Chapter 1

INTRODUCTION

Project Context

In this modern era, technology is evolving every day, even inside a computer laboratory for convenience and monitoring. Electrical appliances are designed to enhance the specific task and give convenience to the users. Left unattended electrical appliances or door can cause many negative effects to an establishment and for the users. It can cause the appliances be broken and it can also give high electricity bill. The professors and staff who are on duty to handle computer laboratories sometimes forget to shut down computers or appliances that can cause damages.

Most electrical devices carry power a week, even when turned off; these appliances continue to use electricity, to operate features such as clocks, timers, touch pads and displays or to receive signals from networks or remote controls. Electrical appliances that are left unattended can bring a high electricity bill (Warren, 2014).

According to the SunStar (2018), the Bureau of Fire Protection Davao reminded the public not to leave the appliances unattended that can cause fire incidents. Do not leave appliances because of the hustle and hastiness that can cause problem in electrical connection.

From the initial interview conducted by the researchers, according to Engr. Natanavan, an Electrical Engineer at City Engineer Services in Calamba City Hall, electrical

appliances that are left unattended are costly to your electricity bill. Standby appliances consume electricity. Even the lights and fan, these are costly to be left unattended. The electrical appliances can be broken if they used to much.

Leaving the electrical appliances unattended can cause danger in the environment.One of the most cases in fire incidents here in Calamba is leaving an electrical appliance/s in their houses not knowing that it may cuase electrical connection problem.

This study is not just for safety reason and reducing electricity bill. It can bring convenience to the staff, students, and maintenance officer in the computer laboratory. From the initial interview conducted by the researchers, according to Mr. Lerios, an ITS head in LSPU Los Baños, Security guards monitor the computer laboratories before the school closes. It may help them to monitoring even outside of the room within an area of bandwidth.

Through the proposed system for computer laboratory, the researchers came up with an idea to improve the controlling and monitoring electrical appliances that can be implemented in computer laboratories in some schools. Through this, proposed system will be more efficient to use through the use of Wi-Fi connection, which is more implemented in computer laboratories, sensors to maintain current and electric consumption of the designated electrical appliances.

According to Dimla, Madrilejo and Vinoya (2017), most reason behind these issues is the same as forgetting that such electrical appliances have been left plugged in their main power outlets. As consequence to this, energy usage rate continues to increase.   They

introduce a typical home automation system with wireless system. The design composed of an android phone used as a remote device to control power outlets and lights at an entire household integrated with wireless communication technology in the form of Bluetooth connection.

Purpose and Description

The goal of the study is to provide the schools particularly their computer laboratory to be implemented by their maintenance staffs and professors, providing an efficient way to control and monitor the electrical appliances, even in school hours and before and after closing. Reducing electricity bill, safe to the possible negative outcomes and less risk of electrical appliance that can be broken in using too much standby are purposes of the proposed system.

It also introduces a single module board called Raspberry Pi. A Raspberry Pi is a series of small single-board computers used in many Robotics and machine learning application that can stand-alone over PCs. Also, since Raspberry Pi has a built-in Wi-Fi connection (Vujović, 2015), this will be the advantage in using this module to our proposed system. The device manages and send signal through the sensors place in the room and relay channel for the electrical appliances.

Statement of the Problem

1. What are the common electrical appliances that can be found in computer laboratory?

2. What are the common ways in monitoring the electrical appliances that can be found in computer laboratory?

3. What are the weaknesses encountered by every professors and maintenance staffs using manual controlling and monitoring of electrical appliances?

4. How can the use of electrical appliances be efficient and convenient for the professors and maintenance staff?

5. How can an interactive and wireless monitoring and controlling electrical appliances be developed using sensors and web page through the mobile phone that will support efficient and convenient usage of appliances inside a computer laboratory?

6. How effective is the proposed system based on the following?

   5.1. Functionality

   5.2. Usability

   5.3. Operability

   5.4. Security

7. How can the Raspberry Pi be integrated using WLAN technology integration be suited to prospect towards the implementation of the proposed system?

Objectives of the Study

The main issue here is to develop the convenient and efficient usage of electrical appliances needed for computer laboratory in a school. The study aims the following:

1. To know what are the common electrical appliances that can be found in computer laboratory.

2. To create web page through the mobile phone with an embedded system that will help in conveniently monitor that electrical appliances that are commonly found in computer laboratory.

3. To identify the weaknesses that is encountered by every professor and maintenance staff in using the manual controlling and monitoring of electrical appliances.

4. To improve in terms of efficient and convenient when using electrical appliances by the professor and maintenance staff inside a computer laboratory.

5. To create and to develop an interactive and wireless monitoring and controlling electrical appliances using sensors and web page through the mobile phone that will provide efficient and convenient usage of electrical appliances inside a computer laboratory.

6. To be effective on the proposed system be measure based on the following.

   5.1. Functionality

   5.2. Usability

   5.3. Operability

   5.4. Security

7. To design a Raspberry Pi to be integrated using WLAN technology integration suits to prospect towards the implementation of the proposed system.

Significance of the Study

This study aimed to develop the convenience and efficient usage of electrical appliances, lightings, etc. mostly needed for the maintenance staffs and professors in the

computer laboratories. The researchers anticipate that this study is beneficial to the following:

Computer Laboratory. The result will provide them an efficient way of controlling and monitoring of electrical appliances inside in their room. It can lessen inconvenience usage using electrical appliances.

Maintenance Staff. The system can be implemented for their maintenance and to their computer laboratories. Giving them the convenience and less possible danger, and reducing electricity bill for the beneficiary of the computer laboratory.

Professors .The system can provide them a convenient usage. It also helps even in busy to have an efficient solution regarding to controlling electrical appliances in their computer laboratory.

The Researchers. The study helps the researchers in enhancing the programming and the researching skills of the proponents. It serves as a training ground for the proponents to get ready in facing the real world soon.

Future Researchers. The study helps them to have an advanced study in doing research once the study has been implemented. The study will serve as an immediate reference to any other studies related to it

Scope and Limitations

The proposed study is focused on providing an efficient way of switching on and off electrical outlets by the maintenance staffs and professors in computer laboratories. It can give convenience for controlling and monitoring electrical appliances to be their beneficiary

to the computer laboratory. It also computes the current and electric consumption in each electrical sockets place to the relay channel with given current sensor. Also, it can reduce their electricity bill, less possible danger to the room and to keep electrical appliances for their longevity.

There are some limitations for this study. This study only focuses on the designated electrical appliances be control and monitor inside or outside of the room. The Wi-Fi connection bandwidth range has limitations inside and outside of a computer laboratory. Electrical appliances are limited due to the relay channel board given to the proposed system.

This study also focuses on the enhancement of the existing automation system using Bluetooth connection with sensors where power outlets are able to control and monitor. For this study, using Wi-Fi connection and providing with Raspberry Pi module, the power outlets, lights, thin clients and other electrical appliances inside computer laboratory are able to control and monitor using relay channel, current sensor and a smart phone through the use of a web page inside of an area bandwidth. . Powering on and off the given in the proposed system. It is also provided a password for safety and security purposes. For this study, using Wi-Fi connection and providing with Raspberry Pi module with relay channel, the electrical outlets with given electrical appliance are able to control and monitor using sensors and a smart phone through the use of a web page inside of an area bandwidth.

Definition of Terms

The researchers prepare some words and terminologies that are needed to be defined according to the propose system.

Conceptual Terms

Desktop Computer - personal computer that are design for regular use at single location.

Electrical Appliances - device to perform a specific task for a domestic use.

Internet-of-Things – a system for interrelated devices and transfer data in a network without any physical interaction.

Smartphone – mobile phones that have capabilities similar to a personal computer such as web browsing, and run applications.

Operational Terms

Raspberry Pi -single-board computer to use learn programming that can develop robotics and automations.

Single Board Computer – are small computing devices that can be used for a variety of purposes that include experimentation, learning how to program, building a media player or NAS drive, domestic robotics and home automation, and performing computing tasks such as web browsing or word processing.

Left Unattended Appliances – is a condition where the appliances are left being forgotten without being monitored

Chapter 2

REVIEW OF RELATED LITERATURE

This chapter presents the related literature and studies after the thorough and in-depth search done by the researchers. Those that were included in this chapter helps in familiarizing information that are relevant and similar to present study.

Related Literatures

The related literature will cover about the literature tackled by different journals and published books. This will provide the proponents to have basis on the proposed system.

Left Unattended Appliances

Most electrical devices draw power 24 hours a day, 7 days a week. According to Warren (2014), even when turned "off," these electrical appliances and computer laboratory electronics continue to use electricity, referred to as standby power, to operate features such as clocks, timers, touch pads and displays or to receive signals from networks or remote controls.

Battery chargers (used by products such as cordless phones, handheld devices and tablets) and external power supplies (used by products such as laptops) also draw power when they are plugged in – even when the device they power is fully charged or disconnected. Many electronics and network-connected products, such as television (TV) set-top boxes and smart appliances, are always awake, waiting to receive or send information.

In fact, the only way to guarantee that an electronic device is not drawing power is to unplug it from the outlet or plug it into a power bar that can be turned off (Egginton, 2014).

If one forgot to switch off light and fan of particular room in the computer laboratory so there is chance of waste of electricity. Some time there is no presence of any one in the room and still the electrical appliances left on. Also, sometimes very few peoples are present in the office and still all the lights and fans are kept on (Rodge,2017).

In many offices fans and lights are unwantedly switched on condition. Reason is employees are forgetting to switch off the electrical appliances while leaving the office. It makes power loss and money loss for the owner and manager. Busy at work is one of the causes why the electrical appliances are left unattended (Selvaraj, 2017).

Computer Laboratory

According to Ajanovski, (2015), computer labs at the universities are used in three general situations: practical demonstrations, individual work by students on projects and conducting exam. Depending on the special use-cases for each situation, different access permissions are required, different network setup is required.

Based on study and research of Nitish, Yash and Shivam (2014), labs will become more and more self-controlled and automated due to the comfort it provides, especially when employed in a private lab. Lab automation system is a means that allow users to control electric appliances. Many existing, well established lab automation systems are based on wired communication. In contrast, Wireless systems can be of great help for automation systems. With the wireless technologies such as Wi-Fi, cloud networks in the recent past, wireless systems.

Computer labs in schools and colleges are not automated or are not secured in a proper way. Students and staff use the lights, fans and computers in the lab while working but often forget to switch them OFF after the specified college/lab hours. This leads to excessive power consumption and leads to heating up of the systems. Unauthorized users or intruders can easily and illegally enter the labs after college hours due to lack of security to the labs. Labs must be provided with such a security that the guards should be alerted if any intruder tries to break into the lab after college hours (Solanke ,Kumar and Ahire., 2017).

Electrical Appliances

Based on study and research of Shivanka, Grover and Arora. (2013), on presently ongoing ways to control electrical appliances through PC and GSM, they hereby propose a system for the same with an idea to do the same operation in the best possible manner with low cost involved and maximized outputs. Furthermore, it is also ensured that this system will prove fruitful for other advancements in the future with more features and benefits in addition to it while preparing this system it is also being ensured that this successful is successful in coordinating huge number of appliances successfully in an industry or in any huge organization with less manpower involved and for prompt and safe controlling simultaneously.

Kim, Lee, and Hwang (2013) introduced smart energy management system for homes and buildings. The proposed system can monitor and measure electricity usage in real-time. With the proposed system, users can remotely control real-time electricity usage through web and other mobile devices such as smart phones or smart pads. Our future work will focus on expanding the current system to include the following functionalities: automatic home appliance detection and context inference. The automatic identification of

appliances and detection of the location of appliances are important for developing efficient energy management systems.

Internet-of-Things

According to Singh, Saha and Raj. (2016), Internet of Things or IoT is nothing but an evolved version of Internet, which includes sensors, consumer electronic devices and other embedded systems connected to it besides computers, smart phones and tablets to collect and exchange data with one another. This connection of the household devices to the Internet will revolutionize the way we interact with them, and will definitely bring us closer to them, while being thousands of miles away from them. They can be switched on/off by just a click on a webpage specially designed to interact with those devices, by being anywhere in the world with a computer or a smart phone connected with the Internet.

Wi-Fi

Wi-Fi is becoming a network of choice for both SPs and consumers alike. The Past few years have seen renewed interest in large-scale Wi-Fi deployment from SPs. Wi-Fi is ubiquitous in houses with broadband connection. The demands on home networks have increased over time. (Mehmet, 2015)

According to Reynolds and Stair (2018), it is a wireless telecommunications technology brand aimed by the Wi-Fi Alliances. With a Wi-Fi wireless network, the user's computer, smartphone, or other mobile device has a wireless adapter then translates into a radio signals and transmits it using an antenna.

PHP

PHP runs on different platforms like windows, linux and unix. PHP is a server-sided scripting language and also an open source software. In addition to this PHP also support many databases

Scripting Language

Scripting languages, on the other hand, are read, interpreted, and acted upon each time you run them. They don't produce a compiled file, and the instructions are followed exactly as written. If you write sloppy code, you get sloppy results. For this reason, scripting languages can result in slower programs. Scripting languages most often run "inside" another program. It can be more readable, are less syntax-strict, and are less intimidating to nonprogrammers. (Donat, 2014)

Algorithm

Delfinado (2016) stated that a computational problem is saved by performing a finite set of instructions called an algorithm. An algorithm is a well-defined procedure that processes input values to generate desired output values to solve a problem. An algorithm is often written in pseudocode before it is implemented in a specific programming language. Pseudocodes combine English with basic programming language constructs.

Python

Python is programming language written by a person called Guido Van Rossum in the 1990's. Programming also allows the user to control what a computer does and the way the user wants (Scott, 2015).

Python is an easy-to-learn programming language that has some really useful features for a beginning programmer. The code is quite easy to read when compared to other

programming languages, and it has an interactive shell into which you can enter your programs and see them run. In addition, its simple language structure and an interactive shell with which to experiment (Briggs, 2015).

Using Python to program the Pi means that many people who would never dream of programming a computer can pick up a Raspberry Pi and do something really cool with it, like build one of the projects presented in this book, without learning a difficult language. This is, after all, why the Pi exists: to make programming accessible to more students, and for that reason Python comes preinstalled on the Raspberry Pi (Donat, 2014).

According to Payment(2015) as stated in his book, Python has may advantages over other available computer language's, one big advantage is that it is free. Another advantage from Python is that it is easy to use and learn.

Python Code is usually 2-10 times shorter that comparable code written in other languages, which means the user can spend less time writing the code and more time using it. Mueller (2014).

Raspberry Pi

Smart objects play the central role in the IoT vision. Equipped with information and communication technology, these objects can store their context, they are networked together, they are able to access Internet services and they interact among themselves and with human beings. According to Maksimović (2015), Raspberry Pi's performances are compared with some popular boards and development platforms on a general level by computing power, size and overall costs of the solutions. Based on performed analysis, it can be stated that Udoo has the best performances among considered IoT hardware platforms, but at the same time its price is quite high. On the other side the detail analyses of Raspberry

Pi have shown that as ultra-cheap-yet-serviceable computer board, with support for a large number of input and output peripherals, and network communication is the perfect platform for interfacing with many different devices and using in wide range of applications.

Related Studies

Foreign Studies

Prakash, Alekhya and Reddy (2018) proposed an efficient implementation for IOT (Internet of Things) used for monitoring and controlling the home appliances via World Wide Web. This project aims at controlling home appliances via Smartphone using Wi-Fi as communication protocol and raspberry pi as server system. The user here will move directly with the system through a web-based interface over the web, whereas home appliances like lights, fan and door lock are remotely controlled through easy website. An extra feature that enhances the facet of protection from fireplace accidents is its capability of sleuthing the smoke in order that within the event of any fireplace, associates an alerting message and an image is sent to Smartphone.

According to Gupta, Yash and Shivam (2017) with their study aimed to give a Lab Automation System (LAS) using Nodemcuesp8266 that employs the integration of cloud networking, wireless communication, which provide the user with remote control of lights, fans, and appliances within their lab and storing the data in the cloud. The system will automatically change on the basis of sensors 'data. This system is designed with low cost and expanded in lab to control variety of devices.

Additionaly, according to Solanke ,Kumar and Sheikh. (2017) the objective of their project is to design a lab automation system which makes operating of electrical appliances and detection of motion through sensors in lab through android application. The speech

recognition is done by Support Vector Machine. Motion sensors are much more data-efficient and far less expensive, but possess limited recognition capabilities.

According to Kapare (2017), proposed a system uses relay make ON and OFF the devices in office. The appliances can be ON/OFF using the graphical user interface on android mobile phone. The camera provides the security and monitoring from unwanted entries. The system is employed using Raspberry pi board. The status of electrical devices can be monitored using internet.

A cost-effective system for offices, hotels and other workspaces is proposed by Rodge et al. (2017). If one forgot to switch OFF light and fan of particular room in the office so there is chance of waste of electricity. Some time there is no presence of any one in the room and still the electrical appliances left ON. Also, sometimes very few peoples are present in the office and still all the lights and fans are kept ON. So, in this case the proposed system will keep a track of Visitors in the office and manages the electrical resources effectively. This situation can either be handled by user or by system itself.

Shaikh (2017) proposed allows existing embedded system to be integrated into an internet of things network. This paper presents a wireless solution based on Internet protocol to accomplish and monitor the office units easily. The application of the IoT technology, in Office area automation means integration of all appliances and the electronic devices like smart mobile phone, personal computer, tablet, along with the the monitoring, control of work environment. The electrical appliances can be monitored and controlled using android smart phone and IoT. Thus, it helps to build an autonomous work environment in the work spaces.

The leverage obtained by preferring this system over the similar kinds of existing systems is that the alerts and the status sent by the Wi-Fi connected microcontroller managed system can be received by the user on his phone from any distance irrespective of whether his mobile phone is connected to the internet. The microcontroller used in the current prototype is the TI-CC3200 Launchpad board which comes with an embedded micro-controller and an onboard Wi-Fi shield making use of which all the electrical appliances inside the home can be controlled and managed (Kodali, Jain, Bose and Boppana., 2016).

Kumar and Pati (2016) proposed a home automation technology provides smart monitoring and control of the home appliances as well as door permission system for interaction between the visitor and home/office owner. The control and monitoring status (on/off of the appliances) have been implemented using multiple ways such as internet, electrical switch, and Graphical User Interface. The system has low-cost design, user-friendly interface, and easy installation in home or multi-purposed building. Using this technology, the consumer can reduce the wastage of electrical power by regular monitoring of home appliances or the proper on/off scheduling of the devices.

The objectives in this work have been achieved with great success. From a practical view, the main goal to use Raspberry Pi to connect multiple devices, with different platforms and Operating Systems was accomplished. Moreover, it is important to highlight that the work developed is a first approach in an area that has a high growing potential and that in terms of the main goal of this dissertation achieved its purpose (Jacinto, 2015).

According to Raid (2015), proposed an intelligent automation system, comprises one or more sensors configured to detect activity; a transceiver; a processor

communicatively connected to the transceiver, the processor configured to control a remotely located device; wherein, in response to detecting activity, the one or more sensors are configured to send detection signals to the transceiver, wherein the transceiver is configured to communicate the received detection signals to the processor, and wherein the processor is configured to control one or more local devices based on the received detection signals.

Moreover, Ossipov (2014) design a web application for managing computers used for software testing. These computers, known as hosts, can be either physical machines or virtual ones. The main function of the developed application was to be able to reserve certain hosts for testing software functionality and to keep track of hosts' software licenses and IP addresses configured for those hosts.

According to Hassan, Kamal and Naqvi. (2014), proposed a system that will provide reliable cooling and lighting system for the satisfaction of users. In this paper intelligent energy saving system and the decision making algorithm are discussed. As per algorithm the system will first check any occupant in the library. If so then the system will check the intensity of light and temperature and make decisions accordingly.

Petrov (2014) proposed as a starting point for implementing a complex control system for real-time processes, using s visual feedback loop. The main focus was made on developing an application for an embedded system that detects fluid levels on an imaged received from a Raspberry Pi digital camera.

In addition, according to Wilson, Brownfield and Wul. (2013), proposed a method receives at a control server, device state data for the controllable device from a first client device in the IPTV network; accesses user interface (UI) data from a data base accessible to

the control server; reflects the device state data in the UI data at the control server; and sends the UI data from an IPTV server to the first client device. In another embodiment a system is disclosed for interacting with a Field of Classification Search controllable device in an internet protocol television (IPTV) system. The system receives at a control server, device state data for the controllable device from a first client device in the IPTV network; accesses user interface (UI) data from a data base at the control server; reflects the device state data in the UI at the control server; and sends the UI from an IPTV server to the first client device.

Local Studies

According to Janamillos, Segunail and Villanueva. (2018) in their study entitled "Electricity Load Consumption Monitoring and Control System in Android application using Fuzzy Logic" aimed to give the users an idea of things to be considered when buying and using appliances by computing the estimated monthly electric bill of a residential rate. House with different appliances and provide statistical presentation after the simulation. While computing the estimated consumption of appliances depending on their wattage and number of hours used, etc. The Fuzzy logic algorithm is applied in this system.

Botaro, Mac and Sianoya. (2018) conducted a study entitled "Effectiveness of Arduino Based Solar Powered Light Fixture with Photo Electric Sensor for Energy Consumption" wherein the objective of the study aims to develop a solar-powered light fixture that suits the needs of the community about lightning management. It contains essential devices that build a tremendous embedded prototype because it is mix of software and hardware. Also, it was a stand-alone device which depends on the environment which basically automatically turns on and off the light. Plus, it gives a better dim of light because of LED that long lasts and economical because it doesn't require electricity. With the use of

newer and better technology, it was capable to benefit the department in conserving energy. Transitioning to the new and better way of consuming and producing renewable energy takes a lot of time and cost a large amount of budget. The Arduino-Based Solar Powered Light Fixture with Photo electric sensor can slowly help LSPU-LB CCS Department to transition to this new and improved way of lighting.

In addition to what has been said, according to Cayabyab et al. (2017) entitled "Air Conditioning Control System using Gizduino ATmega644t with PID Algorithm" their aim is to develop a system that automatically controls the air conditioners and maintain the temperature inside a room using the Gizduino ATmega644t microcontroller board.

According to Remoquillo, Tabernilla and Tomas. (2017) entitled "Local Area Based Monitoring of Electrical Sockets" their proposed system is a WLAN base management that can monitor appliances. They can be turned on and off through checking the website which manages the appliances switches. This is reason why the researches come up with an idea how the owners of the houses or buildings can check the appliances remotely if it is on or off in any part of their houses or establishments. This also has a basic logic system so only members of the houses or family can access. The system is created through the use of HTML and the Arduino Uno. Arduino is a programmable device. The appliances can be controlled through the web and the Arduino receives the command which allows manipulating the flow of electricity through wiring.

The thesis entitled "Poligizmo: A house-hold power outlet and light gizmo using Bluetooth-based technology with Arduino in Android Platform" by Dimla et al. (2017) they conducted a study to help individuals manage their lights and power outlets around their

household premises. This project presents a typical home automation system with low cost design and wireless system. The design composed of an android phone used as a remote device to control power outlets and lights at an entire household integrated with wireless communication technology in the form Bluetooth connection.

According to Abubakar and Khalid (2017) proposed in their study entitled with "Application of Load Monitoring in Appliances" aimed to presents the current state of art of appliances' energy management through Intrusive Load Monitoring (ILM) and Non-intrusive Load Monitoring (NILM), ILM is referred to as distributive sensing and NILM is based on single point sensing. In an effort to explore the recent trend in Energy Management for researchers in the area, various techniques of Home Energy Management (HEM) using ILM and NILM have been analyzed and categorized. Different contributions made by the researchers have been highlighted together with some techniques of reducing power consumption of a building for cost saving and greener environment. Using an android application to monitor the appliances is an efficiency to use.

Moreover, Miraballes (2016) conducted a study entitled "Energy Saving Measures in Air Conditioning System at The Cebu Technological University-main Campus" wherein the main objective of the study is to assess the air conditioning systems operation and its equipment and the common practices in the use of the air conditioning units as basis for the formulation of the Energy Saving Measures in the University. Furthermore, the researcher conducted actual measurements of room areas supplied with air conditioning units as well as air conditioning unit operating conditions as baseline data.

Additionally, according to the study of Panit et al. (2016) entitled "Inventory Monitoring System of Computers and Equipment in ICT Department of Cebu Technological University Main Campus" the aim of the system is to approach on the inventory and monitoring of computers and equipment in ICT Department of Cebu Technological University Main Campus. It is design to meet the demands of the teachers and the institution to properly check the computers and equipment that they have. The system gives information that are relevant, accurate, time saving and consistent. The system can monitor the Brand, Quantity, Specification, Functionality and Location of the computers and equipment on the ICT Laboratories. The system able the user to print the output of the inventory. Authorized person is the only one who can access the system. the system would not run without internet connection.

According to Dalaguit (2016) entitled "Voltage Time Delay Device for Electronics Technology Instruction" the system aimed to create voltage time delay device for protection of electrical appliances from power spike due to brownouts at affordable cost. Technical requirements in the construction are rectifier circuit, relay circuit and time delay circuit. Result showed a fluctuation of voltage, current, and power but is ideal based on the six percent voltage drop in a line. The mean temperature for three treatments in all replicate was normal base on the maximum temperature of the magnetic contractor which is 100 C.

Manzanas (2015) conducted a study entitled "Modified Programmable Toggle Switch Using a Low Power 433 MHz Ism Band Wireless Module" wherein the main objective is to have a low-cost wireless remote switch suitable to replace the physical wiring of the PTS was realized. Many wireless technologies for home automation like ZigBee, Z-Wave, Insteon,

Wavenis, and Bluetooth exist, but either with high price or unavailability in the Philippine market limits their adoption and popularity for use by the masses. The 433MHz ISM band wireless module was chosen for modifying the PTS due to its low cost and performance. The fabricated prototype was tested for functionality and reliability through simulated and actual testing procedures. It was found that it is functional and reliable due to its high success rate considering all the imposed limitations like the assumption of full battery power at the transmitter and within the acceptable distance between the transmitter and receiver.

Bibal, Gonzales and Tejada. (2014) conducted a study entitled "Residential Electricity Consumption: A Simulation" wherein the main objective of the study is to simulate a house running different appliances and compute estimated electricity consumption depending on the user input of number of days who randomized appliances runtime. The system was developed in VB.net programming language running under Windows OS. The design of the software is based on the Meralco application, basically a house with different appliances and corresponding wattage.

Moreover, Celebre , Medina and Suprosa(2014) conducted a study entitled "Home Automation using Raspberry Pi through Siri enabled mobile devices" wherein the study focuses on implementing a home automation system through Siri's capability of speech recognition and through Raspberry Pi as a low-cost control system to automate home devices, namely the air cooler, door, lights, TV and window. Siri Proxy is installed on the Raspberry Pi as a proxy server for Siri. By developing a Siri Proxy plug-in, a set of commands for home automation could be custom create by the user.

Additionally, according to the study of Ong (2013) entitled "Data Collection Protocol for Wireless Sensor Network-Based Home Automation" the aim of the system is to gather data from a multitude of different sensors, each exhibiting different monitoring behavior. While wireless sensor networks (WSN) have been a popular platform to support such applications, these platforms are constrained by low bandwidth, and processing power. For these reasons, the traffic volume and data transmissions must be managed so that data may be delivered in a timely manner despite the limited resources. This study develops a data collection protocol that provides three data traffic priorities and uses a time division-based medium access control protocol to provide differentiated services to each traffic priority. When tested on a simulated model of an intelligent home, the protocol was able to exhibit data traffic prioritization, a high rate of data delivery and low latency.

The thesis entitled "Home based power outlet usage monitoring system" by de Guia et al. (2013) they conducted a study to presents such a system where the power outlet is monitored in current usage. The individualized power monitors are capable of measuring instantaneous wattage and VA (volt-ampere). The instantaneous values are aggregated and sent by powerline communications to a central database, where a web-based client software reports and plots appliance consumption.

According to Co et al. (2013) entitled "Home security system using Zigbee technology" their aim is to create a simple wireless home security system. The components of this security system include the central hub with monitoring display, the sensor arrays, a key fob for remote control, and the light, door lock, and smoke detector components.

According to Crisostomo et al. (2013) in their studied entitled "Android Based Room Device Management System" aimed the creation of an Android based system that manages the use of appliances in a typical room of a student in a boarding house with regards to switching and control via android tablet. It is efficient to use an Android as a device for the management system inside a room.

Flores et al. (2013) conducted a study entitled "Switching on/off home appliances via SMS and personal computer" wherein the study give convenience to home owners, giving them the accessibility of switching on and off certain appliances in a room. Through SMS communication with the system based in the house, the owner still has the control over the appliances even when he/she is not at home. With the use of this system, appliances will not be left unattended, home owners can minimize their energy consumption and monitoring of energy usage may be done.

Synthesis

For this chapter, it discusses the importance of the review of the related literature and also the similarities and differences of the studies in conducting the research, likewise the general discussion of the proposed system.

In different computer laboratories, left unattended electrical appliances and inconvenient management are one of the problems experiences by most of the professors and maintenance staffs. Left unattended and unmonitored electrical appliances is doing everything even in houses and establishment, and with that it can cause high bill electricity, the electrical appliance can be damaged and broken, and some danger like electrical fire. In this era where the smart phone can be useful for managing and controlling electrical

appliances in the computer laboratories, it is highly interest to provide a system that can be more useful and more efficient than the previous existing system.

As the researchers plan through the study, they found some similarities from the foreign and local studies. The use of relay channels and concepts are relative to different implementations like home automation, IoT based smart home, and smart office automation. In extension of the study, using wireless connection is also present because of the portability and efficiency for the user and also developer.

However, there are some differences found in the researched studies. They use different programming language construct in C language instead of Python as programming language. Also, the modules were used are different. Arduino, Zigbee, and Esp modules were used for the implementation. The type of wireless connection is also different from the proposing to the study. Bluetooth connection and GSM are implemented instead of Wi-Fi connection. Bluetooth connection and through the use of GSM is outdated and not much used in most typical computer laboratory.

The researchers propose a system using automation to control and monitor electrical appliances using smart phones. Through the use of Raspberry Pi that has built-in Wi-Fi module and Python library for scripting a machine, the researchers aim to improve the efficiency and convenience of controlling and monitoring electrical appliances. Afterwards, the system also provides a sensor for measuring current and electrical consumption placed in each electrical socket.

Chapter 3

RESEARCH METHODOLOGY

This chapter, includes research framework which illustrate what software development methodology was used by the researchers. Research development methodology deals about the methods used by the researchers to gather necessary information for the study. It includes the research design, research locale, and population of the study, data gathering tools, data gathering procedures and data analysis plan. Also, presents the technical aspects of the project development.

Research Design

The researchers used descriptive and applied research design. Current situation in the environment which completely natural and affects the behavior of any subject are the main focus of research descriptive design. Descriptive research is a study designed to depict the participants in an accurate way. More simply put, descriptive research is all about describing people who take part in the study (Kowalczykl, 2013).

According to Lawrence Berkeley National Laboratory (2013), applied research is designed to solve practical problems of the modern world, rather than to acquire knowledge for knowledge's sake. One might say that the goal of the applied scientist is to improve the human condition.

Software Development Model

The Agile development model is software development method is an approach a project in the Figure 1. This method helps the teams to give responds in as software

construction. It uses incremental, iterative work sequences that are commonly known as sprints.
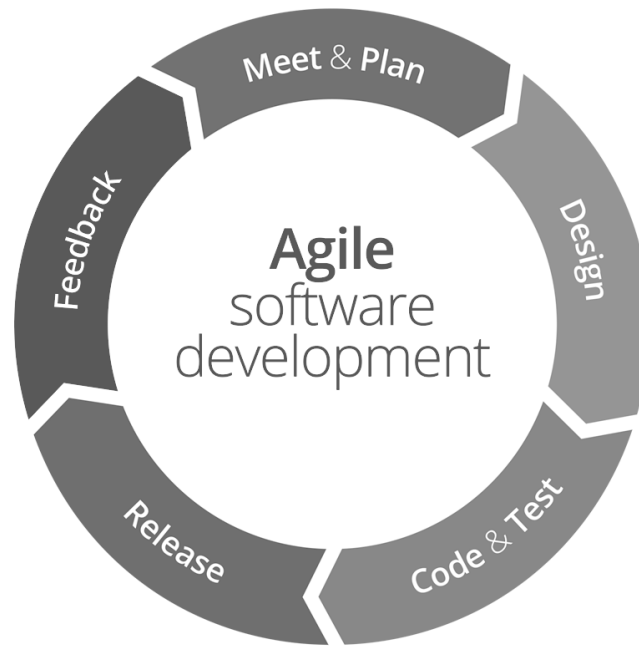
Figure 1. Agile Methodology (courtesy of Fraguela, 2017)

A sprint is a period of time allocated for a particular phase:

Meet & Plan. The customer's demand and product constraints are the requirements to identify for this phase. In this phase, the researchers will observe how the head coordinator and maintenance officer uses electrical appliances inside the computer laboratory. The staff and maintenance staffs sometimes are forgot to close a certain appliance like fan and can't even manage to use during their work hours. The researchers conduct an investigation. There's an existing system that will give the researchers guide for their study. In a review, recommendations and flaws are listed to be seen in this system.

Then for the plan, the researches come up with new features improving the existing system. The features are needed also for the designated person with a security level using for

controlling and monitoring electrician appliances in computer laboratory. As researchers find the result, they sum up the information how to add another feature and introduce a new approach

Design. During this phase, the construction of the system is decided. The researchers give a framework for the system using IoT with a mobile web page , relay channel, and current sensor. They use an algorithm that can use for automation precisely.

Code & Test. They use python for their language that can run in our device. Web page is use in the proposed system for controlling and monitoring electrical appliances. The algorithm that can run to the system inside in a device is required. When the system is now ready for the users, the system will be used for testing and prototyping.

Release. The system is ready for the satisfaction for the users.

Feedback. After the system is developing for the user need, the feedback is needed for the system. The researchers will know the result if it's working and satisfied for the needs using tally for the result.

Research Locale

The researchers conducted the said study along the vicinity of Calamba and Los Baños city. They conducted an interview to know what problems were encountered in a computer laboratory. If applying Computer Laboratory monitoring and controlling electrical appliances system will improve their capabilities in their computer laboratory. Also, to acquire supplementary information about how they manage their electrical appliances that can be manage as results in the study. The researchers target to interview is the representative of each school and universities of managing computer laboratory, who are

willing to answer. And some of the head coordinator, maintenance staffs and professors know what are the methods they do in order to manage their computer laboratory.

Population of the Study

As presented in Table 1, the respondents of the study are the handlers and coordinators of computer laboratories that are representative in each school, due to they are the one experiencing difficulties and had direct interaction with the proposed system. The researchers will be using Random sampling method for data gathering.

Table 1. Respondents of the Study

Respondents	No. of respondents
LSPU – LOS BANOS	
ITS Head Coordinator	**1**
LCBA	
ITS Head Coordinator	**1**
CITY COLLEGE OF CALAMBA	
Maintenance Officer	**1**
STI – CROSSING CALAMBA	
Management Information System Admin	**1**
Total	**4**

Sampling Design

The researchers used convenient sampling technique. It is used in exploratory research where the researcher is interested in getting an inexpensive approximation of the truth. As the name implies, the sample is selected because they are convenient. This non-probability method is often used during preliminary research efforts to get a gross estimate

of the results, without incurring the cost or time required to select a random sample. In this study, the available respondents will get to be interviewed and answer some survey form.

Data Gathering Tools

This study uses the following techniques in gathering related information that will strengthen the said study:

Interviews

In gathering information, interviews are the most essential way. It is used for validity of information and to produce a system that are in favor to all of the respondents. As part of the data gathering tools, the researchers conducted an interview to the head person and staff representative in the computer laboratory of schools and universities around in Laguna.

Library and Internet Search

The researchers used library and internet to gather information and related studies. Searching in library and internet is a huge help for the researchers to gather books, journals, newspapers and thesis that are related to the usable to the study. PDF's and online website also were used for their related literature.

Data Gathering Procedure

Through the use of different data gathering tools, the researchers gather valid and reliable information. First, the researchers went to different school libraries and research in different websites for their review of related literature. To acquire additional data and resources, thesis and books were reviewed that may help the researchers to make the

concept of the study. After conducting research in different school libraries, the researchers

conduct an interview to their target personnel who's related to management ideas.

Data Analysis Plan

The researchers gathered necessary information regarding the study and the

information was analyzed and classified as qualitative.

Table 2. Data Analysis Plan

PROBLEM STATEMENT	PROCEDURES /TOOL	SOURCE OF DATA	ANALYSIS
1. What are the common electrical appliances that can be found in computer laboratory?	Interview	Head Coordinator/ Maintenance Officer	Quantitative/ Qualitative
2. What are the common ways in monitoring the electrical appliances that can be found in computer laboratory?	Interview	Head Coordinator/ Maintenance Officer	Quantitative/ Qualitative
3. What are the weaknesses encountered by every professor and maintenance staff using manual controlling and monitoring of electrical appliances?	Interview	Head Coordinator/ Maintenance Officer	Quantitative/ Qualitative
4. How to improve in terms of efficient and convenient when using electrical appliances by the professor and maintenance staff inside a computer laboratory?	Interview	Head Coordinator/ Maintenance Officer	Quantitative/ Qualitative
5. How to develop an interactive and wireless monitoring and controlling electrical appliances using sensors and android phone that will support efficient and	Interview	Head Coordinator/ Maintenance Officer	Quantitative/ Qualitative

convenient usage of appliances inside a computer laboratory?			
6. How effective the proposed system be measure based on the following? 5.1. Functionality 5.2. Usability 5.3. Operability 5.4. Security	Interview	Head Coordinator/ Maintenance Officer	Quantitative/ Qualitative
7. How can the Raspberry Pi be integrated using WLAN technology integration suits to prospect towards the implementation of the proposed system?	Interview	Head Coordinator/ Maintenance Officer	Quantitative/ Qualitative

The researchers conducted an interview to the employees to answer the problems stated in Chapter 1. The table above shows the data analysis plan of Computer Laboratory electrical appliances monitoring and controlling system in Raspberry Pi using Fuzzy Logic Algorithm. It included the problem statement, procedure or tools, sources of data and analysis.

Technical Aspects

Technical Innovation means developing new ideas, products, services, and processes which exploit technology. At its best, Tec novation creates valuable products and services that no one yet asked for or creates. Tec novation's success in changing world' attitudes about technology. Together, they build the world of Innovation from creative ideas.

Innovation not only means improving but insights help among countries (Ndesaulwa, A. P. & Kikula, J., 2016).

As a result, the proponents wanted to make a system with the use of innovative technology in the society that would be beneficial in every individual. The proponents will be discussing the different Hardware, Software, People ware and Network that will be used to make the system possible.

i.   Hardware

Technology has changed society throughout history. Over the last few decades, mobile devices, iPads, iPods, computers, and most importantly the internet have completely overhauled the way people interact in society and the way educators work in schools. (Sutton,2013)

Early 2012, there is this new released technology called "Raspberry Pi", it is a small board computer   because of its purpose, capabilities, and usefulness. so far they have focused on different technologies. For example, building a cloud, tracking system and surveillance system, and some the projects that you can create using raspberry pi are using blue-tooth or Wi-Fi based applications.

The researchers will use, Laptop/ Personal Computer, Android Device(s), and Raspberry PI 3 Model B/B+ , Lights, Relay Channel, Temperature sensor, and Breadboard as hardware to create the proposed system. PC/ Laptop and Raspberry PI 3. The researchers will be using PC/laptop and a Raspberry PI 3 in connections to each other.

ii.   Software

Software is a program that enables a computer to perform a specific task, as opposed to the physical components of the system. This includes application software such as a word processor, which enables a user to perform a task, and system software such as an operating system, which enables other software to run properly, by interfacing with hardware and with other software (ScienceDaily, 2018).

Software, instructions that tell a computer what to do. Software comprises the entire set of programs, procedures, and routines associated with the operation of a computer system (The Editors of Encyclopaedia Britannica, 2018).

iii.   Peopleware

According to Techopedia (2018), peopleware refers to the human role in an IT system. These includes not only the researches but the people who were present along the study (respondents). The study will have greater benefit the people involved. Especially, those who are in the maintenance staff that are handling the computer laboratories.

Chapter 4

DESIGN AND METHODOLOGY

This chapter presents the frameworks, diagram, architecture, and algorithm that being implemented to the proposed system. Those that were included in this chapter helps in presents the flow of the system and pseudocodes that are being used.

Conceptual Framework

The conceptual framework shows the IPO (Input Process Output) of the study. It includes the diagram and scope of the study how the system work

Input

Power Outlet providing a given electrical appliances

Relay Channel and Current Sensor

Process

The signal passes through the device within the server

Fuzzy Logic Algorithm

Multi-Agent System

Output

Result of the control processed in device from the user on/off of the electrical appliances

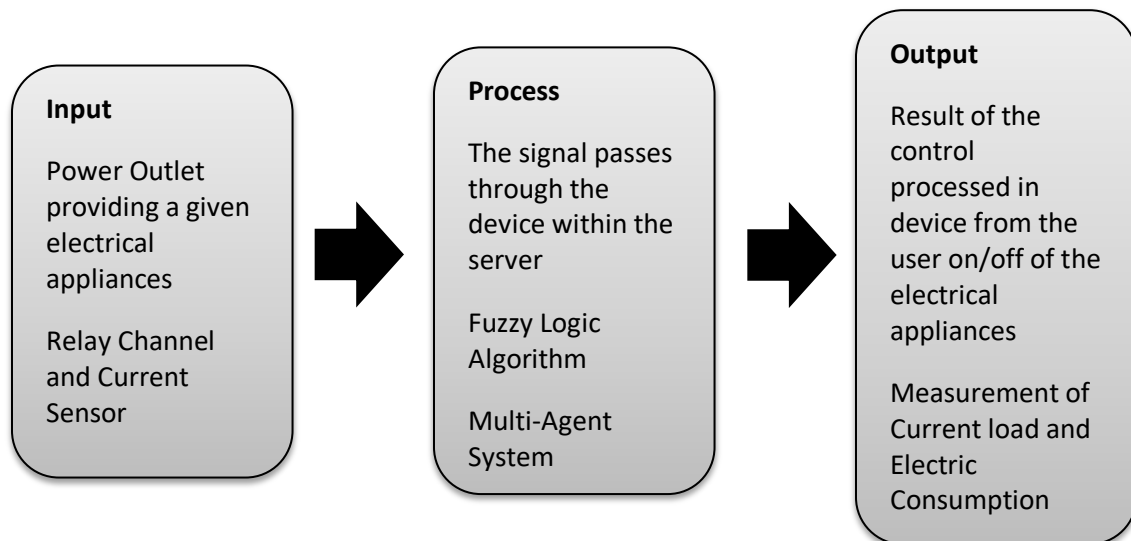Measurement of Current load and Electric Consumption

Figure 2. IPO model of the proposed study

Concept is coordinated with the objectives of the study properly. The input consists of the given electric appliance placed on each electric socket for switching on/off and measuring of each current load and electric consumption.

The process where the signal passes through the Raspberry Pi device and the current sensor placed through the designated area using the fuzzy logic algorithm. The multi-agent system will provide the automation inside the room. This process will be going to the output of the desired control by the user.

The result of the control triggered by the user will be the output of the system. Switching on and off will be output to the given electrical socket with current sensor to give current load and electric consumption of each electric appliances.

Theoretical Framework
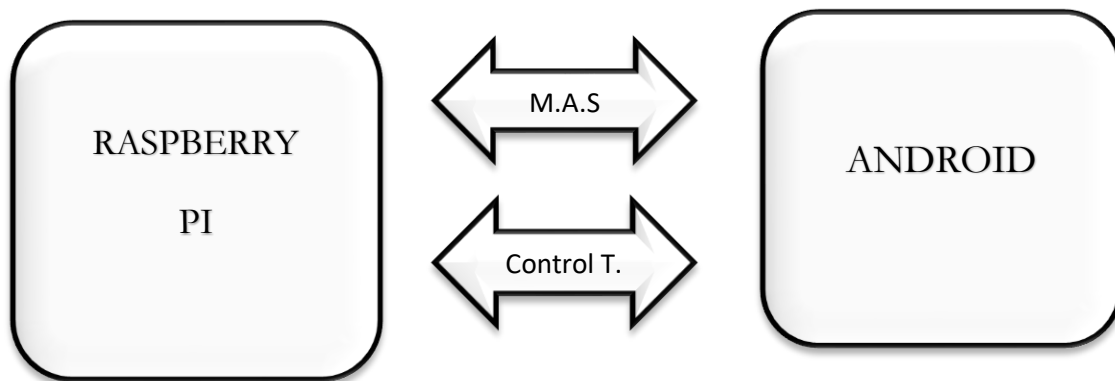
Figure 3. Framework of the proposed study

The researchers summarized and adapted the theories about related in their system. It gives reference and based to the theories giving related to their system. Multi-agent system or "self-organized system" is system with multiple interacting intelligent agents that can solve problems that are difficult for an individual agent to give solution.

It is needed to implement for automations and smart technologies. Distributes computational resources and capabilities across a network of interconnected agents. Whereas

a centralized system may be plagued by resource limitations, performance bottlenecks, or critical failures, a MAS is decentralized and thus does not suffer from the "single point of failure" problem associated with centralized systems. MAS allows for the interconnection and interoperation of multiple existing legacy systems. By building an agent wrapper around such systems, they can be incorporated into an agent society.

The model problem in terms of autonomous interacting component-agents, which is proving to be a more natural way of representing task allocation, team planning, user preferences, open environments, and so on. It efficiently retrieves, filters, and globally coordinates information from sources that are spatially distributed.

MAS provide solutions in situations where expertise is spatially and temporally distributed. It enhances overall system performance, specifically along the dimensions of computational efficiency, reliability, extensibility, robustness, maintainability, responsiveness, flexibility, and reuse. (Carnegie Mellon University, 2013)

Control theory, deals with the behavior of dynamic systems. When one or more output variables of a system need to follow a certain reference over time, a controller manipulates the inputs to a system to obtain the desired effect on the output of the system.

It has become routinely practicable to design very complicated digital controllers and to carry out the extensive calculations required for their design. These advances in implementation and design capability can be obtained at low cost because of the widespread availability of inexpensive and powerful digital processing platforms and high-speed analog IO devices. (Simrock,2013)

System Architecture
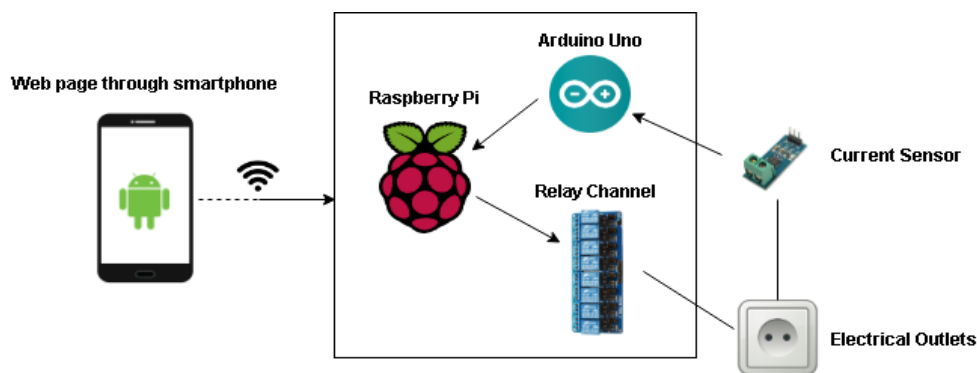
Figure 4. System Architecture of the proposed study

The figure above is the architecture of the proposed system, a way that guides the analysis about frameworks and the behaviors of the system. It will serve, as the conceptual model, that characterize the framework, behavior, and in different views of a system. For this model, the materials and elements used in the system were present.

It usually starts from the web page that user access. The web page has an authentication for security reasons. It will ask you the given password for the security level, admin level and OJT level, given by the administration. It will send to the Raspberry pi through the WLAN connection. Then you can go to the menu and select to control and monitor appliances. Since Raspberry Pi has a built in Wi-Fi module, the Wi-Fi signal pass through the Raspberry Pi. The Relay channel, responsible for switching on and off device, is connected to the Raspberry Pi. The current sensor is connected to the Arduino, making the sensor being read and monitored. Then, the connection between Arduino and Raspberry Pi is through a serial bus type for sending the signal of numbers carrying the monitoring the

electricity consumption, voltage, ampere and kilowatt hour. The Fuzzy Logic Algorithm with the help of PHP will provide the on and off switches through the proposed system.

Block Diagram
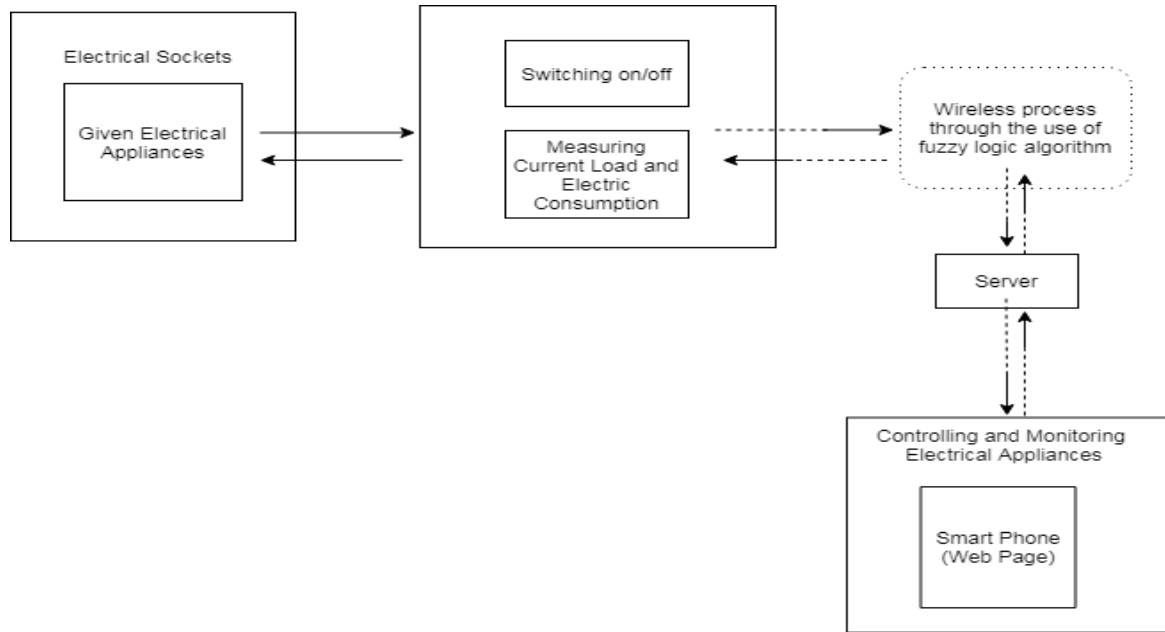
Figure 5. Block Diagram of the proposed

As the diagram shows, the electrical sockets place for each electrical appliance will be the input of the system. Through the use of authenticated web page providing a security level for the privilege users, the Wi-Fi signal pass through by server. The Raspberry Pi will receive the server response for the process, exchange signal for IPO process. Using Fuzzy Logic will apply to the relay channel where it is going to control and monitor the electrical appliances. The current sensor will determine the current load and electric consumption of the electrical appliances.
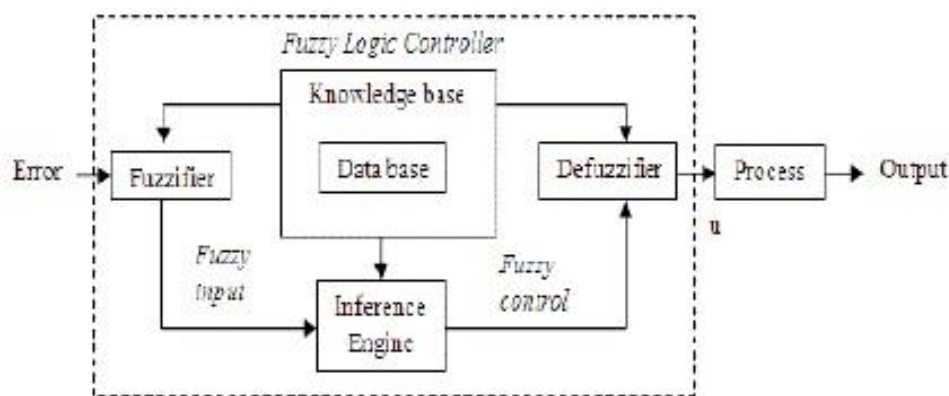
Algorithm

This chapter discusses about how the researchers applied the algorithm in the research. The researchers use different kind of algorithm to make the proposed system.

Fuzzy Logic

Fuzzy logic is a powerful, problem-solving technique especially in the areas of control and decision making. For instance, fuzzy logic has been employed in such tasks as managing stock-market portfolios and controlling subway systems

It is implemented of 1's and 0's that are set value to true or false. Conditional statement or If-else statement is used to determine the value set to true and false.

By introducing the notion of degree in the verification of a condition, thus enabling a condition to be in a state other than true or false, fuzzy logic provides a very valuable edibility for reasoning, which makes it possible to take into account inaccuracies and uncertainties. One advantage of fuzzy logic in order to formalize human reasoning is that the rules are set in natural language (Dernoncourt, 2013).

Figure 6. How Fuzzy Logic Works

The researchers used Fuzzy Logic Algorithm, because of the switching conditions from device to the process that will output. The algorithm is responsible for conditions using true and false. If the conditions are met, the machine will process according to the switching conditions. These conditions will process through the signals and going to the designated devices.

Pseudocode of Fuzzy Logic Algorithm:

```php
<?php
 $pin = $_GET['pin'];

function checkstate($pin)
{
  return shell_exec("gpio -g read $pin");
}

$state =  checkstate($pin);

//0ff
if($state==1){
        shell_exec("gpio -g write '$pin' 0");
        $color = 'blue';
}else{
        shell_exec("gpio -g write '$pin' 1");
        $color = 'red';
}

        if($state==1){
        echo "ON";
        }
        else{
        echo "OFF";
        }

 ?>
```

Chapter 5

RESULTS AND DISCUSSIONS

In this chapter contains the overall results of the survey conducted from the respondents of the study. The data and results of the proponents had gathered from the interview & post-survey are systematically summarized and interpreted in tables of graphs. To be easily understood. It also helps to identify the problems that may encounter in using the proposed system.

To know what are the common electrical appliances that can be found in computer laboratory

The researchers conducted a post-interview in some different college schools inside the vicinity of Laguna, knowing what common electrical appliances are inside of a computer laboratory. The respondents are each representative of each school in managing for computer laboratory. Some of them are maintenance officer, MIS, and ITS head coordinator. Here are the common electrical appliances and their numbers according to the

Table no 3. Result of the interview in question no. 1, 2 and 3 of "Computer Laboratory Monitoring and Controlling Electrical Appliances using Raspberry Pi with Fuzzy Logic" average

List of Common Electrical Appliances	LSPU	LCBA	STI	CCC	Total	Ave
Lights (LED)	6	6	5	6	23	6
Fans	3	0	0	2	5	1
Desktop computers	25	48	45	30	148	37
Network switches	1	2	3	1	7	2

|						
Air conditioners	1	2	2	1	6	2
Televisions	1	0	0	1	2	1
Total	37	58	55	41		

Table 2 shows the total of electrical appliances in all schools that are interviewed and average of electrical appliances that can be found inside of a computer laboratory. Lists are include in overall common electrical appliances including lights (LED), fans, desktop computers, network switches, air conditioners, and televisions. Lights with total of 23 and average of 6, fans have 5 and average of 1, and desktop computer have 148 and average of 37. Network switches with total of 7 and average of 2, air conditioners have 6 and average of 2, and televisions have total of 2 and average of 1. The figure below following shows the graphical presentation in each electrical appliance for each school that is interviewed.

**Figure 7. Graphical Representation of Pre-survey question No.1**
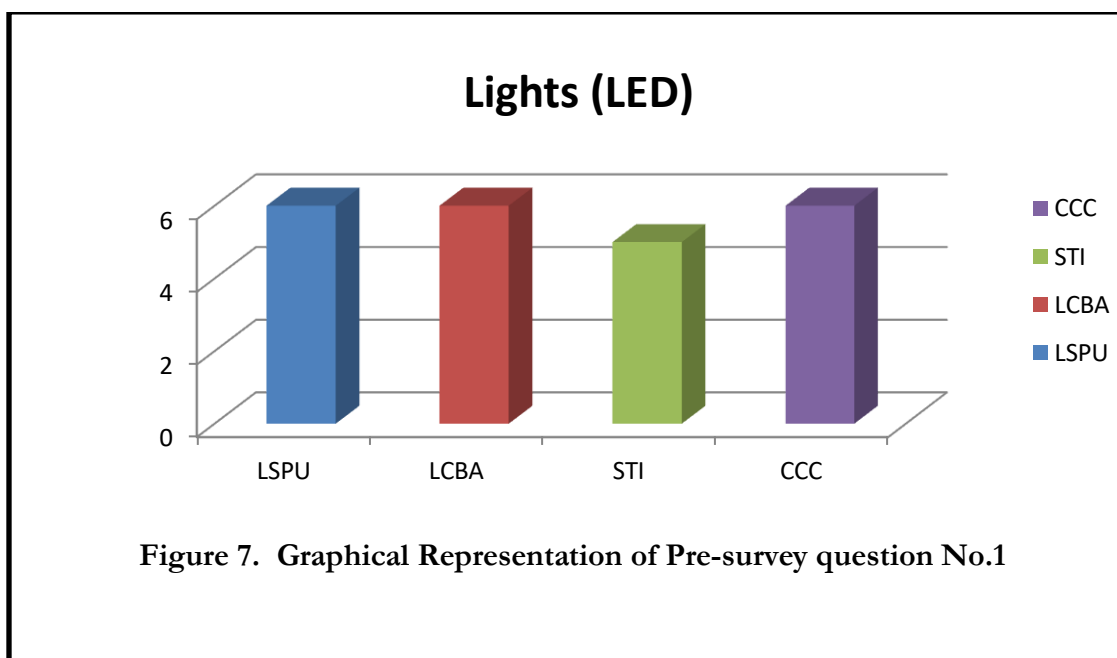
The graph above shows the interpretation of pre-survey questions no.1. for lights(LED). LSPU, LCBA, and CCC have 6 lights average per room, while STI has 5 lights led. Their difference also is in size of a room and scale power of the light.

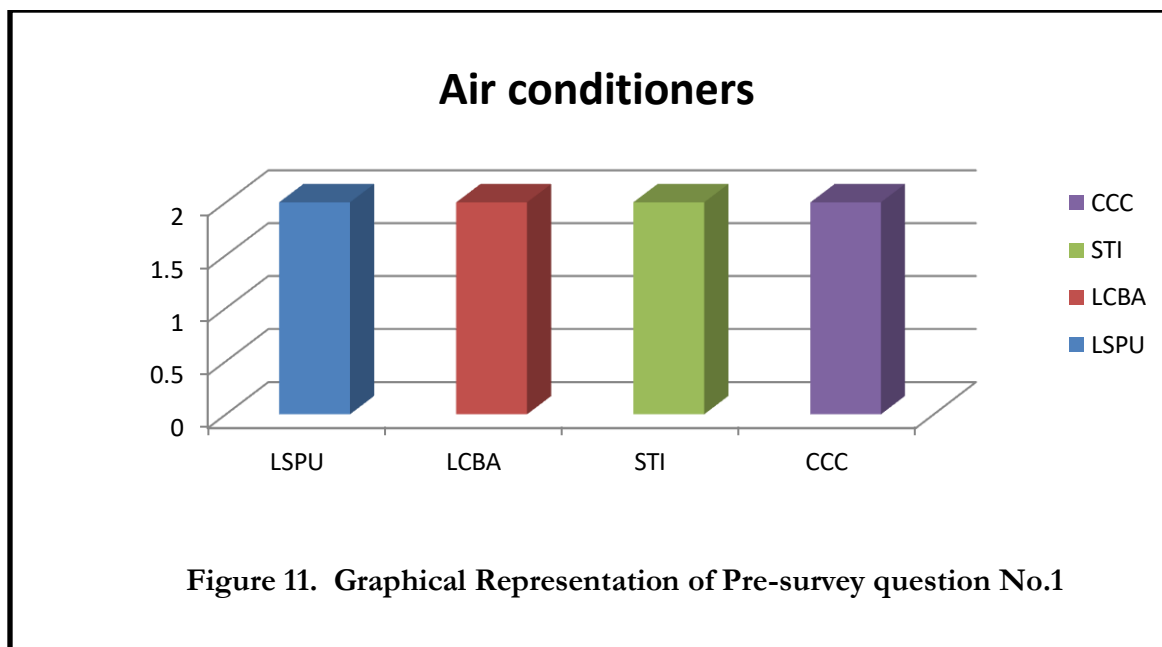**Figure 8. Graphical Representation of Pre-survey question No.1**
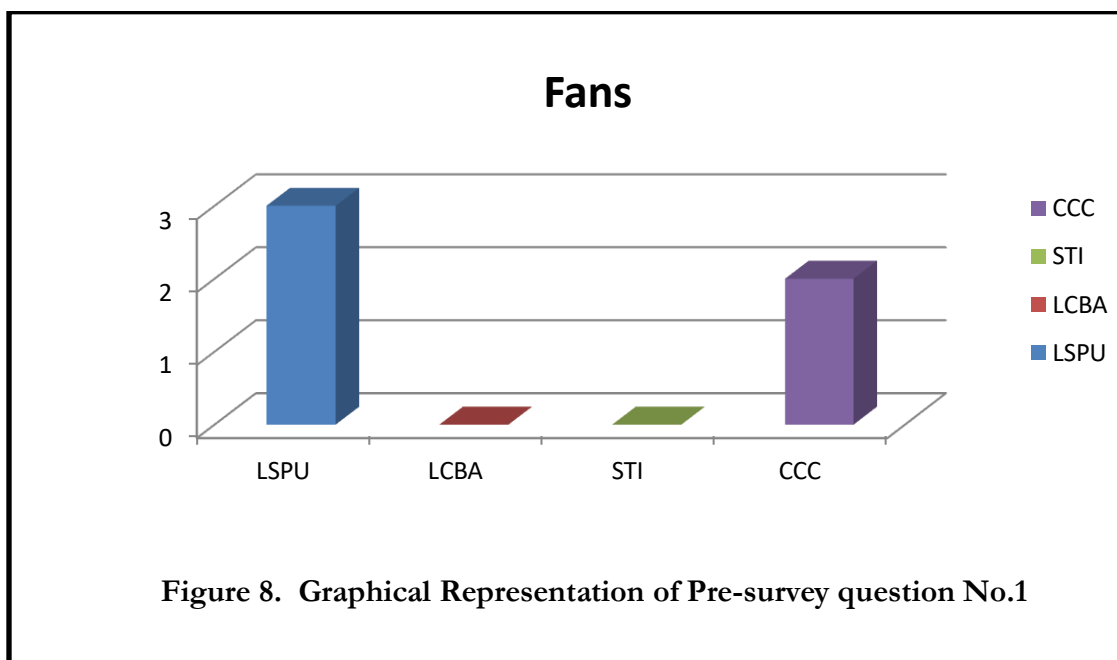
The graph above shows the interpretation of pre-survey questions no.1. for fans. LSPU, has 3 fans, CCC has 2, and others have no fans per room. Their difference also is in size of a room and temperature in every room.

Desktop Computers

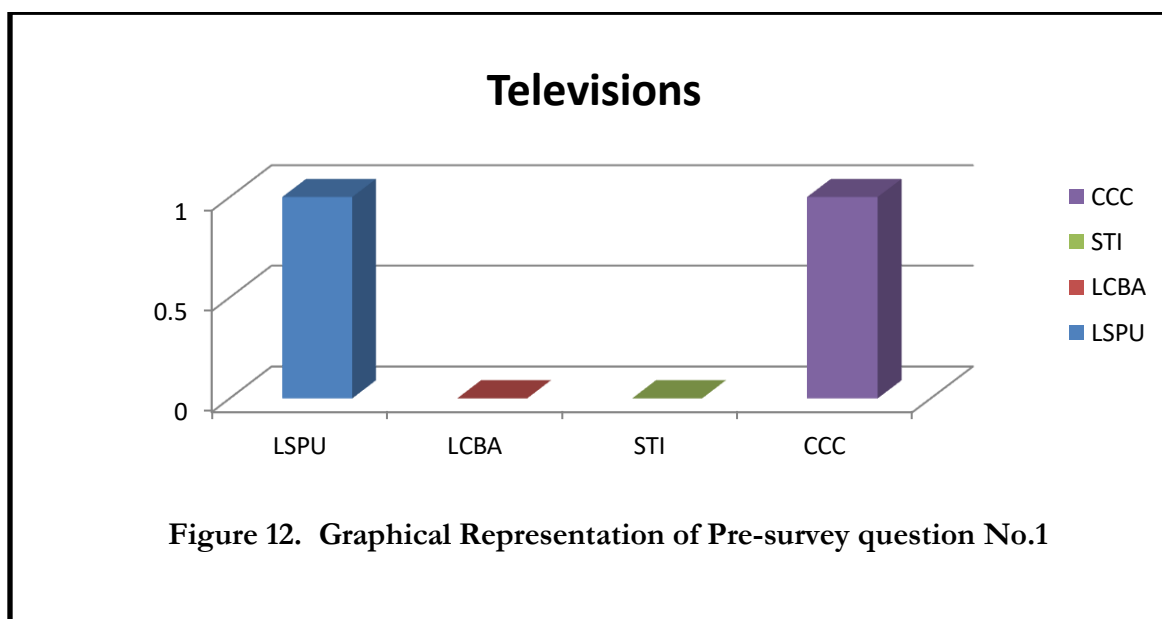**Figure 9. Graphical Representation of Pre-survey question No.1**
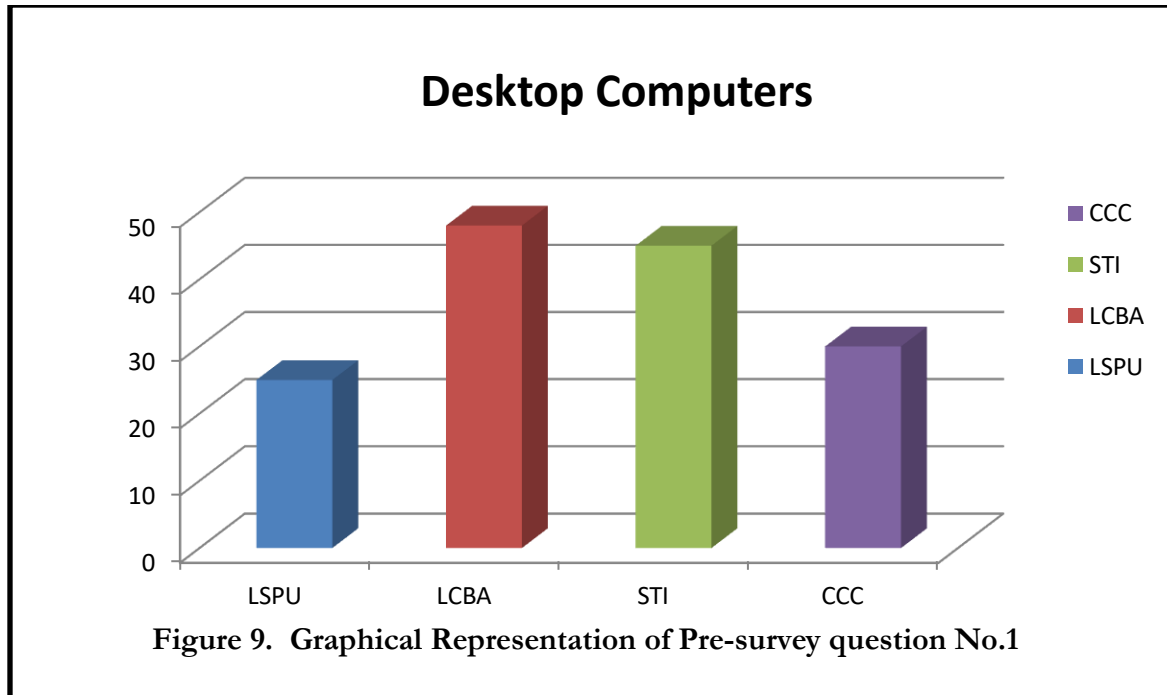
The graph above shows the interpretation of pre-survey questions no.1. for desktop computers. LSPU has 25 desktop computers, while LCBA has 45. STI has 45 desktop and computers and CCC has 30. Their difference is in size of a room, comparing to the other rooms. Also, the provided desktop computers are different in each room of their computer laboratories.

Figure 10. Graphical Representation of Pre-survey question No.1
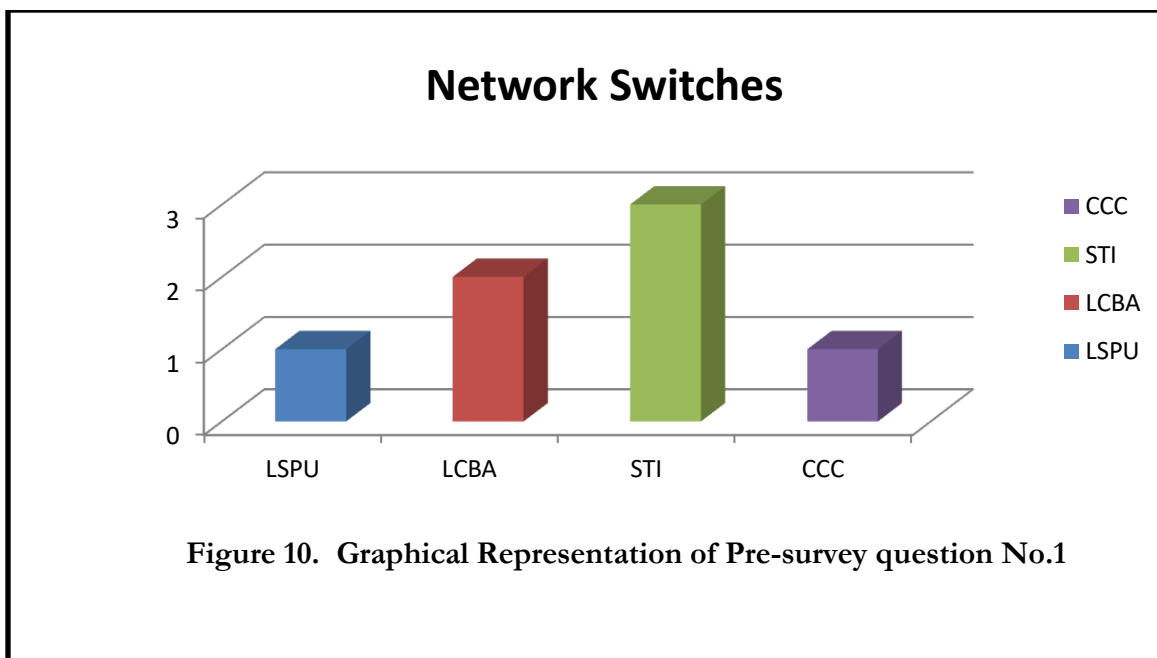
The graph above shows the interpretation of pre-survey questions no.1. for network switches. STI has 3 network switches per room, while the LCBA has 2. The other has only one network switch per room. Their difference is in size of a room, comparing to the other rooms. Also, the network switch is connected for provided desktop computer in each room of their computer laboratories.

Figure 11. Graphical Representation of Pre-survey question No.1

The graph above shows the interpretation of pre-survey questions no.1. for air conditioners. All of them have 2 air conditioner per room. Their difference also is in size of a room and temperature needed for a room.

Figure 12. Graphical Representation of Pre-survey question No.1

The graph above shows the interpretation of pre-survey questions no.1. for televisions. LSPU and CCC have 1 television per room, while the others have no television inside their computer laboratory. Their difference is in size in each room, and provided also other equipment for presenting a work like projectors, desktop computers, and etc...

To know what are the common ways in monitoring and controlling the electrical appliances that can be found in computer laboratory

The researchers conducted a post-interview, where the question is in what common ways are the electrical appliances being monitored and controlled inside a computer laboratory, in some different college schools inside the vicinity of Laguna with each representative of our respondents. The researches use a common term for the result. Here are the common ways in monitoring and controlling electrical appliances.

Table no 4. Result of the interview in question no. 4 and 5 of "Computer Laboratory Monitoring and Controlling Electrical Appliances using Raspberry Pi with Fuzzy Logic"

List of Schools	Typical/Conventional Switch	Full Control / Breaker
LSPU	✓	✓
LCBA	✓	✓
STI	✓	
CCC	✓	✓

The researchers proving a solution in proposing to their system, where the electrical appliances inside of computer laboratories are control and monitor wireless using a WLAN connection inside the area of the bandwidth

To identify the weaknesses that is encountered by every professor and maintenance staff in using the manual controlling and monitoring of electrical appliances.

In the post-interview conducted by the researchers, where the question is to identify the weaknesses that are encountered by every professor and maintenance staff in using the manual controlling and monitoring of electrical appliances, the respondents identified the weakness in table below. Here are the common term for their answers.

Table no 5. Result of the interview in question no. 4 and 5 of "Computer Laboratory Monitoring and Controlling Electrical Appliances using Raspberry Pi with Fuzzy Logic"

List of Schools	Reasons
LSPU	Left Unattended, Strenuous to manual check, No much security and no technicians
LCBA	Left Unattended, and takes a long time to control and monitor
STI	Takes a long time to control and monitor, and Strenuous to manual check
CCC	Takes a long time to control and monitor, and Strenuous to manual check

The negative outcomes common are included that some electrical appliances can be damaged due to the idle according to the temperature and moisture of the air conditioners

provided in each room. Also, the common possible negative outcome for the weakness is causing fire, if the status of an electrical appliance is in danger or the wirings have a short circuit. Idle of some electrical appliances will result in high bill electricity.

The researchers also proving in their proposing system, where it is to innovate and wireless controlling and monitoring electrical appliances, having a much convenient to use and efficient, also to lessen positive danger and prevent damage to the electrical appliances that are left unattended in an idle state.

To improve in terms of efficient and convenient when using electrical appliances by the professor and maintenance staff inside a computer laboratory

The researchers conducted a post-interview and propose their system, to monitored and controlled an electrical appliances in a wireless and efficient way, to the respondents. All of their answers are agreed, some have a little cons about the proposing system. Here are the terms of the respondent's answers

Table no 6. Result of the interview in question no. 9 of "Computer Laboratory Monitoring and Controlling Electrical Appliances using Raspberry Pi with Fuzzy Logic"

List of Schools	Answer
LSPU	**Yes, but it can consume electricity consumption**
LCBA	**Yes, efficient, convenient and has autonomous user level**
STI	**Yes, it can make the job easier**
CCC	**Yes**

Professors and maintenance staffs are able to find the proposed system being useful to the computer laboratories in last post-interview. Their work can be improved to this kind of proposed system, and it can lead to have a better manageable in computer laboratories in

each schools. These answers also to the statement where it is to providing a system with an efficient solution.

To create and to develop an interactive and wireless monitoring and controlling electrical appliances using sensor and web page through the mobile phone that will provide efficient and convenient usage of electrical appliances inside a computer laboratory

The researchers proposed a system where it is use by mobile phone through the use of web page, where it is more find usable in each computer laboratories having a WLAN connection. It is act as the controlling and monitoring of electrical appliances. According to the respondents in last interview, it also find it usable and less hassle to use for using electrical appliances inside and even outside of the computer laboratory.

To design a Raspberry Pi to be integrated using WLAN technology integration suits to prospect towards the implementation of the proposed system

Many microcontrollers are fitted to be implementing to this kind of proposed system. It suits to being the web server of the proposed system and it is also easy to setup a wireless connection with other microcontroller. Even to the other setups of an automation system, it can cost two to three times to the proposed system. The respondents also agree through the use of a web page with a login for security and database, also it is fitted to be implement for the computer laboratories through the use of WLAN connection.

The post-survey conducted by the researches has a data and presentation to give a qualifying to the proposed system.

Table 7.Likert's Scale Conversion Table

Interpretation	Range
Strongly Agree	5.0 - 4.51
Agree	4.50 – 3.51
Undecided	3.50 – 2.51
Disagree	2.50 – 1.51
Strongly Disagree	1.50 – 1.00

Table 6 shows the numerical scale or Liker Scale used by the proponents in evaluating the system. This method is used to organize the gathered evaluation sheets and to monitor the corresponding respondents. The numerical rating is from 1 to 5 which are equal to Strongly Agree, Agree, and Undecided, Disagree, Strongly Disagree. Corresponding to that is the formula getting Weighted Mean Score. It is needed to get the overall result of each question.

Weighted Mean Score Formula:

$$WMS= \frac{(SA*5) + (A*4) + (U*3) + (D*2) + (SD*1)}{TNR}$$

SA= no. of respondents who strongly agreed

A= no. of respondents who agreed

U= no. of respondents who said undecided

D= no. of respondents who disagreed

SD= no. of respondents who strongly disagreed

W= Weighted Mean

TNR= Total Number of Respondents

This is the first part of data gathering done by the researchers. The data are being referenced into the respondents of this study to provide strong evidence that they are experiencing these effects. This has been done by giving some questionnaires to the respondents, which aimed to get their sides concerning the issue. Consist of 25 maintenance staff, On-The-Job training students, and professors, who are respondents in the study, in schools who have computer laboratories in the vicinity of Laguna. These respondents are being selected according to the purpose of the study.

To evaluate the proposed system in terms of:

Figure 13. Graphical Representation of Question No.1 in terms of Functionality
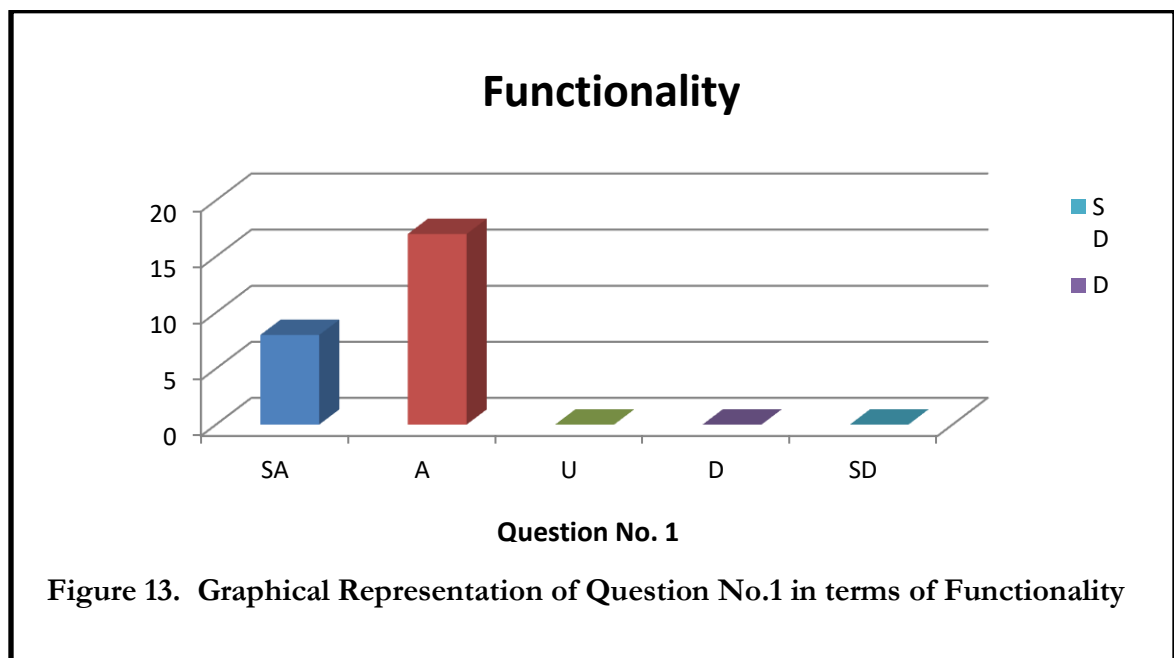
The graph above shows the interpretation of questions no.1. 18 answered with "Agree" and the other 7 answered with "Strongly Agree", while none have answered the others interpretation. With the weighted mean of 4.32 which has equivalent interpretation of "Agree". The user agreed that the system can work on different devices.
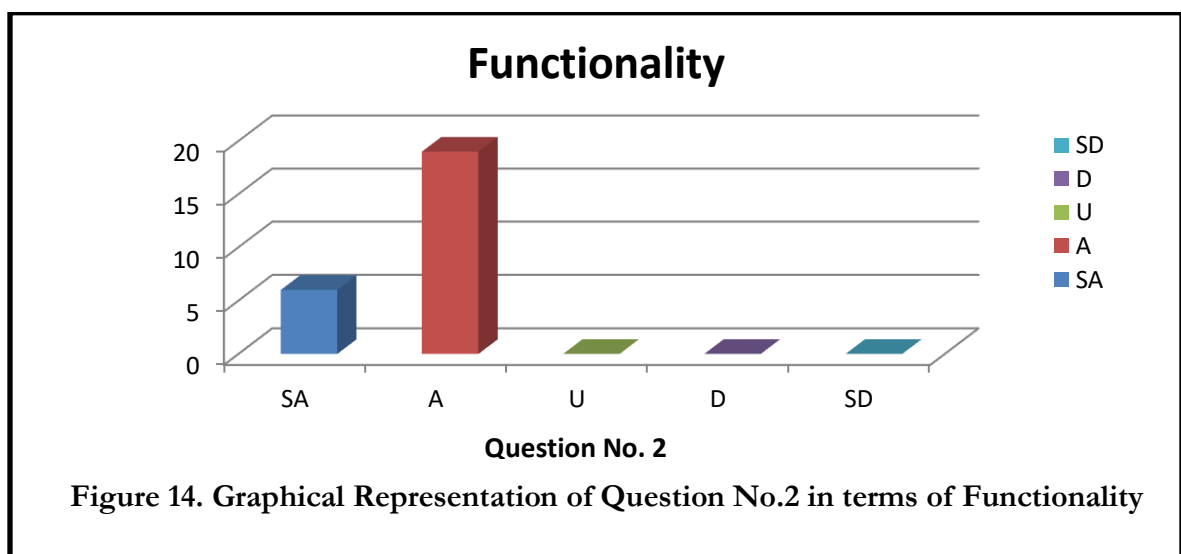

Figure 14. Graphical Representation of Question No.2 in terms of Functionality

Figure 14 shows the result of question number 2. It shows that out of 25 respondents 19 answered "Agree" while the remaining 6 answered "Strongly Agree". With the weighted mean of 4.24 which is equivalent to "Agree", the respondents is satisfied that the proposed system is working in terms of monitoring and controlling different appliances inside a computer laboratory.
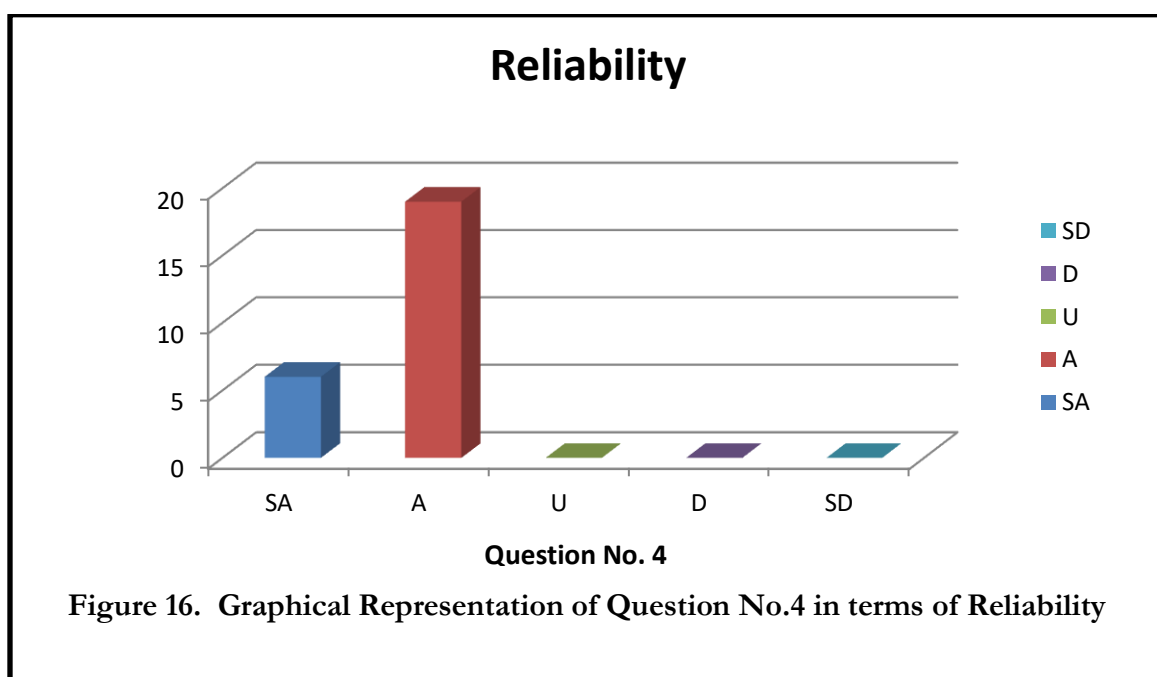
Figure 15. Graphical Representation of Question No.3 in terms of Functionality
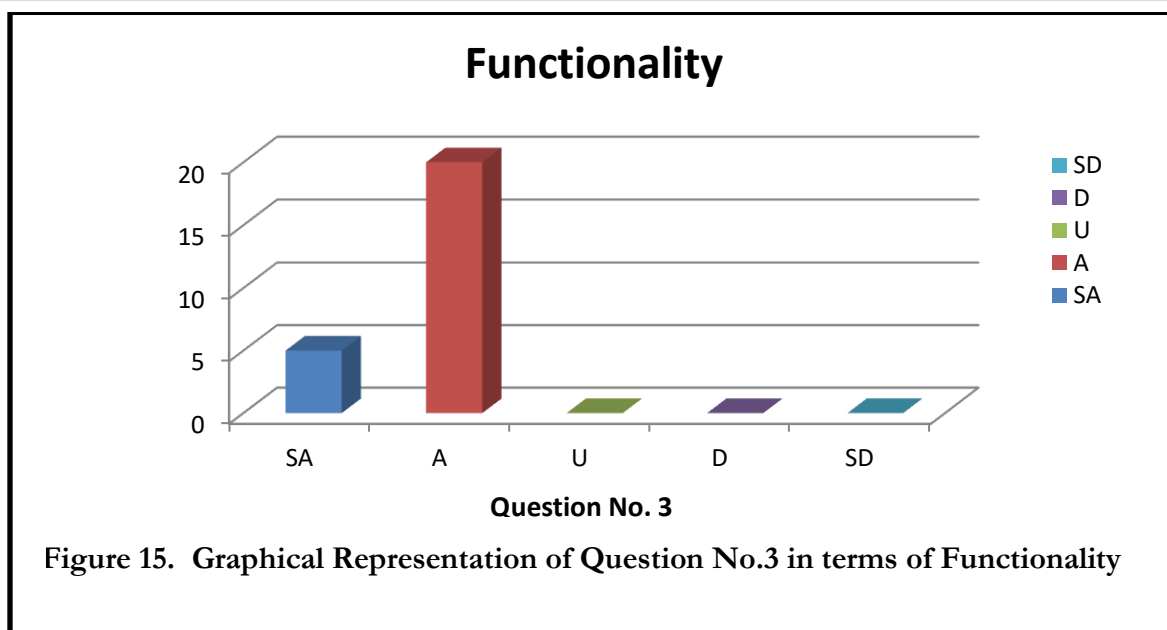
This figure shows that most of the respondents answer "Agree" rather than the other choices. 20 out of 25 answer "Agree" and the other 5 answered "Strongly Agree". With question no. 3, the weighted mean is 4.2 the respondents "Agree" that the Wi-Fi connection of the proposed system is easily established.

Table 8. Result of the evaluation of "Computer Laboratory Monitoring and Controlling Electrical Appliances using Raspberry Pi with Fuzzy Logic" in terms of Functionality.

| Criteria						Total Samples	
Functionality	SA	A	U	D	SD	WMS	Interpretation
1. The system can work on different devices.	8	17	0	0	0	4.32	Agree
2. The system can work in terms of monitoring and controlling different electrical appliances	6	19	0	0	0	4.24	Agree
3. Wi-Fi connection is easily established.	5	20	0	0	0	4.2	Agree
Average						**4.25**	**Agree**

Table 8 shows the total tally of the evaluation in terms of functionality. Functionalities refer to the capabilities of the system to provide function which meet the stated and implied the needs of the users. With the 4.25 weighted mean which is equivalent to "Agree". The users find it that the system can work in terms of functionality.

Figure 16. Graphical Representation of Question No.4 in terms of Reliability

This figure shows that most of the respondents answer "Agree" rather than the other choices. 19 out of 25 answer "Agree" and the other 6 answered "Strongly Agree". With the weighted mean of 4.24 the respondents "Agree" that the Wi-Fi connection of the proposed system is well established between devices.

Figure 17. Graphical Representation of Question No.5 in terms of Reliability
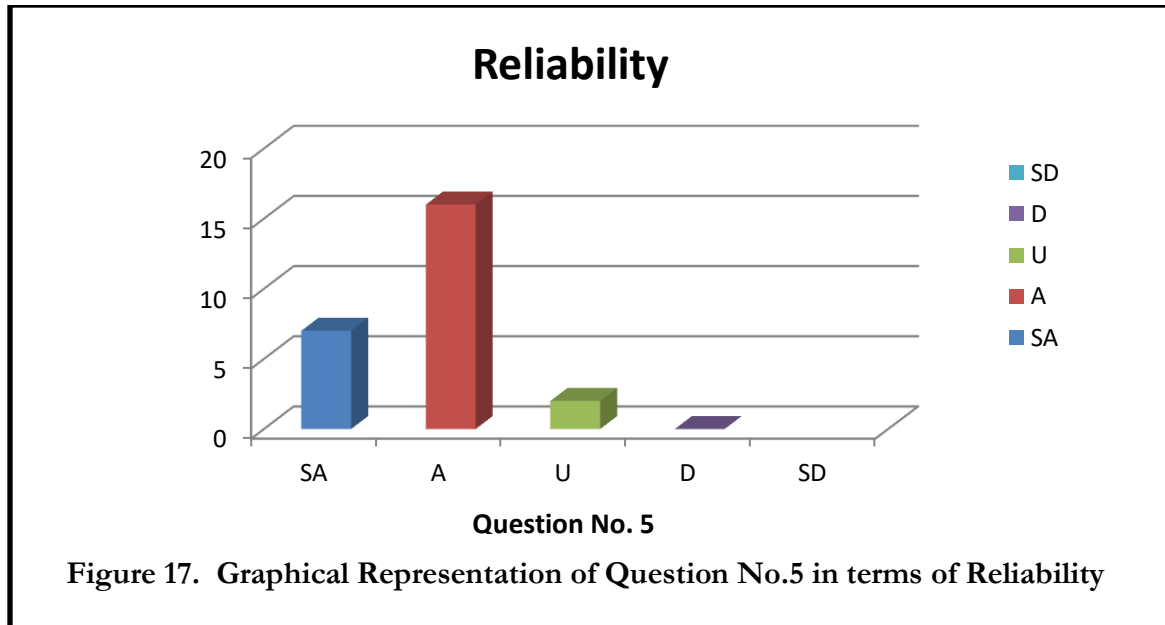
The figure above shows that most of the respondents chose the interpretation "Agree". 16 out of 25 chose "Agree" while 7 chose the interpretation "Strongly Agree" and the other 2 have chosen the interpretation "Undecided". Therefore with the weighted mean 4.2 and an equivalent of "Agree" the respondents "Agree" that the system can notifies the user about the error occurred while using the system.

Figure 18. Graphical Representation of Question No.6 in terms of Reliability
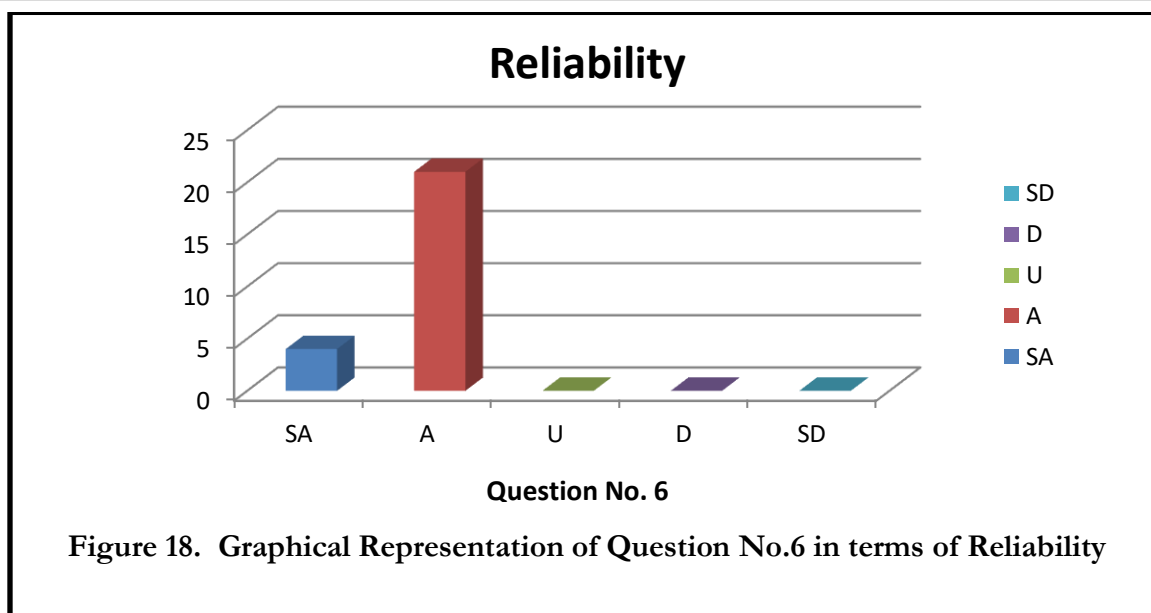
The figure above shows that majority of the respondents "Agree" to the system. 21 out of 25 chose "Agree" while the remaining 4 chose "Strongly Agree". With a 4.16 weighted mean that is equivalent to "Agree", the user satisfied that the current load and electrical consumption of electrical appliance.

Table 9. Result of the evaluation of "Computer Laboratory Monitoring and Controlling Electrical Appliances using Raspberry Pi with Fuzzy Logic" in terms of Reliability.

Criteria						Total Samples	
Reliability	SA	A	U	D	SD	WMS	Interpretation
1. Wi-Fi Connection is well established	6	19	0	0	0	4.24	Agree
2. The system can notifies the user about the error occurred while using the system	7	16	2	0	0	4.2	Agree
3. The system can monitor the current load and electrical consumption of electrical appliances	4	21	0	0	0	4.16	Agree
Average						**4.2**	**Agree**

Table 9 show the total tally of the evaluation in terms of reliability. Reliabilities refer to the capabilities of the system to provide reliable function to the users. With the 4.2 weighted mean which is equivalent to "Agree". The users find it that the system can work in terms of reliability.

Figure 19. Graphical Representation of Question No.7 in terms of Usability
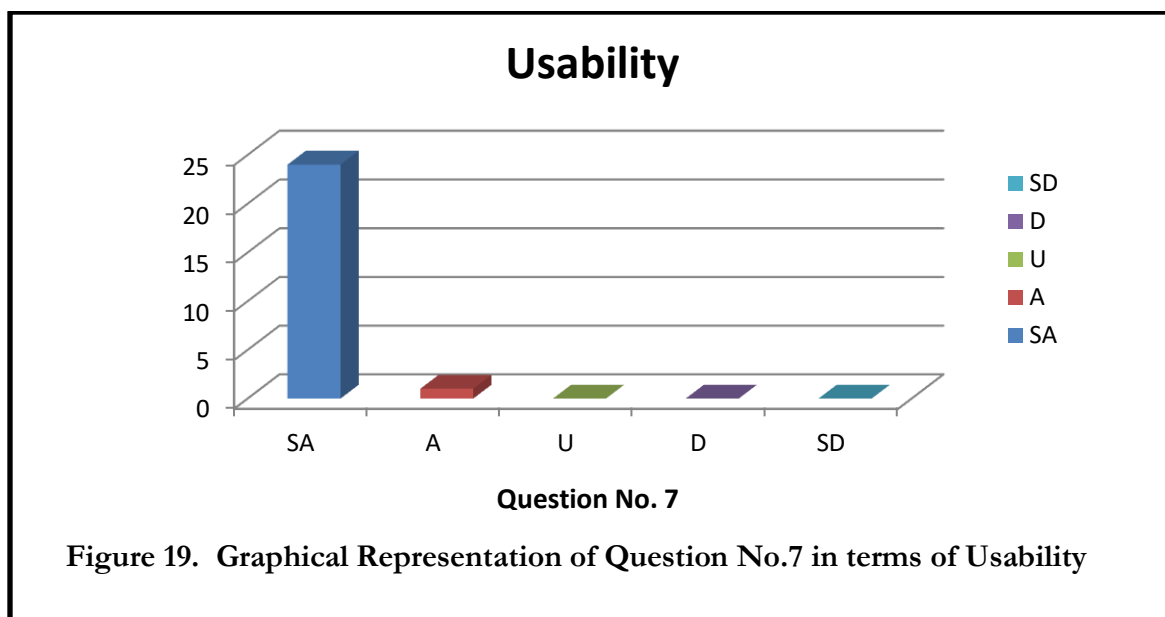
The graph above shows the interpretation of question no. 7, which is majority of the respondents answered "Strongly Agree".24 out of 25 answered "Strongly Agree" and the remaining 1 answered "Agree". With the weighted mean of 4.96 that is equivalent to "Strongly Agree". The respondents "Strongly Agree" that the flow of the system is easily followed by the users
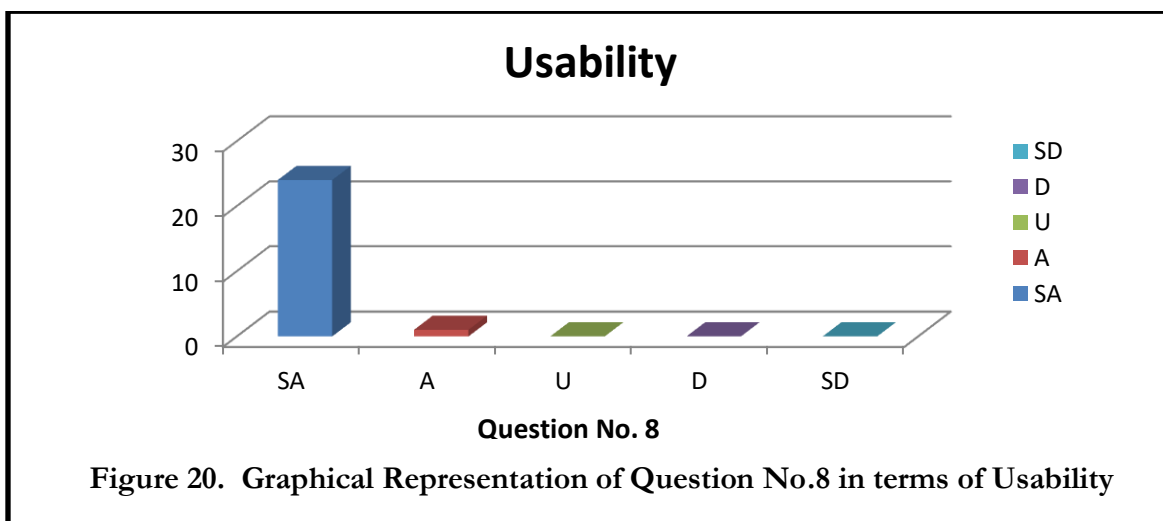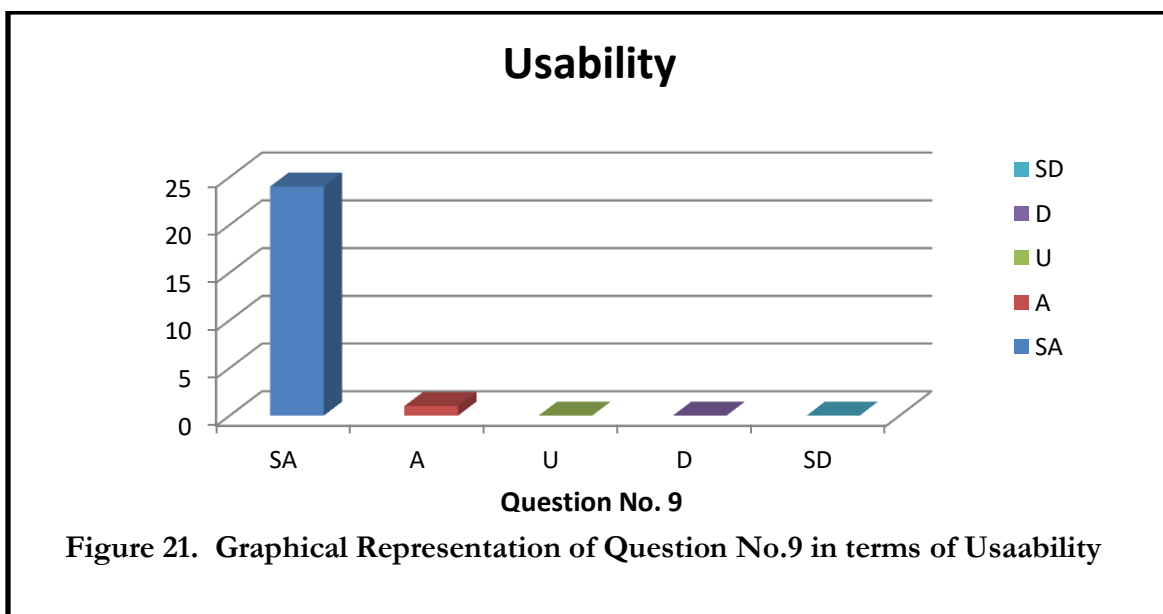
Usability

Figure 20. Graphical Representation of Question No.8 in terms of Usability

Figure 20 show that the majority of the respondents answered "Strongly Agree".24 out of 25 answered "Strongly Agree" and the remaining 1 answered "Agree". With the weighted mean of 4.96 that is equivalent to "Strongly Agree". The respondents "Strongly Agree" that the system has controls or buttons that is easy to click and responds quickly.

Usability

Figure 21. Graphical Representation of Question No.9 in terms of Usaability

The graph above shows the interpretation of question no. 9, which is majority of the respondents answered "Strongly Agree".24 out of 25 answered "Strongly Agree" and the remaining 1 answered "Agree". With the weighted mean of 4.96 that has interpretation of "Strongly Agree". The respondents "Strongly Agree" that the system is easily learned by the users.

Table 10. Result of the evaluation of "Computer Laboratory Monitoring and Controlling Electrical Appliances using Raspberry Pi with Fuzzy Logic" in terms of Usability.

Criteria						Total Samples	
Usablity	SA	A	U	D	SD	WMS	Interpretation
1. The flow of the system is easily followed by the users.	24	1	0	0	0	4.96	Strongly Agree
2. The system has control or buttons that is easily to click and responds quickly	24	1	0	0	0	4.96	Strongly Agree
3. The system can be easily learned by the users.	24	1	0	0	0	4.96	Strongly Agree
Average						**4.96**	**Strongly Agree**

Table 10 represents the total tally of the evaluation in terms of usability. Usability refers to the capabilities of the system to provide the proper way for the users to use the system. With the 4.96 weighted mean which is equivalent to "Strongly Agree". The users find it that the system can work in terms of usability.
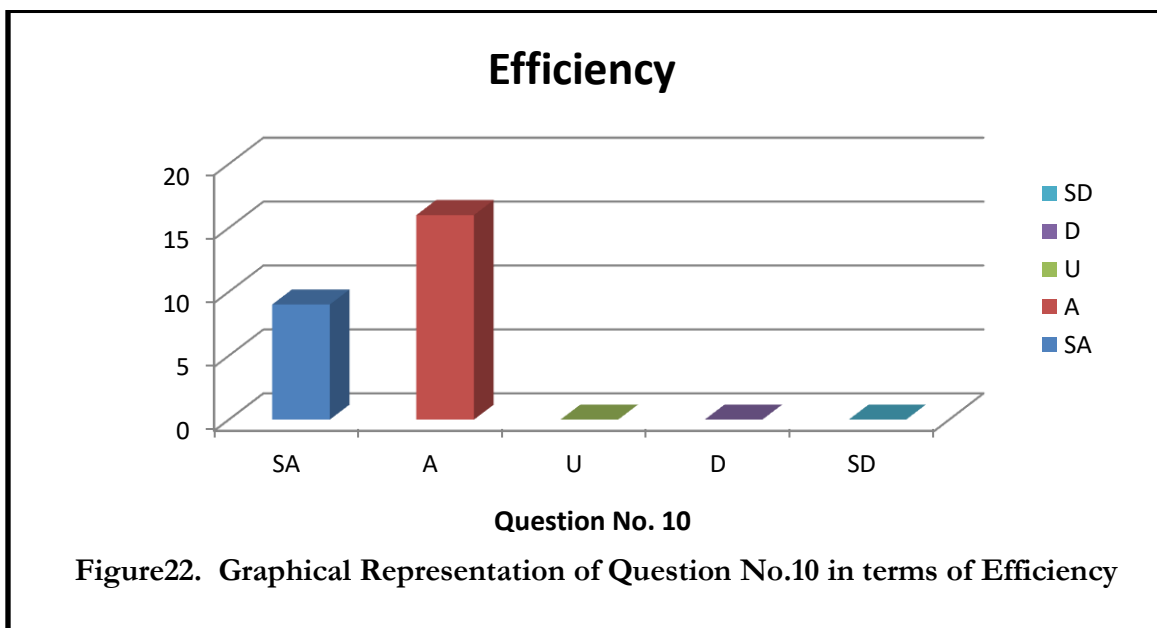
Figure22. Graphical Representation of Question No.10 in terms of Efficiency

Figure 22 show the interpretation of question no.10 that 16 out of 25 respondents answered "Agree" and the remaining 9 answered "Strongly Agree". With the weighted mean of 4.36 that has an interpretation of "Agree". The users "Agree" that the system consumes less data.

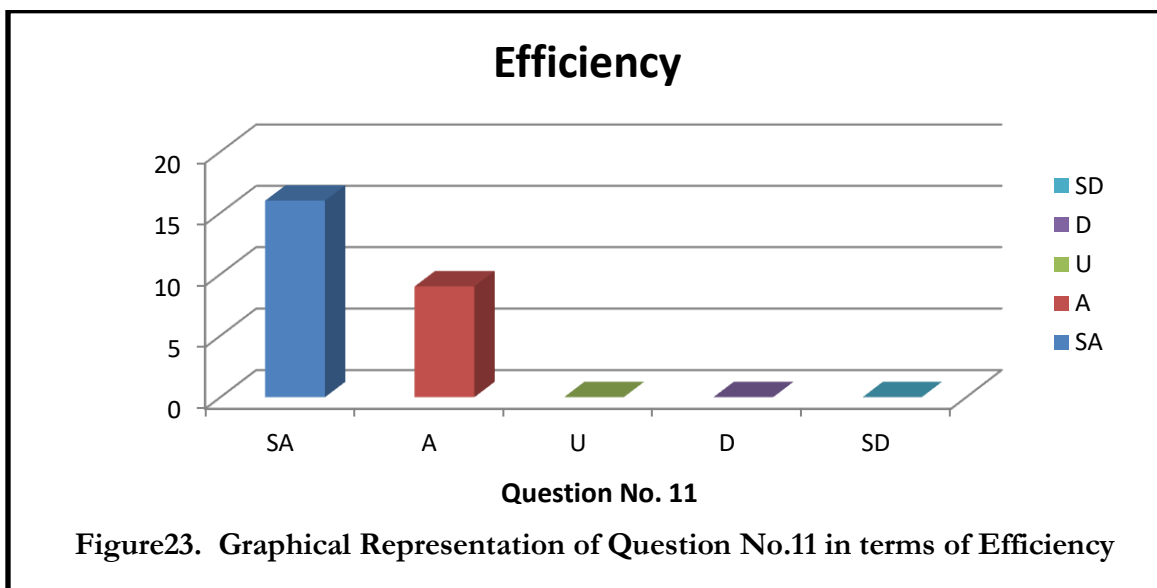**Figure23. Graphical Representation of Question No.11 in terms of Efficiency**

Figure 23 shows the interpretation of question 11. The figure shows that 16 out of 25 answered "Strongly Agree" while the remaining 9 answered "Agree". And with the weighted mean of 4.64 with the equivalent of "Strongly Agree", the users find the system can be used on different smartphone.

Efficiency

Figure24. Graphical Representation of Question No.12 in terms of Efficiency
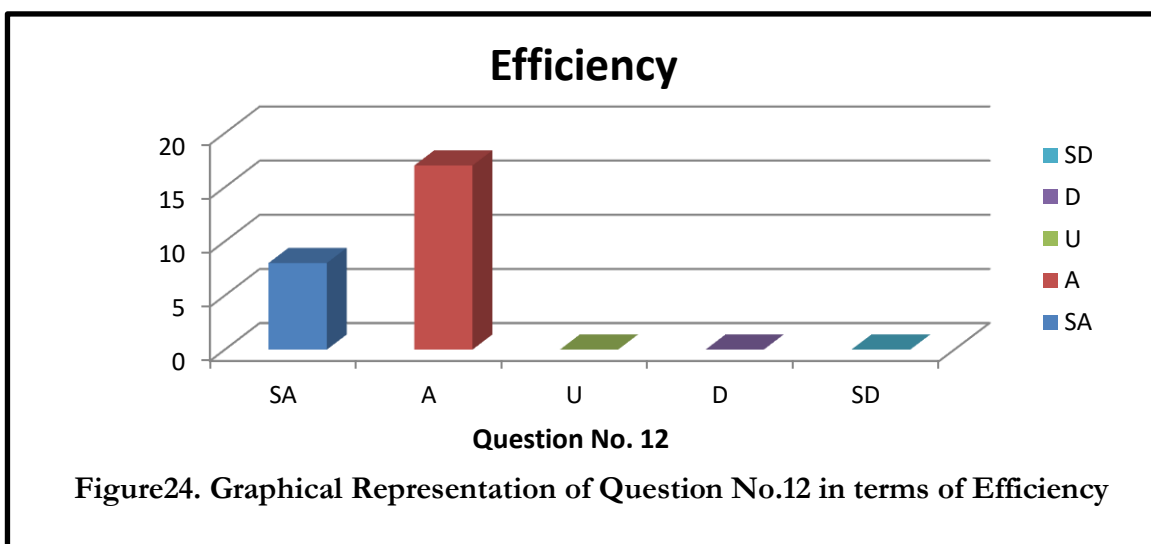
Figure 24 shows the graphical interpretation for question no. 12 and it show that only 17 out of 25 respondents answered "Agree" while the rest answered "Strongly Agree", and with weighted mean of 4.32 an equivalent to "Agree". The users "Agree" that the system can responds quickly even from long distance.

Table 11.Result of the evaluation of "Computer Laboratory Monitoring and Controlling Electrical Appliances using Raspberry Pi with Fuzzy Logic" in terms of Efficiency.

Criteria						Total Samples	
Efficiency	SA	A	U	D	SD	WMS	Interpretation
1. The system consumes less data on handheld devices	9	16	0	0	0	4.36	Agree
2. The system can be used on different smartphone	16	9	0	0	0	4.64	Agree
3. The system can responds quickly from long distance	8	17	0	0	0	4.32	Agree
Average						**4.44**	**Agree**

Table 11 represents the total tally of the evaluation in terms of usability. Usability refers to the capabilities of the system to provide the proper way for the users to use the system. With the 4.96 weighted mean which is equivalent to "Strongly Agree". The users find it that the system can work in terms of usability.
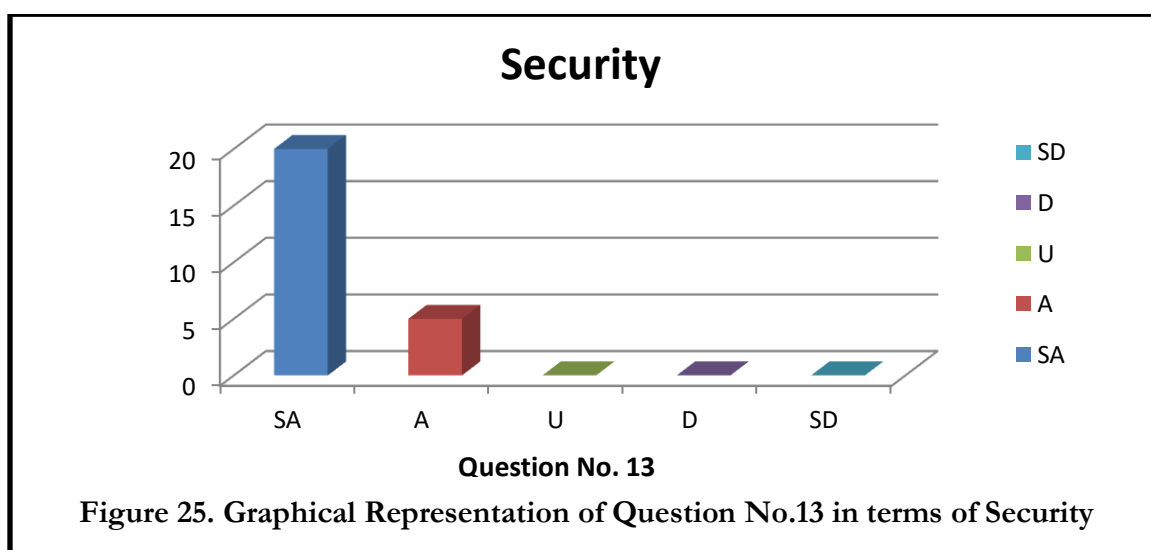

Figure 25. Graphical Representation of Question No.13 in terms of Security

Figure 25 shows the representation of question 13. It shows that 20 out of 25 respondents chose "Strongly Agree" while the remaining 5 answered the "Agree". Therefore with the weighted mean of 4.8 the users find it that the system can be access by authorized person only
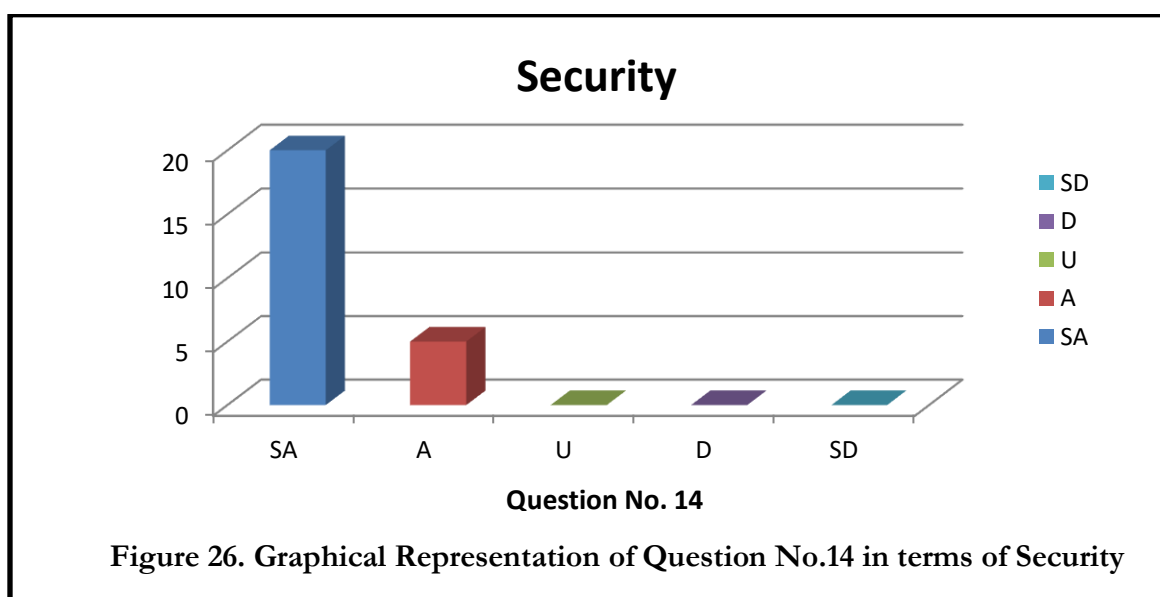

Figure 26. Graphical Representation of Question No.14 in terms of Security

Figure 26 shows the representation of question 14. It shows that 20 out of 25 respondents chose "Strongly Agree" while the other 5 answered the "Agree". Therefore with the weighted mean of 4.8 the users find it that the system secured when controlling limited electrical appliances through web page.

Table 12.Result of the evaluation of "Computer Laboratory Monitoring and Controlling Electrical Appliances using Raspberry Pi with Fuzzy Logic" in terms of Security.

Criteria						Total Samples	
Security	SA	A	U	D	SD	WMS	Interpretation
1. The system can be access by authorized person only	20	5	0	0	0	4.8	Strongly Agree
2. Controlling limited electrical appliances through web page is more secured	20	5	0	0	0	4.8	Strongly Agree
Average						**4.8**	**Strongly Agree**

Table 12 represents the total tally of the evaluation in terms of usability. Security refers to the capabilities of the system to provide security for the users to use the system. With the 4.8 weighted mean which is equivalent to "Strongly Agree". The users find it that the system can work in terms of security.

Table 13.Overall average Weighted Mean of Software

Criteria	Mean	Interpretation
Functionality	4.25	Agree
Reliability	4.2	Agree
Usability	4.96	Strongly Agree
Efficiency	4.44	Agree
Security	4.8	Strongly Agree

Table 13 represents the overall weighted mean for Functionality, Usability, Reliability, Efficiency and Security. It also shows the interpretation for each ISO. With functionality, reliability and efficiency as "Agree" and usability and security as "Strongly Agree".

Functionality means for system can performs its specific tasks according to its required task. Efficiency performs tasks effectively and productively. Usability is for capability of the system to be used by specified user. Reliability is a task to be fulfilled in an accurate result. Security is for making a task secured in any danger. The proponents evaluate these criteria and majority of the respondents are satisfied according to the post-survey. This proves that the system is an effective to be used in controlling and monitoring electrical appliances inside in computer laboratory.

Chapter 6

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter includes the summary, conclusions that are built and interpreted from the gathered data by the researchers. Recommendations are based from the suggestions that can improve the system even more.

Summary Findings

Nowadays, the maintenance staff and professors are still using the manual way of monitoring and controlling of electrical appliances inside computer laboratory. There are still many flaws for manual controlling and monitoring of electrical appliances. They sometimes left unattended that it may cause the electrical appliances to be broken due to the temperature and the reducing the lifespan of the electrical appliances.

With these problems, the researchers proposed a system for innovative way of controlling and monitoring of electrical appliances using a web page in mobile phone with an embedded system. This system is useful for not letting left unattended of their electrical appliances and give an efficient way of controlling and monitoring them, even before and after of using computer laboratory.

The first objective of the study is to know what are the common electrical appliances that can be found in computer laboratory. The goal of the proposed system is to monitored and controlled electrical appliances within inside of the computer laboratory. Knowing the electrical appliances that can be found inside of the computer laboratory will be proposed to the system. The second objective to create web page through the mobile phone with an

embedded system that will help in conveniently monitor that electrical appliances that are commonly found in computer laboratory. The proposed system provides an efficient access and usage knowing to provide a solution for the beter alternative way in manual switch/conventional switch.

The third objective is to identify the weaknesses that are encountered by every professor and maintenance staff in using the manual controlling and monitoring of electrical appliances. The respondents that are representatives in each school are identified their weakness and negative outcomes that can be possible for using a manual monitoring and controlling electrical appliances. The researchers provided a solution for the problems and give an optimal solution also for their work. The fourth objective is to improve in terms of efficient and convenient when using electrical appliances by the professor and maintenance staff inside a computer laboratory. Respondents agreed to the proposed system to give them ease of usage. The researchers proposed this kind of system to give efficient and convenient for their work, and less negative outcomes that may bring out.

The fifth objective is to create and to develop an interactive and wireless monitoring and controlling electrical appliances using sensors and web page through the mobile phone that will provide efficient and convenient usage of electrical appliances inside a computer laboratory. The researchers proposed a system where the electrical appliances can be monitored and controlled using mobile phone connected to the Wi-Fi connection that gives access to the web page. The respondents agreed due to the ease of access and providing a security for using a computer laboratory. The seventh objective is to design a Raspberry Pi to be integrated using WLAN technology integration suits to prospect towards the

implementation of the proposed system. Many microcontrollers can be fitted in this proposed system. Raspberry Pi is the best fit for this kind of system. It is easy to access, which the respondents are agreed to use. The setups are easy to understand and friendly for the developer to give an access.

After the summary result of the proposed system, many of the respondents are agree to this kind of proposed system. Due to the users work and usage the proposed system, it may help to give an efficient work and convenient usage of the electrical appliances inside of the computer laboratory.

Conclusions

The proponents conducted an interview and survey to prove that there are existing problems regarding the monitoring and controlling the electrical appliances inside a computer laboratory. These data gathering tools were used to gathered data in different school, like Laguna Business and College of Arts (LCBA) and STI Calamba. These data gathering tools also show that most of the respondents agreed that monitoring and controlling different electrical appliances inside a computer laboratory is indeed need a better way or technique to do the said problems. These gave the proponents a strong proof that monitoring and controlling electrical appliances inside a computer laboratory is giving the respondents a hard time when using some electrical appliances.

These existing problems help the proponents to develop a system that will help people who is responsible in monitoring and controlling some electrical appliances.

"Computer Laboratory Monitoring And Controlling Electrical Appliances using Raspberry Pi with Fuzzy Logic" is the title of the said study.

And based on the post-survey conducted by the proponents, the results shows that developed system proves that the objective of the study has been met, one of those is to identify the traditional methods in used for monitoring and controlling the electrical appliances inside a computer laboratory. With this objective, the proponents learned that the user prefer a better way in terms of monitoring and controlling some electrical appliances inside a computer laboratory.

Another objectives of the researcher is to give the users a more efficient and convenient way of monitoring and controlling electrical appliances inside computer laboratory. In accordance to these objectives, most of the interviewee agreed that developing a system for monitoring and controlling electrical appliances inside a computer laboratory will give a more efficient and more convenient way of doing it.

As said, the develop system will give the users a better way of monitoring and controlling the computer laboratory. It will give them access to monitor the current load and electrical consumption of electrical appliances, and also it will give them access to control the electrical appliances through web page using a Wi-Fi Connection.

One of the major parts of developing a system is the effectiveness of the proposed system in terms of functionality, reliability, usability, efficiency and security. As said the researchers conducted a post survey to meet the effectiveness of the said study. As a result of the post-survey, the respondents "Agree" that the proposed study will be effective.

Therefore, the "Computer Monitoring and Controlling Electrical Appliances using Raspberry Pi with Fuzzy Logic" is definitely a great help for the user especially to the employee or personnel that is monitoring the computer laboratory.

Recommendations

The system meets the standard of the user, but still, there were recommendations needed to make to make this system more functional for the computer laboratory that needed this. The future researchers should enhance the system by adding more features and technologies for more effective functions. Scope also recommended for the houses, offices, and

The researchers recommend to the future researchers that they should find an appropriate microcontroller with cost effective and efficient use like ESP8266 or ESP32 combine with other microcontroller for bigger system. They should add any sensor providing for sensing high and low temperature of electrical appliances to monitor their temperature and maintain the longevity.

The future researchers also include a camera for better monitoring and security for bigger and wider system usage. They also include solid state relay for better performance switching and less noise.