Model Case of Remote Switching Application System via Telephone Line Using DTMF

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Abstract: An integrating home automation system is now becoming a trend in modern house concepts. These systems may include the function of remotely switching devices/appliances. Different technologies are being utilized to achieve this function for houses termed as "intelligent home". Using the related studies which are gathered and further analysed by the proponents, they have come up with the idea of creating a simple model for a remote switching application system. The proponents choose to develop a model using a telephone system. Telephone line is chosen to serve as the channel for the transmission of instruction signals. The system will be composed of a remote section and a local section. DTMF signalling, which is the standard dialling technique for telephone system, will be used as a means of transmitting of the signals to the local section. The generated signals from the control section will be decoded using a DTMF decoder. The brain of the system is an Arduino microcontroller. This will take care of the processing of the main functions of the system.

Key Words: Home Automation Systems; Intelligent Home; DTMF; DTMF Decoder; Telephone; Telephone Line; Arduino microcontroller

1. INTRODUCTION

1.1 Background of the Study

Oftentimes, people tend to forget to switch off or unplugged electronic devices and/or appliances due to either lack of time or simply forgetting to turn them off, which sometimes causes fire or conflagration. Because of this, intelligent home is developed and now becomes a trend in modern house concept.

This concept started at the beginning of the 20th century. Smart home provides comfort, security, energy efficiency (low operating costs) and convenience at all times to the home owners, whether someone's home or not. This term is commonly used to define homes or residences that have electronic/electrical appliances and devices that can be remotely controlled by a time schedule, from any part of the room or house, from any location in the world [1].

Home automation refers to controlling of appliances, providing security and monitoring the house through a simple, yet powerful controller. It can provide better quality of life to people especially to the elderly and disabled. It includes centralized

control of lighting, HVAC (heating, ventilation, and air conditioning), appliances, security locks of gates and doors and other systems, to provide improved convenience, comfort, energy efficiency and security [2].

Remote-switching/controlling is one function of home automation. It uses different technologies such as Infrared (IR), Bluetooth, Mobile telephony, Radio Frequency (RF), Internet, Dual Tone Multi Frequency (DTMF) and so forth.

Infrared (IR) technology is a technology that uses infrared radiation as a medium of transmitting data. It is portable, requires low power and highly immune to noise but can only be used for short and medium - range communications and line -of -sight propagation [3]. Bluetooth is a wireless technology commonly equipped in cell phones, laptops, mouse and keyboards and headsets to communicate or transfer data within a small and medium - range communications. [4]. Mobile telephony is another wireless technology which is primarily used in communications. It can provide services like Short Messaging Service (SMS), General Pocket Radio Service (GPRS), and Enhanced Data rates for GSM Evolution (EDGE) and etc. It is described as an expensive technology and apart from that it has security issues [5]. Radio Frequency (RF) transmission is a technique which uses the frequencies from 3 Hz to 300MHz to transmit signal information [6]. Therefore, it is only use for medium range and simple communication applications. Internet is a global network that can connect and communicate millions of users [7]. Since it can communicate numbers of users from one another, it can easily share information thus, creates security issues [8].

On the other hand, Dual Tone Multi Frequency or DTMF is widely used in telecommunication systems. It is a method for instructing a telephone switching system of the telephone number being dialled, or to issue commands in switching systems or related telephony equipment [9]. DTMF has enabled the long distance signalling of dialled numbers in voice frequency range over telephone lines. It eliminated the need of telecom operator between the caller and the called and evolved automated dialing in the telephone switching centers [10].

1.2 Problem Statement

In developing a remote – switching controlled system, there are many technologies that can be used. One technique is by the use of infrared radiation. But the operation is limited. It is a point – to – point operation. It can be used in remote controls of the TVs, Video Cassete Recorders (VCRs) and CD players and cellular phones for sending information [11] The next one is the Bluetooth. It is better than the infrared. The only problem is that it can be used for a limited range. Though its range is limited, its energy usage is quite low. Its energy efficiency, combined with its compatibility with existing smart phones and other devices, makes it easy for developers and Original Equipment Manufacturers (OEMs) to create solutions that can immediately be added to existing systems [12]. RF can be used for Wi-Fi, WiMax, Near Field Communication (NFC), Radio Frequency Identification (RFID) and other system that uses RF signals [13].

1.3 Objectives of the Study

The focal objective of the study is to develop a model of a remote switching application system which is based on the telephone line and will use Dual Tone Multi-frequency signalling.

This study aims to:

- present an acceptable model of an Home Automated switching application,
- model an Automated Home Application using a telephone device with Arduino as microcontroller,
- to yield a controlling system in Home Automation using DTMF technique,
- compare and contrast home automation using DTMF technology with other wired and wireless home automations.

2. RELATED STUDIES

2.1.1 DTMF Remote Appliance Control System Using Mobile Phone

In this study, the proponents aim to develop a system that is a cost effective solution that will remotely control the home appliances and enable

security in the home even without the home owner. A cellular phone is the one responsible for controlling the devices in this system. There will be an attached circuit to it that is connected to the devices.

2.1.2 Remote Control System through Mobile and DTMF

In this paper, the proponents propose a method that uses a mobile phone and DTMF decoder to control remote machine. A mobile phone will be used as a remote control to the cutter machine to work. It is the one that will send controlling signal to the SIM card number in the Sudani One modem (connected with PC through USB port). Sudani One modem is an auto-answering mode. A DTMF tone is produced when you press a button on the phone when it is being called. The signal is fed to 8870 DTF decoder chip that will send a BCD value of tone to the PC through a parallel port. It will be the one that will determine if the appliance will switch on/off. This methodology can be applied to remote switching devices using DTMF technology in home automation (Soufi, 2013).

2.1.3 Safe and Secure PIC Based Remote Control Application for Intelligent Home

This study describes a safe and secure way of intelligent home automation that uses PIC controller and DTMF technology. The pin number and the order of the user will be transmitted as DTMF signal, and the PIC Based Remote Controller will receive the signal, since the PIC remote controller is the control unit of the system, it can take the order of the user to the appliances or devices that is being operated (Erol et al., 2007).

2.1.4 DTMF Based Controller for Efficiency Improvement of a PV Cell & Relay Operation Control

This study proposed another way of a controlling system that uses a DTMF tone generated as the user selects the mobile phone keypad buttons or when it is connected to a remote mobile system.

This study presents a simulation of the system in Labview 7.1.The edge of the mobile phone from the other is that it is an apt device to transmit signals to a remote system that allows a connection with the outside devices via mobile communication network where and when the other device is.

2.1.5 Bluetooth Remote Home Automation System Using Android Application

In this paper, the proponents deigned a remote switching control system for home automation via android phone application using Bluetooth technology to help fulfil the needs the elderly and disabled persons in their homes. The Bluetooth enables the system to communicate on the PC /laptop or smart phone with the Graphical User Interface (GUI). In this paper, the window GUI is the one acting as a server to transmit data from/to the smart phone and main control board after the Bluetooth on the smart phone is connected to the PC/laptop. The system Main Control Board is the one controlling the target appliances in the house. The PIC Microcontroller, PIC18F2550, is directly connected to the electrical current by which separates the regulator and relay circuit.

2.1.6 Voice Integrated Home Automation and Security System Through Telephone Line

This paper introduces another system of home automation that is a voice integrated home automation and security system using telephone line. According to the study, home automation can be achieved not only with the household robot but with embedded computing power and memory within dozens of pieces of domestic equipment, each of which can communicate with the user and with other equipment. The device worked by a circuit, which can be divided into two parts, the control unit and the alarm unit.

2.1.7 A Cell Phone-Based Remote Home Control System

In this study, a system was design to allow users, upon authentication, to remotely control and monitor multiple home appliances using a cell phone-based interface.

2.1.8 GSM Based Home Automation System Using App – Inventor for Android Mobile Phone

This study focuses on the design and implementation of GSM (Global System Messaging) based secured device control system using App inventor for Android mobile phones. In this study, the different hardware and software GSM Home Automation System (GHAS) can be used are discussed. The proponents of this paper chose GSM and cellular phone as the controller because of its capability of communicating in any range of distance.

2.1.9 Remote Control of Home Appliances Using Mobile Phone: A Polymorphous Based System

This paper focused solely in the development of a remote control system using Arduino microprocessor and a GSM module. The user of this system can control multiple appliances anywhere else he/she is. This paper also compared the function of the proposed system to other existing system in which multiple appliances can be controlled simultaneously. The proposed system uses GSM Mobile Set and Module and Arduino as seen on the figure below.

2.1.10 Smart Home Electricity Management System Using Cloud Computing (SHEMS)

This paper introduces an electricity management for smart home through cloud computing. The study states that web technology can send and transmit signal from the user anywhere to any electrical devices that is connected to the Internet. The proposed system is composed of a web server as the controller, website, hardware interface

and a software application to monitor the electrical switch control.

2.2 Synthesis

It can be inferred from the review of related literatures that home automation is becoming a popular trend in modern house concepts. The definition of a home has evolved with the development of different technologies involving automation and control systems.

Most of the research models employed wireless transmission in controlling the system, opening the possibilities for limitless range of operation on the technology utilized and the transmitter and receiver chosen. The maximum number of devices and/or appliances controlled in the proposed systems described by the related studies is eight (8).

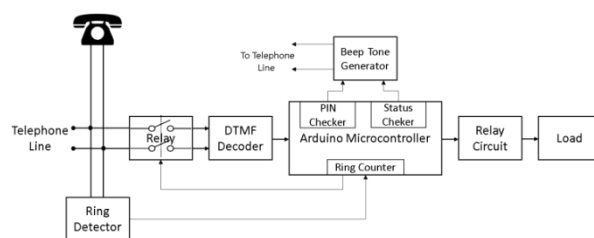### 3. SYSTEM DESIGN
3.1 Proposed Design

Figure 1. Block diagram of the remote switching system

Figure 1 illustrates the high-level block diagram of the remote switching system. In order to remotely switch the devices/appliances, there is a need for a remote controller which is in the form of a telephone or a mobile phone. This will enable the user to control the system from a distant place using DTMF signaling.

3.2 Proposed General System Architecture

Presented in figure 2 is a pictorial representation of the general system architecture. It

is a graphical representation of the model as proposed the proponents.
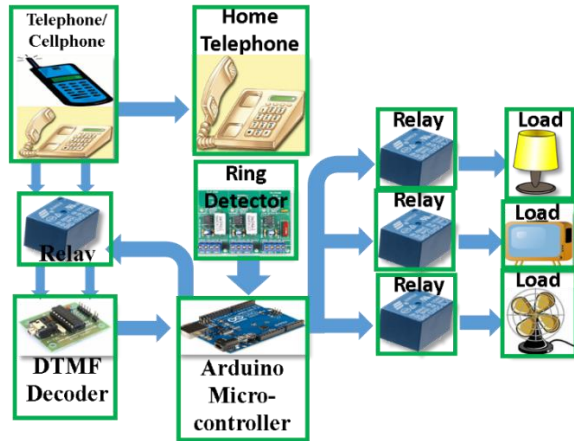

Figure 2. Proposed general system architecture of the remote switching system
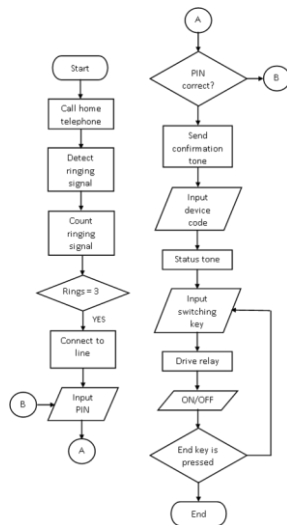
3.3 Flowchart

Figure 3. Process flowchart of the remote – switching system

Presented in figure 3 is the process flowchart of the remote switching system. The process of remote switching system will start from calling the telephone situated at home. After

receiving the call from the remote section, the ringing signal is detected by the ring detector circuit.

4. CONCLUSION

In the paper, the cohesive evaluation model for a remote switching application system, DTMF has been recommended via telephone line. The proposed study expressed the stability, accuracy, and the reliability of the DTMF technology. It also acquaint with the practice of the Arduino microcontroller. The theories and principles of these two lead us to the effectiveness of the switching model discussed in this paper.

The paper introduces a collaboration of DTMF and Arduino for remote switching system in home automation. The paper exists to be significant as per the modernization and improvement of the world.

5. ACKNOWLEDGEMENT

6. REFERENCES

Smart Home USA website. Available: http://www.smarthomeusa.com/smarthome/.

Michael Cahlin (2015) The High – Tech House website. Retrieved from http://thehightechhouse.weebly.com/.

Maureen Kaine – Krolak, and Mark E. Novak, "An Introduction to Infrared technology: Applications in the Home, Classroom, Workplace and Beyond".

Mary, R. (n.d.). Bluetooth Technology. Retrieved August 23, 2015, from http://www.engineersgarage.com/articles/bluetooth-technology

The Advantages and Disadvantages of Mobile Phone Technology retrieved (2015) from http://www.c-gps.org/the-advantages-and-disadvantages-of-mobile-phone-technology/.

The Free Dictionary by Farlex (2015) retrieved from http://www.thefreedictionary.com/radio+frequency.

Webopedia website (2015) retrieve from http://www.webopedia.com/TERM/I/Internet.html.

Enkivillage website (2015) retrieved from http://www.enkivillage.com/advantages-anddisadvantages-of internet.html.

Frank Durda IV. (2015) Dual Tone Multi-Frequency (Touch-Tone) Reference. [Online]. Available: http://nemesis.lonestar.org/reference/telecom/signaling/dtmf.html.

Engineers Garage website. (2015) retrieved from http://www.engineersgarage.com/tutorials/dtmf-dual-tone-multiple-frequency.

Maureen Kaine-Krolak and Mark E. Novak. (2015) An Introduction to Infrared Technology: Applications in the Home, Classroom, Workplace, and Beyond [Online]. Available: http://trace.wisc.edu/docs/ir_intro/ir_intro.htm.

Link Labs website. (2015) retrieved from http://www.link-labs.com/applications-of-home-automation/.

Radio-Electronics.com website (2015) Retrieved from http://www.radioelectronics.com/info/rf-technology-design/.

Abdiweli Abdillahi Soufi, Abdirasoul Jabar Alzubaidi, "Remote Control System through Mobile and DTMF," International Journal of Computational Engineering Research, vol. 03, pp. 45-52, August 2013.

Yavuz Erol, Hasan H. Balik, Serkan Inal, Duygu Karabulu, "Safe and Secure PIC Based Remote Control Application for Intelligent Home," IJCSNS International Journal of Computer Science and Network Security, vol. 7, pp. 179-182, May 2007.