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Development of a GSM Controlled and Real time Obstacle Avoiding Mobile Robot Using DTMF Technology

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Abstract*- We present a system whereby the GSM network can control a mobile robot including Real time obstacle avoidance. This robot interfaced with a mobile phone by Microcontroller and also with a video transmitter module (RF Camera) by which robot transmitted real time video of its surroundings. Users can observe this mobile robot by receiving this real time video and can be controlled it by a mobile phone. To control the robot user should make a call to communicate with the robot. When communication will be done user can use that mobile phone just like a joystick by using DTMF technique to control the movement of that robot. If any button is pressed, tone corresponding to the button pressed is heard at the other end of the call. This tone is called dual tone multi frequency tone (DTMF).Using DTMF code by decoded the DTMF by DTMF decoder (Model: MT8870DE), direction of motion of the robot can be controlled. This robot also can detect and avoid the obstacles on its path by array of IR sensors. At present, the developed robot can control its direction (Like: Forward, Backward, Left turn, Right turn) and can avoid obstacles.*

Keywords: DTMF, DTMF decoder, RF Camera, controller, GSM Network

1. INTRODUCTION

Being able to achieve reliable communication is an important open area of research to robotics as well as other technology areas. As interest in robotics continues to grow, robots are increasingly being integrated in everyday life. The results of this integration are end-users possessing less and less technical knowledge of the technology. Currently, the primary mode for robot communication uses RF (radio frequency). RF is an obvious choice for communication since it allows more information to be transferred at smaller distance. The overall goal of the project is to control robot over a long distance using DTMF technology efficiently. This is like a remote control system. The remote control technologies have been used in the fields like factory automation, space exploration, in places where human access is difficult. As this has been achieved in the domestic systems partially [1], many corporations and laboratories are researching the methods which enable human to control and monitor efficiently and easily in the house or outdoor. Controlling the domestic system regardless of time and space is an important challenge. As the mobile phone enables us to connect with the outside devices via mobile communication network regardless of time and space, the mobile phone is a suitable device to control domestic systems.

This paper proposes a method to control a domestic System using a mobile phone, irrespective of the phone Model and mobile phone carrier. The system suggested Consists of the mobile phone normally registered in communication service and a computer that can receive a call from another phone. Existing methods for control and monitoring, using mobile phones have usage problems because the cost and need for continuous control. One of the disadvantages, being the lack of feedback during the process. This paper proposes to solve the problems of existing methods of control that use simple voice call and SMS. Method proposed uses the DTMF (Dual Tone Multi Frequency) [2]-[7] generated when a keypad button of the mobile phone is pressed by the user. The mobile phone user controls the system by sending the DTMF tone to the access point. Mobile communication network coverage is larger than that of LANs, thus user can take advantage of mobile phones to control the system [8].

2. WORKING PRINCIPLE

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 PIC 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 preprogrammed 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. We can control the robot by real-time video monitoring which video is send by a RF camera. This robot also can avoided obstacle automatically by using IR sensor.

3. FLOW DIAGRAM

The transmitter side is placed in the area which is to be supervised. The receiver section is placed in the operator side which receives the video from the corresponding area.

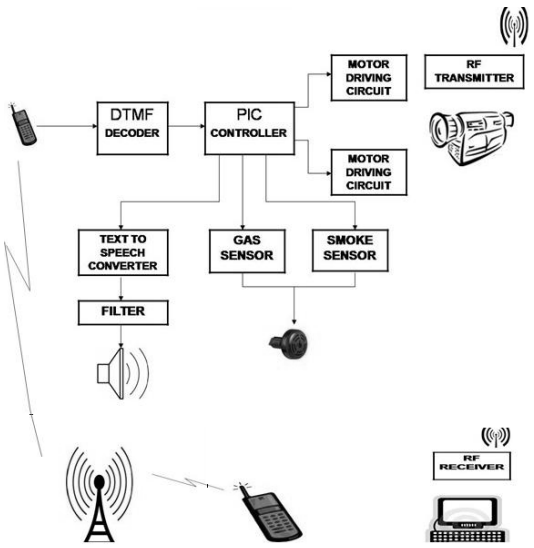

Fig.1 Block diagram of mobile controlled robot [9].

4. DTMF TONE

DTMF is a generic communication term for touch tone (a Registered Trademark of AT&T). The tones produced when dialing on the keypad on the phone could be used to represent the digits, and a separate tone is used for each digit. However, there is always a chance that a random sound will be on the same frequency which will trip up the system. It was suggested that if two tones were used to represent a digit, the likelihood of a false signal occurring is ruled out. This is the basis of using dual tone in DTMF communication. DTMF dialing uses a keypad with 12/16 buttons. Each key pressed on the phone generates two tones of specific frequencies, so a voice or a random signal cannot imitate the tones. One tone is generated from a high frequency group of tones and the other from low frequency group. The frequencies generated on pressing different phone keys are shown in the Table 1.

Table 1 – Frequencies generated on Key presses

Button	Low Frequency(Hz)	High Frequency(Hz)
1	697	1209
2	697	1336
3	697	1477
4	770	1209
5	770	1336
6	770	1477
7	852	1209
8	852	1336
9	852	1477
0	941	1209
*	941	1336
#	941	1477

Each row and column of the keypad corresponds to a certain tone and creates a specific frequency. Each button lies at the intersection of the two tones as shown in Table2.

Table 1 – Row and Column Frequency Correspondence

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

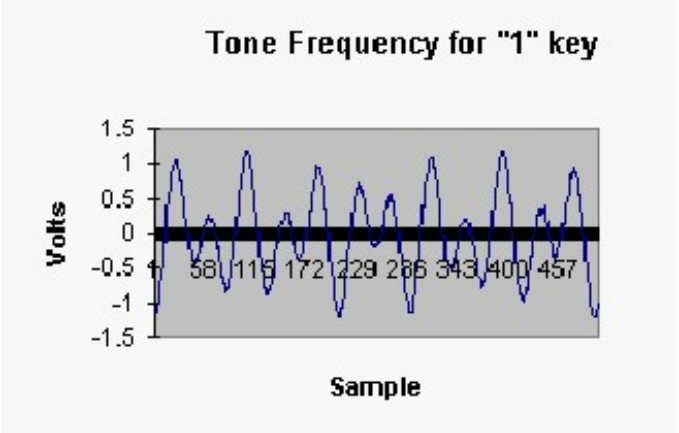

Fig.2 A Typical frequency DTMF signal

When a button is pressed, both the row and column Tones are generated by the telephone instrument. These two tones will be unique and different from tones of other Keys. So, whenever we say that there is a low and high Frequency associated with a button, it is actually the sum of two waves is transmitted.

5. DTMF DECODER

The MT-8870 is a DTMF Receiver that integrates both band split filter and decoder functions into a single 18-pin DIP or SOIC package. It is manufactured using CMOS process technology. The MT-8870 offers low power consumption (35 mW max) and precise data handling. Its filter section uses switched capacitor technology for both the high and low group filters and for dial tone rejection. Its decoder uses digital counting techniques to detect and decode all 16 DTMF tone pairs into a 4-bit code. External component count is minimized by provision of an on-chip differential input amplifier, clock generator, and latched tri-state interface bus. Minimal external components required includes a low-cost 3.579545 MHz color burst crystal, a timing resistor, and a timing capacitor.

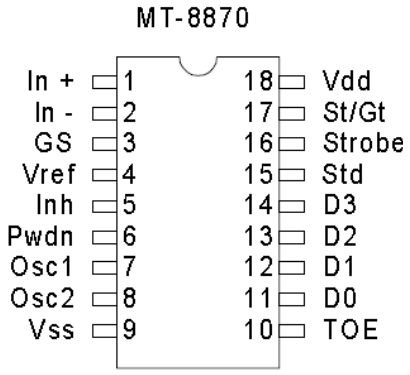

Fig.3 Pin configuration of MT-8870.

The filter section is used for separation of the low-group and high group tones and it is achieved by applying the DTMF signal to the inputs of two sixth order switched capacitor band pass filters, the bandwidths of which corresponds to the low and high group frequencies. The filter section also incorporates notches at 350 and 440 Hz for exceptional dial tone rejection. Each filter output is followed by a single order switched capacitor filter section which smoothes the signals prior to limiting. Limiting is performed by high-gain comparators which are provided with hysteresis to prevent detection of unwanted low-level signals. The outputs of the comparators provide full rail logic swings at the frequencies of the incoming DTMF signals. Following the filter section is a decoder employing digital counting techniques to determine the frequencies of the incoming tones and to verify that they correspond to the standard DTMF frequencies.

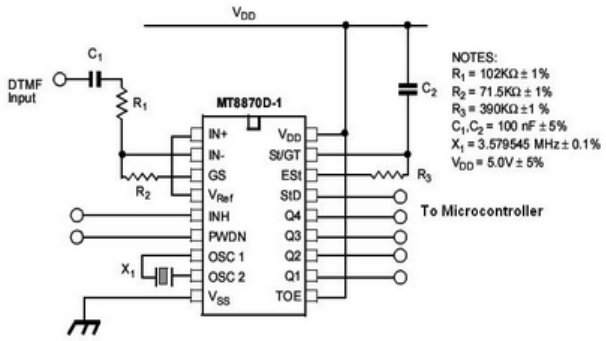

Fig.4 DTMF Circuit diagram

6. Motor Driver Circuit

L293D is a dual H-Bridge motor driver. So with one IC, two DC motors can be interfaced which can be controlled in both clockwise and counter clockwise directions and its direction of motion can also be fixed. The four I/O's can be used to connect up to four DC motors. L293D has output current of 600mA and peak output current of 1.2A per channel. Moreover for the protection of the circuit from back EMF, output diodes are included within the IC. The output supply (VCC2) has a wide range from 4.5V to 36V, which has made L293D a best choice for DC motor driver. The name "HıBridge" is derived from the actual shape of the switching circuit which controls the motion of the motor. It is also known as "Full Bridge".

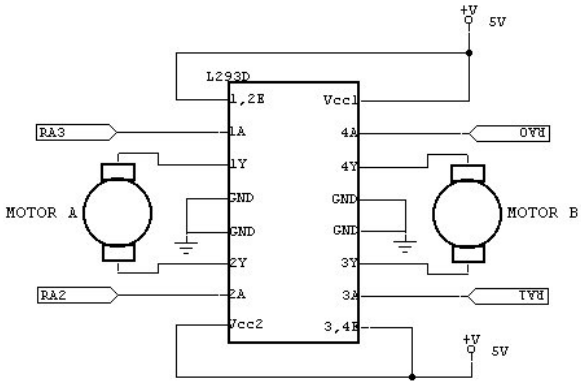

Fig.5 H-Bridge motor driver circuit.

By using two motors the robot can be moved in any direction. This steering mechanism of the robot is called differential drive.

7. RF CAMERA

RF camera consists of a 2.4GHz Audio/Video wireless RF Transmitter. The most popular 2.4GHz ISM band is used and it is designed with high reliability. Airwave RF module is compliance with the criteria of FCC and R&TTE which can transmit a wide band audio & video signals up to 100 meters in an open area. RF camera is of compact size and it consumes a low power. RF camera is composed of a highly efficient FM-FM modulation/demodulation scheme. No external audio circuit is needed. The number of Channels selected is four and default value is ch4 (not enable). Other channels can be selected by applying low to enable.

7.1. RF Transmitter

RF transmitter transmits video and sound to the RF receiver which is connected to the TV located anywhere (up to 100 ft. away).The RF transmitter consists of a wireless 2.4 GHz technology which is combined with a wireless power source that produces a video without any delay.

7.2. RF Receiver

The RF Video Receiver works with Wireless Cameras. The Camera converts video into wireless radio frequency (RF) signals and transmits them to the Video Receiver which is connected to a TV anywhere (up to 100 ft. away from the Camera). The Video Receiver converts the signals back to video signals, which are fed through a cable to our TV's Video input jack.

8. CONCLUSION

This paper presents a method to control a domestic system using the DTMF tone generated by transmitting telephone instrument when the user pushes the keypad buttons of the mobile phone connected to the remote Domestic system. This control method uses commercial Mobile communication networks as the path of data Transmission. This enables the user to control the system Continuously by sending the mobile phone DTMF tone. This system is implemented in the 2G mobile Communication network, so video data cannot be Obtained. Future work includes research on the robot control system in the 3G mobile communication Networks. This will facilitate controlling the remote robot, using the DTMF of mobile phone with video data from the remote mobile robot's camera.

9. REFERENCES

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