Design and Implementation of Appliance Controller using Traditional or Smart Phone

Hussein Abdul Razzaq Lafta
University of Baghdad
College of Engineering
Computer Engineering Department

ABSTRACT
Mobile phones are widely used nowadays, for different application such as wireless control and monitoring due to its availability and ease of use. The implemented system is based on “global system mobile (GSM)” network by using “short message service (SMS)”. The design mainly contains a GSM modem and interfacing unit circuit with microcontrollers.

This system could control up to eight different electrical devices such as light, Air conditioner, washing machine and many more applications which needed in daily life in different area (House, Office, or factory, etc.). The control is done by sending a specific SMS messages from traditional or smart phone. The controlling devices are restricted to a pre-defined phone number and are set in the software of the receiver. Also feedback status of eight devices can be requested in designed system.

The designed receiver recovers syntax errors, like additional spaces, special symbols, and repeated letters.

Keywords
SMS, GSM modem, PIC Microcontroller, appliance controller, smart phone.

1. INTRODUCTION
Mobile phones are widely used nowadays, for different applications such as wireless control and monitoring, because of its availability and easy to use.

There are many definitions of GSM based appliance controlling available in the literature. Fadhil T. Aula, (2005) [1], presented a system of the PC remote Controlling with the Mobile Telephone through accessing the main PC ports; serial and parallel. Serial port for transferring data from Mobile phone to PC and parallel port for interfacing PC with real time controlling hardware. The system was implemented by using the SMS. Mohd Helmy Abd Wahab, et. al., (2010) [2], presented a GSM Based Electrical Control System for Smart Home Application. In this paper, a GSM module was used for receiving SMS from user’s mobile phone that automatically enabled the controller to take any further action. The system was integrated with microcontroller and GSM network interface. It reads message from the mobile phone and responds to control the devices according to the received message. Amit Chauhan, et. al., (2011) [3], proposed approach for designing remote control based on GSM mobile technology, and using SMS message that is generated by mobile user. It is implemented based on microcontroller that receives SMS and commands from a cellular phone over the GSM network. The microcontroller then carry outs the issued commands and then communicate the status of a given appliance or device back to the cellular phone. And C. K. Das, et. al., [4], proposed a method which enables users to control their home appliances and systems from anywhere using a cell phone. To access the control unit, the user should send an authentication code (DTMF) along with the required/desired function/action to his/her home control system via Global System for Mobile communication (GSM).

All surveyed researches do not work on smart phone applications, so, a system controlled by smart phone and also by a traditional phone will be a promising idea and remotely give on-off status function for all devices. The system is designed for controlling eight electrical devices by using SMS; any device switching was achieved by relays as shown in Figure 1. The paper organization is as follows, section two contains the design and implementation of the system. The results were shown in section three, finally the discussion and conclusions could be found in section four.

2. DESIGN AND IMPLEMENTATION
2.1 The Transmitter
A system is designed to transmit a text SMS message to control the appliances to make ON or OFF state for a in a certain places. Furthermore, the system could reads or checks the status of the eight electrical devices which are under the system control. This text message could be transmitted by one of two schemes:

- Using traditional phone

In this scheme an SMS message is sent from traditional or smart phone to the GSM modem using one of the following

Case A- 1ON 2OFF 3OFF 4ON 5ON 6OFF 7ON 8OFF
Case B- 3OFF
Case C- ALL ON

Fig 1: Block diagram of the appliance controller system
Case D: ALL OFF
Case E: Status

Notice that cases (A, B, C, and D) are used to appliance’s control according to the information that is embedded in transmitted SMS message, while In case E, the system could checks the status of the eight appliances by sending a status SMS message and receiving a status feedback message which contains the state of the all eight appliances.

- Using smart phone

Since the wide spread the smart phones and its applications, also for making SMS messages easier and faster we had developed Android-based smart phone application, to do all cases (A, B, C, D, and E) that explained in traditional phone.

The screenshot captured in Android-based smart phone device for the appliance controller application is shown in Figure 2. The application alters the ON-OFF status of Android switches according to the received feedback SMS message. The flowchart of the sending SMS message is shown in Figure 3a while flowchart of the sending status SMS message and receive feedback SMS message is shown in Figure 3b.

GUARD TIME: The time required for the status request and feedback SMS messages (the worst case)
Condition: Is correct phone NO. and (the difference between time of the status SMS message and time of last received SMS message is less than GUARD TIME), To ensure that the application is not used an old message in case of non-arrival of the feedback SMS message.
2.2 The Receiver Circuit

The hardware of the receiver contains the two (PIC16F887) microcontrollers [5], GSM modem, and Interfacing unit circuit. The schematic circuit of the receiver is shown in Figure 4. The Vero board receiver circuit is shown in Figure 5 and the GSM modem (SIM300) [11] is shown in Figure 6.

- Microcontrollers

The first microcontroller is used to receive and read the SMS message from the GSM modem and interpret it, then interpreted message is used to control appliances (switch ON or OFF the eight devices), this microcontroller activates the relays which are connected to corresponding device through relay driver circuit. The Man/Auto function is commonly used in industry for controlling the driver through three tap selector switch (ON, OFF, or Auto position), it is essential for maintenance purposes, as shown in dotted black box (driver and relay NO.1) in Figure 4.

The second microcontroller is used to construct a new message according to the status of eight appliances and send it to the user mobile that sent the request. The flowchart of the receiver software is shown in Figure 7.

- GSM Modem

Modem encodes and decodes signals sent to and from the network servers. Modems are frequently associated with telephone systems, but wireless modems are used with computers and also with communication mediums. Wireless modem interfaces include PCMCIA, Compact Flash, USB and Serial Port. A GSM modem is a network device which connects to a GSM network. A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone, it can be used for sending and receiving SMS [6] [7].

In this project the GSM modem is interfaced through a Serial Port with a microcontroller IC. AT commands are used to automatically receive the SMS messages from the preconfigured number and system also sends the feedback SMS message to preconfigured number to tell us about the status of appliances [8].

- Interfacing Unit Circuit

Interfacing unit includes a MAX232 dual driver/receiver that includes a capacitive voltage generator to supply EIA-232 voltage levels from a single 5-V supply and a RS232 which is the most known serial port used in transmitting the data in communication and interface [9]. This unit is used to interconnect the PIC with the GSM modem. Also a three state buffer (74365) [10] is used for managing data transfer between microcontrollers with (MAX232).
Fig 5: The Vero board receiver circuit

Fig 6: The GSM modem (SIM300)
Deleting old and saved SMS in sim card

Deleting the sms from GSM module

Editing the saved SMS
* remove special symbols
* translate capital to small
* remove repeated ‘f’
* remove spaces

Listening about new SMS

Is the message ‘on’ ‘off’ contained

Setting o/p according to the message

Is the SMS contains status?

Send the phone number & status of the o/p port that connected to the devices from microcontroller 1 to microcontroller 2

Disable the bus of MC1 UART & enable the bus of Mc2 UART

MC2 construct the new message according that received from Mc1 & send it to the user that sends request

Disable the bus of MC2 UART & enable the bus of Mc1 UART

Initialization UART

Read the new sms from GSM and saving it in MC1

Deleting the sms from GSM module

Fig 7: Flowchart of the software
3. RESULTS
In the first case, it is selected to make all devices ON as shown in Figure 8.

In the second case, it is selected to make the devices (1, 2, 6, and 8) ON, and others are OFF. This message contains some syntax errors such as single ‘f’, convert the capital letters to small letters by adding the ASCII code of capital letters with 32, and remove all the spaces and special symbols '=', '(', ')', and any other letters 'hello' as shown in Figure 9.
In the third case, it is selected to check the status of eight devices by sending SMS status message and receive another SMS feedback message that tell the states of the eight devices as shown in Figure 10.

Figure 10a: The text message

Fig 9c: The prototype of a home appliance

Fig 10c: The prototype of a home appliance

Fig 10d: Screenshot of smart phone
4. CONCLUSIONS
- Flexible controlled message using smart or traditional phone.
- The ability to check the status of controlled eight devices.
- Recovery from message's syntax errors, like additional spaces, special symbols, and repeated letters.
- SMS services provide an economical and convenient way to control the electrical devices, and are sometimes provided for free.
- Controlling any appliance remotely, and provides saving in time and in energy.
- Reliable, low power consumption, available components, and even PC are not needed.

5. REFERENCES