Lab Project Report
Signals & Systems (CS-215)

DTMF Based Robot

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THEORY

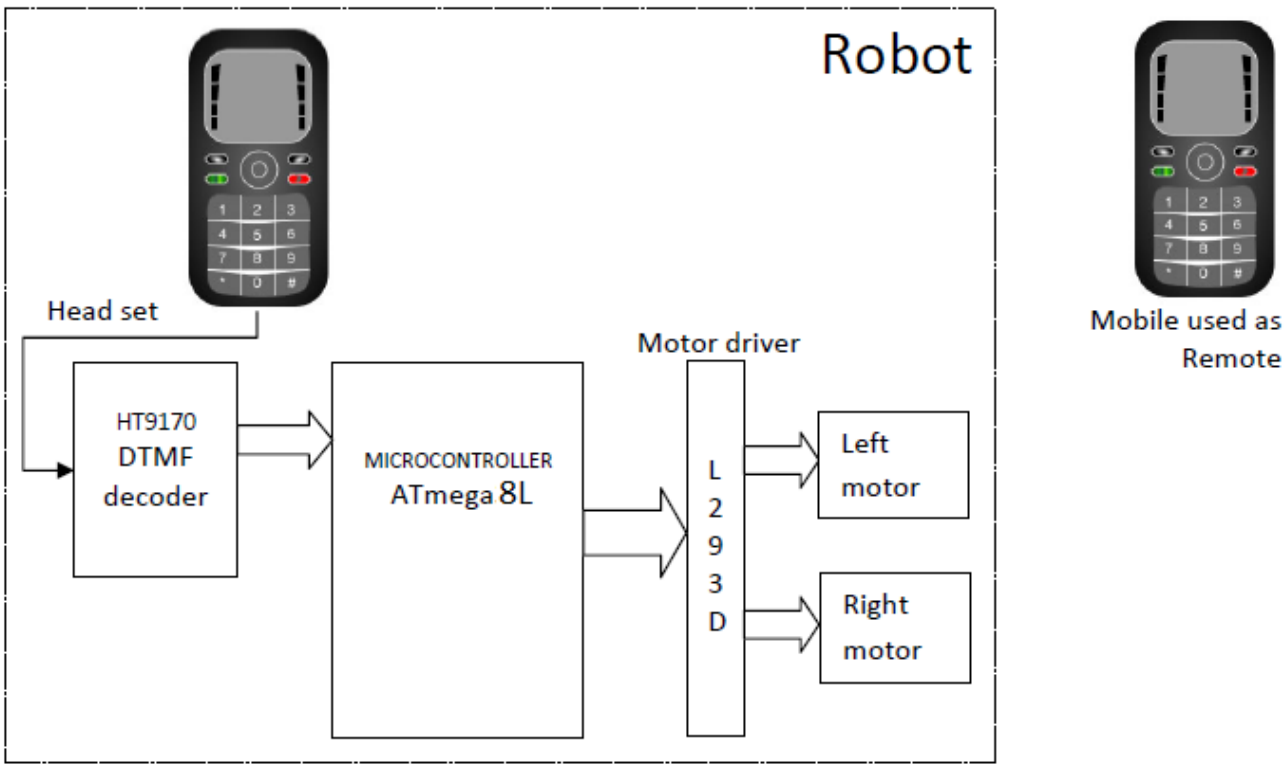
Introduction:

Conventionally, wireless-controlled robots use RF circuits,which have the drawbacks of limited working range, limited frequency range and limited control. Use of a mobile phone for robotic control can overcome these limitations. It provides the advantages of robust control, working range as large as the coverage area of the service provider,no interference with other controllers and up to twelve controls.Although the appearance and capabilities of robots vary vastly, all robots share the features of a mechanical, movable structure under some form of control. The control of robot involves three distinct phases: reception, processing and action. Generally, the preceptors are sensors mounted on the robot, processing is done by the on-board microcontroller or processor, and the task (action) is performed using motors or with some other actuators.

Project Overview :

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. The received tone is processed by the ATmega16 microcontroller with the help of DTMF decoder HT9170.The decoder decodes the DTMF tone into its equivalent binary digit and this binary number is sent to the microcontroller.The microcontroller is preprogrammed to take a decision for any given 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.

Block Diagram :



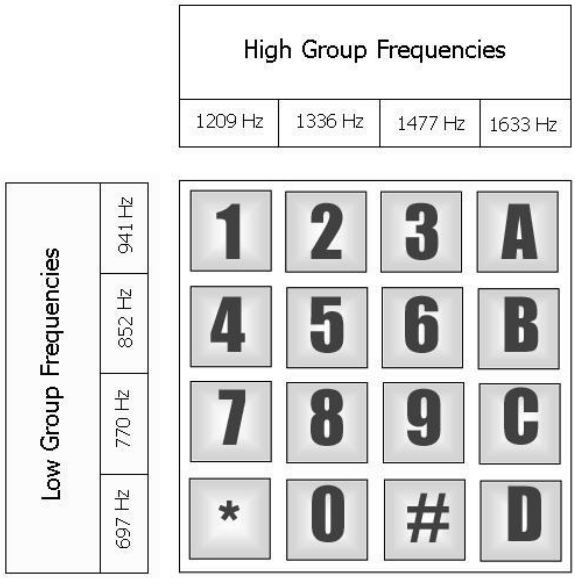
About DTMF :

Dual-tone Multi-Frequency (DTMF) signaling is the basis for voice communications control and is widely used worldwide in modern telephony to dial numbers and configure switchboards. It is also used in systems such as in voice mail, electronic mail and telephone banking.

A DTMF signal consists of the sum of two sinusoids - or tones - with frequencies taken from two mutually exclusive groups. These frequencies were chosen to prevent any harmonics from being incorrectly detected by the receiver as some other DTMF frequency. Each pair of tones contains one frequency of the low group (697 Hz, 770 Hz, 852 Hz, 941 Hz) and one frequency of the high group (1209 Hz, 1336 Hz, 1477Hz) and represents a unique symbol.

DTMF Tone Generation :

Note that the last column is not commonly seen in the telephones that we used, but telephone exchanges use them quite often.The higher of the two frequencies is normally aloud by 4dB, and this shift is termed as twist. If the twist is equal to 4dB, the higher frequency is loud by 4dB.If the lower frequency is loud, then the twist is said to be negative.

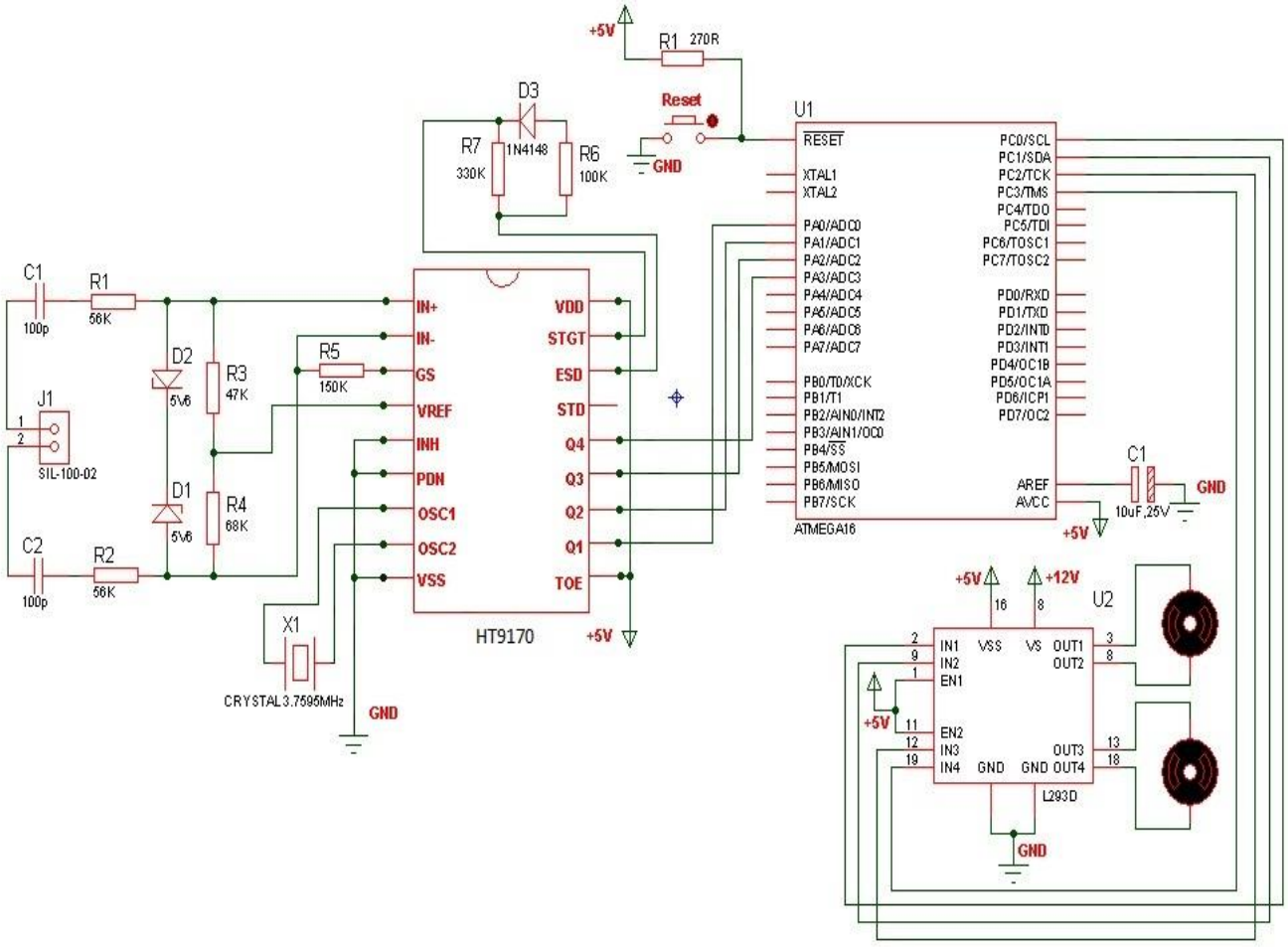


IMPLEMENTATION :

The important components of this rover are a DTMF decoder, microcontroller and motor driver. An HT9108 series DTMF decoder is used here. All types of the HT9170 series use digital counting techniques to detect and decode all the 16 DTMF tone pairs into a 4-bit code output. The built-in dial tone rejection circuit eliminates the need for pre-filtering. When the input signal given at pin 2 (IN-) in single-ended input configuration is recognised to be effective, the correct 4-bit decode signal of the DTMF tone is transferred to Q1 (pin 11) through Q4 (pin 14) outputs.. Q1 through Q4 outputs of the DTMF decoder (IC1) are connected to port pins PA0 through PA3 of ATmega16 microcontroller (IC2) respectively. The ATmega16 is a low-power, 8-bit microcontroller based on the AVR enhanced RISC architecture.. The resulting architecture is more code-efficient. Outputs from port pins PC0 through PC3 of the microcontroller are fed to inputs IN1 through IN4 and enable pins (EN1 and EN2 are high) of motor driver L293D, respectively, to drive two geared DC motors. The microcontroller output is not sufficient to drive the DC motors, so current drivers are required for motor rotation. The L293D is a quad, high-current, half-H driver designed to provide bidirectional drive currents of up to 600 mA at voltages from 4.5V to 36V. It makes it easier to drive the DC motors. The L293D consists of four drivers. Pin IN1 through IN4 and OUT1 through OUT4 are input and output pins, respectively, of driver 1 through driver 4. Drivers 1 and 2, and drivers 3 and 4 are enabled by enable pin 1 (EN1) and pin 9 (EN2), respectively. When enable input EN1 (pin 1) is high, drivers 1 and 2 are enabled and

the outputs corresponding to their inputs are active. Similarly, enable input EN2 (pin 9) enables drivers 3 and 4.

Circuit Diagram :



Software Description :

The software is written in 'C' language and compiled using AVR-stdio4 .The source program is ed into hex code by the compiler. Burn this hex code into ATmega16 AVR microcontroller. The source program is well commented and easy to understand. First include the register name defined specifically for ATmega16 and also declare the variable. Set port A as the input and port C as the output. The program is ,

```
#include <avr/io.h>
#include <util/delay.h>
int main(void)
{
    DDRA=0x00;        //this sets PORTA as input PORT
    DDRC=0xFF;        //this sets PORTC as output PORT
    char y;           //variable initialization (y will be used to store input from DTMF)
  while(1)
  {
      y=PINA;         //this stores the input from the DTMF module in y
```

```
        y&=0x0F;        //to avoid any chances of floating value at upper nibble of PORTA

            /*
            WE WILL BE USING:
            '2' FOR FORWARD MOVEMENT
            '8' FOR BACKWARD MOVEMENT
            '4' FOR LEFT TURN
            '6' FOR RIGHT TURN  */
            if (y==0x02)
                PORTC=0b00001010;       //forward movement of both the motors
            if (y==0x04)
                PORTC=0b00001000;       //stops M-1 and causes robot to turn left
            if (y==0x06)
                PORTC=0b00000010;     //stops M-2 and causes bot to turn right
             if (y==0x08)
                PORTC=0b00000101;       //backward movement of both the motors
    }
      return 0;
}
```

RESULTS & CONCLUSION :

Observation Table :

Input Tone / HT9107 Input	HT9107 Output	Microcontroller Input	Microcontroller Output	L293D Input	L293D Output
1	0001	0001	0000	0000	M1 & M2 stops
2	0010	0010	1010	1010	M1 & M2 moves Forward
3	0011	0011	0000	0000	M1 & M2 stops
4	0100	0100	1000	1000	M1 move & M2 stop
5	0101	0101	0000	0000	M1 & M2 stops
6	0110	0110	0010	0010	M1 stop & M2 move
7	0111	0111	0000	0000	M1 & M2 stops
8	1000	1000	0101	0101	M1 & M2 moves backward
9	1001	1001	0000	0000	M1 & M2 stops
0	1010	1010	0000	0000	M1 & M2 stops
*	1011	1011	0000	0000	M1 & M2 stops
#	1100	1100	0000	0000	M1 & M2 stops

Results :

As the above table shows that when,

- '2' press from your mobile, robot starts moving forward.
- '8' press from your mobile, robot starts moving backward.
- '4' press to turn the robot in left direction.
- '6' press to turn the robot in right direction.

DISCUSSION :

- DTMF robot with slight modifications can be used in industrial applications.
- DTMF robot with human detector sensor can be used at the time of disasters like earth quake to detect the human under buildings.
- DTMF robot with camera can be used in surveillance systems.

ASSESSMENT :

G. MEMBER NAME	ROLL #	DEMO	PRESENT-	CONCEPT	REPORT
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