DTMF Controlled Robotic Vehicle

Suvashis Das Arpan[1], Dipen Dutta[2], Tarak Hossain[3], Shamim Al Mamun[4]
[1,2,3,4]*School of Electronics and Electrical Engineering, Lovely Professional University, Phagwara, Punjab, India*

Abstract **- We are living in an era of science and technology. To make our day-to-day life more comfortable and hazardless scientists are introducing us with new inventions and technologies. DTMF can be considered as one of those. DTMF technology is peerless to the present generation DTMF technology a derived the theory of Digital Signal Processing. Beforehand Radio Frequency circuit is used for wireless controlling but it has the big deprivation that is range. Owing to which it limits the control and has unfavourable effect on the performance of the car, Whereas the DTMF converts this deprivation of Radio Frequency circuit into dominance. It provides increased range of working und also provides better results. This system is controlled und managed using phone in microcontroller. The wireless communication is the remote handling operation of robot using Dual Tone Multi Frequency. Formally, wirelessly controlled robots use radio frequency circuits that have the lack of restricted working range. restricted frequency range and the restricted control these of a cell phone for robot control can overcome these restrictions. It provides the dominance of robust control raise as more as the coverage area of the service provider, no intervention with other controllers and up to 12 controllers. In spite of the fact that the appearance and the capabilities of robots vary largely all robots share the future of a physical, movable structure under some form of control. The Control of robot involves three different phases perception, processing and action.**

Index Terms **- DTMF, Crystal Oscillator, PIC16F877A Microcontroller, Robotic Vehicle.**

I.INTRODUCTION

In 21th century uses of robots are increasing day by day. Robots refers to electromagnetic machine which operates by its own. Use of computer programming, mobile or remote makes it self-sufficient to do specific job or work. The Robot Institute of America define "A robot is a reprogrammable multifunctional manipulator designed to move material parts, tools or specialized device through variable programmed motions for the performance of a variety of tasks." As a result, scientists are research frequently to meet up the growing demand of self-functioning efficient robots. In our day to day life, we acquaintance with various types of robots or robotic equipment which make our everyday life easier. This traditional robot uses radio frequency circuits. Using RF circuit has some downsides also. Limitation in rage is one of them. Due to this drawback, using robot from a great distance is difficult. This problem can be overcome by using mobile phone. ¬DTMF is a kind of technology which allows us to control a robot with a mobile phone at a working range as long as the coverage are of the service provider. That means we can control our robot from a distant place. Moreover, it allows no interfaces with other controllers. In this project we have used a phone to control our robotic vehicle. This process is called DTMF. Where "DTMD stands for Duel Tone Multi Frequency." When we make a call to the robot or press a button in our controller phone it a tone corresponding to the button pressed is heard at the other end of the call. 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 robot involves three distinct phases: perception, processing and action. The DTMF used here is not intended for data transfer, but it is designed for the purpose of controlling the signals. The standard decoders are used to signal at a rate of about 10 "beeps" (=5 bytes) per second. This DTMF tone is recognized by the robot with the help of the mobile mounted on the robot. The Arduino microcontroller processes the received tone by using the DTMF decoder MT8870 IC. This particular decoder decodes the DTMF signal into presided binary digit. This decoded binary code is sent to a preprogrammed microcontroller. This microcontroller than verify the input, processes it and take decision. Then it produces a certain output for the robot. This results in the movement of the fellow robot in a

	1209Hz	1336Hz	1477Hz	1633Hz
697Hz	1	2	3	A
770Hz	4	5	6	B
852Hz	7	8	9	C
941Hz	*	0	#	D

particular direction like moves forward, backward, turns right or left etc. Thus, this technology is used to control a robot or robotic vehicle. So, this simple robotic project does not require any construction of any transmitter or receiver. [2] This DTMF is being commonly used nowadays. Elaboration of DTMF is Duel Tone Multi Frequency. This phenomenon is generally used in modern cell phone system for dialing numbers, to configure telephone exchanges such as switchboards, etc. The codes are often transmitted via a transceiver of 27MHz using DTMF. The DTMF system generally uses eight different frequency signals transmitted in pairs to represent sixteen different numbers, symbols and letters. DTMF assigns a specific frequency (consisting of two separate tones) to each key so that the electronic circuit can easily be identify it. Conveniently all the mobile phones are capable of generating DTMF after the establishment of connection. In case when the mobile is not able to generate DTMF a stand-alone dialer can be used. Here DTMF is designed because it is possible to use voice transfer and the standard microphone is used for receiving the codes. The lowest frequency used is 697 Hz and the highest is frequency used is 1633 Hz.

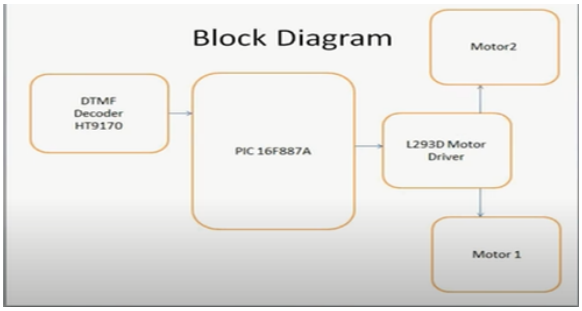

Figure 1: Block Diagram

II.COMPOSITION OF DTMF

Table1 shows the development of any DTMF code. It is seen that each code “beep”, consists of two frequencies that are combined together. Standard specifications provided are 0.7% for typical case and 1.5% for maximum tolerance. The resultant tone is consisting of two frequencies. This signaling system intended for identifying a push button on a DTMF keypad. DTMF signal is a combination of superposition of two sine waves having two different frequencies. Each keypad has its own tone. These tones represent the frequencies of rows as well as column. This row and column refer to the keypad of the DTMF. As soon as we press any key of the keypad, it transfers the signal through the frequency of the key. When we push any input key on our device, it immediately gives two tones of particular frequencies. The first tone is a high frequency tone and the second tone is a lower frequency tone. Basically, row frequencies are low frequencies and column frequencies are high frequencies. The column frequencies are little bit louder than the row frequencies. A DTMF encoder is present in mobile. Each button produces unique tone. A decoder IC is used to convert the output of keypad.

This table resembles a matrix keyboard. The X and Y coordinates of each code give the two frequencies that the code is composed of. Notice that there are 16 codes; however, common DTMF dialers use only 12 of them. The "A" through "D" is "system" codes. Most end users won't need any of those; they are used to configure phone exchanges or to perform other special functions.

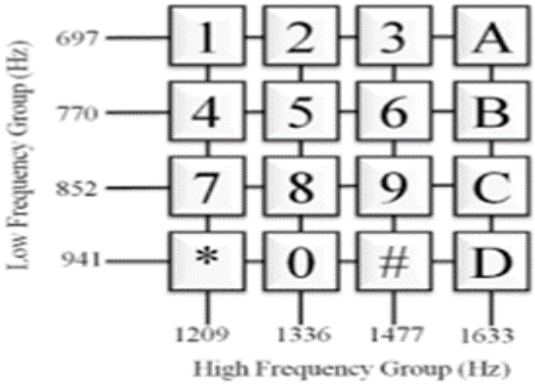

Figure 2: DTMF keypad

III.DTMF OPERATION

[3] This signaling system intended for identifying a push button on a DTMF keypad. DTMF signal is a combination of superposition of two sine waves having two different frequencies. DTMF works by assigning eight different audio frequencies to the rows and columns of the keypad. The columns on the keypad are assigned high-frequency signals, while the rows are assigned low-frequency signals.

When you press a key, which corresponds to a number or symbol, the phone generates a tone that simultaneously combines the high-frequency signal from the column that key is in with the low-frequency signal of the row it's in. This unique signal pair is then transmitted over telephone wires to the local phone exchange, where the two signals are decoded to determine which numbers you are dialing. So when you press the "5" key on your phone's keypad, for example, a combined signal tone of 1336 Hz and 770 Hz is sent to the phone company, which then knows that you've just pressed "5." Once they receive the full number that you dialed, they can automatically route your call to it. Why the signal pair? Turns out that makes it pretty much impossible for the human voice to imitate any key's DTMF tone. It also helps to prevent interference from being received at the local exchange building by other non-DTMF signal frequencies. DTMF-based telephones were first offered to the public on November 18, 1963. At the time, AT&T trademarked the name "Touch-Tone" for DTMF technology, so these phones became widely known as Touch-Tone telephones. DTMF was so effective and reliable that it ended up replacing pulse dialing (along with its associated rotary dial telephones) altogether and even transformed the way that telephone companies operated. Because DTMF signals have the same frequency range as the human voice, they can essentially replace the intermediate operators who were necessary for transmitting long-distance calls.

IV.SIMULATION

This DTMF based controlled robotic vehicle simulation is done in proteus software. Proteus software is a tool which is used primarily for electronic design automation.

Components Used:

- Crystal Oscillator
- DIP Switch (Interactive DIP Switch 4 Independent Elements)
- PIC16F877A Microcontroller
- L293D Motor Driver
- Simple DC Motor

Crystal Oscillator

[4] It is an electronic oscillator that utilizes the mechanical resonance of a vibrating crystal of piezoelectric material to make an electrical signal with a high-accuracy frequency. Crystal oscillators are considered superior to ceramic resonators as they have higher stability, higher quality, and lower cost and are smaller in size. Because the crystal which is used in this oscillator has a very high-quality factor. This crystal oscillator are parts of many digital circuits. These oscillators generate the stable clock frequency. Similarly, it is the essential part of microcontroller for generating the clock signal. It works on the principle of the inverse piezoelectric effect. A mechanical deformation is produced by applying an electric field across certain materials. Thus, it utilizes the vibrating crystal's mechanical resonance which is made of piezoelectric material for generating an electrical signal of specific frequency. Quartz crystal oscillators are superior compared to other resonators such as LC circuits, turning forks and so on. Usually, 8MHz oscillator is used in microcontrollers and microprocessors also. Crystal oscillators are used to establish efficient communication for the navigation purpose in military and aerospace. It has many industrial applications such as computers, instrumentations, digital systems, in phase-locked loop systems, telecommunications, in sensors etc.

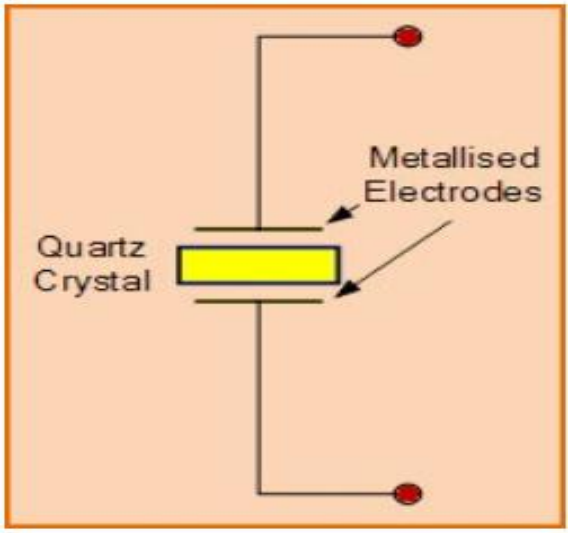

Figure 3: Crystal Oscillator

DIP Switch

[5] DIP switch stands for Dual In-line Package switch. It is a small switch which is mainly contained with a set of electrical switches packaged in a line. The DIP switches are designed for circuit boards to provide a range of electrical inputs to electronic devices. The

main advantage of this switch is the ability to change the position quickly for operating the electronic device. The fact is that there are no parts to lose while using this DIP switch.

In this project, DIP switch is used for giving the command to get the desired output. For giving the signal to control the robot through the DIP switch, we took four binary output-based DIP switch.

Here, “OFF” indicates 0 and “On” indicates 1.

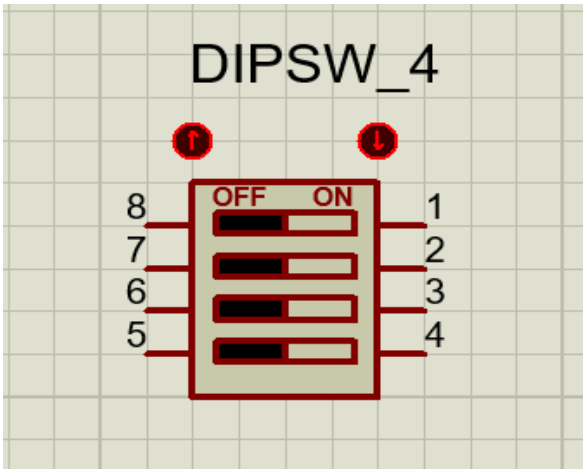

Figure 4: DIP Switch

PIC16F877A Microcontroller

[8] This microcontroller is one of the most famous microcontrollers because of its convenient usage as coding of this is also easier than other microcontrollers. [1] It has 40 pins in total and from there 30 pins are used for input and output. It has flash memory technology.

Through this technology, it can be write-erased as many times as possible. Having flash memory is one of the main advantages.

It has 35 instructions set. It has five ports (PortA, PortB, PortC, PortD and PortE). This microcontroller receives data from RX and transmits data from TX. It can operate up to 20 MHz frequency. Operating voltage is between 4.2 to 5.5volts. If anyone provides voltage more than 5.5 volts, it may get permanently damaged. It does have any internal oscillator that’s why we used crystal oscillator. It supports the SPI protocol also.

It has a huge number of applications in industrial gadgets. It is used in far-off sensors, security and safety devices, home automation, robotics and embedded systems etc.

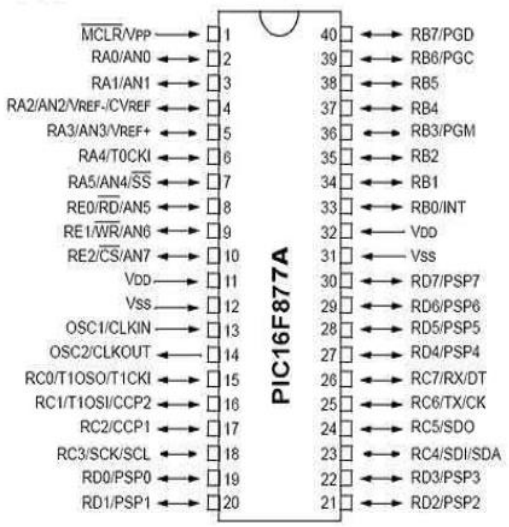

Figure 5: PIC16F877A Pin Diagram

L293D Motor Driver

[6] L293D is a 16 pin motor driver IC which allows dc motors to drive on both directions. It controls a set of two dc motors at the same time in any direction. It provides high voltage and continuous bidirectional direct current to the motor. It controls dc motor speed and direction with a voltage range of 4.5 to 36 volts. This motor driver is taken signal from microcontroller then it gives high voltage to operate the motors. As motors needs to operate high voltage which is not possible to provide by the microcontroller.

L293D motor driver works on the principle of H-Bridge. H-Bridge is a circuit which changes the polarity of voltage applied to any load or motor. Actually, it allows the voltage to flow on the both directions to rotate the motor clockwise and anti-clockwise. As we know for the rotation, voltage needs to change its polarity and this is happened through this H-Bridge, which is installed in the L293D motor driver.

It is used to control stepper and dc motor direction and speed. In children’s cars, street racing cars and robots this motor driver is used because of its separate power supply to the motors.

L293D Logic Table

EN	IN 1	IN 2	ACTION
HIGH (1)	LOW (0)	LOW (0)	Brake /Stop
HIGH (1)	LOW (0)	HIGH (1)	Anti-clockwise
HIGH (1)	HIGH (1)	LOW (0)	Clockwise
HIGH (1)	HIGH (1)	HIGH (1)	Brake / Stop
LOW (0)	X	X	Brake / Stop

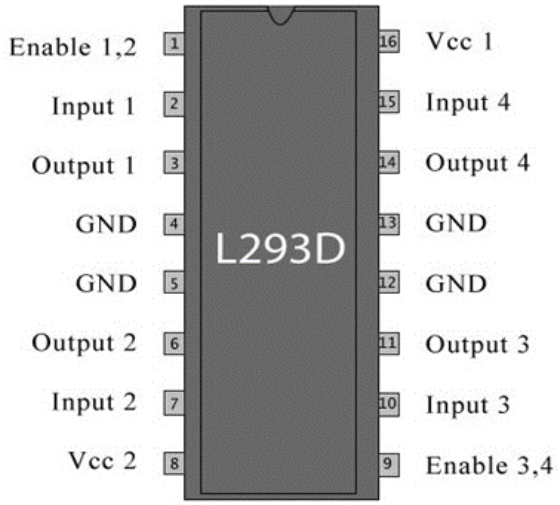

Figure 6: L293D Motor Driver

Simple DC Motor

[7] DC motor is a rotary motor that converts electrical energy to mechanical energy. Here input is direct current as electrical energy which is converted in rotation as mechanical energy. DC motor has two main components, a stator and an armature. A stator is the stationary part of a motor and armature is the moving part in a motor. The stator provides a magnetic field that helps to rotate the armature. DC motor working principle is that when a current carrying conductor is placed in a magnetic field, it gets a mechanical force. This mechanical force helps to rotate the armature part.

V.PROCEDURE

The simulation of the project starts from the software called proteus. The required components are available on the proteus library. The components are crystal oscillator, DIP switch, PIC 16F877A microcontroller, L293D motor driver and simple dc motor.

- Crystal oscillator is connected with 13 and 14 no. pin of the microcontroller.
- Pin number 1, 2, 3 and 4 of DIP switch are connected with pin number 19, 20, 21 and 22 of the microcontrollers respectively.
- Pin number 5, 6, 7 and 8 are connected with power as well as pin number 1 of the microcontroller is connected. Also added the hex file in the microcontroller.
- Pin number 27, 28, 29 and 30 are reciprocally connected and grounded.
- Pin 2, 7, 10 and 15 input pins of motor driver are connected with the 33, 34, 35 and 36 no pins of microcontroller. Pin number 1 and 9 (enable pins), 8 and 16 (VS, VSS) are reciprocally connected along with power. The ground pin of motor driver is grounded.
- Output pins 3, 6, 11 and 14 of motor driver are respectively connected with left and right dc motor.

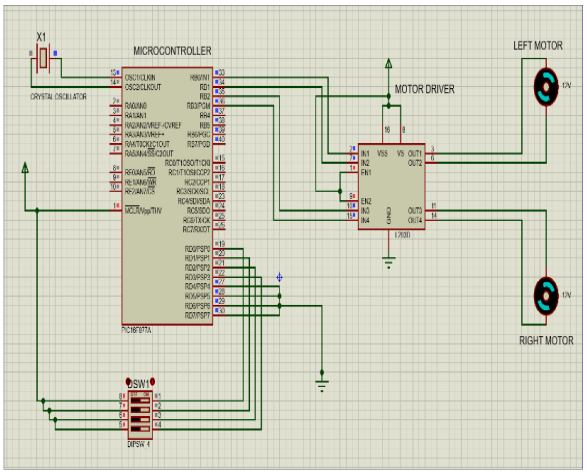

Figure 8: Simulation

VI.RESULT AND DISCUSSION

Dual tone multi-frequency (DTMF) is the sounds or tones generated by a telephone when the numbers are pressed. These tones are transmitted with the voice channel. DTMF is used to control automated equipment and signal user intent, such as the number they wish to dial. Each key has two tones at specific frequencies.

DTMF technology works by having the handset generate tones at specific frequencies and playing them over the phone line when a button is pressed on the keypad. Equipment at the other end of the phone line listens to the specific sounds and decodes them into commands.

Here commands are typically used to dial a phone number to call but can also be used to signal phone control commands or control remote equipment, since the control tones are played on the same channel as the voice signal. It is an in-band signaling system; this is different than out-of-band systems.

Dual-tone multifrequency (DTMF) is a method used to dial telephone numbers or to issue commands to switching systems. DTMF is widely used for

telecommunication signaling between telephone handsets and switching centers over analog telephone lines in voice-frequency bands.

Input Code	Description	Figure No.
0 0 0 0	Motor is stop	3.1
1 0 1 0	Motor is moving forward direction	3.2
0 1 0 1	Motor is moving reverse direction	3.3
1 0 0 0	Left motor is rotating in forward direction	3.4
0 0 0 1	Right motor is rotating in forward direction	3.5

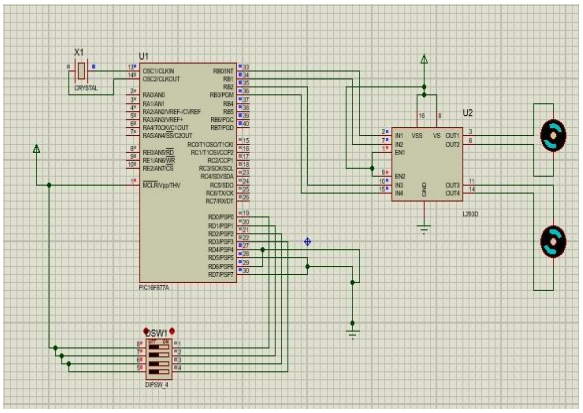

Figure 9: Motor is stop

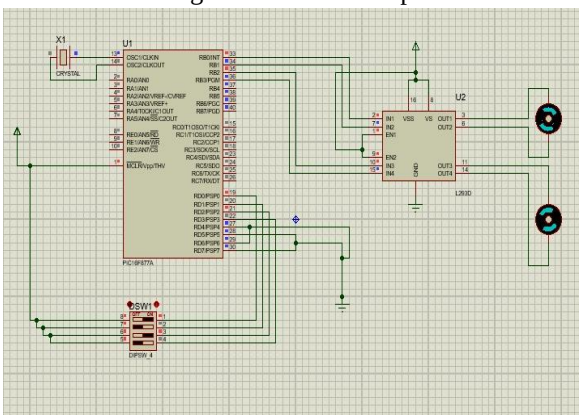

Figure 10: Motor is moving forward

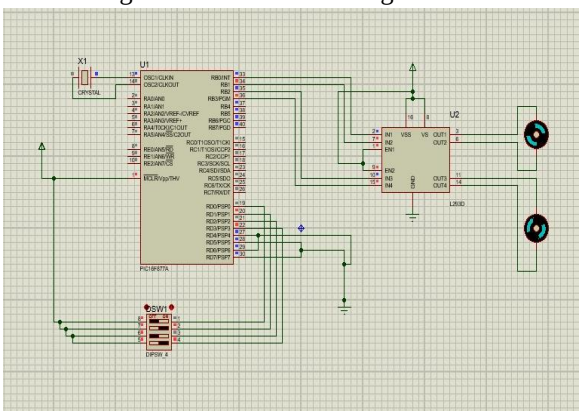

Figure 11: Motor is moving reverse

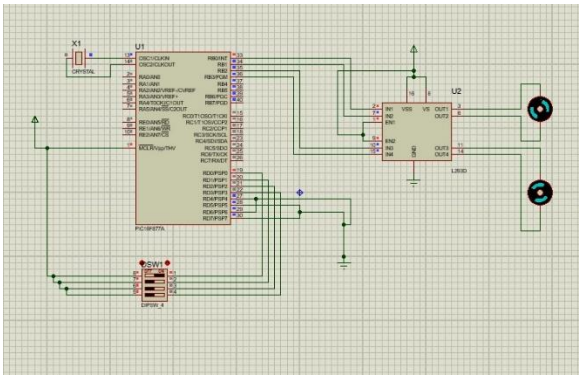

Figure 12: Left motor is rotating forward

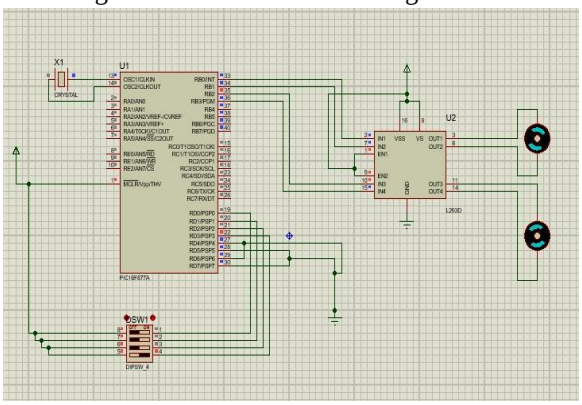

Figure 13: Right motor is rotating forward

VII. APPLICATION OF DTMF

Industrial Unit: DTMF controlled cars are now being used in industrial unit. In storage houses, people are using robotic cars are capable of locating specific products abs carrying them to required location.

Security and Surveillance: DTMF controlled robot is used in security and surveillance nowadays. Using camera in robotic car can provide us love footage of the areas where our solders or defense teams cannot operate directly or may face higher risk of life. Besides these cars can be used at the time of natural or man-made disasters also. Such as at the time or earthquakes, tsunami or tornedo, the affected places turn in to wreckage. At time the rescue team can use this kind of robotic cars. Use of IR sensors or reader can detect human inside the wreckage. In made disaster like fire, DTMF controller robotic car can play a vital role.

VIII.CONCLUSION

At the end we conclude that it can overcome the limitations and problems. It provides the advantages of

robust control, working by developing this robotic vehicle. It is short range communication so to overcome this short-range problem we made system which is consist of DTMF technology. It Concluded that mobile using microcontroller systems and DC motors. So, the short-range problem will be overcome because the DTMF is used for long distance communication. So with the help of this technology, we controlled our car from anywhere and anytime. In this project with the use of mobile phone range as large as the coverage area of the service provider, no interference with other controllers and capabilities of robots varies vastly, all robots share the features of a mechanical, movable structure under some form of control. So, it is useful for the many systems like military, law enforcement, search and rescue operations etc. It is wireless communication system under Digital Signal processing, so helpful for upcoming days. People can generate it many more purposes easily. It is the ultra-modern invention for this busy time. People can easily use to it. Those people using this car they can save their time with right Direction. We are happy for this project can make it.

REFERENCES

[1] Microprocessors and Microcontrollers by Soumitra Kumar Mandal, Tata McGraw Hill, India
[2] https://www.elprocus.com/dual-tone-multi-frequency-dtmf-technology-and-its-applications/
[3] https://ijesc.org/
[4] https://www.electrical4u.com/crystal-oscillator/
[5] https://ph.rs-online.com/web/generalDisplay.html?id=ideas-and-advice/dip-switches-guide
[6] https://components101.com/ics/l293d-pinout-features-datasheet
[7] https://www.electrical4u.com/dc-motor-or-direct-current-motor/
[8] https://components101.com/microcontrollers/pic16f877a-pin-diagram-description-features-datasheet