Mobile Controlled Robot

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Abstract

The mobile controlled robot basically aimed at eliminating the limitations of rang. The locomotion of robot in different directions can be controlled and manoeuvred by pressing the assigned keys on the phone. The robot is controlled by a mobile phone that makes a call to another mobile phone attached to the robot. In this course of call if any button on the controller mobile phone is pressed, a tone corresponding to the button pressed is heard at the other end. This tone is called as the DTMF (Dual Tone Multi Frequency) tone. The robot perceives this DTMF tone with the help of a phone stacked to the robot. This tone is processed by AT89C51 micro controller with the help of a MT8870 DTMF decoder. The micro controller then transmits a signal to the motor's driver ICs to operate the motors and the motor starts moving.

1. Introduction

Being able to achieve reliable communication is an important open area of research to robotics as well as other technology areas. As an 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.

A robot is basically an electrical or mechanical or electromechanical, programmable or non programmable multifunctional manipulator designed to move material, parts, tools or specialized devices through various programmed motions for the performance of a variety of tasks. Robots can be used to perform various tasks that are too dangerous or difficult for humans to implement directly. In this project, we aim at controlling a robot using DTMF technique. Although the appearance and 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. Generally, the preceptors are sensors mounted on the robot, processing is done by the on-board microcontroller or processor and the task is performed by using motors or some other actuators. In this project, we present controlling of a robot using DTMF technique.

2. Limitations of Available Products

The first remote control vehicle was a propeller-driven radio controlled boat, built by Nikola Tesla in 1898. It is the original prototype of all modern day uninhabited aerial vehicles and precision guided weapons, in fact, all remotely operated vehicles in air, land and sea. Powered by lead-acid batteries and an electric drive motor, the vessel was designed to be manoeuvred alongside a target using instructions received from a wireless remote-control transmitter. Once in position, a command would be sent to donate an explosive charge contained within the boat's forward compartment. The weapon's guidance system incorporated a secure communications link between the pilot's controller and the surface running torpedo in an effort to assure that control could be maintained even in the presence of electronic countermeasures.

During World War II in the European theatre the U.S Air force experimented with three basic forms of radio control guided weapons. In each case, the weapon would be directed to its target by a crew member on a control plane. The first weapon was essentially a standard bomb fitted into steering controls. The next evolution involved the fitting of a bomb to a glider airframe, one version, the GB-4 having a TV camera to assist the controller with targeting. The third class of guided weapon was the remote controlled B-17. It's known that Germany deployed a number of more advanced guided strike weapons that saw combat before either the V-1 or V-2.

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 over small distances. However range is a huge limitation in robots designed using RF circuits. Conventionally, wireless-controlled robots using RF circuits have various drawbacks such as the working range, limited frequency and 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.

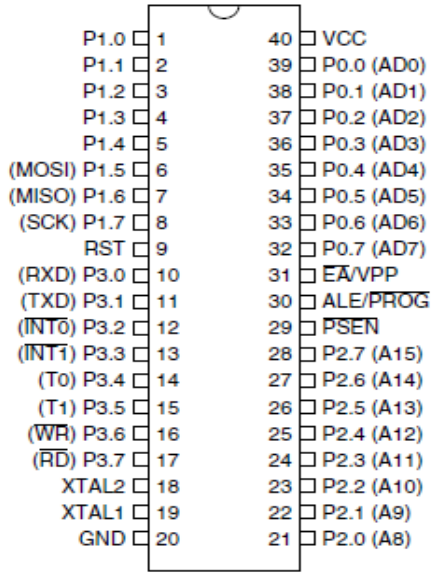
3. Technology Used

Dual Tone Multi-Frequency (DTMF) signalling is used for telecommunication signalling over analog telephone lines in the voice frequency band between telephone handsets and other communications devices and the switching centre. The version of DTMF used for telephone tone dialling is known by the trademark term Touch-tone and is standardized by ITU-T recommendation Q.23. It is also known in the UK as MF4. Other multi frequency systems are used for signalling internal to telephone network. As a method of in-band signalling, DTMF tones were also used by cable television broadcasters to indicate the start and stop times of local commercial insertion points during station breaks for the benefit of cable companies.

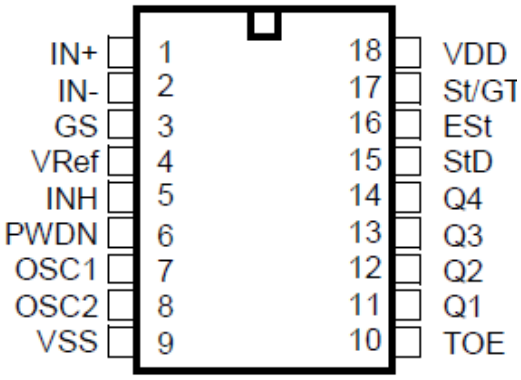
Telephone Keypad is laid out in a 3x4 grid, although the original DTMF keypad had an additional column for four now-defunct menu selector keys. When used to dial a telephone number, pressing a single key will produce a pitch consisting of two simultaneous pure tone sinusoidal frequencies. The row in which the key appears determines the low frequency and the column determines the high frequency. The keypad has levers inside, so each button activates two contacts. The multiple tones are the reason for calling the system multi frequency. These tones are then decoded by the switching centre to determine which key was pressed.

4. Hardware Design

- **AT89C51 Microcontroller:** It is a low power high performance CMOS 8-bit microcontroller with 4k bytes of In-System Programmable Flash memory. The device is manufactured using Atmel's high density non-volatile memory technology and is compatible with the industry standard 80C51 instruction set and pin out. The on-chip flash allows program memory to be reprogrammed in-system or by a conventional non-volatile memory programmer. The AT89C51 provides us with 4K bytes of Flash, 128 bytes of RAM, 32 I/O lines, watchdog timer, two data pointers, two 16-bit timers/counters, a five vector two level interrupt architecture, a full duplex serial port, on-chip oscillator and clock circuitry. In addition the AT89C51 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes, 'Idle mode' and 'Power down mode'. The pin configuration for an AT89C51 microcontroller is as shown below:



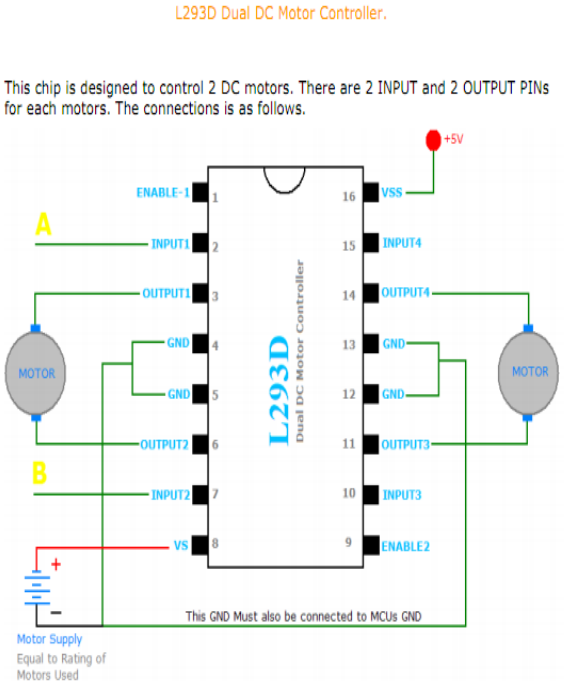
- **MT8870 DTMF Decoder:** It is basically a low power complete DTMF Decoder along with internal gain setting amplifier. The filter section of MT8870 uses switched capacitor technology for both the high and low filters and for dial tone rejection. The filter section is used for separation of the low-group 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 440HZ for exceptional dial tone rejection. Each filter section 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. The decoder section uses a digital counting technique to determine the frequencies of the limited tones and to verify that those tones correspond to standard DTMF frequencies. A complex averaging algorithm is used to protect against tone simulation by extraneous signals while providing tolerance to small frequency variations. The pin configuration for MT8870 DTMF Decoder is given below:



18 PIN CERDIP/PLASTIC DIP/SOIC

- **L293D Push Pull Motor Driver:** It is a chip that controls two DC motors, there are two more input pins and thereby two more output pins. As shown in the diagram below the input 3 and input 4 controls the second motor in the same way as that for input A and B. There are two ENABLE pins that must be held HIGH (+5volts) for operation if they are pulled LOW (GND) motors will stop.
  Pin Description:
  - Enable1**:** It specifically enables all the pins on the left hand side.
  - Enable2**:** It specifically enables all the pins on the right hand side.
  - Vs**:** It is the supply voltage i.e., the maximum voltage we want at the output pins.
  - Vss**:** It is the logic supply voltage required to enable the IC.
  - Input Pins: There are 4 Input Pins which receive input up to 7Volts which makes it either high or low.
  - Output Pins: There are 4 Output Pins. When the corresponding input pin is high the output voltage is Vs otherwise the output is grounded.

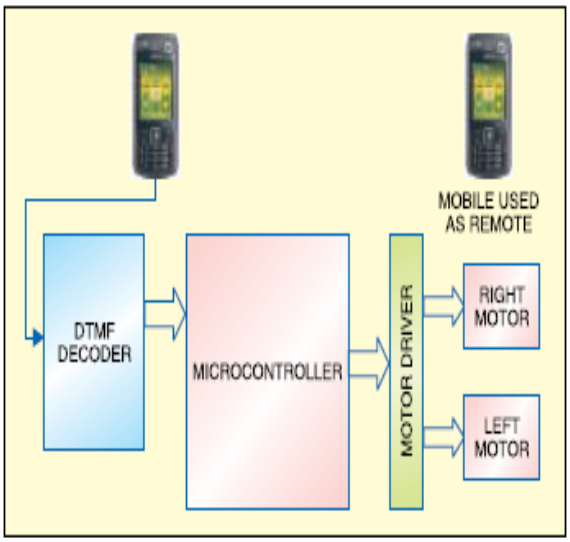
  The pin description given is with respect to the following diagram:



5. Working of the Circuit

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, tone corresponding to the button pressed is heard at the other end of the all. 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 AT89C51 microcontroller with the help of DTMF decoder MT8870. The decoder decodes the DTMF one into its equivalent binary digit and this binary number is sent to the microcontroller. The microcontroller is pre programmed to take a decision for any given input and output sits 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 when constructing any robot, one major mechanical constraint is the number there a two-wheel drive or a four-wheel drive. 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. 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. The block diagram is as shown below.



6. Software Used

- **DIP TRACE:** Dip Trace 1.30 proved to be a very handy & easy-to-use tool for the PCB layout process. Many of its features were utilized leading to an accurate & efficient design. It has Design Error Check & Electrical Rule Check tools which proved to be helpful in the design. It is loaded with huge component list that is categorized in various libraries for giving simplicity.
- **µVISION KEIL:** It provides IDE for AT89C51 programming and it is very easy to use. When starting a new project, simply select the microcontroller you use from the Device Database and the µVision IDE sets all Compiler, Assembler, Linker, and Memory options. Its device database is large which supports many ICs of the ATMEL family. A HEX file can be created with the help of Keil which is required for burning onto chip. It has a powerful debugging tool which detects most of the errors in the program very efficiently.
- **LAB TOOL:** The LabTool-48UXP's on-board intelligence reduces system overhead to a minimum. The LabTool-48UXP has 100% more performance than its predecessor product in programming the high density flash chip; it can program an Intel 32 M bit flash chip in less than 60 seconds. The LabTool-48UXP is much faster than its competitors, making it much more productive with today's high density, multi-megabit memory devices. The LabTool-48UXP performs device insertion and contact checks before it programs each device. It can detect poor pin contact and devices inserted upside down or in the wrong position. This function protects your pocketbook by preventing expensive chip damage due to operator error.

7. Applications

- **Scientific:** Remote control vehicles have various scientific uses including hazardous environments, working in the Deep Ocean, and space exploration. The majority of the probes to the other planets in our solar system have been remote control vehicles, although some of the more recent ones were partially autonomous. The sophistication of these devices has fuelled greater debate on the need for manned spaceflight and exploration
- **Military and law enforcement:** The exposure to hazards can be mitigated to the person who operates the vehicle from a location of relative safety. Remote controlled vehicles can be used by many police department bomb-squads to defuse or detonate explosives.
- **Search and Rescue:** Remote controlled robots will likely play an increased role in search and rescue in the United States. Slowly other European countries (even some developing nations) are thinking about making use of these vehicles in case of natural calamities &emergencies. This was demonstrated by the successful use of UAVs (unmanned aerial vehicle) during the 2008 hurricane that struck Louisiana and Texas.

8. Ideas for up-gradation

- IR Sensors: They can be used to automatically detect and avoid obstacles if the robot goes beyond the line of sight. This avoids damage to the vehicle if we are manoeuvring it from a distant place.
- Password Protection: This project can be modified in order to password protect the robot so that it can be operated only if correct password is entered. Either cell phone should be password protected or necessary modification should be made in assembly language code.
- Alarm Phone Dialler: By replacing Decoder IC by a DTMF Transceiver IC CM8880, DTMF tones can be generated from the robot. So, a project called ‘Alarm Phone Dialler’ can be built which will generate necessary alarms for something that is desired to be monitored. For example, a high water alarm, low temperature alarm, garage door alarm etc.
- Adding a Camera: If the current project is interfaced with a camera, robot can be driven beyond line of sight and range becomes

practically unlimited as GSM networks have a very large range.

This project demonstrates the tele-remote control of the electronic appliances and the DC motors using mobile phone. However, a closed loop system that gives feedback to the transmitter can be implemented so that output work done can be acknowledged by the transmitter side. DTMF receiver and transmitter IC can be used to give feedback to the controlling mobile. Similarly, modern 3G communication system may be used to give feedback to the controlling mobile. Similarly, modern 3G communication system may be one of the intriguing features that can be incorporated in our system to discover the status and location of the robot.

9. Conclusion

Hence, it can be concluded that mobile controlled robots can be constructed using the components IC CM8870 (DTMF decoder), IC 7404(inverter), (AT89C51) microcontroller and L293D (motor drivers). Locomotion of the robot in different directions can be controlled and manoeuvred by pressing the assigned keys on the mobile phone. Similarly, household electric appliances can be remotely controlled with the assistance of ULN2003 and relay circuit.

10. References

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