

Remote Control System through Mobile and DTMF

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ABSTRACT:

This paper proposes a control system which enables controlling remotely through mobile phone and DTMF decoder. The system will control a cutter machine in foam processing factory. The proposed system will take remote control process over mobile network. In this system a mobile phone sends controlling signal from remote location. 3.75G internet modem is used to receive the signal from the mobile and transmits the signal to DTMF decoder through computer headphone, DTMF 8870 decoder is used to decode the tone generated by the buttons of the mobile keypad. PC computer hosts software for controlling cutter machine, latching IC in the system is for signal buffering and Darlington IC for signal amplifying. The proposed system provides solution for industrial sector to access and control devices and machines remotely.

KEYWORDS: Controlling signal, Cutter Machine, DTMF Decoder, Internet Modem, Latching IC, Mobile Phone, PC computer, and Signal tone.

I. INTRODUCTION

Remote Control System is a control system that allows accessing and managing an electrical or electronic device remotely [2]. Remote control systems are used in different fields like home management, factory automation, space exploration, robot operating, and other critical fields [1,5]. There are many advantages of using remote control systems; remote control systems are great time and effort savers, also they provide flexibility, security, independence of location or geographical distance.

This paper proposes a method to control remote machine using mobile and DTMF decoder. The proposed system will take remote control process over mobile network to control a cutter machine, without regarding the phone model and mobile phone carrier. Using mobile networks in remote control system has following characteristics: Reliable and resilient, immune to interference from other radio sources, data and internet oriented, broadband capability, and wider coverage [7]. This system uses a mobile phone and internet modem. PC computer is a central unit for the system which hosts software program to manage controlling process. Many proposed systems for remote controlling uses two mobiles to send and receive controlling signal from the user to the side where controlled device is allocated. In this system a mobile phone and 3.75G internet modem are used, the modem can receive call from the mobile, since the modem is used primarily for internet usage using controlling purpose can be useful. The proposed system will control cutting machine in foam processing factory. The machine cuts foam blocks by rotating the blocks into different predesigned sizes. The system can carry following commands to control cutting machine; Turn-on/turn-off machine, change foam size to predesigned shapes (designs one, design two, etc.), Increase machine speed, decrease machine speed.

II. SYSTEM COMPONENTS

DTMF Decoder

DTMF is short for Dual Tone Multi Frequency. It is a generic communication term for touch tone (a Registered Trademark of AT&T). The tones produced when dialing on the keypad on the phone could be used to represent the digits, and a separate tone is used for each digit. Pressing any key generate unique tone which consists of two different frequencies one each of higher and lower frequency range. The resultant tone is convolution of two frequencies [1,5,6]. Figure 1 shows mobile keypad frequencies and table1 also shows tone frequency associated with a particular key.

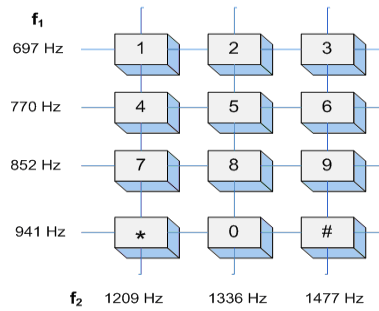


Figure 1 Phone keypad for DTMF generation [10]

Table1 Tone frequency associated with a particular key resulting

Button	Low Frequency	High Frequency	Key Frequency
1	697	1209	1906
2	697	1337	2034
3	697	1477	2174
4	770	1209	1979
5	770	1337	2107
6	770	1477	2247
7	852	1209	2061
8	852	1337	2189
9	852	1477	2329
0	941	1209	2150
*	941	1337	2278
#	941	1477	2418

Each of these tones is composed of two pure sine waves of the low and high frequencies superimposed on each other. These two frequencies explicitly represent one of the digits on the telephone keypad. Thus generated signal can be expressed mathematically as follows:

$$f(t) = AH \sin(2\pi fH t) + AL \sin(2\pi fL t) \quad (1)$$

Where AH, AL are the amplitudes & fH, fL are the frequencies of high & low frequency range. Properties of DTMF tone frequencies are:

- No frequency is an integer multiple of another
- The difference between any two frequencies does not equal any of the frequencies
- The sum of any two frequencies does not equal any of the frequencies

1. Sudani One 3.75G Internet modem:

Sudani One 3.75G Is a USB modem for wireless internet connections, based on 3.75G (HSDPA/HSUPA) technology with speeds up to 7.2 Mb/s to provide convenient and flexible Internet access, whether the user machine is PC computer , laptop, Mobile or any other device[8].



Figure 2 Sudani One Modem[8]

2. PC Computer:

PC computer hosts developed software using C++ programming language to control cutting machine. The PC computer is connected with 8870 DTMF decoder via parallel port inputs. The software dictates the processor to handle controlling process. A corresponding signal is then sent via the output pins of the parallel port to the HD74LS373 latch IC.

3. HD74LS373 Latching IC:

The HD74LS373 is eight bit register IO mapped used as a buffer which stores signals for future use. Different types of latches are available HD74LS373 octal D-type transparent latch will be used in this system. This type of latch is suitable for driving high capacitive and impedance loads[12].

4. ULN 2001A Darlington IC:

The ULN2803A is a high-voltage, high-current Darlington transistor array. The device consists of eight NPN Darlington pairs that feature high-voltage outputs with common-cathode clamp diodes for switching inductive loads. The collector-current rating of each Darlington pair is 500 mA. The Darlington pairs may be connected in parallel for higher current capability[11].

5. Cutting Machine:

Cutting machine is an electrical machine used to cut raw blocks of expanded foam into predesigned shapes. The machine uses a type of tool known as a hot-wire foam cutter. The predesigned shapes are both manual and fully automatic designs. The applied cutting machine cuts foam blocks by rotating the block.



Figure 3 cutter Machine

III. METHODOLOGY

The main goal of the proposed system is to send controlling signal remotely from mobile phone to controlled machine using mobile network. The whole system can be divided into following stages:

a. Mobile Phone Stage:

A mobile phone is used to send controlling signal. The mobile user dials SIM card number in the Sudani One modem. After initiating the call, pressing particular button of mobile keyboard produces specific DTMF tone.

b. Internet Modem Stage:

Sudani One modem is used in this system but any other internet modem contains SIM card can be used. Sudani One modem is connected with PC computer through USB port. The modem is auto-receiving mode. The mobile and the modem are connected via mobile network by receiving call from the mobile. After receiving the control signal the modem transmits the signal to the PC through.

c. 8870 DTMF Decoder Stage:

The signal is fed to 8870 DTMF decoder chip through headphone connected with the PC computer. The DTMF decoder will give corresponding BCD value of tone as shown in table2. Each key press at transmitter end reflects as a BCD value of Q1, Q2, Q3, and Q4. The outputs of the DTMF decoder are sent to the PC through parallel port [5].

Table2 8870 DTMF output truth table

Button	Low Frequency	High Frequency	TO E	Q4	Q3	Q2	Q1
1	697	1209	1	0	0	0	1
2	697	1336	1	0	0	1	0
3	697	1477	1	0	0	1	1
4	770	1209	1	0	1	0	0
5	770	1336	1	0	1	0	1
6	770	1477	1	0	1	1	0
7	852	1209	1	0	1	1	1
8	852	1336	1	1	0	0	0
9	852	1477	1	1	0	0	1
0	841	1209	1	1	0	1	0
*	841	1336	1	1	0	1	1
#	841	1477	1	1	1	0	0

0= LOGIC LOW, 1= LOGIC HIGH

d. PC Computer Stage:

The output signal from the 8870 DTMF decoder is fed to the computer via parallel port inputs. The software dictates the processor to make a sequential pulling for the parallel port control to check if any signal is available from input pins. The detected signal is handled by the Micro-processes according to the instructions in the software. A corresponding signal is then sent via the output pins of the parallel port to the HD74LS373 latch IC.

e. Latching Block Stage:

The HD74LS373 is eight bit is register IO mapped and has unique address that work with parallel port. The signal received from the parallel port of the PC computer must be latched to be available to the interface to be controlled till a further change in the signal occurs.

f. Darlington Pairs Block:

The outputs of the latch pins are fed to the input pins of the ULN 2001A Darlington pair chip, this chip is the ideal solution for the interface between the low level logic circuitry and multiple peripheral power loads.

IV. BLOCK DIAGRAM

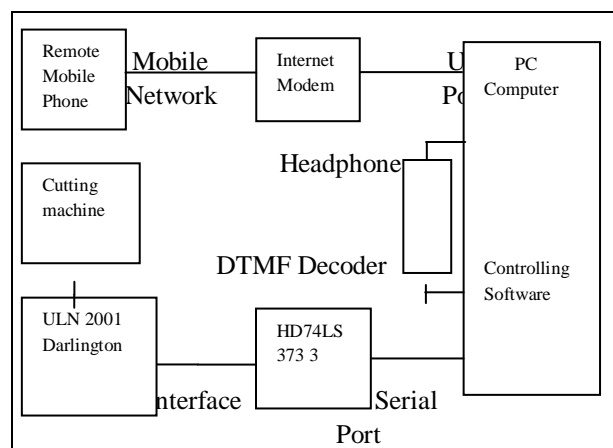


Figure 4 Block diagram

SYSTEM ALGORITHM AND FLOWCHART

Following Algorithm and flowchart are designed to control mixing machine remotely.

a) System Algorithm

1. Make Parallel port address (0x378) as outputport and Parallel port address (0x379) as inputport
2. Put outputport off (outputport=0x00)
3. Read input from inputport
4. Check if the input at inputport is 0001 then
Turn on cutter machine (outport=0x01)
Go to step 4
Else go to step 6
5. Check if the input at inputport is 0010 then
Design One (output=0x02)
Go to step 4
Else go to step 7
6. Check if the input at inputport is 0011 then
Design two (output=0x04)
Go to step 4
Else go to step 8
7. Check if the input at inputport is 0100 then
Design three (output=0x06)
Go to step 4
Else go to step 9
8. Check if the input at inputport is 0101 then
Increase the speed (output=0x08)
Go to step 4
9. Else go to step 10
Check if the input at inputport is 0110 then
Decrease the speed (output= (0x010))
Go to step 4
Else go to step 11
Check if the input at inputport is 0111 then
Turn of the machine (outport=0x00)
Go to step 4
Else go to step 12
If the user wants to continue
Go to step 4
Else Finish

b) System Flowchart

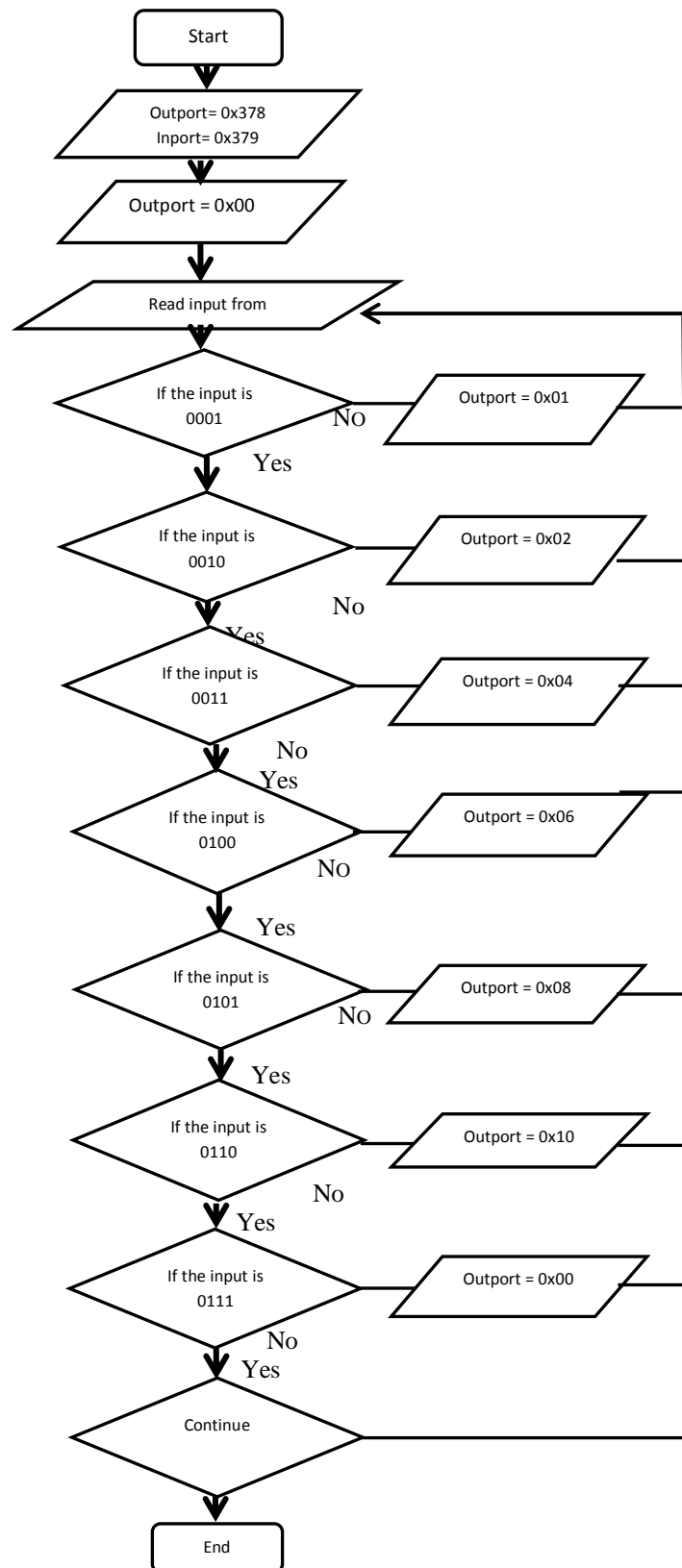


Figure 5 System flowchart

V. RESULTS

The controlling process for cutting machine was implemented successfully. The system was connected with the machine and executed all commands with unlimited number of times, following tables describes results of system implementation.

Table3 Implemented system Commands

Pressed key	Command	Result
1	Turn on	The machine is started
2	Design one	Changed to design one
3	Design two	Changed to design two
4	Design three	Changed to design three
5	Increase rotation speed	Increased
6	Decrease rotation speed	Decreased
7	Turn off	The machine is stopped

Table4 PC computer input and output results

Key Pressed	DTMF 8870 OUTPUT (BCD)	Input from Parallel Port				Output to Latching IC Pins (2,3,4,5,6,8,9)
		Pin 13	Pin 12	Pin 11	Pin 10	
1	0001	0	0	0	1	0x01
2	0010	0	0	1	0	0x02
3	0011	0	0	1	1	0x04
4	0100	0	1	0	0	0x06
5	0101	0	1	0	1	0x08
6	0110	0	1	1	0	0x010
7	0111	0	1	1	1	0x00

VI. CONCLUSION

This paper presented a method to control cutting machine using mobile phone and DTMF decoder. DTMF tone is generated by pressing the keypad buttons of the mobile which is connected to internet modem through mobile network. The popularity and availability of the mobile and mobile network makes this kind of control very useful and powerful. The main advantages of the proposed system are its reliability, low cost, and wide area coverage. Future works for this system can be following

- Adding SMS message to carry controlling commands as alternate way for DTMF tone.
- Upgrading the system to control more than one machine at same time.

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