

# A PRACTICAL APPROACH FOR MOBILE-BASED REMOTE CONTROL

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## Abstract

Nowadays, the increasing role of advanced electronic Systems, Mobile networks, wireless communications and digital technologies affects many methods used in remotely controlled Systems. One of these methods is the mobile –based control system design and analysis, which is practical and applicable in read-time development. This paper suggests a new remote control technique based on mobile capabilities to control a driving motor circuit which in turn will monitor and control the direction of the dc-motor. The proposed system can generate a control signal through a Global system for mobile communications (GSM) modem either by SMS or Dual Tone Multi-Frequencies (DTMF) techniques to drive the dc- motor movement s. An experimental study was done and the obtained result showed the effectiveness of the proposed method .

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**Keywords:** DTMF, SMS, GSM, Microcontroller, DTMF decoder

## Introduction

### Related works

The main focus of this paper is to show how to monitor and regulate the direction of a dc-motor remotely using mobile techniques. The actuality of the use of mobile in tele-remote system was inspired by many factors:

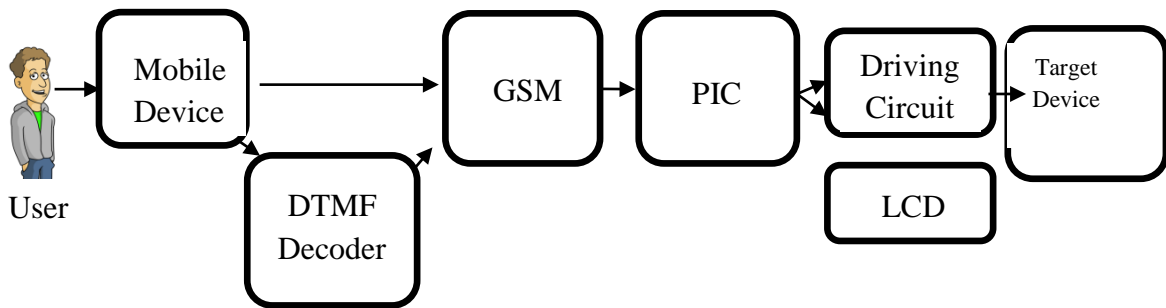
- The Huge number of people that use mobile phones in their daily lives.
- The low cost of mobile communication.
- The existing infrastructure that supports mobile communication across the globe (such as GSM).
- The use of DTMF Signals instead of Radio Frequencies (RF) signals.

These Factors encouraged many researchers to work in this area, for example the problem of implementing of home automation system were considered by (Delgado,et,al.,2006) and (Ciubotaru,et al.,2006) who presented designs and implementations of SMS -text based control . On

the other hand, some research works were interested in remotely controlled system based on DTMF signals such as D.Manoj Kumar that considered in his work industrial applications .In additions, shatnawi and his group were interested in such a problem in their work “ Digital Reciever for DTMF signals,(Mghawish,et al.,2012), and also related research work was done by Callahan in his article “Integrated DTMF receiver(Callahan,1979).

**The block diagram for the proposed System**

The Proposed system was done to serve remote control of a dc-motor via SMS text message and DTMF signals based on GSM modem, DTMF decoder. Micro controllers, Driving circuit, and other required electronics .such as (transistors, resistors, LEDs, etc.....) as shown in the figure1 below:



**Figure 1.** A block diagram for the remote control system.

The mechanism of the system consists of two aspects:

The first one uses SMS-text messages to perform the control actions, where the second aspect uses the DTMF model to generate the call signal that that will be served later after its processing as tele-control signal for electronic appliance .

**A short Description of some devices used in the system.**

- A mobile phone is used to send a message or the DTMF code from a user (remote location) to the control system regardless of time and space.
- A GSM modem receives SMS messages and converts them into suitable required code for later controlling actions.
- A DTMF decoder decodes the signals and sends them to microcontroller.
- A microcontroller is the main device in the board of the control system, which receives the decoded DTMF signals and SMS messages from a GSM, Processes them, and then produces output control signals.
- A driving system consists of relays, transistors, resistors, LEDs, and other required electronics. The driving system gets signals from

microcontrollers and directs them to regulate the movement of the dc-motor.

- A liquid crystal display (LCD) is used to display the command (coded signals) and SMS messages.

**What is a DTMF?**

DTMF is a system of signal tones used in telecommunications.

There are twelve standard signals and four extra buttons “A”, “B”, “C”, “D”, which normally are unseen on telephone keypad.

Each signal is comprised from two tones “**low**” and” **high**” as shown in this table:

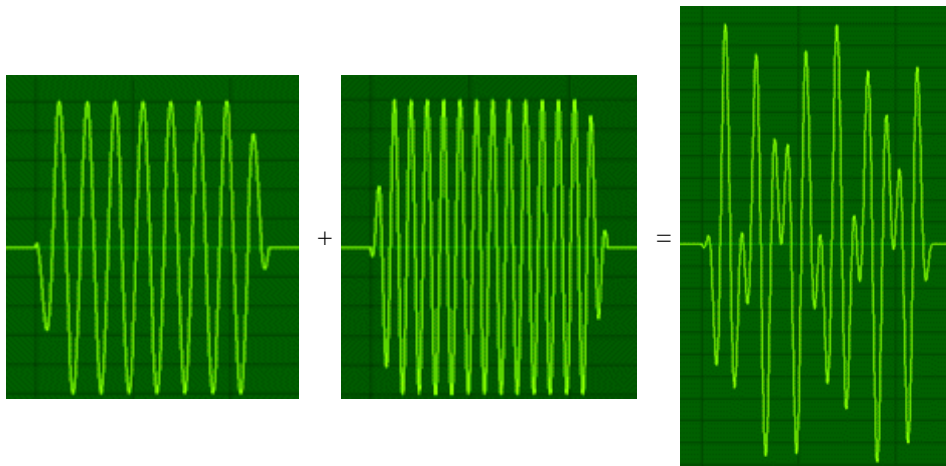
**Table 1.** The frequencies used for each DTMF signal.

	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

When a button is pressed on a keypad, a connection is made that generates two tones at the same time. These two tones identify the pressed key to controlled device.

The calculation of the frequency for each keypad button is performed by adding the frequencies of a row and a column for every corresponding button.

For example, in order to generate the DTMF tone for "1", you mix a pure 697 Hz signal with a pure 1209 Hz signal, like so:



$$697 \text{ Hz Sine Wave } + 1209 \text{ Hz Sine Wave } = \text{DTMF Tone "1"} \\
\text{.wav, .au} \qquad \qquad \qquad \text{.wav, .au} \qquad \qquad \qquad \text{.wav, .au}$$

**Figure 2.** Two Pure Sine Waves combine for form the DTMF Tone for "1"

and so on.

The use of four extra buttons “A” “B” C D” is to prevent to control remote device.

The calculation of frequencies of all characters placed on the keypad of the mobile phone is summarized in this table.

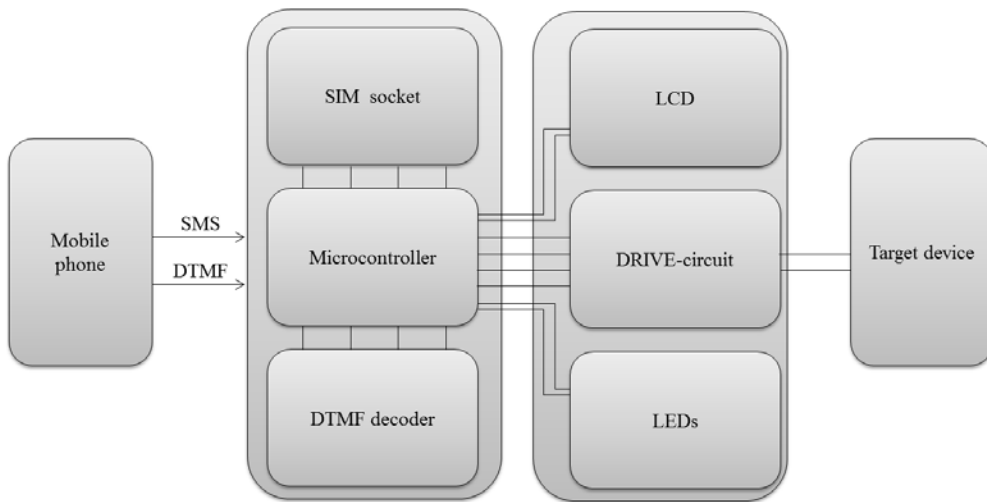
**Table 2.** The high and low frequencies for each key of the keypad.

Number	High frequency	Low frequency	BCD
1	1209	697	00000001
2	1336	697	00000010
3	1477	697	00000011
A	1633	697	00010000
4	1209	770	00000100
5	1336	770	00000101
6	1477	770	00000110
B	1633	770	00010001
7	1209	852	00000111
8	1336	852	00001000
9	1477	852	00001001
C	1633	852	00010010
*	1209	941	-----
0	1336	941	00000000
#	1477	941	-----
D	1633	941	0001H0011

**Remote Control System Methodology**

In this paper a remote control system is developed to perform controlling actions using a mobile phone. The proposed system can receive SMS commands and DTMF signals and sends them via GSM modem to microcontroller then to a driving system that in turns will control the target device (Xuehua C.P,2008).

The SMS messages are sent from the user – mobile phone to a GSM modem with a SIM card connected to the main circuit of the controller an shown in figure2.



**Figure 3.** The schematic remote control circuit.

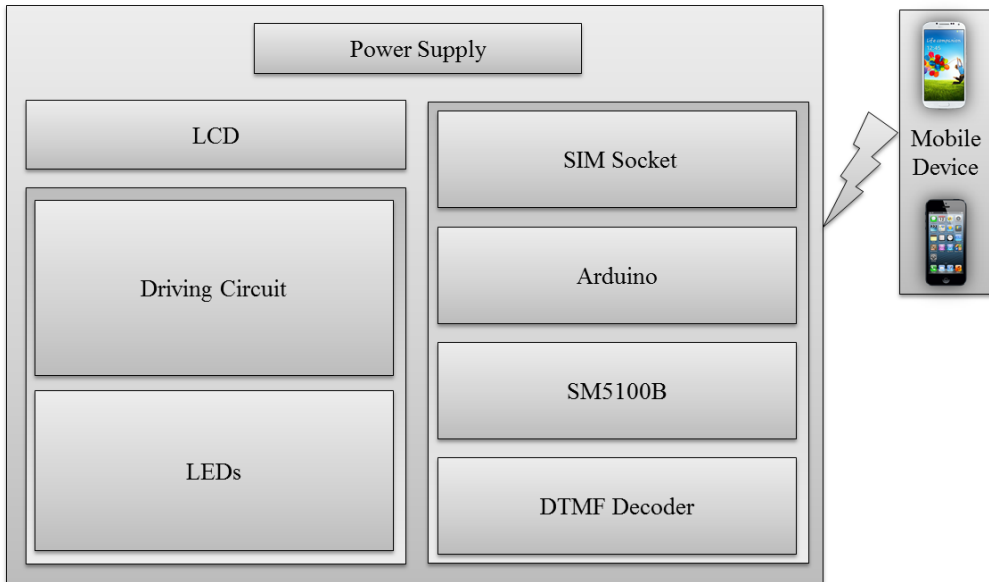
The DTMF signal is generated when the keypad button is pushed by the user – mobile phone, then this signal is decoded to Binary Decimal Digits (BCD) by the DTMF decoder, after that the BCD is sent to microcontroller (Sharma K.,et al.,2006).

The following steps describes how the proposed system operates:

1. The user sends SMS text messages to GSM modem or DTMF tone to the GSM through the DTMF decoder.
2. GSM modem will send to microcontroller the appropriate signal (text message or coded DTMF tone in a form of BCD suitable for microcontrollers.
3. An interrupt is done and the signal will be loaded to the memory of microcontroller.
4. The microcontroller processes the obtained signals from GSM and the LEDs will glow at the specified output pins of the microcontroller indicating the processed signals.
5. These processed signals will send to the driving system that contained the relays, which must regulate the motion of the motor in required direction.
6. Programming a microcontroller ship in such a way for responding to user requirements on how to control the target device.

### **The Experimental Part**

The general kit of the implemented circuit, which has been used to test a practical developed remote controlled system( Mghawish,et al.,2012), is shown in the figure.3 below :



**Figure 4.** Testing circuit.

The main hardware parts using in designing the proposed system are as follows

- Power supply.
- Microcontroller (Arduino).
- GSM modem (SM5100B).
- DTMF decoder.
- SIM socket.
- Liquid crystal display (LCD).
- Ligth Emitting Diodes (LEDs).

#### **Main Implementing Procedure**

The implementation part of the proposed system has been done following the below procedure

- Analyzing and testing the sending and receiving processes for DTMF signals and SMS text-messages to ensure their correctness.
  - The verifying of DTMF signals has been done by repeatedly generating sample signal tones for some keypad buttons and testing the output of the DTMF decoder to ensure that the obtained signals are decoded to BCD format, which in turn will be sent to microcontroller ports. This will affect the specified pins of the microcontroller, where the LEDs are connected to be glow.

- SMS text messages have been tested insuring that the character string obtained from the mobile phone read the required command.
- This is done by verifying the GSM modem:
  - The GSM modem receives the message signal by its antenna; the SM5100b chipset reads a message or the decoded DTMF signal and converts them to desired form for use in the next step.
- The microcontroller Arduino obtains the signals produced by GSM (DTMF or text message) processes them for sending later to driving system.
- The microcontroller Arduino and the chipset SM1500B have 13 pins as outputs. These output pins were programmed to produce desired outputs.

The results obtained by the experimental study are summarized in the following table:

SMS messages	DTMF		Actions to be performed by driving circuits
	Pressed Key	BCD code	
Leftr1	“1”	00000001	Motor rotation” counterclockwise within a specific units of time“.
Rightr1	“2”	00000010	Motor rotation”clockwise”within a specific units of time“.
Off	“3”	00000011	A motor driver drops.
Ledglowon	“4”	00000100	Leds will glow.
Ledglowoff	“5”	00000101	Leds stop glowing.
Systemshutdown	“6”	00000110	Whole system drops.

**Table3.** Results of experimental study.

The sending messages and the DTMF signals will be displayed on the Liquid Crystal Display (LCD) connected to the main board of control system as was mentioned in figures 2and 3.

**Conclusion**

The proposed paper demonstrates the remotely controlled system based on mobile phone device which can operate using two methods: DTMF coded signals and SMS messages to affect the driving system for controlling a direction of a dc –motor. The movement of a dc-motor in different

directions can be controlled by pressing the specified keys on the mobile phone keypad or by sending message from a mobile phone through GSM modem as shown in the table 3 above. The main advantages of the proposed system are its reliability, low cost, and wide area using.

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