Controlling Systeming GSM

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Abstract
In recent years people, tend to use smart devices and live in smart buildings to facilitate our day by day actions. Nevertheless, digital electronics components are becoming popular and advanced than the analog, and the world is becoming modernized digital world. Smart buildings use very advanced technology in order to control devices automatically. However, we are still facing problems while forgetting some devices turned on while we left the building which consumes energy a lot. Additionally, elder people are facing difficulties to move for switching off / on devices (AC, lighting, TV, and washing machine). Also, sometimes we wish if we can turn on the AC before arriving to the building especially with Saudi Arabia's weather. The suggested solution is to design a system that allows the GSM (Global System for Mobile Communication) to communicate with the mobile phone to send the orders from the user. After that, the GSM will interface with the microcontroller to control the devices and implement the action. The system can be used in anywhere of the world if the GSM network is available.

Keywords: *Wireless; laser; video; underwater*

1. Introduction

Smart building automation systems refer to the control of buildings' appliances and it is an integral part of smart grids. The concept of building automation has been around since the late of 1970s [1]. However, with the advancement of technology and services, people are expecting an up to date development of what a smart building should do or how the services should be provided. If we look at different building automation systems over time, they have always tried to provide efficient, convenient, and safe ways the users. Nowadays, smart buildings have varying types or levels of intelligence [2]. They fall into one of four classes. The first level is buildings that contain intelligent objects, and these objects are not communicating with anything. They are just there to function whatever they have to do. The next level is buildings that have intelligent communication with other devices. This means, the smart devices are connected and able to exchange information. The third class is connected buildings through one cloud. The fourth one is a big step in this field, which is the devices can now be controlled from inside and outside of the home [3].

According to Al-Ali, and Al-Rousan [4], a java based building automation system has been developed through World Wide Web (WWW). It is integrated to a Pc based server at a building. The system works good, though in order for the system to work it has to be connected to the PC. Moreover, the PC should be turned on and connected 24/7 to the server [4].

In view of Brush et al. [5] a home automation system has been created by utilizing X10 innovation. It utilized the existing home power to control light, machines, security system remotely. As per Tseng, Li, Pan, and Lin [6], the proposed keen building screen depends on the ZigBee. All sensors and actuators are associated by a ZigBee remote system. They composed a basic shrewd attachment, which can be remotely controlled through ZigBee. For instance, PC have is utilized as an information authority and movement sensor. All detecting information is exchanged to the cloud. Additionally, the client can utilize the PC or telephone to screen and control the power sparing of the working through the Internet. Besides, Arduino microcontroller is getting the client's directions to execute through an Ethernet shield. Moreover, the cell phone can be either wired to the focal controller through USB link or speaks with it remotely, inside the extent of the building. [6]. The systems have impediments in the region of vitality utilize confinements for confirmation. Also, they have restricted memory measure, preparing pace of information, and size of data transfer capacity as talked about [7].

The work of Sikandar, Khiyal, Khan, and Shehzadi [8], Proposes an SMS-based building security system called SMS-based wireless home appliance control system (HACS). According to Saeed, Sayed, Qazi, N.

Khan, A. Khan, and Babar [9], who also proposed SMS-based automation system, the system has a Java application running on the phone. Real clients can sign in to the application utilizing their username and secret phrase, and can choose the building/floor/room/gadget that they wish to remotely control. Moreover, they can choose an appropriate action from the list of available actions. The researcher uses a 4-digit passkey and facial recognition for security. [9]. In a study has been done by Baig, Beg, and Khan [10], a mixing of three types of technologies (Bluetooth, ZigBee, and GSM) was designed. They designed the application to communicate just with an android mobile [10].

Buildings automation systems using global system for mobile communication (GSM) is attractive to researchers because it has to be applied using mobile phones, which are very popular nowadays [11]. A modern building can be accessed by its inhabitants from the outside through Internet, GSM, wireless portable devices like mobile phones, tablets, laptops, and stationary devices like an office workstation (PC) [12-14].

In most of buildings, people accidently forget some electrical devices on, when they leave the building. This cause a huge energy loss, as it is not always feasible to be near the building in order to go back and switch the devices off. Moreover, in Saudi Arabia, , the weather is very hot, therefore, one of the citizens' wishes is to be able to turn on the air conditioner before arriving to the building. Thus in this work, The aim was to design and implement a system to control multiple devices of a building devices, such as air conditioning, lighting, TV, and washing machine by the mobile phone, through communicating the mobile phone with the GSM (Global System for Mobile Communication), along with controlling the building devices by the Microcontroller.

2. Prototype Description

2.1 The Proposed System

The system proposed is controlling the building devices (on\off) based on global system for mobile communication (GSM) technology. The system allows the communication between the mobile phone and the GSM through a pre-defined phone number. In another word, the mobile phone sends a short message service (SMS) with the command of control to the devices and the GSM is able to receive the SMS. Moreover, the GSM interfaces with the microcontroller to control the devices. The system is wireless; it is accessed through the SMS. Also, the system is accessible from all over the world.

2.2 Project Specification and Features

The GSM interfaces with the microcontroller to be transmits the SMS came from the mobile phone. The microcontroller energizes the relay to control the devices and implement the needed action through relays driver circuit (ULN).

The GSM (Global System for Mobile Communication) modem is used to facilitate the communication between a computer and GSM system. Moreover, it is an architecture have been used for mobile communication in the whole world. The GSM needs a SIM (Subscriber Identity Module) card to activate the communication with the network, just like the mobile phone. Furthermore, it is a device that supports any processor to communicate over the network. It can be connected to the processor via serial, Bluetooth connection, and USB.

Microcontroller PIC18F4550 was used in this work. The PIC18F4550 has a large RAM for buffering. Moreover, it has an enhanced flash program memory. Relay consists of an internal coil that creates a magnetic field which attracts a movable lever and then when the current flows though it the switch contacts will be changes. The main usage of the relay is to link 2 circuits or components together. After that, it switches automatically on / off the device. The relay repeats the coming signal, and retransmitted it to the second circuit. Relay is mostly interfaced with digital systems and the microcontroller. However, the microcontroller can't provide enough voltage to be able to energize the relay. For that reason, the relay driver circuit is used. Furthermore, the control signal which coming from the microcontroller to the relays passes through the driver. The ULN has been chosen as a method for the relay driver circuit because it can derive more than 7 relays at a time.

3. Design, Modeling and Analysis

The block diagram of the system is shown in Figure 1. The system comprises of GSM module, microcontroller, relay circuit using (ULN).
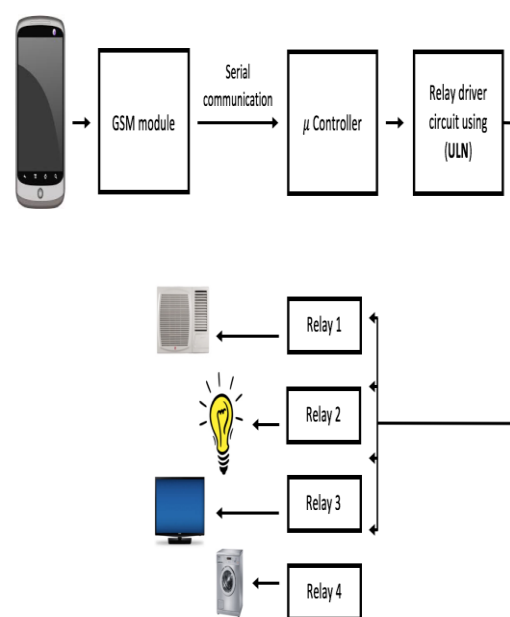

Figure 1: The Block Diagram of the System Overview

3.1 Communication of the Mobile Phone and the GSM Module

The owner of the building who wants to control the buildings using short message service (SMS), will do so from a preset registered mobile number. The SMS will be a command that is sent to the system to perform a specific control action on the devices. After that, the GSM receives the message through the SIM card inside it, and transmits it to the microcontroller.

3.2 Interface Between the GSM Module and Microcontroller

The GSM has RS-232, which is a Data Terminal Equipment (DTE) interface to facilitate exchanging the data with other serial devices. Furthermore, it has Universal Asynchronous Receiver / Transmitter (UART) microchip inside it. The UART microchip is programmed to control the interface to its attached serial devices. An external clock is not needed due to the UART microchip. The GSM module is shown in Figure 2.
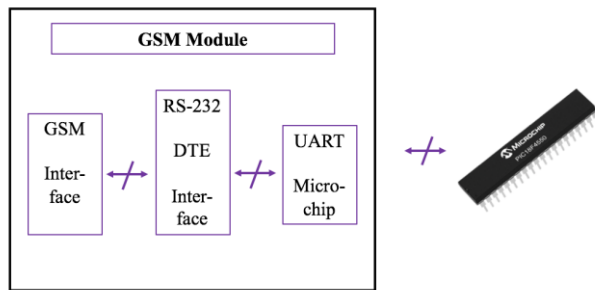

Figure 2: GSM Module Interface

The GSM module already has the SMS transmitted to it using the GSM interface inside it. After that, the data goes through the RS-232 following with the UART to be delivered to the microcontroller. The microcontroller also has UART microchip, which allows it to receive the message immediately. So, the microcontroller recognizes the number of the phone. If the SMS has not been sent from a legitimate mobile number, the system ignores the message. Otherwise, the microcontroller will decode the SMS to perform the needed action. The GSM module already has the SMS transmitted to it using the GSM interface inside it. After that, the data goes through the RS-232 following with the UART to be delivered to the microcontroller. The microcontroller also has UART microchip, which allows it to receive the message immediately. So, the microcontroller recognizes the number of the phone. If the SMS has not been sent from a legitimate mobile number, the system ignores the message. Otherwise, the microcontroller will decode the SMS to perform the needed action.

3.3 Controlling the Microcontroller to Buildings Services

The microcontroller needs the assistance of the relays in order to be able to control the devices of the building. The relays can be energized by the microcontroller to automatically switch on / off the devices. However, the relay needs a higher voltage level than the supplied from the microcontroller to be able to apply the control signal. So the electrical control signal which coming out from the microcontroller has to pass through a driver. That's why the relay driver circuit using ULN is connected between the microcontrollers and the relays. The ULN can drive up to 7 relays at a time. After this communication is done between the microcontroller and the building devices, the needed action should be successfully obtained by the devices due to the digital control signal that has been moved to them. The diode is connected between the relays and the ULN to protect the ULN from the back EMF (back voltage) that has been generated in the relays' inductive coil when it turns the devices off. The back EMF (back voltage) happens because the current in the relay is abruptly interrupted when the coil is disconnected from the supply. The voltage which has been induced before the switching off across the coil will be opposite in polarity since the direction of the field is changing in the opposite direction. The flow chart of the show system is shown in Figure 3. The connection circuit diagram is shown in Figure 4.
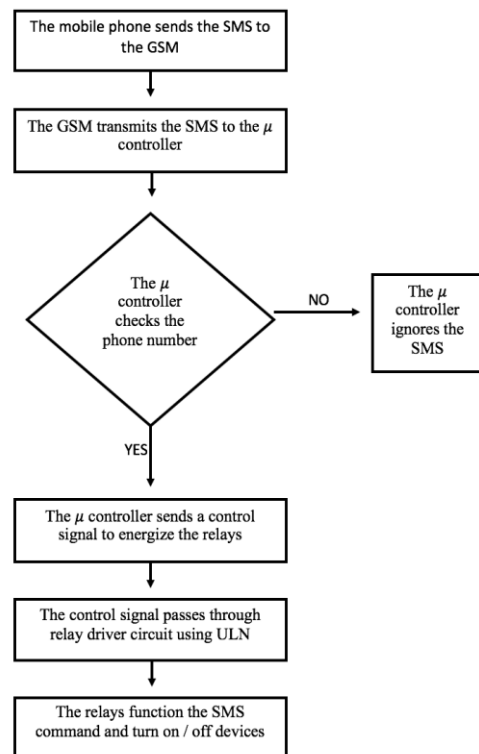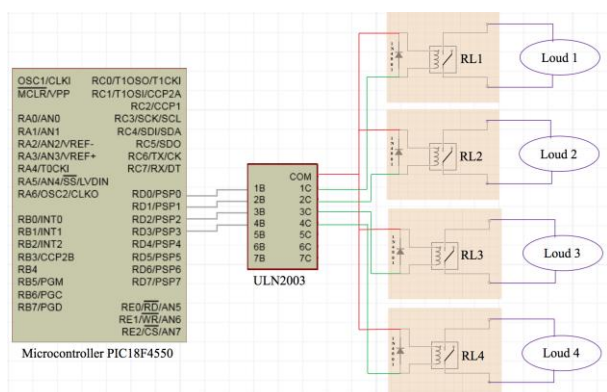

Figure 3: The Flow Chart of the System

Figure 4: Circuit Connection Between Microcontroller and Controller Devices

4. Result and Discussion

The module was designed in breadboard with all the components connected as per the circuit diagram in Figure4. The given voltage for the circuit is 5V along with current value of 2 Amp. The code was successfully uploaded on the PIC Microcontroller with the use of PicKit3. After that, the system was tested. The look up table of the system is shown in Table 1.

Table 1: Circuit Connection between Microcontroller and Controller Devices

Situation no	Message	Operation
1	A	Load 1 ON
2	B	Load 1 OFF
3	C	Load 2 ON
4	E	Load 2 OFF
5	F	Load 3 ON
6	G	Load 3 OFF
7	D	Load 4 ON
8	H	Load 4 OFF

The module was tested and it worked as desired. The microcontroller responded to the instructions sent by the mobile phone and the devices worked according to the need of the user. Figure 5 shows the status of the hardware when no message is sent. During this status, all LED are turned off. When message is being sent, the system will verify the sender's phone number. Then the system will function the needed task. So since the typed letter is "A" so LED 1 will be turned on as shown in Figure 6. When there is more than on, we can see more than one device are turned on, we have LED 2 and LED 3 turned on as shown in Figure 7. This project was a system to control the building smartly. The user of the system sends a message to the GSM modem located in the building which considered to be as an input of the system. The respective action performed by the microcontroller

by energizing the relays to switch on and off the LEDs is considered to be the output of the system. The combination of the software and hardware gave the final design. The project is dependent as it can work only with the microcontroller from PIC family.
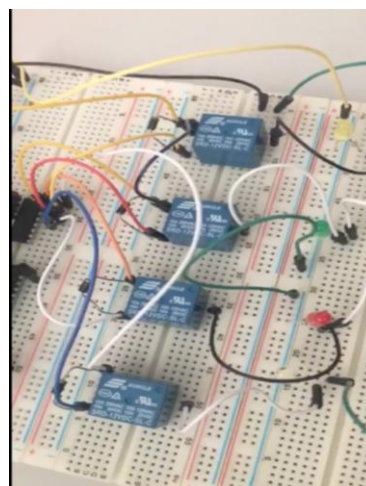

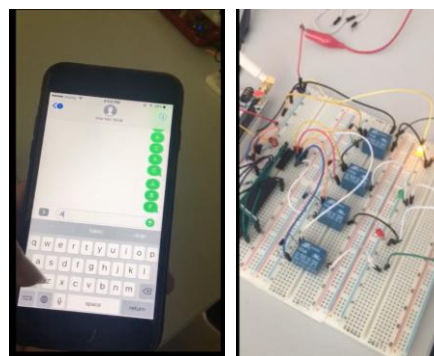
Figure 5: No Message is Sent, All LED are Turned Off
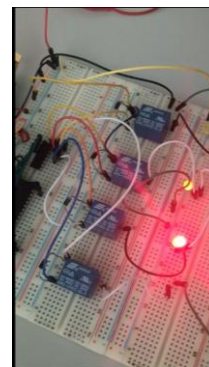

Figure 6: Testing output1

Figure 7: Testing output 2

5. Conclusion

The work was done as per the aim, as the designed system allowed the GSM to communicate with the mobile phone and to interface with the microcontroller for the

purpose of controlling the devices. The project scope was achieved as the mobile phone needed to communicate with the electrical devices in order to be able to control them, which happened successfully using the GSM and the microcontroller. The system can be developed further using different loads other than the LED which was used for testing purpose only. Moreover, the concept of the system can be used for home security or other home systems.

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