DISTRESS SIGNAL TRACKER USING GPS AND SMS TECHNOLOGY: A PROTOTYPE

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ABSTRACT

There is no time in history that tracking has become a part and parcel of almost everyone's lives than it is today. Due to the need of a device that enables easy access in locating a particular person, thing or vehicle, the proponents aim to develop a study which comprises of the communication between a distress signal tracker incorporated in a server through mobile communication (SMS) that contributes to public safety, delivers accurate location of the user to the corresponding recipients and provides a real-time monitoring system using VB.Net and MySQL. The method of research used in this study was experimental method which involves the identification of response time and availability of the network signal. A series of testing was performed in 30 different locations in Calamba, Laguna demonstrating the versatility and accuracy of the device and server under various circumstances. Based from the evaluation of the data gathered, the results are proved to satisfy the required objectives and specifications of the study.

***Keywords**: Distress Signal Tracker; Accurate Location; Real-time Monitoring; VB.net; MySQL.*

INTRODUCTION

Background of the Study

As this world seems to be a big place for everything, it is best if people can track the exact location of things, people, vehicles and assets and not to lose control of them; that is why tracking has become a part and parcel of almost everyone's lives in this century. Manual tracking of location such as the use of landmarks, old maps and even the position of the stars are considered outdated and may cause a lot of misunderstandings and uncertainties. Thus, the shortcomings of the old way of tracking and the immense popularity of tracking numbers of people paved way to the implementation of innovative tracking systems starting from the early years of technological advancement.

The emergence of Global Positioning System (GPS) gives tracking units the sense of power and modification which helps one to identify the exact location, time and speed of a person, vehicle, pets and other things including one's assets to which the unit is attached to. Moreover, the development of a compact, portable and economical GPS device or receiver has made a lot of difference in today's living; aside from GPS devices, GPS can also be implemented in mobile phones and computers with Internet [1]. When it comes to its value, GPS is a benefit to almost all areas -- agriculture, military, maritime, automotive, surveying, aviation and forestry, environmental and public safety [2]. This can also be applied to mobile phones through the creation of Global Positioning System navigation via online applications such as

Waze and Google Maps Navigation and offline applications including iGo and Maverick [3].

Although GPS started to dominate important aspects and areas particularly in the Philippines, there are issues that still have not received much favor from it -- one of these is the surge of criminal cases nationwide. According to the report of Philippine National Police (PNP), the total crime volume rose in the first five months of 2014 from the corresponding period last year. The dramatic rise in numbers is brought by varying practices in counting crime incidents in which crime rate has not been properly reported or recorded by the authorities as explained by PNP spokesman Chief Superintendent Reuden Theodore Sindac [4].

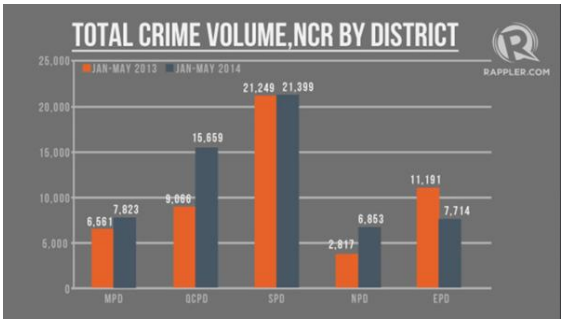

Fig. 1. PNP DIDM NCR Crime Volume

Fig. 2. PNP DIDM NCR Crime Statistics

The figures released by PNP demonstrated an upsurge of 17.86% in the crime volume from January to end of May 2014 – from 245,347 incidents in 2013 to 289,198 in 2014. The total crime volume, as shown in the statistics above, is the sum of reported index (murder, homicide, robbery and theft) and non-index crimes (estafa, prostitution, kidnapping and car napping) [5].

Index crimes have increased across the board compared to the statistics gathered in 2013, based on the report, with incidences of theft rising the most. There have been 25,354 index crimes as of 2014, 19.3% higher than the 21,252 recorded the other year, which include Murder (412 from 296), Homicide (400 from 386), Physical Injury (8,455 from 7,597), Rape (450 from 369), Robbery (5,189 from 4,510), Theft (9,170 from 7,109) and Car napping (1,278 from 985).

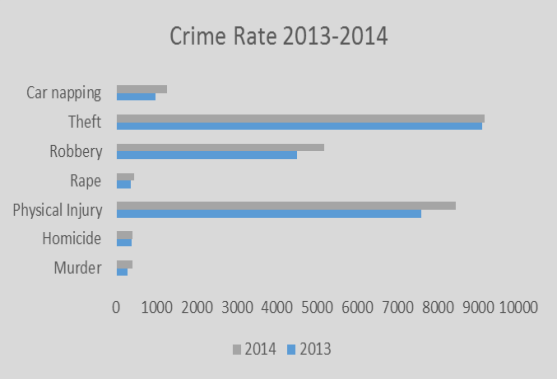

Fig. 3. PNP 2013-2014 Crime Rate

According to PNP, these index crimes are crimes “which are serious in nature and which occur with sufficient frequency and regularity” that they can be used as an indicator of the crime situation in an area [6].

With the growing cases of crimes everywhere, one might not feel secure when going outside and even at home. The availability of police stations in almost every place does not guarantee the avoidance of crime since it often occurs unexpectedly without having the time to call a police. It is often unnecessary to bring out the phone and call someone for help as the crime is taking place since it might cause a lot of trouble.

As the technological advancement brought the availability and affordability of cellphone in today's century, the immense popularity of texting has been an unstoppable phenomena that completely altered the way people communicate. The development of text promos such as unlimited texting and the emergence of the popular "group messages" or "GM" in which users can send same messages to more than one contacts for that matter paved way for the Philippines to be hailed as the "Texting Capital of the World" for the year 2013 alone with an average of 600 text messages per month (43% more than their counterparts in United States) based from the Short Message Service (SMS) statistics aggregated from various sources including New York Times [7]. With this, the use of cell phone, whatever unit it may be, as well as texting are indeed became part of everyday life of vast Filipino people [8].

With these observations and research, the proponents came up with the idea of developing a project entitled "Distress Signal Tracker using GPS and SMS Technology" which serves as an innovation to public safety. This project implements an easy and convenient way to inform the people of the community the exact location of a certain person who is in danger and for them to provide aid and safety through Global Positioning System (GPS) and Short Message Service (SMS) via Global System for Mobile Communications (GSM) technology. Furthermore, this provides a sense of security that whenever the user of the device is in danger, a particular receiver will acquire notification of the exact location of the user and most likely he can do something to provide immediate service.

Objectives of the Study

Due to the need of a device that will help establish a safe and secured community, this study primarily aims to develop a system that can be used for tracking the user when in danger.

Specifically, this study aims to:

- Develop a server that will be able to obtain accurate location of the user, around Calamba area only, to be transmitted by a tracking device.
- Develop and design a software using VB.net that will convert the corresponding coordinates into the specific location through Google Map, will provide real-time tracking and system monitor-ing to the server administrator and will send SMS notification to immediate family.
- Test and evaluate the functionality, accuracy and reliability of the system.

METHODOLOGY

Block Diagram

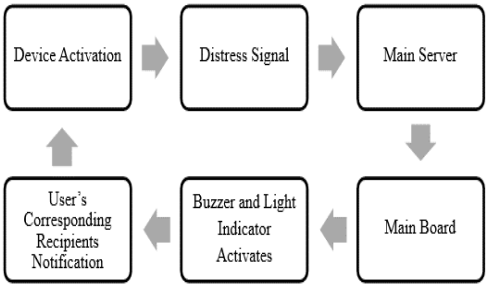

Fig. 4. Distress Signal Tracker Block Diagram

The diagram shows the process as to how Distress Signal is interpreted. The system flow begins during the GPS tracking device activation. Once activated, the Device will then send a particular message understood by the main server through several codes in VB.net. Once the message is received by the Main Server, through the instruction sets enlisted on its codes, it will send specific bits of information that will trigger the indicators of Blinker and the Buzzer notifying the Main Server that the user is under undesirable circumstances. Furthermore SMS will be automatically sent to the necessary recipient of the user letting them know of the danger.

As an added function, the user's corresponding recipient can continually monitor the whereabouts of the user by texting a code recognized by the device commanding it to send its coordinates to the Server without even pressing the panic button.

Systems Flowchart

The proponents used system flowchart to represent the overall flow of the system; from recognizing a distress signal, continuous real-time tracking and the notification of both the server and recipients when the user is in distress.

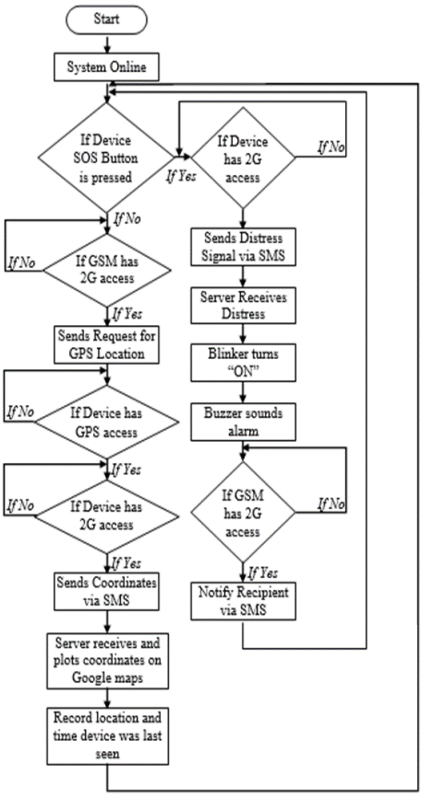

Fig. 5. Distress Signal Tracker Flowchart

Proposed Design

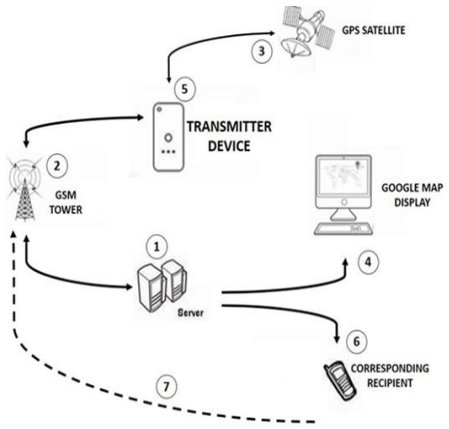

Fig. 6. System Overview of the Research

The project is subdivided into various key components. The main server continuously request for the GPS' location in the form of coordinates. Given there is both GPS and 2G network available the device, via SMS, will send its coordinates accessed from the nearest GPS satellite to the main server; under the circumstances that GPS signal is available the main server will prompt the administrator that the device has no GPS signal through the activation of indicator. Once the server receives the necessary information needed it will then plot the coordinates in Google Map enabling a visual representation about the device's whereabouts; simultaneously, it will record the event to its log for security purposes.

Under the circumstances that the SOS button on the GPS device is pressed for 3 seconds. The device will then send a notification, via SMS, of a distress call to the main server. At the same time the main server will send information to the Main board activating the Buzzer and the Blinker which indicated that the user is sending a distress call. Once the task are done the main server will then send, via SMS, notification that the user has send a distress signal and the last location the device was last located to specific recipients denoted by the user.

In case of long term casualties, specific individuals can access the user's location by texting specific code to the main server via SMS. Once the text message is recognized by the server it will then relay the device's last location it was traced to the sender. This function of the device can also be used as to locating certain things, specifically vehicles, given that the device is in the thing/vehicle itself.

DESIGN CONSIDERATION

Hardware

- Main Server. Serves as a workstation containing all the software needed to execute the entire system of the study. It is in charge of receiving the information: coordinates, battery status and GPS status of the device given by the Main board conceded from the GPS Tracking device. The main server is composed of a Core 2 Duo processor (2.6 Ghz), 2-Gb of memory, and a dual display video graphics accelerator (VGA).

- Dual Display VGA. The main server uses a dual display VGA which provides a better utilization of the software. Display 1 would show the overall status of the program while it is being executed as while Display 2 would continuously display the real-time tracking, via Google Map, of the current location of the device given that it has access to GPS signal.

- USB (2.0) Port. A standard communication port which serves as the main communication between the Main board and the Main Server. It delivers asynchronous communication which interfaces the information given by the main board. It is composed of 4-pin

namely: Vcc, Gnd, Rx, Tx which transfers 400-Mb/sec.

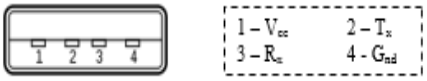

Fig. 7 USB Pin Configuration

- GPS Tracking Device. Acts as the main access to the GPS satellites to locate its coordinates. The GPS device transmits the location data in real-time via the same cellular data network used by mobile phones. The GPS sends the coordinates to the GPS receivers (server) which converts location and the time information into a useful display format like that of a website for real-time location mapping. GPS needs to access to the open sky to be able to get a signal from the cellular network and to capture the satellite signals. This also needs a power source.

- Main Board. Governs the overall flow of bits of information for the activation of the relay switches connected to the indicators. The main board schematic diagram is as shown in the figure below:

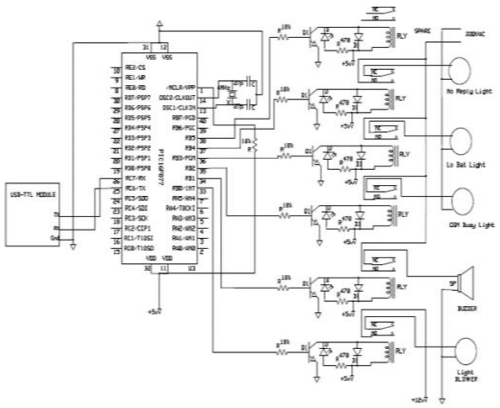

Fig. 8. Main Board Schematic Diagram

GSM Module. The core communication of the system is a wireless communication that uses a GSM Module. After receiving the converted coordinates of the user, the GSM Module will send SMS to the relatives of the user which are saved in the database of the system to notify the location of the user.

Software

- MySQL. Serves as the main relational database of the software containing information about the records as to where the GPS tracking device was located in Google Map.

- PICkit. Works as the instructions sets encoded in PIC as to how it will function given the varying conditions delivered by the main server.

Test and Evaluate the System

Using experimental method, the proponents will conduct series of testing that held in different places of Calamba, Laguna to determine the credibility and functionality of the device in transmitting distress signals to the server. The said server will be placed in Castillo's residence in Brgy. Saimsim, Makiling, Calamba Laguna which will serve as the police station and will be checked also to see if it can perform its function. Aside from the functionality, the device will undergo testing to identify the places that are within its coverage and its corresponding coordinates and time. All testing operations, when received by the server, will be recorded in the database. Results will be tabulated and will further be evaluated by the proponents.

Further Enhance the System

After the proponents analysed the functionality of the device and the server, the proponents will then further improve the shortcomings that will exist in the whole system to provide desirable results. Modification of the device and server will take place once uncertainties occur within the system. Furthermore, the whole system will try and test another network carrier if the current network carrier will be proven to have weak signal strength in most of the areas.

Implementation of the System

The Distress Signal Tracker and the tracking device will be implemented using GSM module to establish two-way transmission of notification between the device and the server. The device is also integrated with GPS module to track its location on real time. As for the server, VB.net and MySQL platforms will be applied for the construction of the main software and the database, respectively. The server is also proposed to implement in police stations if possible.

CONCLUSION

The development of a Distress Signal Tracker in connection with a tracking device is focused in this study. The distress signal tracker has the ability to determine the status of the whole system, which includes the tracking device and the distress signal tracker, as displayed through the indicators. The indicators were calibrated to test if the microcontroller can able to operate these according to their respective functions.

Through the integration of GSM and GPS modules, the device and the tracker can send and receive the corresponding coordinates to the tracker and from the device, respectively. This was verified as these two have established successfully a two-way communication through SMS and in fact, have acquired a minimum average time of 1 minute and 8 seconds and maximum average time of 3 minutes and 45 seconds, which do not exceed to the time difference limit, throughout the simulations. As the signal strength of Globe Telecom weakens in a certain area, the delay in the response time of the server lengthens; thus the response time varies for different locations.

Aside from obtaining coordinates, tracking is also made possible in this study since the tracking device is connected to GPS satellites. Through the developed software, the user's location can be viewed in a specific place in Google Map based from the corresponding coordinates. As supported by the data in Chapter 5, the shortest delay from the time the coordinates were received to the time the user's location was plotted on the map is 1 minute & 15 seconds and the longest delay, on the other hand, is 1 minute and 36 seconds. In places where there is no stable signal of the GPS such as in congested areas and inside a building, there is a tendency to have a delay in the display of location and much worst, there is a possibility that the tracking device will transmit notification with no indicated

coordinates. Aside from that, GPS signal may also be weakened during rainy days.

In accordance to our interview with SP01 Emil Janairo, Calamba Municipality Police, he stated that:

"The system would deeply help the police crime operation given that we would fast track instances of casualties. And if ever we are ask for absorbing the system we would be more than glad to adopt it"

Given the statement above the implementation of Distress Signal Tracker using GPS and SMS Technology would intensely benefit the Police in responding to the crime rate undergoing in Calamba. Not only would they easily know as to when a crime is undertaking, likewise they would be knowledgeable as to its whereabouts.

With all these, it was proven that the Distress Signal Tracker can be used to track the user in danger and might as well keep him/her from being a victim of potential crimes. The only way for these to be done is through a press from SOS button. Given that the system acquired good and favorable network and GPS signal strength, the whole system was verified to have functioned properly and was determined to be reliable as this acquired accurate results including the time and the location of the user. However, the consistency of the system regarding its accuracy and reliability may possibly change since these are all up to the strength of the network and GPS signal.

RECOMMENDATION

In lieu of the aforementioned projections, the proponents are prompted to formalize their expectations into two parts:

1. Those based on the research findings/data of the study.

2. Those that will grow out of the study, requiring further related studies.

Expectation based on Findings/Data of the Study

This study aims to develop a distress signal tracker integrated with GSM and GPS module along with a main server which will be implemented in a police station. If future researchers would want to add modification for further improvement of the present study, the following are the recommendations that might greatly help them:

a) The network carrier employed for both the device and the server during a series of testing is Globe Telecom. For further researchers, it is advisable if they can use different network carriers for testing to evaluate and determine the best network carrier for the device and the tracker in the locale of the study. Moreover, it would be great and efficient if the SIM card to be inserted is subscribed to postpaid plan with unlimited text promo in order to avoid running out of load in times of danger.

b) Since the proponents were not able to conduct testing in other areas of

Calamba due to time constraints, researchers, who are planning to continue and support this study in the future, are recommended to conduct testing to all areas in Calamba most especially to remote areas considering that there is an available network and GPS signal.

c) It is more preferable if the server, during testing, is implemented in a police station with installed internet connection in order to determine if a police station is really capable to handle the system and to better satisfy the objective of this study.

d) Considering that the proposed system is subjected for one device only for it is meant to be a prototype and due to the inadequacy of Google Map to display location of two or more different GPS devices at the same time, the future researchers are recommended to pursue on a platform which supports multiple devices and employ a web mapping service application which displays locations from different devices, or they can make their own application for the system.

Expectation beyond the Context of the Study

Other limitations of the study, specifically the tracking device and the server, could also be enhanced through the following:

a) The tracking device used in this study is a ready-to-use tracking device in which the proponents have programmed according to its functions. The future researchers could go beyond that by developing their own tracking device based from what they want for their device to offer or they could purchase a high-end tracking device instead. They can provide additional functions including the ability to inform the police what is the specific crime the user is concerned with by adding buttons for each crimes.

b) As the tracking device is small in size, there is a possibility that the user might left it in places where it is hard for it to find; with that, it is recommended to develop a tracking device that can be used as an accessory in order to avoid being misplaced; this can be a watch, a necklace or any other personal accessories that can be worn by the user.

c) In connection to the previous recommendation, the future researchers can also integrate the tracking device into mobile phone since it is also a part of a person's everyday life. They can create an application that will perform functions similar with that of the tracking device. Instead of clicking the app itself, the future researchers could probably employ algorithms to launch the app and automatically transmit notification just by long-pressing a certain button of the phone.

REFERENCES

[1] [Online]. Available:http://www.gmat.unsw.edu.au/snap/gps/pdf/gps-article2.pdf [Accessed: Nov. 21, 2014].

[2] [Online]. Available: http://www.extension.umn.edu/youth/mn4-H/projects/docs/geospatial-science-technology-GPS.pdf [Accessed: Nov. 21, 2014].

[3] [Online]. Available: http://www.academia.edu/4579217/Gps [Accessed: Nov. 21, 2014].

[4] [Online]. Available: http://www.manilatimes.net/crimevolume-up-in-first-5-months-of-2014-pnp/107301/ [Accessed: Nov. 24, 2014].

[5] [Online]. Available: http://www.rappler.com/nation/61798pnp-crime-stats-2014 [Accessed: Nov. 24, 2014].

[6] [Online]. Available: http://www.gmanetwork.com/news/story/367656/news/nation/pnp-crime-up-by-17-percent [Accessed: Nov. 24, 2014].

[7] [Online]. Available: http://jatps.hubpages.com/hub/ThePhilippines-is-Still-the-Undisputed-Text-Capital-of-the-World [Accessed: Nov. 24, 2014].

[8] [Online]. http://www.interaksyon.com/infotech/20-yearson-sms-remains-king-in-the-texting-capital-of-the-world [Accessed: May 7, 2014].

[9] [Online]. Available: http://newsinfo.inquirer.net/433667/did-you-know-330 [Accessed: May 7, 2014].

[10] [Online]. Available: https://www.osac.gov/pages/ContentReportDetails.aspx?cid=15294 [Accessed: May 7, 2014].

[11] [Online]. Available: http://2013-eng-student-projects.port.ac.uk/ecne-meng-projects/odo-emmanuel-oluchukwu [Accessed: May 7, 2014].

[12] [Online]. Available: http://www.projectsof8051.com/vehicle-tracking-system-using-gps-and-gsm-modem/ [Accessed: June 14, 2014]

DEVELOPMENT OF WI-FI- BASED SWITCH CONTROL SYSTEM FOR HOME APPLIANCES USING ANDROID PHONE

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ABSTRACT

This study aims to develop and design a prototype that can be used, together with an android phone, as centralized switch for simple home appliances via Local Area Network or Internet. The prototype can handle up to seven devices at the same time with a master switch. The main body of the prototype contains an Arduino microcontroller connected to a relay driver circuit. An android application is also developed using Basic4Android IDE. The proponents add features, such as renaming devices and password security to make a user-friendly interface. The proponents used the developmental method and conducted several tests to determine if the prototype satisfied the scope and limitations. The proponents tested the prototype to handle varying number of output devices from two to seven loads and showed that the prototype can really automate the switching of simple home appliances and therefore can further develop for a full home automation system.

Keywords: *Arduino, Android, Android phone, Switch Control, Automation*

INTRODUCTION

Home Automation nowadays can be done in different ways. A variety of solutions for connectivity are available such as SMS, Wi-Fi, Radio Frequency or Bluetooth.

Among the possible hardware for the main system are microcontrollers including Arduino, computers even a Raspberry Pi or a combination of two. Microcontrollers are cheaper than computers. Choosing the right device depends on the size of project [1].

Another aspect of concern is the base operating system of the smartphone. Android, Windows, iOS, BlackBerry and Symbian are among the operating systems that are currently installed to smartphones. Android may have the largest market share but iOS and Windows are gaining more percentage as the OS matures. Another thing, Symbian is still the third largest smartphone OS by installed base even they already have stopped making the phones [2].

Objectives

This study aims to develop and design a Wi-Fi based switch control that can be used, together with an android phone.

Specifically, this study aims:

- To design and construct a switch control system that is applicable for common home appliances.
- To develop an android application that will interface the android phone and the prototype to the devices.
- To test and evaluate the functionality, accuracy and reliability of the prototype.

SYSTEM DESIGN

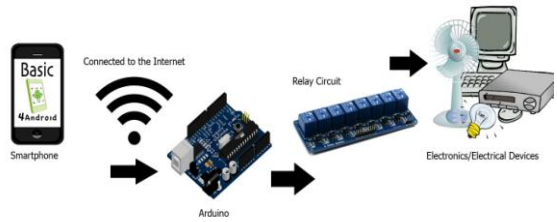

Figure 2a: Components of the System

Android OS

Android is a software stack for mobile devices that includes an operating system, middleware and key applications. The Android OS is based on Linux. Android Applications are made in a Java-like language running on a virtual machine called 'Dalvik' created by Google. The Android SDK provides the tools and APIs necessary to begin developing applications on the Android platform using the Java programming language [3].

Mobile Application

A mobile application is an application for mobile devices like smartphone or tablet. It varies from simple application to sophisticated application that contains a lot of functions. In order to develop an application, an Integrated Development Environment (IDE) is needed. The proponents developed the mobile application using Basic4Android IDE that uses Basic Programming Language instead of Java Programming Language.

Web Server

A web server is a computer that runs a web site. Using the HTTP protocol, the web server delivers web pages to browsers as well as other data files to web-based applications. [4]

The server can be easily accessed via LAN. The server can also be accessed outside the network using port forwarding. The device will work just like a CCTV which also needs port forwarding.

Arduino Ethernet Board

The Arduino Ethernet is a microcontroller board based on the ATmega328. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz crystal oscillator, a RJ45 connection, a power jack, an ICSP header, and a reset button. It is like a Uno + Ethernet Shield built in one PCB. [5]

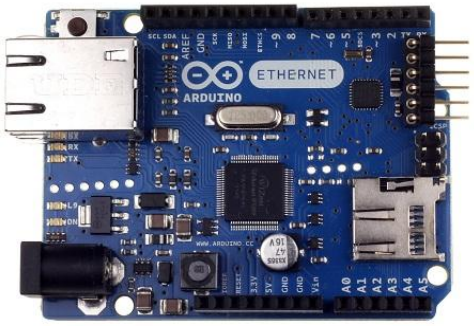

Figure 2.4a: Arduino Ethernet Board

The proponents make use of the ability of the Arduino Ethernet board to function as a web server to avoid the user of desktop or laptop computer.

8-Channel Relay Module

A relay functions as switch that has the capability of switching multiple circuits which can either be individually, simultaneously, or in sequence [6].

The proponents used an 8-channel relay to accommodate 7 output devices. Arduino Ethernet's output pins are connected to each of the input pins of the relay module

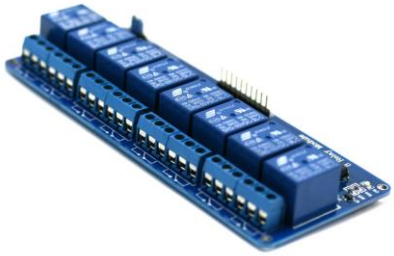

Figure 2.5a: 8-Channel Relay Module

DESIGN CONSIDERATION

The proponents will use the developmental method to achieve the outcome of the study. This method aims to develop, design and then evaluate instructional processes, programs and products. It has a set of criteria to meet via internal effectiveness and consistency as well.

Problem Identification and Objective Statement

The study started upon the approval of the thesis adviser and the completion of the academic year requirements. Together with the adviser, the proponents ensure that multiple goals are explicitly considered throughout the process, provide a common vision and come up with the topic and concept of the chosen system. After setting the objectives, the proponents identified the problems that exist and prioritize the problems identified. The proponents then established the desired output and then set the objectives of the study.

Definition of Scopes and Limitations

The proponents discussed and completed the idea of the system and prototype during the development process. The proponents planned and established all the details of the system and prototype such as the components to be used to integrate to the prototype. All of these are gathered from the different studies and literatures.

Prototype and Mobile Application Initial Development

This phase focuses on building the hardware aspects of the system. At the same time, it also involves the development of the mobile application and the source code to be loaded to the Arduino Ethernet Board.

3.3.1 Hardware

For the hardware part, it includes the construction of the relay circuit. From the output pins of the Arduino Ethernet Board, the proponents connect it to the input pins of the relay circuit. Then they connect each channel of the relay to a power outlet.

3.3.1.1 Arduino Ethernet Board

In the Ethernet plug an Ethernet cable must be connected going to the user's router to connect the board in the internet or LAN. External power supply should be plugged. The proponents used 7 digital I/O pins as output and are to be connected to each channel of the relay.

3.3.1.2 Relay Circuit

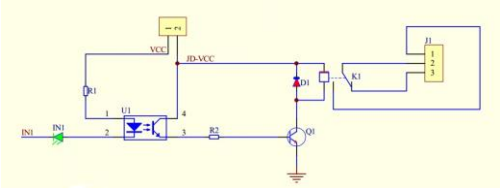

Figure 3.3a Relay Schematic Diagram

Figure 3.3a shows the schematic diagram of a relay channel. In the prototype, the relay circuit used is active LOW which means each relay needs GND or 0V to switch. During Arduino's boot/reset sequence, each digital pin is at HIGH state which will switch the relay if it is not active LOW which will cause problems when a power outage happens and then comes back immediately.

3.3.2 Software

For the software part, the proponents write a source code to make the Arduino Ethernet Board works like web server and determine and monitor the states of the output devices in each relay channel. Then they develop an Android application that has the capabilities to switch/monitor the states of output devices.

3.3.2.1 Arduino Web Server Sketch

The Arduino Ethernet Board is able to host a web server that monitors the states of each of the digital I/O pins that is also connected to the relay. It also handles user requests.

```
void setup()
{
    Ethernet.begin(mac, ip);
    server.begin();

    for (byte index = 0; index < sizeof(ledPins); index++) {
        digitalWrite(ledPins[index], HIGH);
        pinMode(ledPins[index], OUTPUT);
    }
}
```

Figure 3.3b setup() Function of the Sketch

Figure 3.3b shows the setup() function which is called when the sketch starts. It is important to note that the digital I/O pins that is used is needed to be initialized as HIGH before setting them to OUTPUT. This part gave the active LOW relay circuit a 5V to avoid it from switching.

3.3.2.2 Android Application Development using Basic4Android

The Android application of the system (dubbed as ZSwitch) includes 3 activities. The first one is for password purposes, another for the main program and lastly for renaming the output devices.

Figure 3.3c Login Activity

Figure 3.3c shows the starting activity of the application. The user is being requested to

input the password to access the main program. It is added to provide security and avoid not permitted access. When the application is first installed the initials password is “jomaivantonetkim”. The proponents also added a feature for changing the password.

Figure 3.3d Main Program Activity

Figure 3.3d shows the main program. At the top, the user can select the mode of connectivity. Below it, the current IP being used is being shown. In LAN mode, the IP is always set to “192.168.1.9” which is set in the Arduino Sketch. After logging in, the application will synchronize the current state of the output devices from the Arduino Web Service. Initially, the names of the output buttons are: OUTPUT1, OUTPUT2, and so on. The user can rename them to correspond to the output device plugged to the outlets of the system. The renaming activity is shown in Figure 3.3e.

Figure 3.3e Renaming Activity

4.4 System Initial Tests and Evaluations

An initial series of tests were conducted to determine if the system passed the required specifications. The proponents encountered different problems such as bugs on the mobile application. Those problems were evaluated and listed to prepare the system for finalization.

4.5 Prototype and Mobile Application Finalization

Problems stated on Section 4.4 were given solution in this part. At the same time, the proponents add finishing touches to the design of the hardware and to user interface and appearance of the android application developed. Some features are added to provide users a friendlier environment so they can control the system easily.

4.6 System Final Tests and Evaluations

Finally, the system was tested and evaluated one last time to ensure that all the required specifications are met. The prototype was first tested its LAN mode and determine if every channel in the relay is working. Then, it was tested using its NET mode which user can

used to control each channel anywhere in the world as long as they have internet connectivity. Each mode latency is tabulated to determine if there is a delay with the switching of the output devices.

EXPERIMENTS AND ANALYSIS OF REPORTS

To easily understand and analyze the results of the tests, the proponents tabulated them or put them on a chart.

The table follows the following:

Legend

0- Off or Failed

1- On or Successful

The remarks column shows the result of a particular test. It is either successful or failed.

4.1 Connection Functionality Testing

Internet and LAN connectivity of the router that will be used is vital part of the system. Without it, all functions of the system will become useless. The connectivity is expected to be up all the time so the web server setup at the Arduino will always be available.

Table 4.1a System Functionality Test (Wi-Fi equipment connectivity)

TEST	EXPECTED OUTPUT	ACTUAL OUTPUT	REMARKS
1	1	0	Failed
2	1	1	Successful
3	1	1	Successful
4	1	1	Successful
5	1	1	Successful
6	1	1	Successful
7	1	1	Successful
8	1	1	Successful
9	1	1	Successful
10	1	1	Successful
11	1	1	Successful
12	1	1	Successful
13	1	1	Successful
14	1	1	Successful
15	1	1	Successful
16	1	1	Successful
17	1	1	Successful
18	1	1	Successful
19	1	1	Successful
20	1	1	Successful

Table 4.1a show the functionality of the system via Wi-Fi connection. The proponents conducted twenty (20) trials in which the expected output is the same as the actual testing except during the first test. That first test is analyzed and found out that the cause of failure is due to initialization of the router since the proponents tested immediately after it was powered on. Therefore 95% of it is successful and proven adequate.

4.2 Hardware Functionality Testing

Hardware component of the system (Arduino, Relay Circuit) should be functional to carry out their respective task for the system.

Table 4.2a Test on Functionality of the System (Hardware)

TEST	EXPECTED OUTPUT	ACTUAL OUTPUT	REMARKS
1	1	1	Successful
2	1	1	Successful
3	1	1	Successful
4	1	1	Successful
5	1	1	Successful
6	1	1	Successful
7	1	1	Successful
8	1	1	Successful
9	1	1	Successful
10	1	1	Successful
11	1	1	Successful
12	1	1	Successful
13	1	1	Successful
14	1	1	Successful
15	1	1	Successful
16	1	1	Successful
17	1	1	Successful
18	1	1	Successful
19	1	1	Successful
20	1	1	Successful

Table 4.2a show the functionality of the system hardware components. In twenty (20) trials that the proponents conducted, the result shows that the components works properly together 100% of the time during the tests. It shows that the Arduino can drive the output to make the relay function appropriately.

4.3 Accuracy Testing

The system aims to control the state of devices therefore it is needed to prove that the system is accurate. Accuracy of the system is measured if the input of the user (to on or off a device) is synchronize to what the output of the system shows. Since there are two modes (via LAN and Internet) of connection for the system, two series of test are made.

Table 4.3a Test on Accuracy of the System (via LAN)

TEST	Expected Output							Actual Output							Remarks
	Device							Device							
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Successful
2	1	0	1	0	1	0	1	1	0	1	0	1	0	1	Successful
3	0	1	0	1	0	1	0	0	1	0	1	0	1	0	Successful
4	0	0	0	1	1	1	1	0	0	0	1	1	1	1	Successful
5	0	0	1	0	1	1	1	0	0	1	0	1	1	1	Successful
6	1	1	1	1	0	0	0	1	1	1	1	0	0	0	Successful
7	1	1	1	0	1	0	0	1	1	1	0	1	0	0	Successful
8	0	0	1	1	1	1	0	0	0	1	1	1	1	0	Successful
9	0	1	1	1	1	0	0	0	1	1	1	1	0	0	Successful
10	0	0	1	1	1	0	1	0	0	1	1	1	0	1	Successful
11	1	0	1	1	1	0	0	1	0	1	1	1	0	0	Successful
12	0	0	1	1	0	1	1	0	0	1	1	0	1	1	Successful
13	1	1	0	1	1	0	0	1	1	0	1	1	0	0	Successful
14	0	1	1	1	0	0	1	0	1	1	1	0	0	1	Successful
15	1	0	0	1	1	1	0	1	0	0	1	1	1	0	Successful
16	0	0	1	1	1	1	1	0	0	1	1	1	1	1	Successful
17	1	1	1	1	0	1	0	1	1	1	1	0	1	0	Successful
18	0	1	1	1	1	1	0	0	1	1	1	1	1	0	Successful
19	1	0	1	1	1	1	0	1	0	1	1	1	1	0	Successful
20	0	1	1	1	0	1	1	0	1	1	1	0	1	1	Successful
21	0	0	1	0	1	0	1	0	0	1	0	1	0	1	Successful
22	1	1	1	1	1	1	0	1	1	1	1	1	1	0	Successful
23	1	1	1	1	1	0	1	1	1	1	1	1	0	1	Successful
24	1	1	1	1	0	1	1	1	1	1	1	0	1	1	Successful
25	1	1	1	0	1	1	1	1	1	1	0	1	1	1	Successful
26	1	1	0	1	1	1	1	1	1	0	1	1	1	1	Successful
27	1	0	1	1	1	1	1	1	0	1	1	1	1	1	Successful
28	0	0	0	0	1	1	1	0	0	0	0	1	1	1	Successful
29	1	0	1	0	0	1	0	1	0	1	0	0	1	0	Successful
30	0	1	0	1	1	0	0	0	1	0	1	1	0	0	Successful

Table 4.3a shows the result of the thirty (30) tests conducted by the proponents using the system via LAN. All actual outputs where the same with the expected output. 100% of the tests are successful.

Table 4.3b Test on Accuracy of the System (via internet)

TEST	Expected Output							Actual Output							Remarks
	Device							Device							
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Successful
2	1	0	1	0	1	0	1	1	0	1	0	1	0	1	Successful
3	0	1	0	1	0	1	0	0	1	0	1	0	1	0	Successful
4	0	0	0	1	1	1	1	0	0	0	1	1	1	1	Successful
5	0	0	1	0	1	1	1	0	0	1	0	1	1	1	Successful
6	1	1	1	1	0	0	0	1	1	1	1	0	0	0	Successful
7	1	1	1	0	1	0	0	1	1	1	0	1	0	0	Successful
8	0	0	1	1	1	1	0	0	0	1	1	1	1	0	Successful
9	0	1	1	1	1	0	0	0	1	1	1	1	0	0	Successful
10	0	0	1	1	1	0	1	0	0	1	1	1	0	1	Successful
11	1	0	1	1	1	0	0	1	0	1	1	1	0	0	Successful
12	0	0	1	1	0	1	1	0	0	1	1	0	1	1	Successful
13	1	1	0	1	1	0	0	1	1	0	1	1	0	0	Successful
14	0	1	1	1	0	0	1	0	1	1	1	0	0	1	Successful
15	1	0	0	1	1	1	0	1	0	0	1	1	1	0	Successful
16	0	0	1	1	1	1	1	0	0	1	1	1	1	1	Successful
17	1	1	1	1	0	1	0	1	1	1	1	0	1	0	Successful
18	0	1	1	1	1	1	0	0	1	1	1	1	1	0	Successful
19	1	0	1	1	1	1	0	1	0	1	1	1	1	0	Successful
20	0	1	1	1	0	1	1	0	1	1	1	0	1	1	Successful
21	0	0	1	0	1	0	1	0	0	1	0	1	0	1	Successful
22	1	1	1	1	1	1	0	1	1	1	1	1	1	0	Successful
23	1	1	1	1	1	0	1	1	1	1	1	1	0	1	Successful
24	1	1	1	1	0	1	1	1	1	1	1	0	1	1	Successful
25	1	1	1	0	1	1	1	1	1	1	0	1	1	1	Successful
26	1	1	0	1	1	1	1	1	1	0	1	1	1	1	Successful
27	1	0	1	1	1	1	1	1	0	1	1	1	1	1	Successful
28	0	0	0	0	1	1	1	0	0	0	0	1	1	1	Successful
29	1	0	1	0	0	1	0	1	0	1	0	0	1	0	Successful
30	0	1	0	1	1	0	0	0	1	0	1	1	0	0	Successful

Table 4.3b shows that the thirty (30) test conducted by the proponents using system via Internet. It shows that 100% of the tests are successful and working accurately.

CONCLUSION

In this study, the proponents develop a Wi-Fi based switch control system for home appliances using Android phone. This paper gives basic idea of how to control various home appliances and provide a security using android phones. The programming platform used for the software is the Basic4android and the code is generic and flexible in a user friendly manner. Moreover, the system has four hardware components: a relay in which the appliances should be plugged in, an Arduino microcontroller that transfers signal to the relay, a web server that monitor and change the status of the appliances when the user is using a personal computer, and an android phone that serves as the controller of the appliances.

The prototype of the proposed system is tested based on its functionality, accuracy and reliability. The functionality is tested into two parts, the functionality of the system and the functionality of the Wi-Fi connectivity. Same with the accuracy, it is tested based on internet connection and local area connection. The reliability of the system is the summary of its functionality and accuracy. According to the reliability results, the proposed system which uses Android phone, Wi-Fi connection and Arduino microcontroller is adequate in overall.

RECOMMENDATION

Recommendation based on radio frequency.

Technology and appliances make lives easier and enjoyable, but all those wires create a disaster area. This is why the proponents recommended the use of the radio frequency in plugging the home appliances. Using the radio frequency, it will allow the user to plug their appliances in any nearby outlets. The use of radio frequency will help the user reduce and avoid all the tangled wires.

Recommendation based on supporting other operating system (windows and iOS)

Many people are using smartphones nowadays and smartphones have different operating systems like android, windows, and iOS. Even if most of the smartphone runs the android operating system, there are still millions of user that uses windows and iOS. This is why the proponents recommend to make an application that is applicable for windows OS and iOS, so that other windows and iOS user can also secure their appliances and help them save energy through the use of switch control for home appliances.

Recommendation based on Arduino board maximization

The Arduino Ethernet board includes analog input pins that can be used for sensors (i.e. temperature, light, etc.). This will open other potential home automation features to be added to the system.

REFERENCES

[1] [Online] http://www.openhomeautomation.net/build-your-own-home-automation-system-technologies/

[2] "Apple Leads U.S. Smartphone Market, But Android Is Top OS." *PC Magazine Online* 4 Apr. 2013. *Academic OneFile*. Web. 8 July 2014.

[3] [Online]_http://developer.android.com/about/index.html

[4] [Online] http://www.pcmag.com/encyclopedia/term/54342/web-server

[5] [Online] http://www.allaboutcircuits.com/vol_4/chpt_5/1.html

[6] [Online] http://arduino.cc/en/Main/arduinoBoardEthernet