

A Rough Set Based System for Analyzing Databases



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Abstract: *Internet of Things or IOT is the future of technological automation that helps everyday living easier. An application of IOT is for building or home automation. With regards to which parts of the building, creating a smart lighting and ventilation system is one way to implement IOT. This paper aims to create a system model for smart home lights and ventilation systems where they can be monitored and controlled wirelessly with Bluetooth connection. The main controller of the lights and mechanical ventilation is the Arduino microcontroller which has a Bluetooth module that would transmit and receive signals to the end-device which is a mobile phone. The mobile phone is equipped with an application that monitors the status and allows the user to control the lights and ventilation. The group was able to create a system model for lights and ventilation control and status monitoring using a mobile device, which connects to the microcontrollers through Bluetooth connectivity in a full-duplex connection. These systems have databases, the Rough Set Theory was used to analyze them.*

Index Terms: *Bluetooth, Internet of Things, Automation, Lights, Mechanical Ventilation, Low-power, Rough Set Theory, Optimization*

I. INTRODUCTION

In today's world, it is the information age where multiple devices across the world are interconnected. A lot of objects are being developed to become smart objects that allow them to be connected to different devices. These smart objects can be interconnected through a network and they could work together to create an automated environment. To create this type of environment, the objects interconnected should be able to receive and transmit data using electronic devices and sensors, software applications, and a network [1]. These components are embedded in the objects part of the interconnected environment. The network between the objects and the people using it is called the Internet of Things.

In this project, only the lights and ventilation of a house will be focused on for the network at home. Both lights and ventilation are controlled by their respective microcontrollers which in this research, an Arduino Uno microcontroller. The

Arduino microcontroller is equipped with a Bluetooth module for communication and an end-device, which sends instructions to the microcontroller and receives information back, will utilize its Bluetooth module. In this study, the end-device chosen was a smartphone, which is used frequently by people on a daily basis. The smartphone is equipped with a programmed software that would allow the lights and ventilation to be controlled at the same time, receive the status info on the lights and ventilation. This system also promotes understandable user interface and helps reduce power consumption [2].

II. BACKGROUND OF THE STUDY

With the emergence of smart devices, living conditions have been made easier. With a simple touch of a button, a person can turn on and off an appliance or an electronic device wirelessly. The integration of a wireless network wherein all devices are connected and controlled wirelessly has made life even easier. The network wherein all electronic devices are connected can be attributed to the Internet of Things (IOT) [6,7]. The concept of Internet of Things aims to enhance the living conditions of people by connecting everything for a person to be able to access everything with ease. The concept of smart home is closely related to the concept of IOT. A smart home is implemented using IOT. A smart home connects various facilities through a network [8]. A smart home can be implemented on even the most basic yet essential part in a person's home like lights and ventilation. The concept of smart home and IOT can be applied to a home's lighting and ventilation which allows them to be accessed through a controller like a smartphone.

There are a lot of researches on IOT and the implementation of a smart home but these researches use complex ideas in trying to further improve these technologies. An essential yet overlooked part of all of these concepts is its power consumption. As systems get more complex, they use more and more power. One approach to this problem is by using a low-powered bluetooth network. A bluetooth network is a popular short-range communication protocol common in almost all mobile phones. Bluetooth low energy is a popular technology in the implementation of IOT. It is a most suitable for low power consumption wireless consumption. This study aims to make a smart home with emphasis on a home's lighting and ventilation as power efficient as possible and as user friendly as possible. The database of this system will be analyzed using the Rough Set Theory [9,10].

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III. STATEMENT OF THE PROBLEM

With the fast advancement of modern technology in today's information age, a lot of people are falling behind due to inaccessibility to new technology mainly because they are costly, and a lot are not user-friendly. Internet of Things technology is one modern technology that is very costly to implement because a lot of purchasable IOT devices are costly for the mass.

With this current issue, in the future, Many will fall behind, failing to be connected to the modern world. Another issue is that a lot of people consume power excessively and to counteract this, there must be an automated way to prevent the problem. These problems must be addressed as soon as possible because the world is evolving fast and to create a connected world through interconnected technology for every person, people should have access to affordable, user-friendly, and energy-efficient technology, starting with Internet of Things implementation at each residence.

IV. SIGNIFICANCE OF THE STUDY

The study aims to provide insight on the further development and improvement of technology that contributes to living conditions of people through the concept of IOT. This study will not only contribute in the further development of IOT systems and smart homes but also give an alternative approach to the study of these concepts in the form of power efficiency and ease of access. The study will also help provide insights in the different implementations of IOT systems and smart homes. Since the study will use a bluetooth protocol in the implementation of the project, future research can benefit from this study by further researching on how bluetooth is one of the most suitable approaches in controlling different devices in a small proximity. Other research can also benefit from this study by using bluetooth as a low-power network system in the implementation of IOT systems and smart homes. Ultimately, the main purpose of the study is to improve the living conditions of human beings. As technology rapidly advances, different technologies make things easier for humans like wirelessly controlling appliances, electronic devices and house facilities through smart homes and IOT systems make this very evident. The research will contribute to the connection and communication of all our devices for ease of access.

V. DESCRIPTION OF THE SYSTEM

The study will focus on finding a means to wirelessly control a home's lighting and ventilation in the implementation of a smart home. The lights and ventilation of the system of the home will have a microcontroller, Arduino Uno. The Arduino Uno will be connected to a bluetooth module that will serve as its transmitter and receiver to an end-device or a smartphone. The end-device or smartphone will send instructions and receive information back from the lighting and ventilation. The end-device or smartphone will have an interface to allow ease of use for the smart home controller. Through the app interface, the smartphone would

allow the lights and ventilation to be controlled at the same time and receive the status info on the lights and ventilations.

VI. METHODOLOGY

The researchers plan to have a low-cost and flexible standalone smart home system which is designed using RESTful based web services and bluetooth. It consists of an Arduino Ethernet as the controller, with the hardware modules. The smart home system has features such as human proximity sensor, temperature sensing, and temperature adjustment. The master controller has a web server running which consists of Arduino 2560 and Arduino Ethernet shield and other hardware such as ultrasonic sensor, which would be used to coordinate actions with the other sensor module. The system is designed to control more than switching, because it is designed to be low cost and energy efficient, and automatic home environment control. Furthermore, it also supports voice signals for switch functionalities. The Android based smart home app would be designed using the Massachusetts Institute of Technology App Inventor v.2. In the main menu screen it would show the controls, upon changing a devices parameters there would be a pop-up that would ask for a password. Access is only granted when the said credentials match. The usage of the proximity sensor is to switch off the lights and ventilation if no human heat is detected in the surroundings.

VII. REVIEW OF RELATED LITERATURE

A smart home system helps you by making your life easier. It could control everything you own in the house in a click. To aid humans to efficiently do task and save energy has been the goal of a smart home. As such IoT based smart home poses itself as a solution to different technological problems. Because of its independence, therefore, the system has no distance limitations. However, Bluetooth application provides a very low cost, flexible and suitable capability when applying it to a smart home system [9]. Because smartphones became a necessity in human life to help them be efficient that it has a wide range of applications such as healthcare, entertainment, and education usage of proposed smart home system using bluetooth has been successful with the features of being low cost and effective [8]. Another approach is to use Bluetooth Low Energy to improve the energy management of the system as it still is low cost this aims to address the costs of high power rating loads of energy-consuming devices [10]. Additionally, we could add features in cooperation with bluetooth such as operation status monitoring, internal data processing, and information feedback [11]. Additionally, we could also pair bluetooth with the use of PIC technology and it would still have its low cost and flexibility [12]. A variation of bluetooth smart home may also come in having a smart grid wherein, it also has capabilities to harvest energy [13]. The system may also different kinds sensor like fire, light and motion sensors to help to check appliances that uses excessive energy [14]. It could also be a sensors like ultrasonic and soil moisture sensors to help check the garden and irrigation system [15].

A specialized system could be done a specific one is for disabled people which uses assistive domestics that could be used in the future for hospitals and homes it integrates with the usage of WiFi to be able to maximize the efficiency of the system [16]. However, the most common limiting factor to the usage of bluetooth is the distance but for persons who are disabled, this helps them by having accessible technology they would not waste energy [17]. In addition, we could also add servo motors to utilize the bluetooth module by having fast switching and speed control, and light intensity control [18].

Bluetooth could also cover a specific part of the house an example of this is a smart lock system for doors that is only opened when the password is entered or the smartphone is in the perimeter for it to be controlled [19]. We could also improve the system by identifying the white space frequency to improve network throughput and performance of the bluetooth home automation system [20]. Similarly, aside from the sensors that were mentioned above a voice sensor to help those who are physically unable to do so [21]. In the same fashion, we could also make a security-based system which incorporates bluetooth in the door it could also check the status not only to lock and unlock the door in case a problem may arise like someone trying to open the door forcefully [22]. However, we may opt to add a lot of sensor but bluetooth protocol stack is not required for a network of sensor as bluetooth is ideal for small scale use [23]. Similar to how a thermostat reads the temperature of the air we could also have a thermometer based on bluetooth that could rapidly read the body temperature to help those who're sick to change the temperature accordingly [24]. An application of bluetooth of railway application to detect a moving object toward it could also be used in smart homes when it detects the owner's house the garage door would open [25]. A variant-hop scatternet may be used so that the network would also organize itself [26]. The usage of bluetooth is flexible that it could also be used to detect human physiological parameters as such we could detect blood oxygen, pulse, and blood pressure this parameters are important for those who have heart disease and could detect and send the information instantly in a smartphone that whenever grave happens the phone could call an emergency ambulance [27]. A camera may also be used as a wireless visual sensor with the usage of bluetooth we could get a status update from the sensor if there is an undetermined object that was detected [28]. An addition for the Bluetooth Low Energy devices mentioned above is it is also have good data throughput and simple software stack [29]. Similar to the door lock its aim is to secure the garage door for the car that it could only be accessed by mobile phone to have it locked or unlocked [30].

VIII. THEORETICAL CONSIDERATIONS

1. Internet of Things (IOT) - Is a network of networks that process and exchange data. The network is usually comprised of various electronic devices that exchange data with each other. The concept of IOT heavily relies on the transmission medium in order for the network to communicate reliably. Communication of IOT devices are usually wireless. Commonly, the interconnection of devices

is made through the Internet, however, some other wireless means like Bluetooth and ZigBee is being used for IOT implementation.

2. Bluetooth - Bluetooth can be used as an IOT implementation because of the introduction of Internet Protocol Support Profile (IPSP). It is now capable of a link-layer connection and devices are able to detect each other.
3. Microcontroller - a microcontroller is a small computer in an integrated circuit that used in control automation of devices. Microcontrollers are essential in the implementation of IOT devices. Since some IOT devices are just normal devices a microcontroller is used in order for them to communicate with other IOT devices.
4. Rough Set Theory – It is a proper approximation of pair sets which produce the lower and upper approximation of the original set [31,32].

IX. DATA AND RESULTS

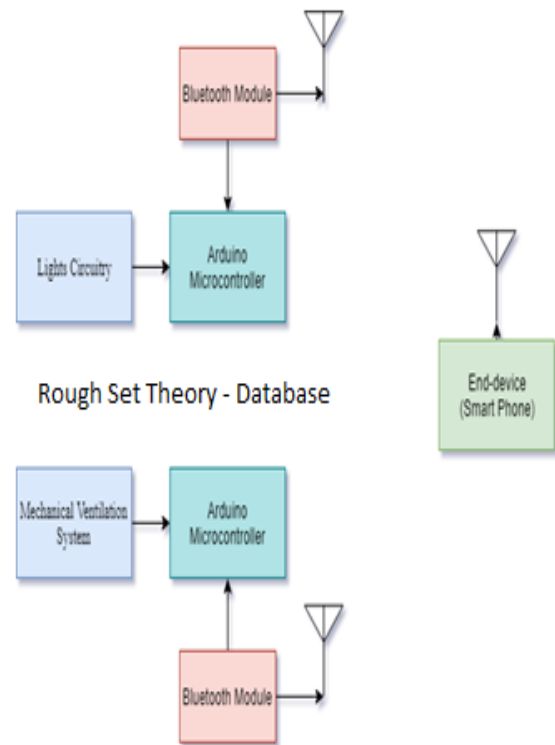


Fig. 1: System Block Diagram

X. ANALYSIS OF DATA

The design created by the group can be seen in figure 1. This, however, is just a system model and lacks actual testing of the practical circuitry. Figure 1 shows the system block diagram where the lights circuit and the mechanical ventilation control circuitry is connected to their respective Arduino microcontrollers. The microcontrollers are equipped with Bluetooth modules that allows the microcontrollers to communicate with the end-device (i.e. smartphone) through Bluetooth wireless communication.

The usage of Arduino microcontrollers allows for a low-power consumption system that will control the lights and mechanical ventilation.



The Arduino microcontroller is also programmed to send information to the end-device of the status of the lights and ventilation if they are on or off. The Arduino can also be programmed to limit the time of operating period of either the lights or ventilation to ensure saving of energy.

The smartphone is equipped with an application that connects to the microcontrollers via Bluetooth connection and with the app, the end-user can control manually the lights or mechanical ventilation or set a time limit for operations so that the microcontrollers can automatically turn off the systems to save energy.

These components were chosen for this project because they allow for a low-power consumption and smooth wireless communication with a smartphone device, which is almost present with everyone in today's information age.

XI. CONCLUSION

The research done was implemented using Arduino. It was used as a home automation system to detect human presence and to change the room temperature and light system accordingly. Its database was analyzed via Rough Set Theory.

The process of the system works by as automatic system. Then, if the user wants to override the home system he would be asked to input his password and then, he would be able to change the parameters of the system.

XII. RECOMMENDATIONS

This research paper is only limited to making a system model for the Internet of Things implementation of lights and mechanical ventilation control at home. This allows for an energy-efficient system at home that helps conserve energy by having an automated control to the lights and ventilation and having manual control wirelessly through the user's smartphone. This research paper lacks on implementing the final physical product and is only limited to a theoretical model. For future studies, the group recommends implementing the model found in this paper and study data on its energy usage and how it impacts a household.

Lights and ventilation are not the only parts that can be connected through the system model designed in this project. A lot of things such as different household sockets can be wirelessly controlled in order to maximize power conservation. A socket extension can be used to control electricity flow wirelessly again, like the paper suggests, through the use of Bluetooth connection and with the use of smartphone which is accessible to the mass today.

Besides Bluetooth, other types of network can be used to implement the whole system. If a household has a stable internet connectivity, the wireless local area network (WLAN) can be implemented to the system model instead of Bluetooth connections. This can help make the system more user friendly because the devices will be connected to the same network. Using an internet router for the local area network is also better than using Bluetooth modules because it can be accessible for a farther distance.

The system model found in this paper can also be used for reference on future models to make a cost-effective implementation of Internet of Things technology to the mass households. It is also recommended to test the system using

cheaper microcontrollers for cheaper implementation and low power consumption.

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