Android Powered Modular Robot using DTMF and Artificial Intelligence

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Abstract: This paper is about ease of developing a modular robot with the help of basic electronic CHIPsand attaching it with an android phone. Here, it also mentionsusage of most of the hardware and software features of an android device for a robot.It suggests why android robot will change to robotics.

Keywords: Android, robot, DTMF, Network Coverage

I. INTRODUCTION

Whoever works with or builds robots, understands that they areset of complicated IOT devices making them out of an average developer's approach.Most developersthese days areonly software developers and are unfamiliar with electronic chips and microcontroller programming.Besides all the fuzz, robots are limited to a very small set of taskswhich they are programmed to and to perform different ones, different programis developed and pushed to the CHIP.

An android phone is a package ofmost of the usefulsensors and other hardware& software features that a robot mayrequire. An android device can beused in building a smart robot that contains the features of both android's operating system and hardware. Android is used by over a billion users where about 19 million are developers. It is easy to build an ideal robot with the help of its light weight applications and IDE platforms to develop the apps, like Eclipse, Netbeans, Android Studio with the help of GUI, drag and drop etc.

II. MODULES

A. DTMF decoder (IC-MT8770D)

DTMF (Dual-Tone Multi-Frequency)is a generic term for touch tone. When a number is pressed on a phone's dial pad, it outputs a sound. Each number on the number pad has different frequency of sound. Instead of that sound, the electrical signals can directly be passed to the DTMF decodercircuit which is a universally known circuit board used to consumethesefrequencies in the formof electricalsignals. These signal inputsare further multiplexed into 5 outputs Q1, Q2, Q3, Q4 and StD (Not Apllication).
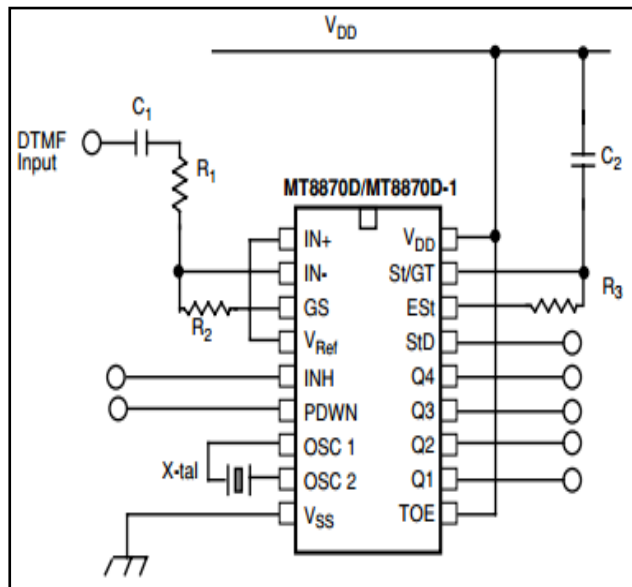

Fig. 1. DTMF Decoder Circuit (MT8770D)

These outputs work as an input to the L293D IC (motor driving IC).Following is the chart of possible Outputs based on the inputs given to circuit.

Table 1. DTMF Board Outputs

Button	Binary Code Output			
	Q1	Q2	Q3	Q4
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
0	1	0	1	0
*	1	0	1	1
#	1	1	0	0

B. Motor driving IC (IC-L293D)

This is a 16-Pin IC that is used for driving a DC motor bi-directionally. As shown below, it can control a couple of DC motors simultaneouslyconsumingthe output from DTMF circuit.

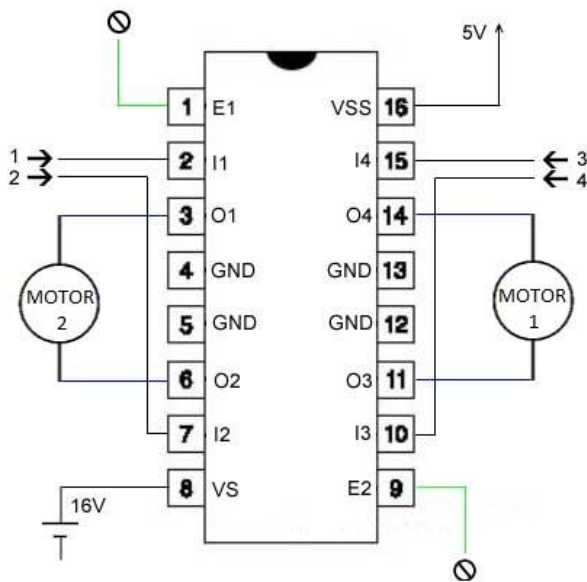# Android Powered Modular Robot using DTMF and Artificial Intelligence

Fig. 2. Motor Driving Circuit (L293D)

As shown in the diagram above, 3rd and 6th pins are the outputs where these pins can change polarity based on input at 2nd and 7th pin to makes the rotor toggle its direction between clockwise and anti-clockwise. Similarly, another pair of motors can be controlled using output from 11th and 14th pin.Pressing a single button generates four-digit binary code and the only two input controls amotor. Therefore, the application of remote controlled car can be accomplished by only single button press.

Following is the input-output chart for L293D IC (considering pin 3 & 14 as input 1 and, pin 6 and 11 as input 2):

Table 2. L293d Input Output Chart

Input 1	Input 2	Output
Low	Low	Motor stop
High	Low	Clockwise
Low	High	Anti-clockwise
High	High	Motor stop

C. Android

Android is an open sourcemobile operating system based on Linux kernel which highly modular and can be manipulated according to use. Its modularity has been utilized and demonstrated by many mobile phone manufacturing companies and individuals world-wide.It costs nothing, and its license terms are commercial friendly and developer friendly. It allows user to install applications on-the-go just on a tap and has a dedicated application market place called as 'Google play store'.

Looking at the capabilities of android enabled devices, possibilities ofcheap and advanced robotsand its development will increase to very large scale world-wide. Moreover, as it is based on android, these robots will be updatable.

Below are advantages of using android as robot:

✓ Apps can be published and installed from Play store
✓ Wide range of android devicesare available
✓ Small and light weight
✓ Android device has built-in sensors and gadgets
✓ Android is open source can be modified

✓ Most android phones have expandable memory and cloud sharing features like google drive etc.
✓ With OTG support, detachable peripherals can be applied on-the-go
✓ Multiple options for connectivity are available like Wi-Fi, Bluetooth, internet etc.

III. HOW IT WORKS?

The android phone sends DTMF signal through earphone output to the MT8770D IC (DTMF decoder)which is then further used by the L293DIC (Motor driving IC) and L293D controls the motors(or any other appliance like LED).

Taking example of a robot car with the help of the Android phone,working as receiver signal-receiver, attached to DTMF board, the motor's movement can be controlled. The receiver phone is set to fetch data from sender' device, working as signal transmitter.
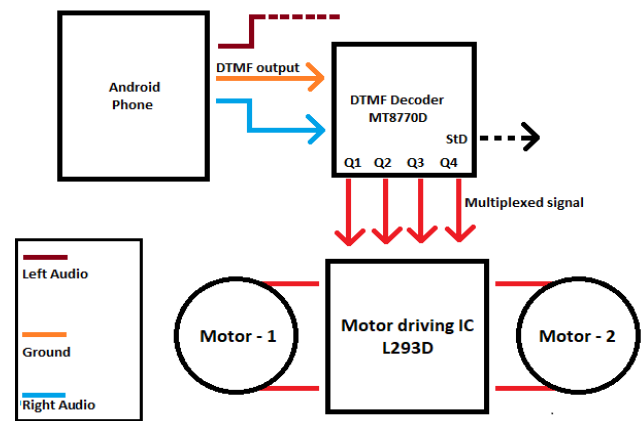

Fig. 3 working flow of setup

According to the signals received by L293D, input current from the batteries is handled by the same IC. This current which passing through the L293D can be upto36volts. The polarity of current can be switched anytime using MT8770D which toggles the clockwise and anticlockwise rotation of the rotors.

A. Application Support

Since, it is an android operating system, DTMF outputs can be produced using an app.This feature of android enables the robot to use any communication medium available.Based on range and accessibility, signalscan be transferred over internet, Wi-Fi and GSM or can be controlled using voice commands. Modularity of the android operating system makes it possibleto attach any new device easily and an android app can be updated,or new app can be installed to support the same.

B. AI support

Android operating system provides possibility to use artificial intelligence which can automate in case of any failure in the robot or pre-programming to complete a tasklike, line following,without the connection withany sender as it also comes with many useful sensors like GPS,compass etc. For instance,

if connection to the sender breaks in the middle of a task, it can search for othercommunication mediums to connect to the sender. Below is such an examplescenario andresponse of the robot:

The robot is moving in forward directiontowardsa wall and it is supposed to turn left soon. But, during this time, it goes out of the WIFI range which was the communication media at that time. In response to this, it uses its proximity sensor and stops or turns the robot at pre-defined distance before it hits the wall.

C. Comparison Between Android Robot Andarduino Robot

Arduino robots are quite mainstream and popular amongdevelopers and hobbyists due to their simplicity, modularity and less weight.But, an android powered robot can replace it giving a tough competition according to many aspects. Developing an Arduino robot with as many features as an android robot, will cost to a great vertical extent and take highly exceeded time to complete the development and, yet it will not be compatible as an android robot.Following table compares between android and Arduino robot that contains.

Table 3. L293d Input Output Chart

Points	Android	Arduino
Costing	$40+	$142+
Over-the-air update	Yes	No
Application market	Yes	No
Cloud	Yes	No

IV.   APPLICATIONS

It can be controlled from any part of the world using another android phone and installing new hardware/software is quite easy. By giving a robot an android operating system powered brain will push the boundaries of robotics ever made. For most applications, android apps are probably already developed and can be found on the google play store i.e. IP Camera for real time monitoring. Below are some of most common applications of it:

- ✓ Real time surveillance and search missions using camera and GPS
- ✓ Fingerprint authenticated to door unlocking
- ✓ Monitoring remote or dangerous areas like nuclear disaster aftermath

Besides the above predictable purposes, it can also work as.can be tracked if lost using Google's find my device

A. Challenges in usage of android robot

Following challenges may be faced using this setup:

- ✓ Android device should be chosen or else, it may lag while performing tasks
- ✓ Any hardware failure in the electronic CHIPs may not be identified by the android phone

V.   CONCLUSION

A robot with all the applications and features of an android, can complete all the tasks and revolutionize the development and advancement of the robotics industry. Due to hugenumber of java & android developers around the world and Google's application marketplace known as 'Google Play Store' with infinite number of useful tools and utilities on it, it can be built within a limited time.

With the increasing involvement and employment of AI and robotics in both personal and commercial purposes, it is going to provide an alternative to unreasonably expensive and task-limited robots due to its modularity in terms of hardware and software.

Also, ease in development of such a model will encourage more developers to make use of technology.

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