DTMF BASED LOAD CONTROL SYSTEM

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Abstract. The paper presents the design of a DTMF based home automation system. DTMF means Dual Tone Multiple Frequency. Now a day's mobile phones are a part of our day-to-day life, since the price is also getting low, they are widely used in home automation. Key benefit of a DTMF based system is that it may remotely be controlled from a far place which minimizes human stress. The DTMF-based system consists of 2 mobile phones, one mobile is used as a remote and the other as a receiver. The DTMF decoder MT8870 decodes the DTMF tones and hence the appliances are operated.

Keywords: Home automation, DTMF decoder, Mobile phone, etc.

1   Introduction

At present, we are in the age of fast and advanced technology and manual operations are talk of past, conventionally electrical appliances are operated via switches. With the help of this modern contemporary technology, the home automation method allows everything to be managed automatically. Home automation is in charge of the house's operation. Modern homes are getting smarter with the advancement in engineering and technology. Smart home automation provides user the fast and easy access to the home appliances. Dual Tone Multiple Frequency (DTMF) was developed in 1963 by Bell system in the USA and was known as Touch Tones and were widely used in push-button telephones given to the telephone users. DTMF signaling is a type of in-band telecommunication signaling structure that uses frequency band to communication with telephone and other communication device. Before the arrival of Dual Tone Multi Frequency system, Pulse dialing was used intensively. Pulse dialing had some major drawbacks such as, the physical range was restricted due to distortions and required end to end metallic links in communication line. DTMF is a reliable means of signaling and can be transmitted over the telephone as well as over the internet. DTMF tones is carried on the same wire the voice signal is carried in the form of audio signals. Each key has its designated different frequency one low and other high frequency. The DTMF based home automation can be controlled from a remote distance. It is overall a wireless system, but instead of using a separate module, we're engaging a cell phone. Home automation system uses various components, with the inter-connection of the components and with the application of cell phone, user can control home appliances. System provides low cost to the development of load control, Appliances can be controlled with an affordable Cost excluding the cost of mobile as mobile increases the cost but this is small as comparison to the cost of withstand system [1], [2]. This is achieved by connecting cellular unit to the system via headset. When we call, the call will automatically be answered in auto-answering mode and then, when we press any key on dialer pad to operate the loads connected with the system [3-5]. On pressing the button on the dialer pad, it produces high as well as low frequency tones that is further converted into the binary code via DTMF decoder. DTMF decoder decodes and sends information to the relay. The function of relay is to switching ON/OFF the loads that is connected with the relay in the system [6], [7].

2   Proposed Work

This is a wireless control system developed to control home appliances from any place through a communication network. Our final module will somehow look like a small version of a set-top box which will include three components namely the decoder, relay, and adaptor circuit, and will also have input ports for mobile connection and power supply. The main purpose is to make life easy. The system is operated by a mobile phone, which sends DTMF tones to the DTMF decoder. The system is operated on a cellular network, which controls all devices wirelessly. The user has to operate the appliance by dialling through his cell phone, and then the user can easily control the electric devices as per the necessity. The system also has a relay that acts as a switch and operates the electrical appliances according to the input.
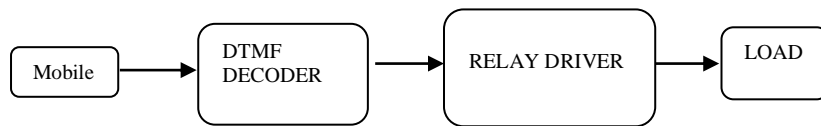The block diagram of the overall system is shown in fig.1

Fig.1. Block diagram

A few of the following advantages of this model are:

- When compared to voice, Bluetooth, or similar means of providing inputs to the system, the operating range of this model is much higher.

- The number of devices to be operated on can be increased as per the user's need since the relay driver can be used to drive up to 16 different devices at a time.

3   HardwareComponents

3.1   Power Supply

A power supply system is defined as a system that provides electrical energy to the load connected. In this system we need a 5V DC continuous power supply, for this, we require a rectifier, filter circuit, step-down transformer and voltage regulator. Fig.2 shows a normal charging module that includes all the above-mentioned components.

Fig.2. Adaptor module

3.2   DTMF Decoder

The DTMF decoder used in this setup is MT8870, which decodes the DTMF tones caused by the keys of the user's cellular phone. Fig.3 shows how an MT8870 DTMF decoder looks. Through the digital counting technique, it detects and decodes each 16 DTMF tone pairs into a 4-bit code. When a dial pad is pressed, a combination of 2 separate sine waves having distinct frequency signal that can further be decoded. For example- when a user dials '1' in his/her cell phone, the output result generated by the decoder is 0001, and device 4 gets on. The MT8870 demands its four digital input/output pins to be interfaced with four binary bit output pins and also a constant 5V supply. This output is then used to operate the relay module for operating the output devices attached to the system.
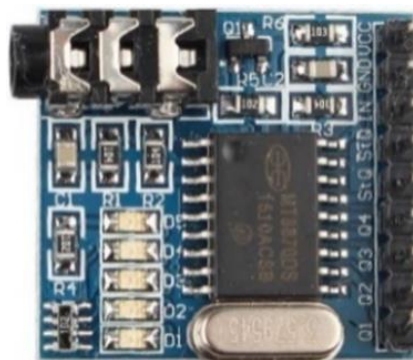

Fig.3. MT8870 Decoder

3.3   Four channel relay module

In this setup, the relay module is a device that allows us to switch ON or turn OFF a circuit. Fig.4 shows a picture of a 5V 4-channel relay. It contains four 5V relay and it is easy to interface with a microcontroller or any sensor. This relay interface needs a 15-20mA driver current. Four-Channel Relay Module can be used to control numerous home loads and equipment with a huge current rating. It can be established as a central hub from which various remote loads can be operated. Each relay connected on the board.

Fig.4. Four-Channel Relay module

4   Hardware Implementation

Fig. 5 Connection of System

Fig. 5 illustrates the connection of the whole system. If the user dials the home mobile phone number, the phone at the home starts to ring and if in case nobody picks up the voice call, then the system automatically picks up the call. When we push any number on the phone keypad it generates a distinct particular frequency later which is when received by phone at the other end and then the number is further decoded by the DTMF decoder (MT8870). Here the decoder in the circuit decodes the unique frequency of the tone obtained by the particular number. The DTMF decoder circuit generates a binary output as a response of key pressed which is then forwarded to the microcontroller. Here the microcontroller activates/switch ON the relay module and in accordance with the key pressed by the other side over call. A 4-channel relay module is connected between the microcontroller section and the loads attached. It drives the appliances based on the output out of microcontroller. Thus, when the relay drive is triggered by the microcontroller, the device will get ON or OFF as per the user's requirement.

5   Results

Testing was found to be successful. When the user makes a call to the phone connected to the decoder and presses the keys, the DTMF decoder converts the signals into binary code. This is then used to initiate the relay module for operating the output appliances connected to the system. The keys pressed by the user and the binary code output by the DTMF decoder are shown in

table 1.

Table 1
Binary code output

KEYS	BINARY OUTPUT	DEVICE OUTPUT
1	0001	Device 4 will be ON
2	0010	Device 3 will be ON
3	0011	Devices 3 and 4 will be ON
4	0100	Device 2 will be ON
5	0101	Devices 2 and 4 will be ON
6	0110	Devices 2 and 3 will ON
7	0111	Devices 2,3 and 4 will ON
8	1000	Device 1 will ON
9	1001	Devices 1 and 4 will ON
0	1010	Devices 1 and 3 will ON

6   Conclusion

Effort on developing a cell phone-based controlling system for home appliances was successful. Since there has been an increase in the percentage of older people in certain regions of the world, a mobile-based home automation system was proposed. The system here uses the DTMF tones generated by mobile phones as control signals, which are further decoded by the DTMF decoder (MT8870) and are operated through relays. The final assembled system has a higher range than infrared and radio remote control, which provides the user with better ease of living in their home.

7   Future Scope

In every system there is always a room for improvement for future development, in our assembled system there can also be some future improvements, some of which are listed below:

- We can add password protection. Through this,the user can give access to the selected people that can control the home appliances.
- Our home automation system concept does not involve a microcontroller concept, using one will bring more control to our system.
- Memory system can be installed to store the appliance status during power failure.
- Can be converted to an IoT device using Wi-Fi.
- Project can be made more user-friendly by employing advanced and different ways of providing inputs.

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