e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:04/Conference:01/December-2022 Impact Factor- 6.752 www.irjmets.com
1st National Conference on Applications of soft Computing Techniques in Engineering NCASCTE-2022
Organized by Department of Electrical & Electronics Engineering, ACE Engineering College, Hyderabad

DTMF BASED HOME AUTOMATION

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DOI: https://www.doi.org/10.56726/IRJMETS-NCASCTE202217

ABSTRACT

The aim of this project is to develop a home automation system that can be controlled remotely using mobile phone. The home automation is one of the most emerging trends in modernization of home appliance control.It becomes very difficult for the elderly or physically handicapped people to do so. The another advantage of this project is that, some time we forget to switch off the home appliances when we go out of station and by this DTMF based home automation system we can switch on or off from any part of the world.This system is designed by ARDUINO UNO but is based on digital logic using DTMF technology (Dual Tone multiple frequency) which receives the command from the phone to develop digital output. This digital signal is further processed to actuate switching mechanism through relay driver to turn on/off the loads/appliances. It can be used to switch appliances from anywhere, overcoming the limited range of other infrared and radio frequency type controls. This proposed system gives a new direction to the development of home automation.

Keywords: Home Automation, Arduino UNO, DTMF Decoder, Physically Handicapped, Home Appliances.

I. INTRODUCTION

In this project, we propose a unique System for Home automation utilizing Dual Tone Multi Frequency (DTMF) that is paired with a wireless module to provide seamless wireless control over many devices in a house. We can operate our system from any distant or remote area. It is a wireless system but instead of using a separate wireless module (transmitter and receiver) we are using the cell phones for this purpose. Cell-phone operated system is having a wide range (service provider range), less fear of interference as every call is having a unique frequency and moreover it has more control keys. The principle used for cell-phone controlled system is the decoding of DTMF tone.

The advantages of using this technology are many. One can control home appliances from anywhere in the world. It helps in reducing the wastage of electricity. The cost for this system is also less as compared to other technologies like GSM.

II. LITERATURE SURVEY

The Internet of Things (IoT) describes the network of physical objects—"things"—that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet.

We use many different types of communication in control applications to control home appliances, industrial appliances, and other type of automation. There are two types of communication that is we generally use - one is wired and other one is wireless. In wireless communication we transmits signal wirelessly, like using radio frequency (RF) and in wired communication in which we uses wires like copper wire. In this project "**DTMF Based Home Automation System**" we are going to control our home appliances wirelessly. Other important feature of this project is, that we are not going to use any microcontroller in it.

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In this section will categorize past systems and literatures according to their cost and further discusses the varieties and concepts of their systems. Discussions will include the analysis of how all these systems are implemented.

A.Low Cost:

Systems The latest related journal was produced by [1] which used the open source microcontroller, the Arduino Bluetooth (BT) platform comprising of ATmega 168 and Bluegiga'WT II' Bluetooth module, paired with smartphone application built using Python running on Symbian OS. The journal highlighted its low cost installation but did not offer customization for the user in adding appliances and devices. Its limitation to operate on only Symbian phones has limited the operability of the system. However, [1] provided a useful concept in connecting the appliances to a control board controlled by the ATmega microcontroller that uses relay in controlling power supply to the appliances; the concept can be adapted into the current project. Another study done by[2] achieved a very complete and moneywise concept by using GPRS as the medium to control and monitor home appliances. They summarized that at low polling rates at 30 seconds, monthly cost of using their system reaches only US$ 5.10. This tactic however, requires the setup of 4 main systems including the central server, and 3 sub-systems at home, on the web, and on the mobile platform which is tedious. It utilizes Local Area Network (LAN) at home using RabbitCore modules and is capable of alerting, controlling and monitoring premises at the user's home. The special feature covered in this journal is its concept to map the appliances at home from the web which would provide a neat configuration of the household controllable appliances [2].

B. High Cost

Systems The concept studied by referee[3]can be seen implemented by referee [4], in 1995 where they had conducted a long term research on disability categories and developed the AUTONOMY system applying Environmental Control Systems (ECS) and Alternative and Augmentative Communication (AAC). The unavailability of wireless technologies then, limited the systems interconnection to European Installation Bus (EIB) standards and home installation of this system was tedious and complex. However, the remote control context had been developed to control Infrared (IR) electronics such as television (TV) and CD players, development of a mobile platform to run the UI, video door control, telephone and internet connectivity, and finally the emulation of keyboard and mouse for ease of control for disabled people. The implemented system was highly customizable in sense that the UI could be easily configured by the care-taker of the disabled person to suit each disabled person's capability to control. Utilizing smart home concept in helping the disabled and elderly people, [5] created a modular system which was easier to install in conventional houses. Their primary concern was towards the convergence of disability due to accidents and aging effects. As these individuals were not subjected to limitations by birth, their condition required different outlines where the B-live system was made modular so that the system could be implemented to suit different cases. Every module would provide control of different categories of devices. The system designed was complex as its modules can be integrated with several local (SPI, I2C, etc.) and remote (CAN, Zigbee, etc.) communication technologies simultaneously.

C. Research and Analytic Systems

Referee [3] on the other hand, studied on the knowledge of smart home technologies for disabled people and the factors involved in providing better systems and services for the smart home concept of these cases. The research pointed out the increasing numbers of disabled people around the world based on statistics due to increasing population growth, and that improving the lifestyle for this category is crucial in sustaining their independence and comfort. Referee [6] also conducted research in relation to interest as described in [3] by applying Semantic Matching Framework (SMF) to provide personalization of smart home services based on the semantics matching of user's model (capabilities) and linking to environmental model (preference). SMF here is used to identify suitable configurations and relevant smart home adaptations to be implemented into different individual cases. Several journals such as [7], [8] provided a different approach to home automation for the elderly and disabled. Instead, they developed systems to monitor movements and habits of these groups and

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through records, depict their habits and recording these information in their activity profiles. The concept applies large amounts of sensor built on to the Human Machine Interaction (HMI) and surrounding.

D. Analysis of Literature

In terms of concept, it was found that the original project proposal resembled the idea of referee [1] in the sense of the appliances connection to the main control board and also the use of relays to control two state switches. Difference can be found in the application's specification of this project to use PIC16F877A instead of the AVR Atmega 168 microcontroller used by [1]. Also, referee [1] only provided UI for Symbian OS phones where other OS users could not use the system. As proposed in this project, there will be two main UI, namely on Windows 7 OS and Android OS to offer a larger platform variant. From referee [4], the idea to control IR electronics such as television and radio could be used. However, due to time limitations, the implementation of this idea could only be jotted down for future improvements. However, unlike journal [4], this project will only rely on simple design and will not include emulation of user input devices to suit each disabled person's disability. However, the customizability of the system could be studied. This project will also not be a research or analytic based system to monitor human behavior. It will only provide ease of access to control house appliances and also monitor certain areas of the house. In terms of connection variant, this project proposed mixture of wired and wireless connection, where wired connection will run from the home appliances to the main control board while wireless connection will only exist in between the main control board and the UI platform, which is the phone or PC connected via Bluetooth.

III. COMPONENTS USED

- MT8870 DTMF Decoder
- ULN2003
- Relay 5 volt
- Bulb with holder or LED
- Connecting wires
- Breadboard
- Aux Wire
- 9 volt battery
- PVT or Terminal Block
- 100K Resistor
- 330K resistor
- Mobile phone
- LEDs
- 1K resistor
- Raspberri pi

ARDUINO UNO:

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Figure 1: ARDUINO UNO

Arduino is an open source electronics prototyping platform that is flexible, easy-to-use hardware and software. It is designed for artists, designers, hobbyists and anyone interested in creating interactive objects or environments. Arduino Uno is basically based on ATmega328 microcontroller (MCU). It consists of 14 digital input/output pins, six analogue inputs, a USB connection used for programming the onboard MCU, a power jack, an ICSP header and a reset button. It is operated with the help of a 16MHz crystal oscillator and contains everything needed to support the MCU. It is very easy to use as we simply need to connect it to a computer using a USB cable, or power it with an AC-to-DC adaptor or battery to get started. The MCU onboard is programmed in Arduino programming language using Arduino IDE.

Table 1: Specifications of Arduino Board

Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 Ma
DC Current for 3.3V Pin	50mA
Flash Memory	32 KB of which 0.5KB
SRAM	2 KB
EEPROM	1 KB
Clock Speed	16 MHz
Length	68.6 mm
Weight	25g

DTMF Decoder:

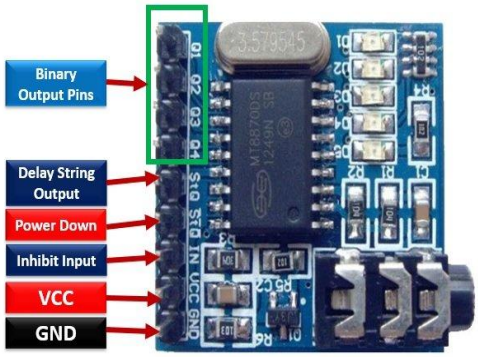

Figure 2: DTMF Decoder

The DTMF Decoder (MT8870) is a device which is used to decode the DTMF tones generated by the dialer keys of a cell-phone. It integrates both the band split filter and digital decoder functions. The decoder utilizes the digital counting techniques to detect and decode all 16 DTMF tone-pairs into a 4-bit binary code. For e.g. - if a user dials '1' in his keypad the output generated by the decoder is 0001 and so on. The output of the DTMF decoder can be used to drive home appliances.

DTMF tones are sometimes used in caller ID systems to transfer the caller ID information, but in the United States only Bell 202 modulated FSK signaling is used to transfer the data.

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Ac register signaling is used in DTMF telephones, here tones rather than make/break pulse are used for dialing, and each dialed digit is uniquely represented Fig. 3: DTMF Decoder161 20 by a pair of sine waves tones. These tones (one from low group for row and another from high group from column) are sent to the exchange when a digit is dialed by pushing the key, these tone lies within the speech band of 300 to 3400 Hz, and are chosen so as to minimize the possibility of any valid frequency pair existing in normal speech simultaneously. Actually, this administrator is made possible by forming pairs with one tone from the higher group and the other from the lower of frequencies.

A valid DTMF signal is the sum of two tones, one from a lower group (697-940 Hz) and the other from a higher group (1209-1663 Hz). Each group contains four individual tones. This scheme allows 10 unique combinations. Ten of these code represent digits 1 through 9 and 0. Tones in DTMF dialing are so chose that none of the tones is harmonic of are other tone. Therefore, there is no change of distortion caused by harmonics. Each tone is sent as along as the key remains pressed. The DTMF signal contains only one component from each of the high and low group. This significantly simplifies decoding because the composite DTMF signal may be separated with band pass filters into single frequency components, each of which may be handled individually.

The underlying principle mainly relies up on the ability of DTMF (Double Tune Multi Frequency) ICs to generate DTMF corresponding to a number or code in the number pad and to detect the same number or code from its corresponding DTMF. In detail, a DTMF generator generates two frequencies corresponding to a number or code in the number pad which will be transmitted through the communication networks, constituting the transmitter section which is simply equivalent to a mobile set. In the receiver part, the DTMF detector IC, for example IC MT 8870 detects the number or Fig 3.3.1 Code represented by DTMF back, through the inspection of the two transmitted frequencies.

MT8870 IC: There is an inbuilt Op amp present inside the M-8870 decoder IC. The electrical signals from microphone pin are fed to inverting input of the Op Amp via a series of resistance (100kΩ) and capacitance (0.1 µF).

- The non-inverting input of Op-amp is connected to a reference voltage (pin4 -VREF). The voltage at VREF pin is Vcc/2
- Pin 3 (GS) is the output of internal Op Amp, the feedback signal is given by connecting the output pin (pin3- GS) to inverting input pin (pin2- IN-) through a resistor (270kΩ).
- The output of Op Amp is passed through a pre filter, low group and high group filters (filter networks). These filters contain switched capacitors to divide DTMF tones into low and high group signals (High group filters bypass the high frequencies whereas low group filter pass low frequencies).
- Next processing sections inside the IC are frequency detector and code detector circuits. Filtered frequency passed through these detectors.
- At last the four digit binary code is latched at the output of M-8870 DTMF decoder IC.
- The entire process from frequency detection to latching of the data, is controlled by steering control circuit consisting of St/GT, Est pins, resistor (390kΩ) and a capacitor (0.1µF).
- 5th Pin, INH is an active high pin, inhibits detection of A, B, C, D tones of character.
- 6th Pin, PWDN is an (active high), inhibits the working of oscillator thus stops the working of our circuit.
- The 10th pin 10; TOE is the output enable pin which is active high logic and enables the latching of the data on the data pins Q0, Q1, Q2, and Q3
- 15th Pin STD is the Data valid pin, turn out to be high on detection of valid DTMF tone or else it remains low.

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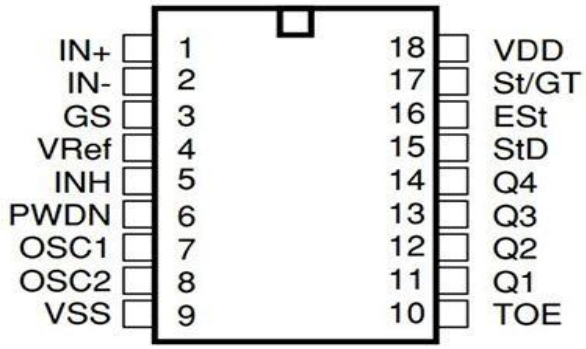

Figure 3: Pin Diagram of MT8870 IC 23

Features

- Complete DTMF Receiver
- Low power consumption
- Internal gain setting amplifier
- Adjustable guard time
- Central office quality
- Power-down mode
- Inhibit mode
- Backward compatible with MT8870C/MT8870C-1

Applications

- Receiver system for British Telecom (BT) or CEPT Spec (MT8870D-1)
- Paging systems
- Repeater systems/mobile radio
- Credit card systems
- Remote control
- Personal computers
- Telephone answering machine

A miniature 3.579545 MHz quartz crystal enclosed in a hermetically sealed HC-49/US package, used as the resonator in a crystal oscillator. Pins 7 (OS1) and 8 (OS2) are used to connect crystal oscillator.

A crystal oscillator is an electronic circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a very precise frequency. This frequency is commonly used to keep track of time (as in quartz wristwatches), to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies for radio transmitters/receivers.

RELAYS:

In order to enable a circuit to be isolated from the system only under faulty conditions, protective relays are used. In normal cases, it is open circuit relay. The relay is usually provided with 4 terminals, two of which are connected to relay winding and other two are connected to the circuit to be controlled. It has following characteristics:

- Sensitivity
- Speed
- Selectivity

IV. EXISTING SYSTEM

Research work designed a home automation system using Dual Tone Multi Frequency (DTMF). The design uses the Dual Tone Multi Frequency (DTMF) technique used in touch tone telephones, to control multi electronic

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devices from long distances using the mobile phones. The system made use of the DTMF technology to operate several electronic gadgets over a long distance using a cell phone. The system allowed the user to control and monitor the current state of home appliances using a cell phone. This was accomplished by sending a signal from a cell phone (control phone) to another cell phone in the house (home-based phone). The cell phone was connected to an interface circuit that detects DTMF signals and to grants access to the control unit that controls and monitors the home appliances.

Drawbacks:

- Security issues may arise since any unauthorized person can access the devices at home.
- Short working range by using Bluetooth.

V. PROPOSED SYSTEM

When the DTMF controlled home appliances circuit is powered, then the controller continuously checks the inputs. When 1 is pressed from the DTMF or mobile keypad, the decoder IC decodes the tone and generates 1, which is given to the Arduino or Raspberry Pi, which in turn generates high output at the pin and this is connected to a relay. Here, the relay is used to switching the circuit and thus light is turned on. If the received output is 2, then the light will be switched off. In the same way, if the received input is 3, then the fan will be switched ON and if it is 4, the fan will be off.

To overcome the problems of the existing system we are using Raspberry Pi. Compare to Arduino, Raspberry Pi has more number of pins. By this we get accurate outputs with in less time.

Architecture Diagram:

Architecture is nothing but an abstract description of entities in a system. It defines the relations between them and involves a series of decision-making processes. The architecture is a vision and a structure. A system architecture diagram is the distribution of the functional correspondences. These are formal elements, the embodiment of concepts and information. Architecture defines the relations between elements, amongst features, and the surrounding elements. Creating an Architecture diagram is not easy. The examples aim to make things easy for people to understand.

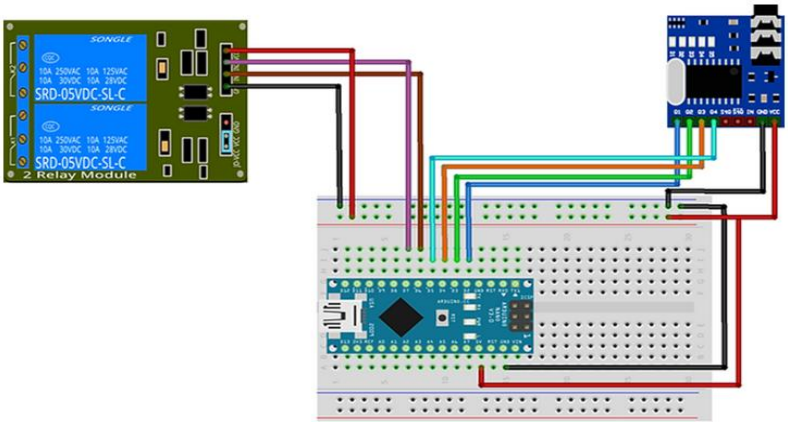

Figure 4: Architecture Diagram of DTMF Based Home Automation

VI. CONCLUSION

The smart home system was created to allow user's control over home appliances from a remote distance. One of the controllable platforms is the Android device that controls home appliances by connecting to the main server. The main server, which can also control home appliances, is also programmed to perform commands received Using DTMF based application for user using any mobile to control appliances without any interface. It fixed the problem of having cell phone to be fixed in the circuit which makes the system bulk by making use of the GSM Module instead, thereby making the system as small as possible. It also solved the distance problem involved in all other home automation systems, that is one does not need to be home(manual) or close to the

home (Bluetooth) before one can control the devices. By accomplishing the objectives, the problem statement to replace control of home appliances via conventional switches have been solved.

ACKNOWLEDGEMENTS

We would like to thank our guide Mrs. P. KAMAKSHI THAI and our project coordinator Dr. K. PREM KUMAR for their continuous support and guidance. Also, we are extremely grateful to Dr. M.V.VIJAYA SARADHI, Head of the Department of Computer Science and Engineering, Ace Engineering College for his support and invaluable time.

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