Mobile Phone Based Device Control using PSoC

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Abstract— It often happens that we may forgot to turn off the light or the electric devices while leaving home for a journey. This will results in the wastage of energy and the device may get damaged due to overheating. Even if we remember that we have not switched of the devices, it may result for us to come back and switch them off. Also if we are away from our home we have to on the light at night these are normally not possible in the present condition. In this paper we will give a novel solution for this problem by using a mobile phones, a common electronic gadget. This device is built around PSoC, a powerful system on chip. This uses DTMF (Dual Tune Multi Frequency) from mobile phone keypad to attain its functionality. For decoding the DTMF tones we are using MT8870, CMOS integrated DTMF receiver. For eliminating any unauthorized entry into the system we are providing a password checking facility.

Keywords— Programmable System on Chip, Embedded System, circuit Description, Pin Description

I. INTRODUCTION

It would be very interesting if we can control the home appliances such as fan and bulbs by a mobile phone at a far distance from home. This project utilizes DTMF coding technology for controlling the devices connected to the PSoC. It is operated by a mobile phone which generates the DTMF code corresponding control actions and it is transmitted through the network. These DTMF codes are received by another mobile phone at the receiver end and is decoded and processed by PSoC based DTMF decoder and control system. This output is used to control the functioning of the devices.

The circuit of our proposed project has two parts:
(i) The hardware part
(ii) The software part

The hardware part comprises of Programmable System on Chip CY8C42, DTMF decoder MT8870, ULN2003 and a few discrete component. PSoC4 is the heart of the circuit. PSoC4 is scalable and reconfigurable platform architecture for a family of mixed-signal programmable embedded system controllers with an arm cortex-m0 CPU.

It is a lowpower, high performance, 32bit microcontroller, 48MHz ARM Cortex-M0 CPU with single cycle multiply up to 32 KB of flash with read accelerator up to 4KB of SRAM.

A. Components Required

Hardware Components: Hardware components comprises of the following:-
- Microcontroller [AT89C51]
- DTMF receiver [MT8870]
- Relay [ULN2003]
- Power supply
- LED
- Resistors
- Capacitors
- Diodes
- Switch
- Crystal Oscillator
- Buzzer
- Cell phone with headset

Software Components: Software components comprises of the following:-
- PSoC programming software
- Assembly language

B. Introduction To Embedded Systems

1) Definition: Embedded System Any sort of device which includes a programmable computer, but itself is not intended to be a general-purpose computer.

2) What is an Embedded System An embedded system is a microcontroller / digital signal microprocessor based system that is designed to be flexible and built to control or monitor the functions of equipment, machinery, plant and many devices in common use today.
II. METHODOLOGY

A. Block Diagram

The telephone systems and mobile phones have switches in the form of matrix. Different frequencies are assigned to every rows and columns having a frequency range between 500 to 2000Hz. The selection of each switch selects the corresponding row and column line on which it is placed. So by pressing of a switch selects corresponding rows and columns and it is connected to a DTMF decoder. The DTMF decoder multiple the frequency of which its column and it gives the dual tune multiple frequency output. We can produce the DTMF output of 0-9 numbers and other function keys on the keyboard by selecting the corresponding switches. Our system uses a mobile phone as its remote controller. In the receiver section we use another mobile phone and a head phone is connected with this mobile which is an auto answering mode.

The call from the transmitter mobile is answered automatically and the electrical signals of sound which is reproduced by the receiver mobile phone can get from the input of loud speaker from ear phone. At the time of call between two ear phones, if we switches any switches on the keyboard produces the corresponding sound signal of the DTMF attached to the key. So the electrical waveform of the digits can get at the input of loud speaker by pressing the corresponding switch at the transmitter end. The input signal at the loud speaker is directly fed to a DTMF decoder and it gives the binary combination of the number for the corresponding DTMF fed into it.

These digital input or binary combination of each number is connected to the programmable system on chip and it can read the data. By these binary data given, PSoC controls the function of the connected devices through relays and its interfacing circuits. A password is also attached to its system for avoiding the improper usage.

B. Detailed Description

PSoC 4 (Programmable System on-Chip)

PSoC 4 is used as the CPU of the system. PSoC 4 is a scalable and reconfigurable platform architecture for a family of mixed signal programmable embedded system controllers with an arm cortex-m0 CPU. PSoC 4 is used to control all the functions of other blocks explained here. The decoded signal from the DTMF decoder is given to the PSoC4. Then the PSoC4 operates the relay connected to it. PSoC cannot operate a relay directly. It operates the relay through the interfacing circuits.

Mobile Phone

In this project mobile phone performs an important role for the transmission and reception of the signals. Here we have two mobile phones one is at the transmitter end and another is at the receiver side. The mobile phone in the transmitter section is at the automatic answering mode. The call from the transmitter mobile phone is directly connected to the receiver side, so there is automatically created a communication path between these two phones. HEADSET Headsets are generally used for converting electrical signal to sound. But in this case the headset is used to take electrical signal from the mobile phone and then this signal is given to a DTMF Decoder. DTMF DECODER (MT 8870) Dual-tone multi-frequency (DTMF) signaling is used for telecommunication signaling over analog telephone lines in the voice-frequency band between telephone handsets and other communication devices and the switching center. Here devices are controlled by the DTMF signals from the mobile phone in the transmitter section. Another mobile phone is used with the receiver end to receive the signal from the controlling mobile phone. We assigned a secret code with the system to avoid the unauthorized access.
DTMF keypad frequencies

<table>
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<tr>
<th>Frequency (Hz)</th>
<th>1209</th>
<th>1336</th>
<th>1477</th>
<th>1663</th>
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</thead>
<tbody>
<tr>
<td>697 Hz</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>A</td>
</tr>
<tr>
<td>770 Hz</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>B</td>
</tr>
<tr>
<td>852 Hz</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>C</td>
</tr>
<tr>
<td>941 Hz</td>
<td>#</td>
<td>0</td>
<td></td>
<td>D</td>
</tr>
</tbody>
</table>

Pin diagram of DTMF Decode

In this system M-8870 DTMF decoder IC decodes tone generated by the keypad of cell phone. The decoder distinguishes the DTMF tones and produces the binary sequence equivalent to key pressed in a DTMF (Dual Tone Multi Frequency) keypad. The signals from the ear phone are processed by the DTMF decoder IC which generates an equivalent binary sequence as a parallel output like Q1, Q2, Q3, and Q4.

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 noninverting 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.

Relay Interfacing

Relay interfacing circuit is required because the current output from the Programmable System on Chip is very small that it is not sufficient to magnetize the relay. So it is necessary to have an amplifying circuit. The output of the PSoC is fed to the relay interfacing circuit for current boosting. The output of this magnetizes the relay. This current amplifier works on the principle of Darlington emitter follower configuration. Here we use the ULN 2003 IC as the switching circuit of relay.

Relay Driver

A Relay driver IC is an electro-magnetic switch that will be used whenever we want to use a low voltage circuit to switch a light bulb ON and OFF which is connected to 220V mains supply.

The relay driver uln2003 ic is a high voltage and current Darlington array IC, it comprises of 7-open collector Darlington pairs with common emitters. A pair of Darlington is an arrangement of two bipolar transistors. This IC belongs to the family of ULN200x ICs and various types of this family interface to various logic families. This ULN2003 IC is for 5V TTL and CMOS logic devices. These ICs are used as relay drivers as well as to drive a wide range of loads, line drivers, display drivers etc. This IC is also normally used while driving Stepper Motors. The pairs of Darlington in ULN2003 is esteemed at 500mA and can withstand peak current of 600mA. In the pin layout, the inputs and outputs are provided reverse to each other. Each driver also has a suppression diode to dissipate voltage spikes while driving inductive loads.

Electrical Relays

A relay is an electrical switch that opens and closes under the control of another electrical circuit. In the original form, the switch is operated by an electromagnet to open or close one or many sets of contacts. It was invented by Joseph Henry in 1835. Because a relay is able to control an output circuit of higher power than the input circuit, it can be considered to be, in a broad sense, a form of an electrical amplifier.

A simple electromagnetic relay is an adaptation of an electromagnet. It consists of a coil of wire surrounding a soft iron core, an iron yoke, which provides a low reluctance path for magnetic flux, a movable iron armature, and a set, or sets, of contacts. The armature is hinged to the yoke and mechanically linked to a moving contact or contacts.
It is held in place by a spring so that when the relay is de-energized there is an air gap in the magnetic circuit. In this condition, one of the two sets of contacts in the relay pictured is closed, and the other set is open. Other relays may have more or fewer sets of contacts depending on their function.

When an electric current is passed through the coil, the resulting magnetic field attracts the armature and the consequent movement of the movable contact or contacts either makes or breaks a connection with a fixed contact. If the set of contacts was closed when the relay was deenergized, then the movement opens the contacts and breaks the connection, and vice versa if the contacts were open. When the current to the coil is switched off, the armature is returned by a force, approximately half as strong as the magnetic force, to its relaxed position. Usually this force is provided by a spring, but gravity is also used commonly in industrial motor starters. Most relays are manufactured to operate quickly. In a low voltage application, this is to reduce noise.

C. Software Section

PSoC creator provides a unique and powerful PSoC hardware/software co-design environment. Unlike fixed function microcontrollers, PSoC allows you to choose the on-chip peripherals which are need. Instead of setting for a part that has most of what we need and a lot what we don’t, with PSoC we simply configure the device with our chosen functionality.

Top design

III. FUTURE SCOPE

The VIR (Voice Interactive Response) algorithm implementation using PSoC.

IV. CONCLUSION

Remote controlling of devices with very long distance is possible with this project. DTMF based communication which are very much reliable are used in this project. This is applicable for both home and industrial purpose. In our project we can control four numbers of devices by advanced circuits and program in future. Mobile phone is an essential part of all the people and we can use it as a remote controller of devices in this project.

REFERENCES