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Implementation of Controlling Home Appliances Via Secure Short Message Service Technology

A B S T R A C T

These days, homes include a variety of electrical devices that are important to families for accomplishing daily tasks. These devices are powered by electricity and in some cases, require a lot of power consumption. Home users must control these devices manually by switching them ON/OFF; this exposes them to potential electric shock and can give rise to other dangerous situations. This paper presents a new approach for creating an electrical system that makes it easy to control household domestic appliances via short message service from a smartphone device. In this manner, users can be provided with a relaxed and safe approach to using electrical devices. The result of this work, users can access to the home devices easily and interact with them without any problem of electrical shock and personal effort.

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تطبيق التحكم بالأجهزة المنزلية عبر تقنية خدمة الرسائل القصيرة الامنة

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الخلاصة

في الوقت الحاضر ، تشمل المنازل مجموعة متنوعة من الأجهزة الكهربائية المنزلية التي تعتبر مهمة للعائلات لإنجاز المهام اليومية. يتم تشغيل هذه الأجهزة بالكهرباء ، وفي بعض الحالات ، تتطلب استهلاكًا عاليًا للطاقة الكهربائية يجب على مستخدمي المنزل التحكم في هذه الأجهزة يدويًا عن طريق تشغيلها وإيقافها ؛ وهذا يعرضهم لصدمة كهربائية محتملة ويمكن أن يؤدي إلى مواقف خطيرة أخرى. تقدم هذه الورقة نهجًا جديدًا لإنشاء نظام كهربائي يجعل من السهل التحكم في الأجهزة المنزلية عبر خدمة الرسائل القصيرة من جهاز الهاتف الذكي. بهذه الطريقة ، يمكن تزويد المستخدمين بنهج مريح وآمن لاستخدام الأجهزة الكهربائية.

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INTRODUCTION

Smart home technology or home automation refers to using home devices remotely through wireless communications. Communication services such as a home wireless access point, smartphone, Bluetooth communication, and short message service (SMS) technology can control home appliances by sending messages from mobiles to the specified device [1,2].

Several investigations have been conducted into smart technologies, many of which are considered wireless home communications that can be controlled using a smartphone. Additional research also indicated how to connect home appliances via Bluetooth communication with a smart home. However, many of these studies do not address security options, which is an important aspect of preventing hackers and other unauthorized users from accessing a designed system.

The current paper proposes a new system design for controlling home appliances via SMS from any location worldwide. Moreover, this study also presents additional functionality, i.e., providing a secure environment to prevent the unauthorized use of devices.

This paper begins with an introduction defining the main purpose of the research paper. Background research is also provided to highlight existing studies and ideas about the topics and additional opinions. Related studies are introduced to highlight the differences between them, followed by results and discussion section, the implementation and design of the proposed system, and the outcome of the research and final results. Finally, a conclusion is presented to summarize important points to make the ideas more understandable.

2. LITERATURE REVIEW

"Smart home" refers to a residence where the family that lives in the house can control its electrical devices remotely using different types of communication devices [2, 3]. This can be done using processes that involve smart home technologies and the Internet of Things (IoT), through which home devices can connect to household users via the internet [4]. The IoT can be described as an interrelated system for mechanical and digital machines that have a unique identification; this system creates a network environment via which these devices can transfer data. In this way, users can access these devices remotely [4, 5].

Wireless technology enables the communication between electrical devices and smartphones used worldwide, enabling household users to control devices remotely using their smartphone [6]. As it is shown Fig. 1.

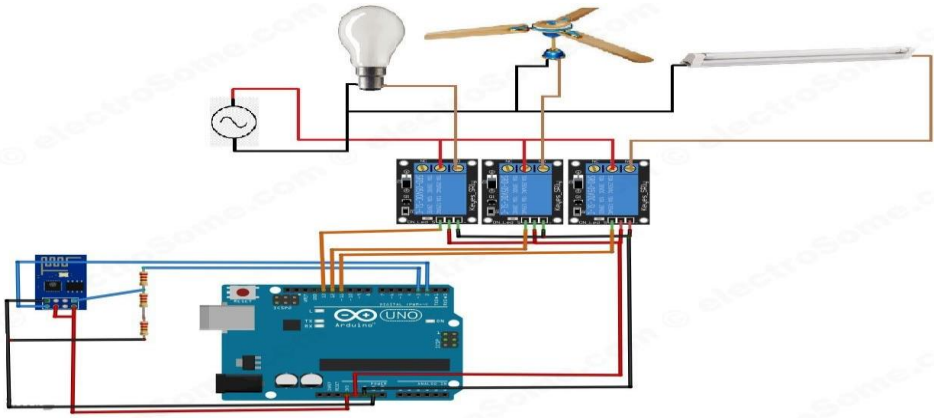

Fig 1. A smart home using Bluetooth system technology [6].

Another way of enabling communication is by using a wired local area network (LAN) using cables. This type of communication is rarely used by householders due to the availability of smartphones, which reduces the need for wire cables. Smartphones employ wireless communication, which can connect to internet services and in this way enable control from extensive distances [7]. Fig. 2 shows an example of a wired LAN connection.

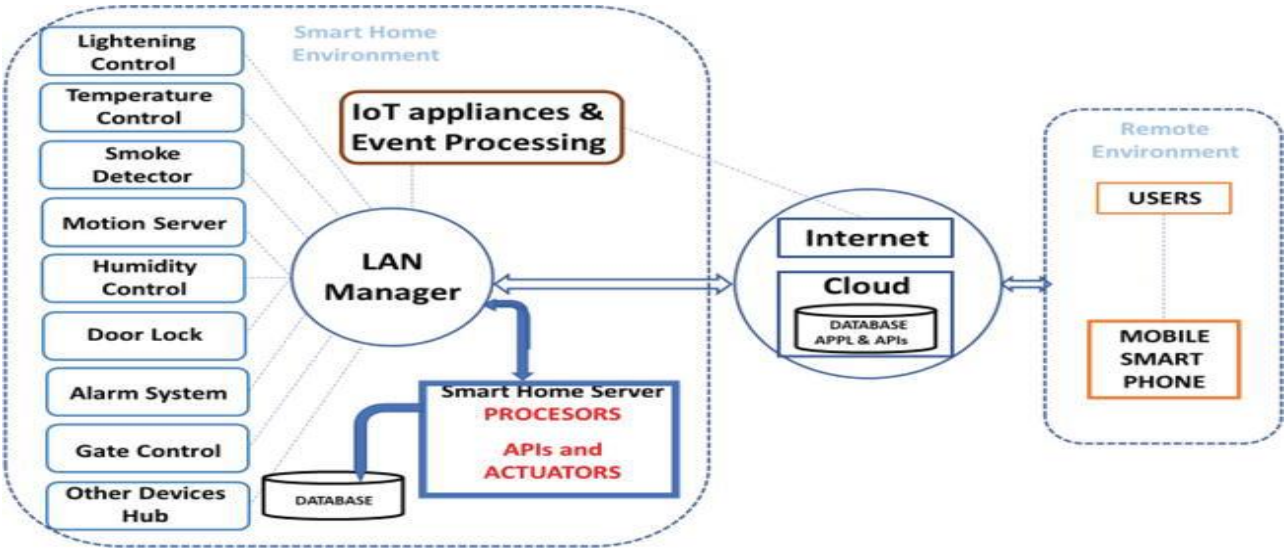

Fig 2. Smart home using a wired system connection with internet service on the controlling/receiving end [7].

Other studies have illustrated communication among devices using the Bluetooth system of communications. Currently, smartphones typically include the Bluetooth function, while home devices can be provided with a Bluetooth module after connecting them to Arduino Bluetooth modules, [8]. Fig. 3 illustrates the process of Bluetooth.

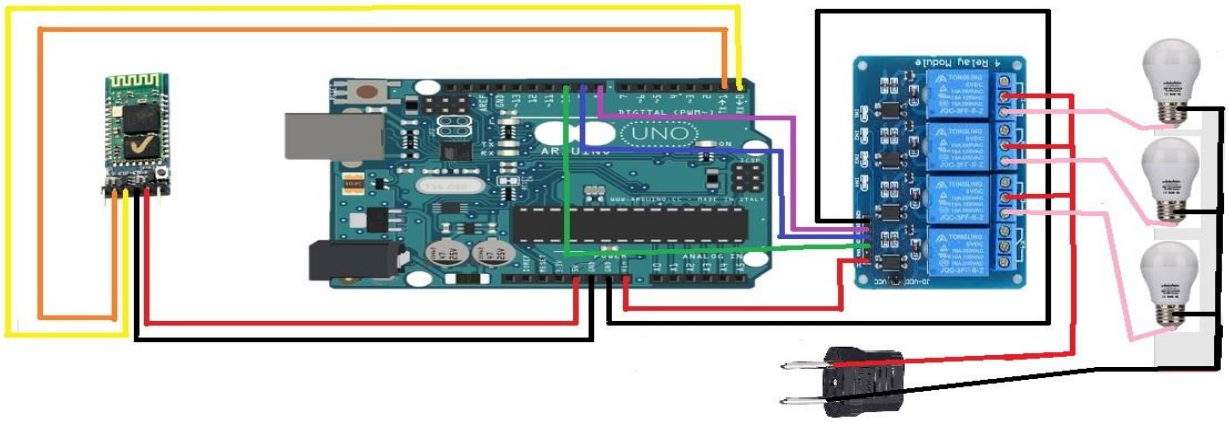

Fig 3. Bluetooth system technology inside a smart home [8].

In the context of smart homes and IoT technology, existing research indicates the primary positive and negative aspects of such tools. The many advantages involved have encouraged new technological smart system designs for householders. Home devices can be managed in one place, with users using their

smartphone and a specific application installed on devices. Globally, most users who own a smartphone will have the ability to download and install applications that enable home device functionality [9]. Additionally, by using a smartphone to control devices remotely, less power energy will be consumed compared with traditional processes, where the user had to affect all control processes manually [10].

Another important advantage of smart home technology is that it provides additional security to people in terms of preventing sudden electrical shock. By not having to physically interact with devices, this potential type of harm will be decreased [9, 10].

In addition, smart homes and IoT also present some potential drawbacks. For example, designing a system for controlling devices may be expensive, and the reason is that the process needs to have many electronic devices to make the system function properly [10]. These devices include electronic boards (Arduino), wireless and Bluetooth modules for effecting communication among devices on one side (transmitting), and an electronic board on the other side (receiving). All of these parts must be bought and sometimes they may become expensive [11].

In addition to the cost, another issue concerns technical security threats; that is, the system may be vulnerable to technical attacks by intruders and hackers who wish to control it. These individuals may attempt to severely damage home appliances and householders [10, 11].

In this paper, a new approach has been created to build a smart home system by using SMS technology, i.e., sending messages to control devices, adding security measures for the encrypting the message, and ensuring that connections were secure by adding data encryption, using AESLib in Arduino which encrypt the sent text from mobile smart phones. And this idea is different from other ideas which have used different types of communication technology system.

SMS technology is used to send text messages from one person to one or more devices at a time. This service is provided by telecommunications companies that work in the area limitation which is provided with antenna towers of telecommunication in the specific country, which is set around the area of the country [12]. Although mobile lines are country-bound, selected telecommunications companies provide a line that can also be used outside the country where it is established. In this case, the capability to send messages is often available on a global level [12, 13]. Fig. 4 illustrates how SMS works.

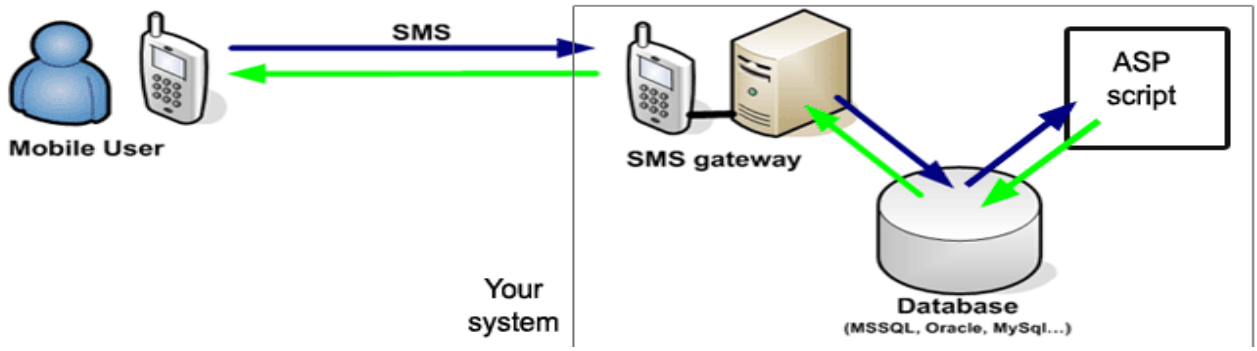

Fig 4. A diagram illustrating how an SMS is sent [13].

Many communication companies also provide security alongside their services to ensure the privacy of their customers who use their lines to make calls and send messages. This security is imperative for protecting people's privacy when using telecommunications lines [14].

3. RELATED WORK

In [15], the author attempted to design a new technique for creating a smart home by using a wireless communication system. Users with Android phones then be controllable by users from their phones. Users will need to install a specific Android application from the play store application that is specifically designed for controlling home devices remotely. This application would be able to connect to a wireless network with a password and network SSID (Service Set Identifier). The connected devices on the same network would will include a user interface with options that should make it easy to use the application. Fig. 5 shows the process of sending commands from an Android mobile phone.

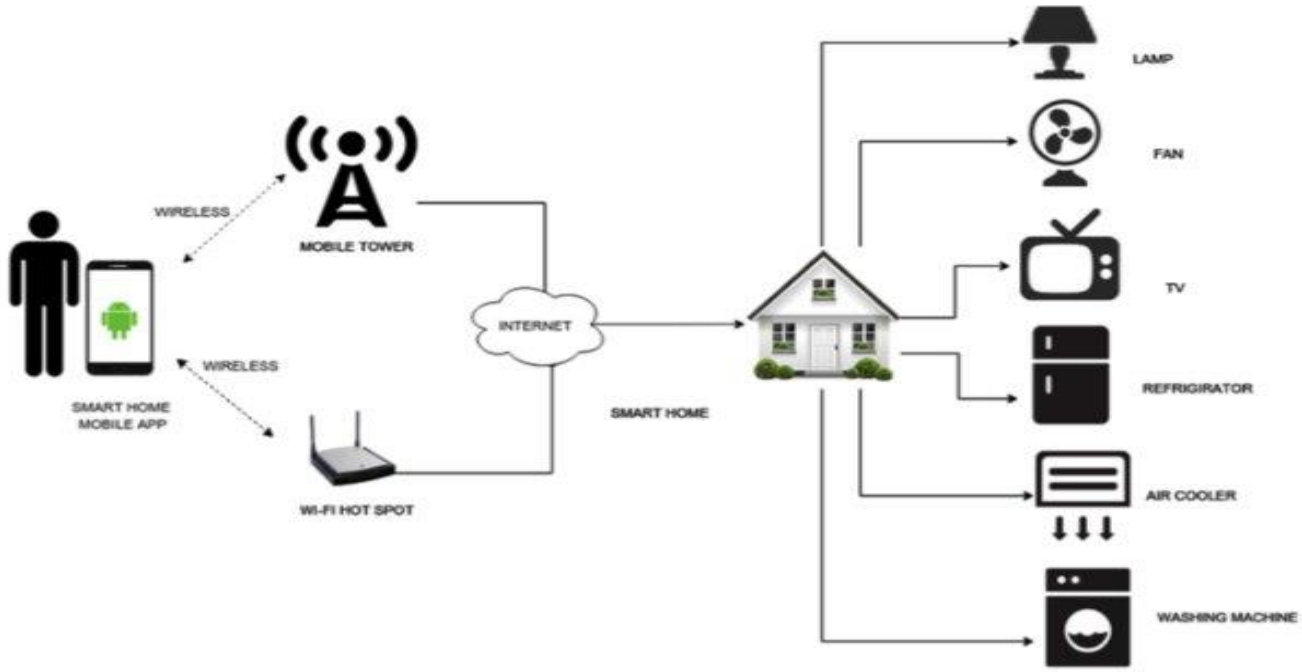

Fig 5. Using wireless techniques to design smart homes [15].

In [16], the author used a different approach to make home appliances gain smart abilities, i.e., using LAN network communications in homes between rooms. This technique requires using more wired LAN cables to connect all the devices involved. Moreover, it is possible to connect the LAN network with internet service to provide additional connectivity, which can help the users to control the device over internet and from anywhere. Fig. 6 illustrates a LAN connection diagram.

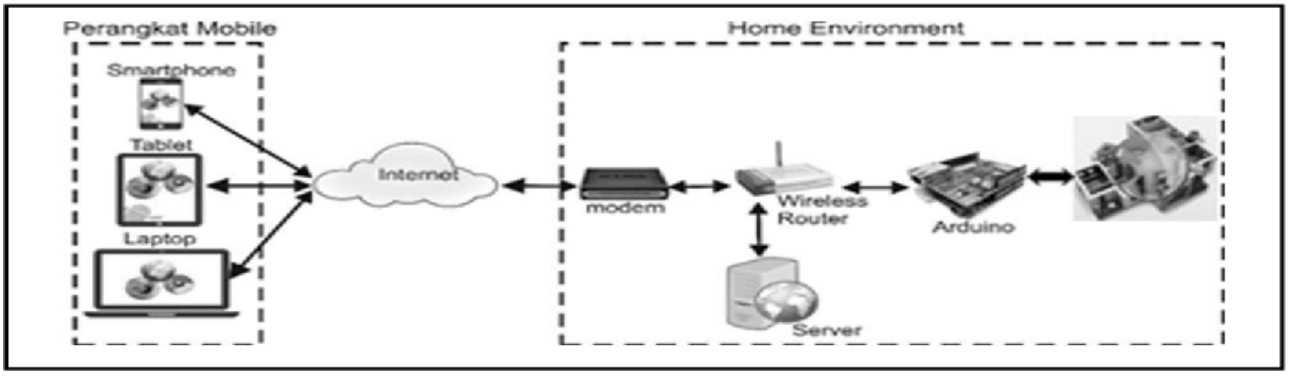

Fig 6. Using wireless techniques in smart housing design [16].

In [17], smart housing using Bluetooth networking techniques is discussed, in which all devices are connected to their Bluetooth service in a peer-to-peer networking system. In this way, all the devices can be controlled using a smartphone. However, in this type of connection, Bluetooth can connect only to one device at a time. Fig. 7 shows a diagram representing a Bluetooth connection.

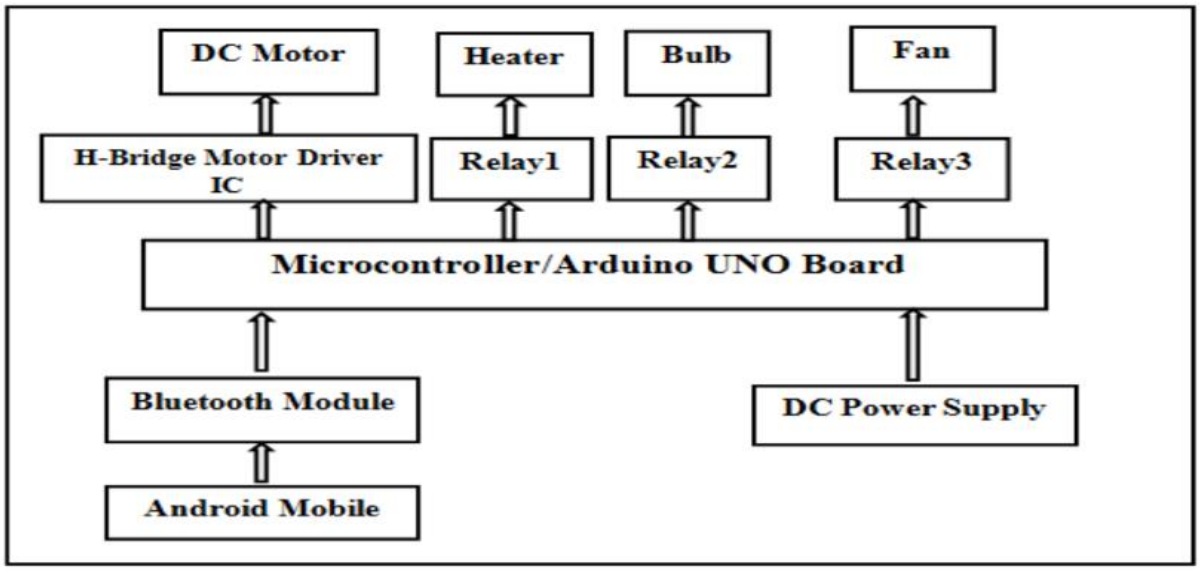

Fig 7. Using the Bluetooth technique in smart housing design [17].

In [18], the researcher used another technique, i.e., creating a web model using webpages. For these pages, the author created a user interface via webpage comprising buttons and interaction arrangements. In this way, householders can easily access their home devices via a webpage. Furthermore, since the pages are published online, users can access the devices anywhere worldwide. Also, the author used PLC instead of the Arduino board. Fig. 8 (a) and Fig. 8 (b) illustrates the process of a system using online webpages.

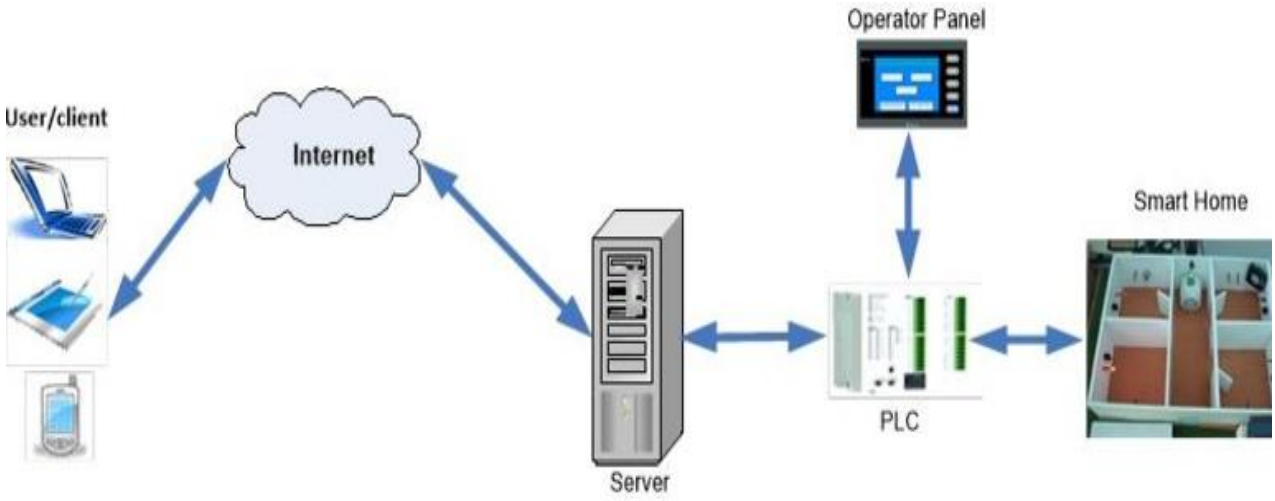

Fig 8 (a). Architecture design of the Internet connected to the server [18].

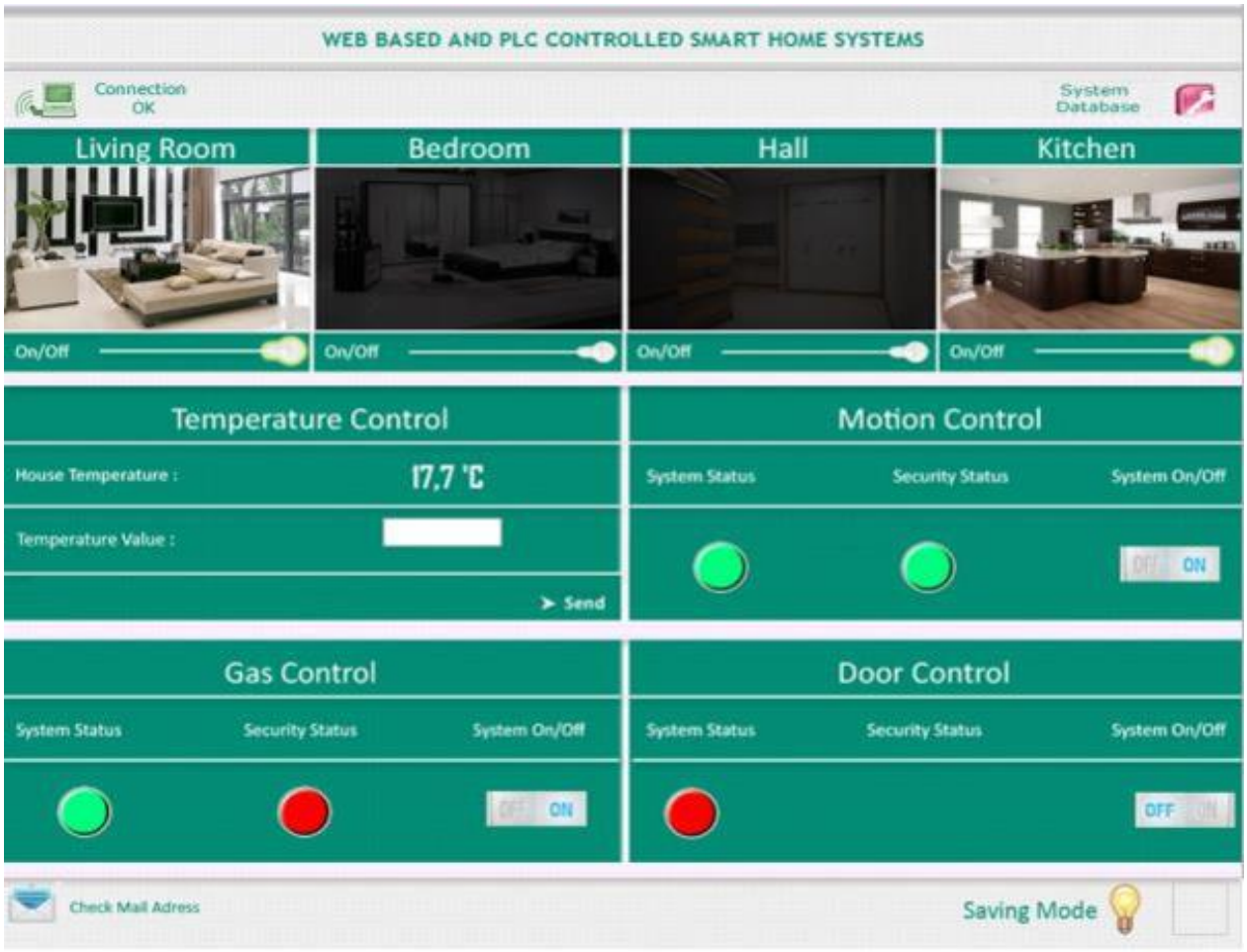

Fig 8 (b). Web design for the system [18].

4. IMPLEMENTATION AND DESIGN

In this work, a new system is designed for controlling home devices using an SMS service that sends messages from a mobile phone to smart devices. These messages comprise of numerical data between 0–9, i.e., decimal-based numbers, which are encrypted with Arduino package named AESLib, to encrypt the text that is sent from smartphone, during the sending process to hide the real data from possible intruders, thus preventing them from hacking the information and the system in general.

First, creating electronic circuits using Arduino boards and other required module devices. Those modules (breadboard, multi-relay parts (4-relay-in-1), System for Mobile Communications (GSM) modules, connected wires, transistors, and capacitors). These devices were connected to create the system.

In this system, a simple electronic circuit is used to control a lamp as an example. By connecting the lamp to the relay, which provided electric power management for the lamp. Also, we connected the relay to the GSM module due to receive the commands in the form of SMS messages sent from mobile phones. The commands were given as two digits, e.g., 0/1, where 0 was for switching the lamp off and 1 was for turning the lamp on. All the modules were controlled by the Arduino board, which included the microcontroller that controlled all the actions in the system. Fig. 9 shows the connection and process design of the system.

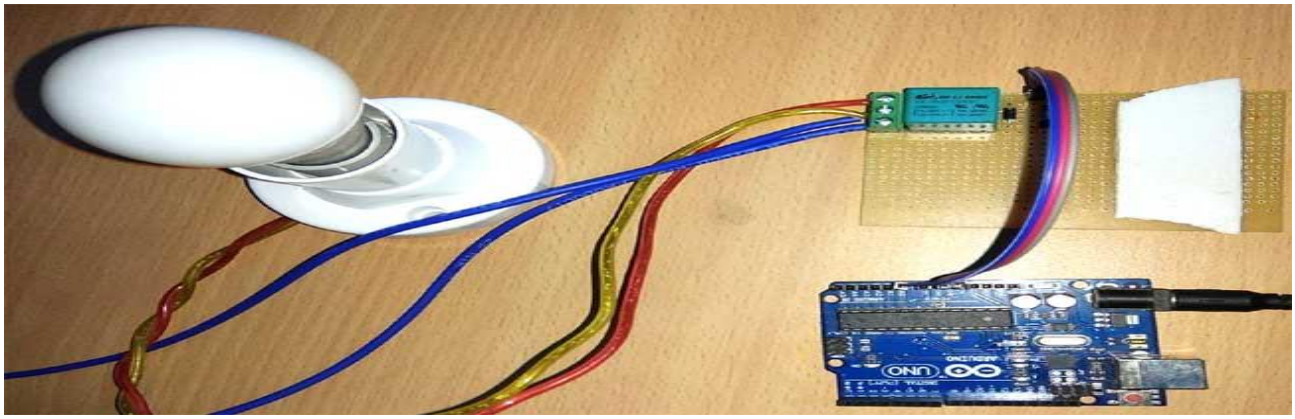

Fig 9 (a). Architecture design of the connected modules.

Fig 9 (b). Process design of smart house technology using GSM module.

To set all the commands correctly, we used the Arduino programming language to create all the programming lines and commands. In this way, all the actions could be set correctly and all the working processes could be controlled by the Arduino, as the microcontroller inside the board would hold all the Arduino compiled code.

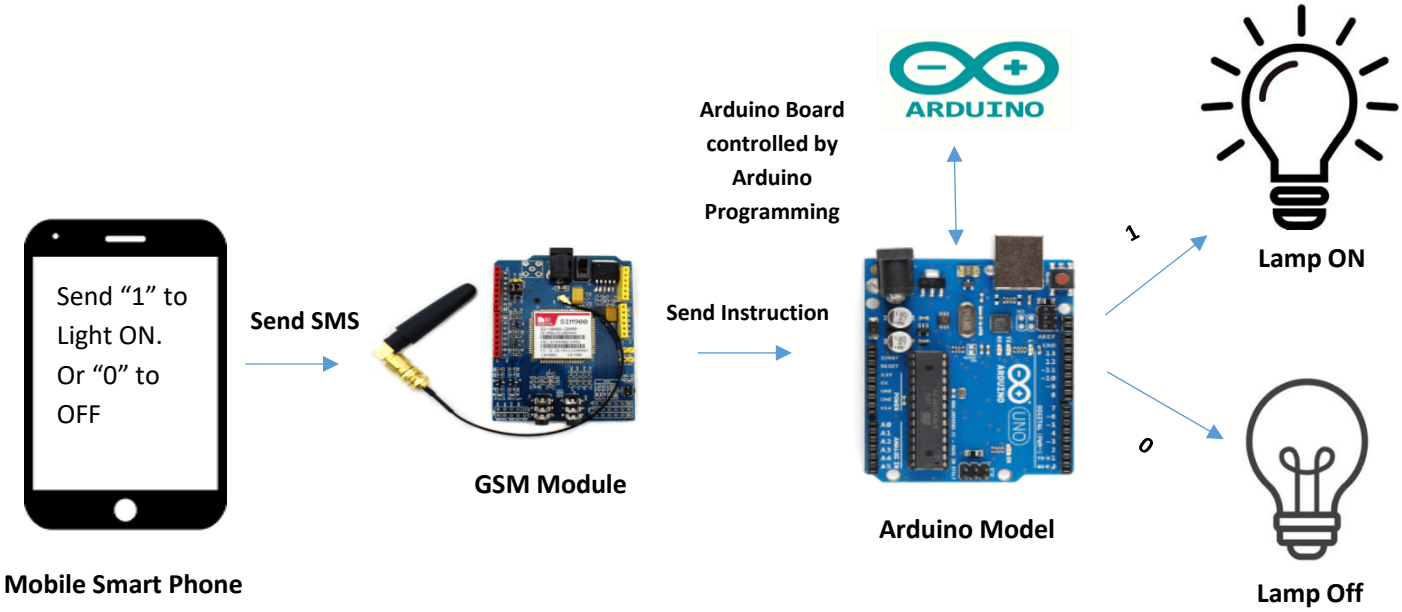

Fig 9 (C). Chart design of working process in smart house technology using GSM module.

5. RESULTS AND DISCUSSION

This system was tested and worked successfully, indicating the possibility of controlling the lamp remotely by sending an SMS. When we send the number '1' as an SMS to the Arduino connected to the lamp device, the lamp was turned on. On the other hand, when we send '0' in the text messages, the lamp is turned off. Accordingly, the working process of the electronic circuit functions correctly.

The above indicates that using a GSM module for controlling a Lamp, makes it possible to affect the same connection with any electrical device. Furthermore, SMS services can work from anywhere in the world, enabling the user to send a message from any mobile phone. Additionally, it is not required to have a smartphone or install a specific application to achieve this.

Also, this system is not expensive because it does not require buying a large number of wires and cables, installing a specific application, or procuring an expensive smartphone to send messages. However, when using wireless, a wired LAN, Bluetooth, and creating a webpage interface, it will be expensive. Additionally, such a system will require a high degree of security to protect the entire system from hackers and other unauthorized users. In this context, users will be susceptible to security breaches because they are connected in a network, where intruders can hack wireless communications and gain access to private data.

By using SMS, there is less of a possibility to be attacked by hackers because there are no wireless networks that make connections between multiple devices, or peer-to-peer devices that can exchange data together.

6. CONCLUSION

In summary, composing a system that will make people, especially householders, lives easier by having smart devices in their homes was an important aspect of this study. The proposed system also makes the use devices at home easy and safe because they reduce the potential for receiving an electric shock, and also reduce the amount of power consumption by householders. This can help governments provide more electric power to their populations, particularly in poor countries with fewer capabilities for providing power from petrol.

his paper can help future studies to enrich the idea, by adding more functionalities to this system. For example, using free online SMS applications such as Viber and WhatsApp to easily communicate with smart devices. Also, further research can expand the idea of this paper to include more functionality such as providing more security to the system in order to keep householders safe.

REFERENCES

[1] Robles R, Kim T-h. Applications, Systems and Methods in Smart Home Technology: A Review. *International Journal of Advanced Science and Technology* 2010; 5(1): 37-48.

[2] Gaikwad PP, Gabhane JP, Golait SS. A survey based on Smart Homes system using Internet-of-Things. *2015 International Conference on Computation of Power, Energy, Information and Communication (ICCPEIC)* 2015; Melmaruvathur, India. p. 0330-0335.

[3] Tseng S, Li B, Pan J, Lin C. An application of Internet of things with motion sensing on smart house. *2014*

International Conference on Orange Technologies 2014; Xi'an, China. p. 65-68.

[4] Balaji S, Nathani K, Santhakumar R. IoT technology, applications and challenges: a contemporary survey. *Wireless personal communications* 2019; 108 (7): 363-388.

[5] Jyotsna Gabhane, Shradha Thakare, Craig M. Smart Homes System Using Internet-of-Things: Issues, Solutions and Recent Research Directions. *International Research Journal of Engineering and Technology* 2017; 4 (5).

[6] Li M, Gu W, Chen W, He Y, Wu Y, Zhang Y. Smart Home: Architecture, Technologies and Systems. *Procedia Computer Science* 2018; 131:393-400.

[7] Domb M. Smart Home Systems Based on Internet of Things. In: Ismail, Y, editor, Internet of Things (IoT) for Automated and Smart Applications; 2019.

[8] Internet Source: BILAL Malik. Bluetooth based home automation system using android phone. 2016: Available from: https://microcontrollerslab.com/bluetooth-home-automation-system-android/

[9] Wilson C, Hargreaves T, Hauxwell-Baldwin R. Benefits and risks of smart home technologies. *Energy Policy* 2017;103:72-83.

[10] Lobaccaro G, Carlucci S, Löfström E. A review of systems and technologies for smart homes and smart grids. *Energies* 2016;9(5):348.

[11] Fagbohun O, Fagbohun O. Design of a Central Wireless Security System Using Atmega328, ZigBee and Arduino. *Archives of Current Research International* 2018;13:1-14.

[12] Internet Source: Gateway ONS. SMS API for ASP/ASP.NET Developers. 2020: Available from: http://www.ozekisms.com/p_2400-ozeki-asp-sms-api.html.

[13] Battestini A, Setlur V, Sohn T. A large scale study of text-messaging use. *MobileHCI '10: Proceedings of the 12th international conference on Human computer interaction with mobile* 2010; Lisbon, Portugal. p 229 -238.

[14] Zakharchenko M, Korchynskii V, Kildishev V. Integrated methods of information security in telecommunication systems. *2017 International Conference on Information and Telecommunication Technologies and Radio Electronics (UkrMiCo)* 2017; Odessa, Ukraine. p. 1-4.

[15] Govindraj V, Sathiyanarayanan M, Abubakar B. Customary homes to smart homes using Internet of Things (IoT) and mobile application. *2017 International Conference On Smart Technologies For Smart Nation (SmartTechCon)* 2017; Bengaluru, India. p. 1059 – 1063.

[16] Kusriyanto M, Putra B. Smart home using local area network (LAN) based arduino mega 2560. *2016 2nd International Conference on Wireless and Telematics (ICWT)* 2016; Yogyakarta, Indonesia. p. 127 – 131.

[17] Kaythi Wut Hmone Khin KMN, Lin Lin Phway, Zarni Sann. Ardunio and Bluetooth based Smart Home Control System. *International Journal of Scientific Research in Science, Engineering and Technology* 2020;6(4):244-250.

[18] Taşdelen K, Bingöl O. Web-based Smart Home Automation: PLC-controlled Implementation. *Acta Polytechnica Hungarica* 2014;11(3):51-59.