

Smart Electrical Appliances Controller using SMS

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Abstract—This article is about a simple low cost, small sized controller that helps people controlling their home appliances remotely even if they are outside their properties. The system lets them turn on or off any device while being outside home by sending messages using mobile phones. Moreover, a message could be sent to know more specific details like the temperature of the boiler, AC, etc. The main purpose of this system is to adapt with the private electricity subscription issue that almost all the Lebanese citizens are using to cope with the long electricity current cut off periods. However, the difference in payment rates between the normal current and that of the subscriber is always making a big concern over electricity consumption. Hence, the system will help users to minimize their payments for electricity usage by informing them if the current is on or off so they can control their appliances accordingly.

Keywords—Home automation; electrical appliances control; Arduino microcontroller.

I. INTRODUCTION

Technology is a model of progression, principles and patterns that people develop and work on over years. More importantly, this model is spread around the people from different nations by exchanging the ideas. Also, technology could be improved and upgraded when it's shared between different people and used at homes. So, nowadays it's very important to apply technology for home uses and purposes. One important part of any technology process is to make people comfortable and enhance their home devices flexibility. This is usually done by providing more methods and applying more technological systems at their homes. This new domain of research and engineering is called 'Home Automation' which means the use of developed technologies to control basic home functions and features automatically and remotely. Although this domain is well developed in different world sides to serve people to the maximum, some countries like Lebanon, still need some important automation functionalities that serve the special requirements of the citizens.

There's no doubt that electricity's availability is a big problem in Lebanon. Due to the long periods of electricity current cut-off, almost all the Lebanese citizens are using private subscription, which is a subscription controlled by a private provider in the neighborhood, who will be charging

the subscriber based on his consumption with a separated bill from that of the governmental electrical bill. However, the difference in payment rates between the normal current provided by the government and that of the subscription is always making a big concern over electricity consumption. Shall the heating be turned on during the normal current or during the subscription current? Do we need to watch out our electricity consuming during the subscription current? Is the subscription current enough for us to power on some electrical machines that needs more power than others such as microwave, ironing machine, water boiler, etc?

Many methods were already developed in order to cope with the issue of electricity long term cut-off. Nevertheless, all of them are manual and need the user to do the switching on/off of any machine by his hand.

The objective of our work presented in this paper is to design a system that will help users to know whether the normal/subscription current is available. Also, to automatically switch on/off the electrical machine that he wants to control by simply sending a message (SMS) to the controlling system. In addition, different other details could be requested from the system by texting the corresponding code to receive a reply message with for example the state, the temperature, the level of filling up, etc of the difference controllable electrical appliances at home. Since the water boiler is one of the most important equipment in this scope, we have chosen to implement the idea over it. Moreover, a temperature sensor will be added to provide the boiler's water temperature upon request.

This article continues with presenting some related work in Section II. The system design and user specifications are shown in Section III. Then, the implementation tools and details are briefed in Section IV, before concluding the article in Section V.

II. RELATED WORK

Home automation and control systems offer great benefits of convenience, cost and time savings. Depending on your budget and the needs of your home, an integrated whole-house automation system or a series of standalone systems may be the right choice. Regardless of which approach you choose, it is likely you will see immediate returns both economically and in terms of increased free time.

The most common method used in Lebanon for controlling home appliances is the standard switch control that is applied manually. In this chapter, we will illustrate the disadvantages of such systems in terms of cost and lack of benefits. Besides, we will discuss the disadvantages of systems such as home automation via wi-fi, Internet or Bluetooth and highly sophisticated systems in other countries systems.

A. Manual home appliances control

Up till now, in Lebanon most of the houses don't have a home automation system that is controlled from a distance via a remote control like mobiles and computers. Every home is equipped with the simplest method for controlling home appliances like the manual home appliances control which lacks mobility. This kind of system is applied in countries with low technological progress.

B. Home automation via Internet, bluetooth or wifi

Different communication means have been widely used in order to apply home automation concept. Bluetooth and Wifi communication are from the most well known technologies for such an objective [1,2]. For these two modes of communication, coverage area will always raise as a challenging issue. Bluetooth communications are usually meant to be used for indoor control, which means if you are out of home, your system will not be functioning or beneficial. Besides, the access range of Bluetooth does not exceed the 100 meters in the best case [3], not forgetting its affection by barriers such as walls or doors. Wifi came as a solution, but the range of it is still to limit it for indoor applications. Usage of the internet has been increasing a lot in the last few years and it became a need in every house and place. Hence, a good solution for outdoor home automation applications could be to use Internet or 3G communication networks [2,4,5]. However, the problem here is the low speed and the unreliable connection in some countries such as Lebanon which makes it hard to apply on such a system that is mainly based on the internet. Due to this, this kind of system is not preferable. Instead simpler systems that are not based on the internet are more beneficial.

C. High sophisticated systems

In high technological countries and organizations a developed home automation websites and applications are available in the market to subscribe and use in your house [6]. Such systems require high budget and its cost is so expensive. In spite of their high performance and reliability, these systems could be considered sometimes over qualified for small places. Due to this, it is not always preferable to use such an option.

III. USER SPECIFICATION AND SYSTEM DESIGN

We dedicate this section of our article to list the user requirements obtained by the smart electrical appliances controller. Then, we briefly explain the general architecture and the connectivity required by the system to run as illustrated in Fig 1.

Motivated by the challenges presented in the related work from the one hand and by the needs of the life style in some of the Third world Countries such as Lebanon, we came to the objective of our project which is to apply home automation to control electrical appliances remotely and even in case of being out-door the home. Since Bluetooth and Wifi coverage area are not appropriate to be used in outdoor applications, and since the internet connection is not always available with good quality in these countries, we have chosen to base our controlling system on SMS exchanging between the system and the user. Hence, user is only required to have a functional mobile line to be able to communicate with his smart system. On the other hand, and in order to cope with the issue of having two different electricity bills that are for the normal current and for the private subscription current, our system should be designed to tell the user automatically and in real time when each of the two currents is the available one so he can decide to turn on/off his appliances accordingly. Since the billing method for the private subscription is different from region to another, and hence it is sometimes cheaper or more expensive than the normal current, the system will notify the user by the type of current and give him the authority to decide what to do with his appliances based on his desire.

A. User requirements

Smart electricity appliances controller system is designed to cover the below requirements:

- Specify a phone number to receive the instructions message and dedicate the system to the entered number.
- The ability to receive informing message about the electricity's and machine's state.
- Control any appliance that is connected to our system by messages.
- Request the temperature degree (in case it is applied to the water boiler).
- Reset our system.
- Change the recipient number.

B. System general architecture

As illustrated in Fig 1, the system starts working by specifying a recipient number by using the keypad. This number will be saved to the system (the microcontroller) and a detailed message will be directly sent to the user informing him about the instructions in how to use our system. Here comes the importance of the keypad and the lcd which shows the user what he is typing. Also, as you can

see in the figure the component which is responsible for sending and receiving messages from or to the system by communicating with a smart phone is the GSM network represented by a shield dedicated for this type of connection. After receiving a control message from the user using one of the codes specified by the information message sent to him earlier, the system will directly interpret the code and send it to the relay if needed to perform what the user seeks by connecting it with an appliance. After that, system will read the appliance's state and send it again to the gsm and then to the number which performed the control actions (recipient number that was entered at the begging).

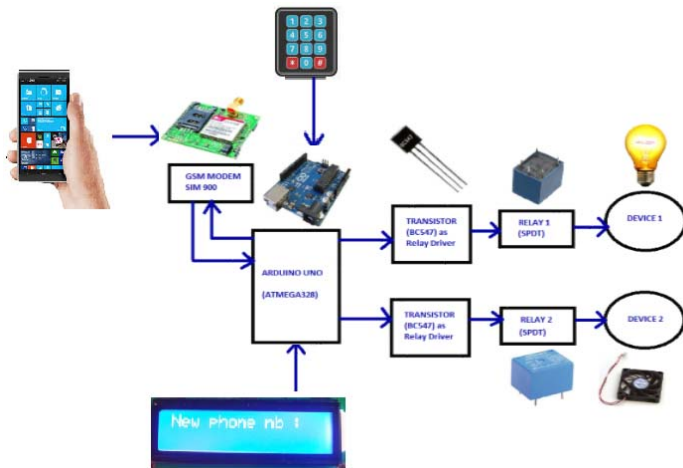


Fig 1- General Architecture of Smart Electrical Appliances controller

C. Use case Diagram

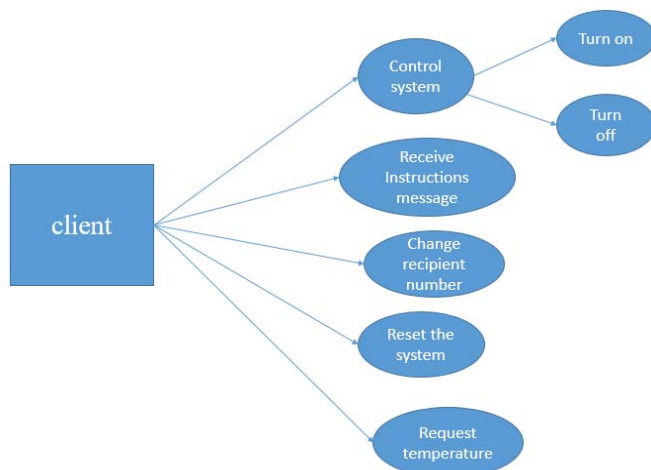


Fig 2- Use case diagram for the system

As you can see in Fig 2, these are the uses of our system. Our system provides the client with the options to do different actions such as controlling the connected appliances, request the temperature in case the system is connected to the boiler. Also, it provides the user with an informing message about how to use the system. Moreover,

it informs the user about the appliances state. Finally, you can change the recipient number with few clicks and reset the system in case of any lag.

IV. IMPLEMENTATION TOOLS AND DETAILS

This chapter will include all the elements behind implementing and testing our system.

A. Implementation Tools

The implementation of our project is done using multi hardware and software components. For the side of hardware: we used arduino mega, keypad 4x3 , LCD, gsm shield , temperature sensor and a relay.

- **Arduino MEGA:** The arduino mega is a chip based on the Atmega1280. It has about 54 digital input/output, a reset button, 16 analog ports, a crystal oscillator, a usb connection. The arduino mega can be programmed and it works as a small computer. Just connect it to a computer or laptop with a USB cable or power it with a AC-to-DC adapter or battery to get started.

- **SIM808 GSM/GPRS/GPS Module:** SIM808 module works as a GSM, GPRS and GPS three-in-one module. So, this gsm could be used to fulfill three roles which is gsm communications, the GPS which is responsible for navigations the spot, and the GPRS role. It depends on the latest SIM808 module from SIMCOM.

- **Temperature sensor (LM36):** By connecting the three wires from the lm36 which are divided as input to the voltage, input to the ground and an input to the analog pin specified on the code. The sensor starts to indicate the temperature degree by using the analog input and informing the arduino about the temperature degree which will be transformed later by using formulas on the code.

- **Relay 5V 4CH:** This tool is used to control electric current when using electronic machines. Also, it has a bug role on the usage of arduino applications which works as channel from the arduino to the connected home appliances.

- **Lcd crystal:** liquid crystal display is used to display the digital and analog inputs in the code or the ones responsible
Keypad 3*4: Keypad is a set of buttons that are responsible for the analog input to the arduino, 3*4 refers to the matrix which is consisted of 4 rows and 3 columns.

B. Implementation Summary and test case

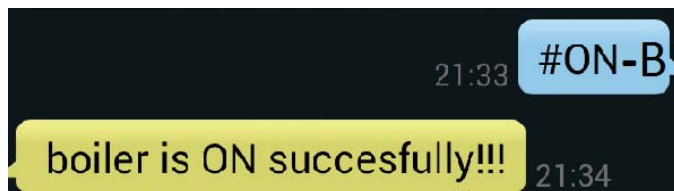
All the components have been connected to the Arduino chip and have been tested to make sure they are all working properly. After the test, the system could be deployed and used by first entering the mobile number that will receive the messages and communicate with the base station as shown in Fig 3. As we can notice from the figure, the main objective of using the LCD screen and the keyboard which is to facilitate the editing of this number since we may need

to send the electrical current corresponding message to a different number each time.

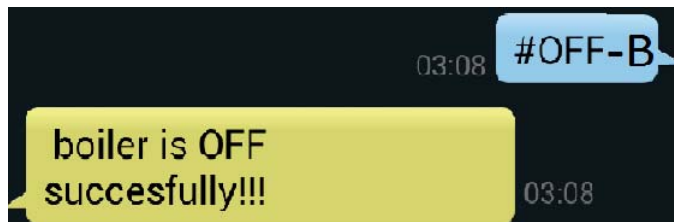


Fig 3- youLCD and Keyboard for insert/edit the user phone number

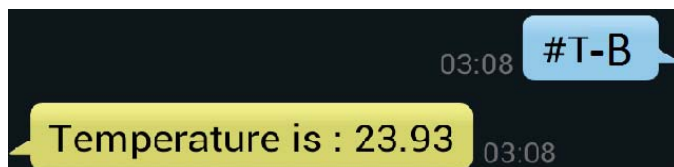
Fig 4 shows an example of the received messages according to the sent control code. Since the water Boiler is an appliance that consumes a lot of electricity power, we can see how it has its own control messages (ON-B, OFF-B, T-B, where the B is for Boiler). Fig 4 a, b and c respectively represent the codes sent to turn on, off the boiler and finally the code sent to get the temperature of the water so to decide to turn the boiler on or off accordingly and according to its current situation.



(a)



(b)



(c)

Fig 4- Examples of System functionalities

V. CONCLUSION

One important part of any technology process is to make people comfortable and enhance their home devices flexibility. This is usually done by providing more methods and applying more technological systems at their homes. Some countries suffer from the long term current cut off. So, a double edged system needs to be introduced to solve this problem, a system that informs the user when the real current is on and which device to turn on or off.

The smart appliances controller that we have created will help us to control our appliances remotely even if we are outdoor and use the electricity in beneficial way. Also, it allows us to get more specific details about our electrical device in run.

Smart appliances controller is considered to be an easy system to be applied at houses for home automation uses. However, the work is still in progress and needs many improvements. The system should be flexible to connect and disconnect any desired machine to be controlled. It should contain many sensors such as a fill-up sensor, a light sensor, etc. it should be also upgraded to use more developed brain such as Raspberry Pi instead of the Arduion to be able to make decisions autonomously without human intervention.

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