTMF is the ultimate technique used in any of the Mobile, Telephone communication systems.

DTMF (Dual tone multiple frequency) is the most popular and nowadays ubiquitously used telecommunication signalling method. A DTMF decoder detects the DTMF tones and generates the binary sequence corresponding to key pressed in a DTMF keypad. The circuit of this project presented here is a DTMF decoder. DTMF keypads are used in almost all landline and mobile handsets. The DTMF decoders, therefore, are used at the telephone switching centres to detect the number dialled by the caller. The DTMF version used in pushbutton telephones is called touch tone and is a registered trademark of AT&T.

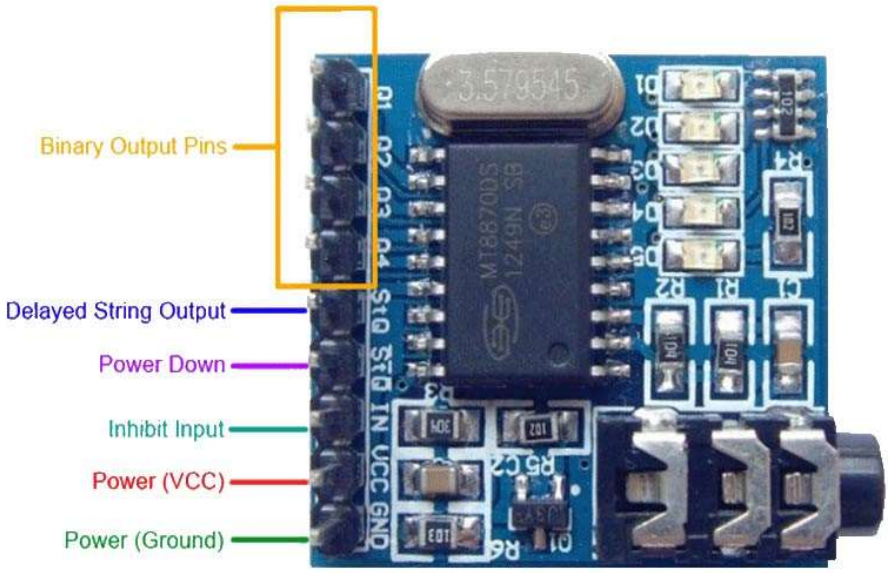

Figure 3.2.1: MT8870 DTMF Decoder

Figure 3.2.2: MT8870 DTMF Decoder IC

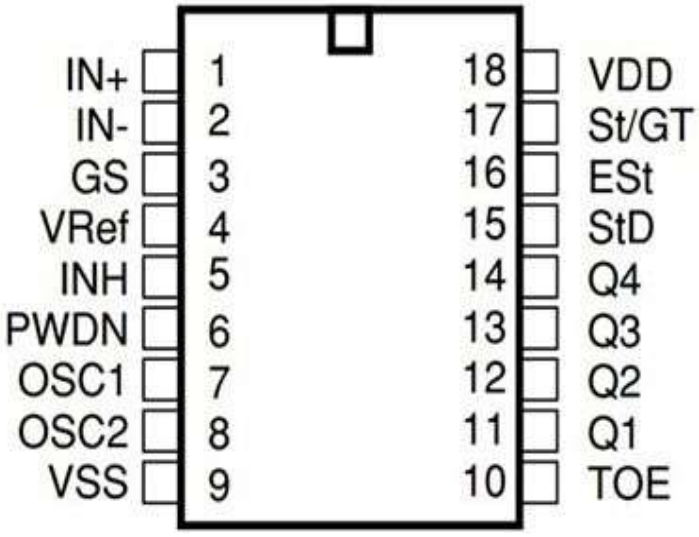

Figure 3.2.3: MT8870 DTMF Decoder IC Pin Configuration

3.3 Motor Driver

Motor driver IC used is L293D. It has 16 pins. 2, 7, 10, 15 pins are the inputs of motor driver IC connected from output pins of the decoder IC. The output pins are 3, 6, 11, 14. These pins are connected to the two motors of robotic vehicle. 8th pin is connected to the 5v. Vss is the input voltage with which the motors runs. Motors cannot be driven with 5Vof microcontroller. So, a driver IC is used to amplify this voltage. VSS pin provides this voltage.

Figure 3.3.1: L293D Motor Driver Module

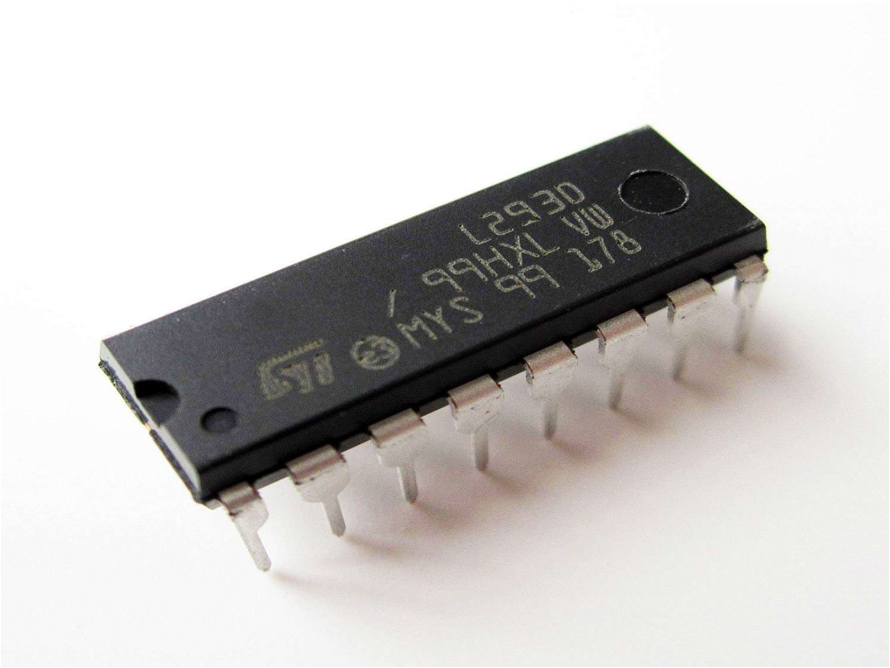

Figure 3.3.2: L293D Motor Driver IC

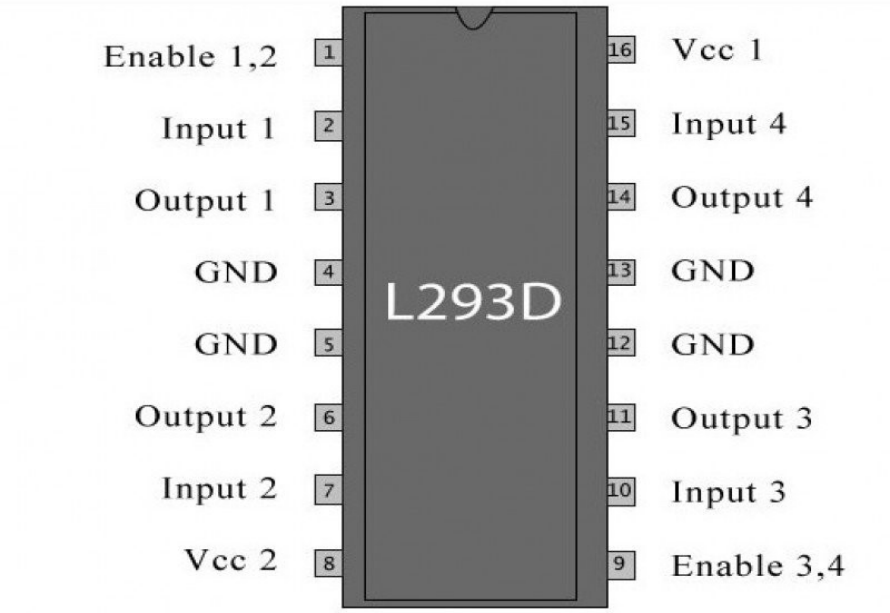

Figure 3.3.3: L293D Motor Driver IC Pin Configuration

3.4 Function of Crystal Oscillator

An electronic circuit or electronic device that is used to generate periodically oscillating electronic signal is called as an electronic oscillator. The electronic signal produced by an oscillator is typically a sine wave or square wave. An electronic oscillator converts the direct current signal into an alternating current signal. The radio and television transmitters are broadcasted using the signals generated by oscillators. The electronic beep sounds and video game sounds are generated by the oscillator signals. These oscillators generate signals using the principle of oscillation.

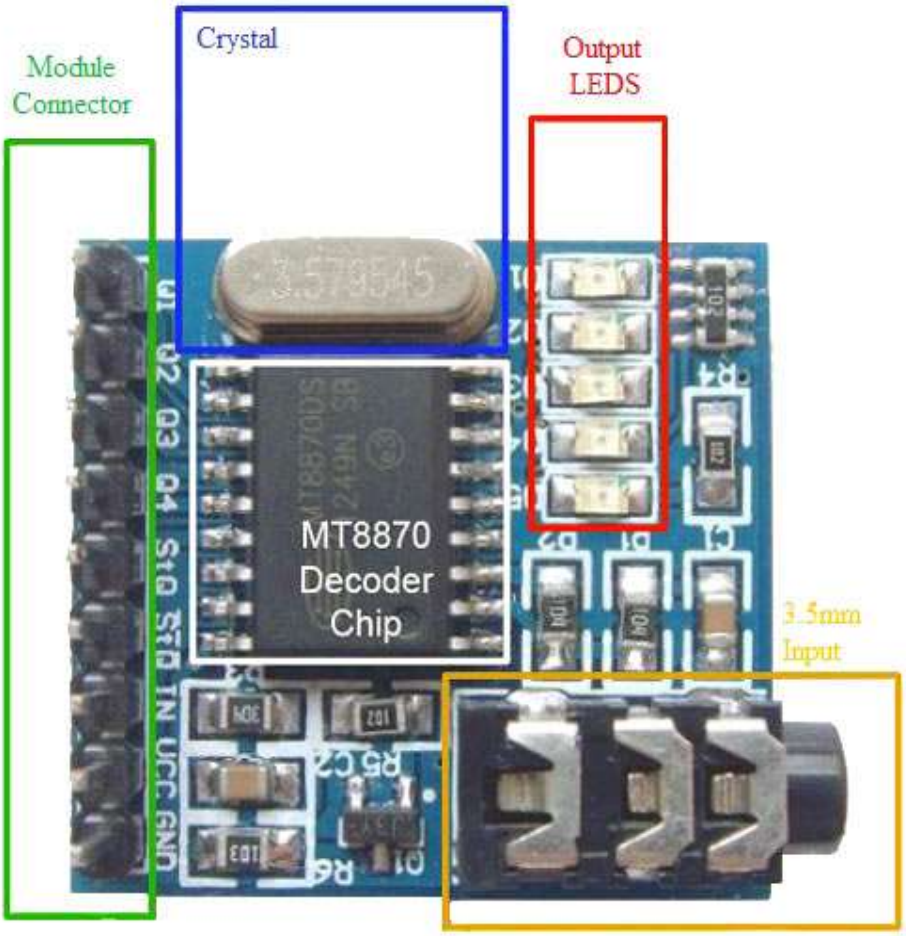

Figure 3.4: Crystal in MT8870 Decoder Module

3.5 Circuit Diagram

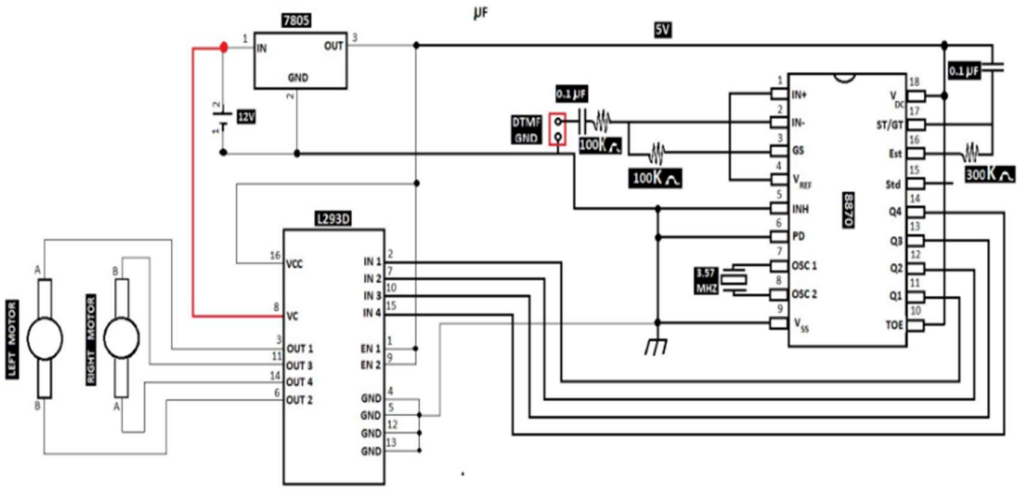

Figure 3.5: Circuit Diagram of DTMF Based Mobile Controlled Robot

Components Required

- 4 Dc Motors
- 4 Clamps
- Female to Female Burg Connecting Wires
- Power Board Module
- L293D Motor Driver Module Board
- MT8870 DTMF Decoder Module Board
- Chassis
- Nuts and Bolts
- 3.5mm Audio Connector
- Double Sided Tape
- Cable Tie

3.6 Working

The unmanned vehicle could either have a two wheel drive or a four wheel drive. We choose to go with a four wheel drive as it provides a better control and more torque than the two wheel system. The circuit as shown in fig.5 has been designed on a breadboard. The breadboard on which the circuit was constructed is mounted on a steel chassis. In addition the cell phone (receiver one) which is attached to the vehicle is also mounted on the chassis (not shown in the figure). Motors which are used for motion of the robotic car are fixed to the bottom of the steel chassis. In the four wheel drive system which we had used in the configuration of our circuit, the motors on both the sides are managed independently of one another. However a single L239D motor driver IC is enough to control the four motors. Now to operate the vehicle, we need to make a call to the cell phone attached to the circuit on the receiver side. Moreover, we should note, that the call is only possible if the operator on the transmitter side knows the cell phone number of the other phone. Any GSM enabled phone can be used as the transmitter; which sends the DTMF tones through the existing GSM network.

The tones are received by the receiver phone accordingly. One thing to keep in mind is that the cell phone at the receiver side should be kept in auto answer mode, so that the call can be taken after a single ring. The DTMF tones which are received are fed to the circuit through the headset of the cell phone.

The DTMF tones are fed as input to the DTMF decoder which produces the 4 bit equivalent of the received tone and passes it on to the motor driver as input. The motor driver on receiving the corresponding input drives the motor as specified.

3.7 Operation

If the button pressed from mobile is '8', it gives a decoded output of '1000' (in the order of Q1, Q2, Q3 and Q4). Thus motor connected to the first two pins (OUT1 and OUT2) will rotate and the second motor stays off. So, the robot moves in one direction either to left or right. If the robot is to rotate forward or backward then the binary value should be either '0101' or '1010'. These values indicate that two motors rotates in the same direction i.e. either forward or backward. The below table gives the low frequency, high frequency and binary output value of each button pressed in the keypad.

Button	Low DTMF frequency (Hz)	High DTMF frequency (Hz)	Binary coded output			
			Q1	Q2	Q3	Q4
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

Truth Table

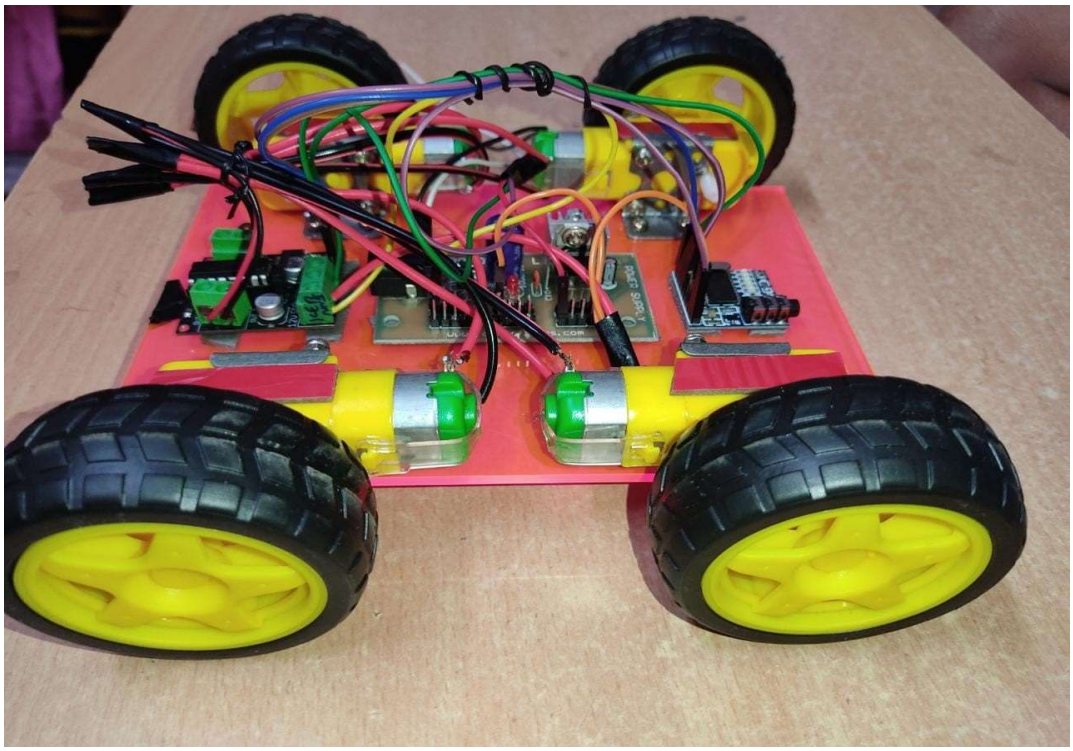

Figure 3.7.1

Figure 3.7.2

3.8 Application

These unmanned vehicles can have various scientific uses in hazardous and unknown environments.

- USVs have also been used for space exploration purposes examples of which are Voyager-I and the Martian explorers Spirit and Opportunity. Similarly, military usage of these robotic vehicles dates back to the first half of the 20th century.
- Remote controlled vehicles are used by many police department bomb-squads to defuse or detonate explosives.
- Current USV's can hover around possible targets until they are positively identified before releasing their payload of weaponry.
- USVs also play an increased role in search and rescue. These vehicles could be used in case of natural calamities & emergencies. This can also be a great asset to save the lives of both people and soldiers.
- In recent times, there has been a serious endangerment to the wildlife. Many animals are significantly on the verge of extinction.
- These spy robotic cars can be used to patrol the different sections of the forested areas for any suspicious activity and since it is a live streaming device as well as mobile, it can keep the forest guards constantly updated and alert about the status of different areas which are vulnerable to attack.
- As a result, it can help to prevent further destruction of the forest resources by enabling correct prohibitory action at the appropriate time.

3.9 Limitations of DTMF Controlled Robotic Vehicle

- DTMF robot may not work properly if it is operated with another mobile when there is no signal.
- Mobiles with particular jacks are only used.
- Only touchtone mobiles can be used.
- Only can be used as a car robot, not as an arm robot.

CHAPTER 4

Conclusion and Future Scope

4.1 Conclusion

DTMF (Dual tone multiple frequency) is the most popular and nowadays ubiquitously used telecommunication signalling method. DTMF keypads are used in almost all landline and mobile handsets. So, it has become a great field for students to explore and to use this technique in other fields too.

It is a must for every budding engineer to study it so that various other advanced and complex signalling techniques can be studied and explored.

DTMF based robots are very useful and can be modified for the future applications.

All the basic learnt in this course will stay with me all my life.

4.2 Future Scope

DTMF controlled robot can be further improved to control more functionalities like pick and place of objects. It can be inbuilt with various sensors like infra-red proximity sensor, ultra-sonic distance measurement. Furthermore, we can also inbuilt camera and GPS tracking system to get more accurate information.

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