DTMF CONTROLLED WIRELESS MOBILE SWEEPER ROBOT

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ABSTRACT- In this paper we control the sweeper wirelessly using Dual Tone Multi Frequency (DTMF) technology. DTMF technology is a most useful technique at present days. It willbe worked on to the methods digital signal processing (DSP). Wireless control of the robots uses RF circuit that has the drawbacks of limited working range and limited control. The DTMF gives advantage over the RF, it will increase the range of working and gives good results in case of motion and direction of robot using mobile phone through micro controller. Generally, a vacuum cleaner is an effective technology for household cleaning purpose, but it requires to beoperated manually by any person. The main purpose to develop a DTMF-controlled room sweeper robot is to implement the automatic cleaning system which can be operated from any distance by using the mobile phone. Such type of wireless communication gives the remote handling operation of robot using DTMF.

KEYWORDS: **- DTMF, Sweeper, DSP, Wireless Communication**

INTRODUCTION

DTMF Mobile Sweeper is a machine that can be controlled by a mobile phone that makes a call to the mobile phone attached to the sweeper. In the middle of a call, if any button is pressed a tone corresponding to that button pressed is heard at the other end of the call. This tone is called Dual Tone Multi Frequency (DTMF) tone.It is an electronic device with self-controlled obstacle avoidance capability along with a waste and dust cleaning system.The sweeper perceives this DTMF tone with the help of the phone stacked on the sweeper. Whatever the toneis received it will be processed by the Arduino microcontroller with the help of DTMF decoder MT8870 IC is the decoder that decodes the DTMF tone to its equivalent binary digit and this binary number will be sent to the microcontroller, and that microcontroller is already pre-programmed to take decision to motor drivers in order to drive the motors for forward or backward motion or turn or for a suction. The DTMF technique allows the programmer to assign a specific frequency (consisting of two separate tones) to each key so that it can easily be identified by the electronic circuit.

Since we are using the DTMF technology the working range will be as long as the service provider unlike the RF circuits it doesn't have drawbacks of limited range and frequency, it can work with no interference and with other controllers up to 12 controls. DTMF is designed for controlling signals only but not for data transfer.

In this paper the development of a sweeper robot is presented which has overcome some limitations of previous commercial room cleaner robots. Remote control features using DTMF with two different types of smart path following methods have been implemented to construct the robot.The robot has been developed on Atmega microcontroller-based platform known as Arduino Uno which offers numerous advantageous features for robotics developments.

METHODOLOGY

DTMF is known as a dual tone multi-frequency signaling system with ability to detect the keys or number pressed on a mobile phone which has replaced the earlier pulse or a loop disconnect signaling method as well as enabled the long-distance signaling of dialed numbers in voice frequency range over telephone lines by using a combination of two sine wave tones of row and a column frequencies to represent the key of DTMF.The expected frequency will be converted into an analog signal which will be received by the DTMF Decoder and given to microcontroller for controlling the sweeper according to the frequency received by the DTMF receiver. The system will contain an obstacle detecting system by employing an ultrasonic sensor known as HC04 to guide the robot for obstacle avoidance. It will provide the information about any obstacle in front of the robot within a specific range.A functional block diagram of the robot is illustrated in figure 1. Remote control system of the room sweeper robot will be developed using a DTMF receiver which is known as MT8870 IC with functions of band split filter and a digital decoder.

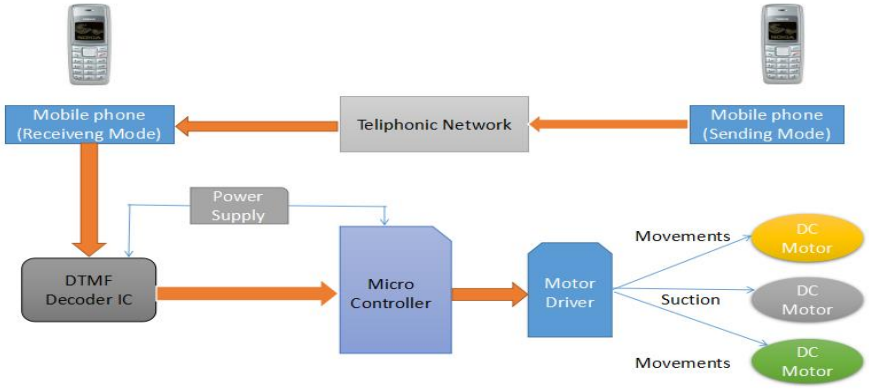

Fig 1: Functional block diagram of the DTMF controlled sweeper robot

Two geared DC motors operated by a DC motor driver L293D will be employed for the movements control of the sweeper robot. L293D will operate the motors according to the signal received from the microcontroller. Vacuum system (Suction) will be the main part of the robot which will be installed in front of the robot. For the suction purpose we use a high RPM vacuum motor.

IMPLEMENTATION

The body of the sweeper is in rectangular shape of 0.11 m X 0.22 m dimensions. Two strong grip rubber tires with two different DC motors and one caster wheel in the center of the sweeper are installed for the movement's purposes. Vacuum cleaning system consists of high RPM vacuum motor, impeller, filters and storage for dirt there are two dirt collector storages inside the vacuum system.

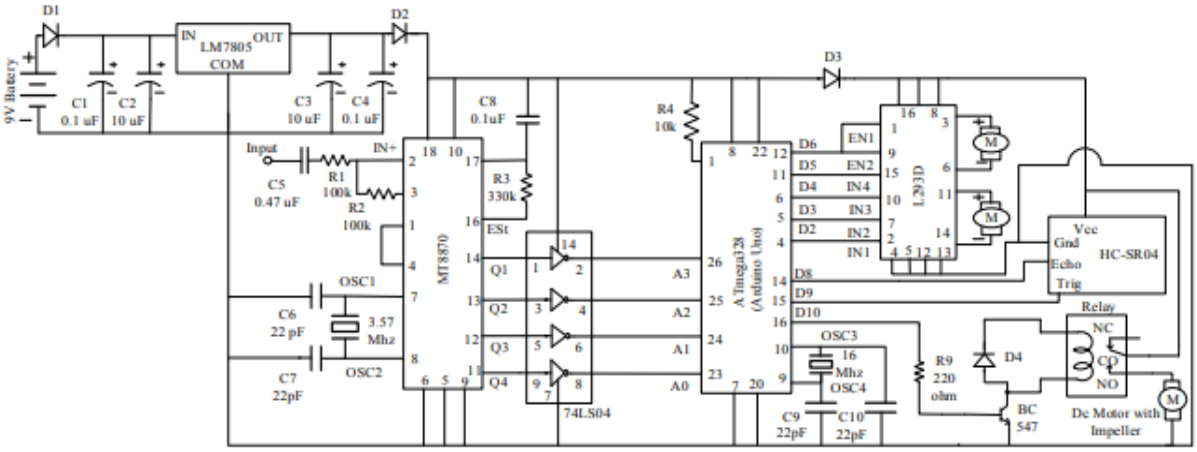

Fig 2: Circuit diagram of DTMF controlled sweeper

The robot has been powered by a 9 volt 1.5 Ah source and the vacuum cleaner have been powered by 6v 4.5 Ah source.

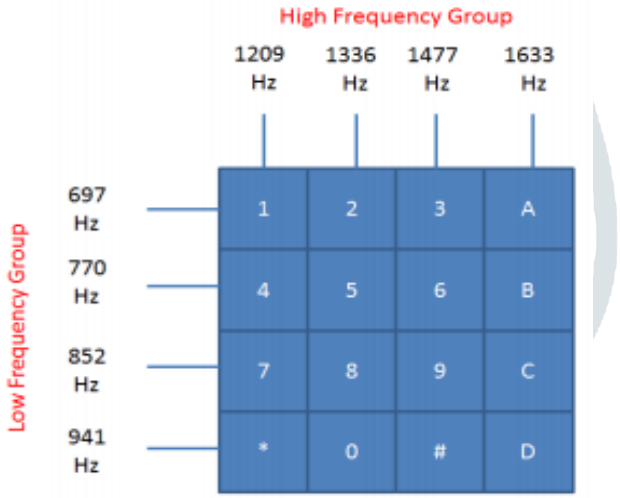

Fig 3: DTMF Keypad frequency

Each key has a specific Tone frequency. For example, if the key "5" is pressed then the generated frequency tone will be770 + 1336 = 2106 Hz. If the key "1" is pressed then frequency of 697 + 1209 = 1906 Hz which is shown in thebelow figure.

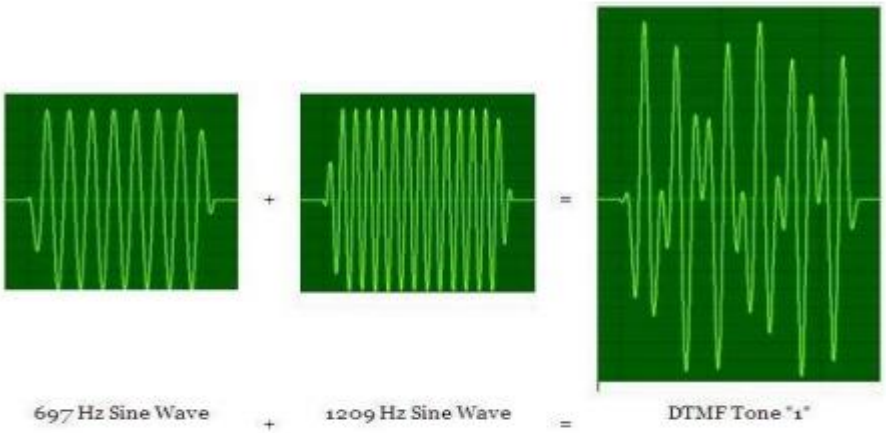

Fig 4: Two pure sin waves combine to form the DTMF tone for "1"

The robot can be turned on by pressing 1 but it does not move in any directions until the movement's keys are pressed. Movement control generally depends on motor control and remote operation along with obstacle sensor's reading. After the robot is turned on by the remote control, and press any movement button (e.g.: if the key "2" is pressed it moves forward and if the key "6" is pressed it moves right side direction) then the movement with continuous vacuum cleaning process will be started.

The movement of the robot is guided by the ultrasonic sensor and it can also be guided by manually. The ultrasonic sensor is able to detect the distance of obstacle by analysis the duration of sending and receiving ultrasonicsound. At the same time, it sends a high-frequency sound pulse to measure the distance from the obstacle of the path. The microcontroller measures the time how long it takes forthe echo of sound to reflect back from an object and converts time into a distance.

PERFORMANCE ANALYSIS

The robot has been tested to analysis the time requirement of cleaning and the performance of obstacle sensors. Both results have shown satisfactory analysis.The robot has been placed and tested in a 3.6 m x 2.4 m room with dust and dirt to determine the time of cleaning process. The dimension of the testing room was 8.6 m2. The size of the robot is 0.11 m x 0.22 m and the dimension of the robot is 0.025 m2. The average speed of the robot was 0.30 m2 per second.

The time required to clean the room can be determine using following formula.

Time of cleaning = distance / speed (3)

The distance was the dimension of the room. The speed was the product of dimension of the room and the speed of the robot per second.

FUTURE SCOPE

Add two modes i.e., Mode A and Mode B in which Mode A is completely autonomous and Mode B is manually used.

CONCLUSION

By developing the DTMF controlled sweeper we have overcome the drawbacks of RF communication which have only a limited range whereas this mobile controlled robotic sweeper can be controlled from anywhere by just using this DTMF technology. In this projectby using the mobile phone for robotic control has overcome these limitations. It provides the advantages of the robust control, and working range as large as the coverage area of an service provider, no interference with other controllers and up to twelve controls.Development of a more efficient path routing method and research on using other sensors for detecting waste and obstacles can be able to bring more improvising to the developed robot.

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