# Arduino-Based Control and Monitoring System of Household Appliances Status using Android Application

**Mark Anthony A. Castro, Sherwin V. Mallari, Russell John M. Torres, Romy A. Manese, Lorinda E. Pascual**

***Abstract:*** ***The purpose of this study entitled Arduino-based Control and Monitoring System of Household Appliances status using Android Application is to help the people to have control over the house by means of switching on/off and monitor the loads that are plugged into the outlet by the use of cellphones/ tablets. This project provides the simple way to access loads that are left running and forgotten to unplug at home. The structure of the prototype is made up of HardieFlex physical appearance making it fire retardant consisting of 3 sockets available. The 2 outlets are for the normal house sockets while the other one is separated for the Air-condition unit. The circuit breaker is on the upper left side corner dividing the wires of each sockets. The Android Application uses text messages to send information then received by the GSM (Global System for Mobile) and translates it to the Arduino. The Arduino commands the relays to cut and provide electricity for the outlets. This device can notify an individual if there are loads left running, wherein the current sensor able to read the current from the outlet to determine if it has a working load that are plugged into the outlet. The study implements power interruption notification in terms of using the voltage sensor to acquire information of possible power outage occurrences. Based on the results of the evaluation, 95.83% believe that the project was made conveniently, that they are now aware of their surroundings giving them the idea of their house is beyond their reach, and also 95.83% of the respondents are certain that the system is relevant and beneficial to the society.***

***Keywords: fire retardant, fire hazard, android application, global system for mobile, power interruption.***

## I. INTRODUCTION

The continuous development and changes in technology is comparable to the increasing needs and demands of the people these days. Safety and security is the primary concern of all people. In households, various appliances are needed for daily living and most of these appliances need electricity in which during power outages these appliances are commonly being affected. In some instances, people leave their home appliances plugged. Most of the reasons is that they forgot to unplug it which can cause tragedy like fire incidents.

In the first quarter of the year 2018, the Bureau of Fire Protection (BFP) in Davao City has recorded a total of PHP2.5 million in damages caused by a series of fire incidents in the first three days of the month of April. This are all related to electrical malfunctions and unplugged appliances [1]. According to BFP public information office chief Supt. Renato Marcial stated that Electrical connections are consistently at the top of the list when it comes to fire hazards [2]. Basically, this boils down to how properly electrical wirings are connected.

One of the advancement of technology which is relevant from the past and up to this time is the Global System for Mobile (GSM) technology, securing our home has never been easier. By sending a simple text message to the Arduino it is now possible for users to control and monitor the load of each appliances in their household with the help of their smartphone applications [3].

Mobile devices have been a huge part in people's lives. Consequently, providing facilities and security are becoming increasingly prominent features on mobile devices [4]. Using the "Arduino-Based Control and Monitoring System of Household Appliances status using Android Application" they can control outlets of the house by sending a message using the android application and then the message would be decoded by the arduino controlling the state of the said outlets. It can also monitor whether the appliance is plugged in and working or if it's not with the use of a current sensor, to be aware of the appliance current state, which is also controlled using the android application.

The objective of the study is to control and monitor household appliances that causes fire incidents by notifying the user through an application that there is power outage. Similarly, to monitor the status (ON/OFF) of the appliances in the system using an Android application. Also, to turn on/off the household appliance connected in the system using Android application. This study will provide assistance in monitoring the unattended household appliances that cause fire incidents.

Revised Manuscript Received on February 28, 2020.

* Correspondence Author

**Mark Anthony A. Castro.**, Graduate School Department, Nueva Ecija University of Science and Technology, Cabanatuan, Nueva Ecija, Philippines. E-mail: markanthonyacastro0531@gmail.com

**Sherwin V. Mallari.**, Graduate School Department, Nueva Ecija University of Science and Technology, Cabanatuan, Nueva Ecija, Philippines. E-mail: sherwinmallari625@gmail.com

**Russell John M. Torres.**, Graduate School Department, Nueva Ecija University of Science and Technology, Cabanatuan, Nueva Ecija, Philippines. E-mail: russelljohntorres@yahoo.com

**Romy A. Manese.**, Graduate School Department, Nueva Ecija University of Science and Technology, Cabanatuan, Nueva Ecija, Philippines. E-mail: romy.manese@gmail.com

**Lorinda E. Pascual.**, Graduate School Department, Nueva Ecija University of Science and Technology, Cabanatuan, Nueva Ecija, Philippines. E-mail: lorindapascual15@gmail.com

## II. METHODOLOGY

### A. Research Design

The study shows different types of current sensors depending on their principles and what can be the function of which. The researchers have identified and compared distinct approach of current sensors. These sensors are Ohm's law resistance principle, Faraday's law of Induction, Magnetic field sensors, and Non-invasive Current Transformer. The following sensors will further discuss and why the researchers have decided to use The Non-invasive Current Transformer.

**Table 1: Comparative Analysis of Current Sensors**

| | Limitations |
|---|---|
| Shunt Resistor | An overcurrent can permanently damage the shunt resistor. High power losses make it difficult to measure high currents. In high voltage applications the missing galvanic isolation is a problem. |
| Rogowsk i Coil | The accuracy depends on the conductor position. Difficult to measure small currents due to poor sensitivity. A high number of turns reduces the measurement bandwidth. |
| Current Transfor mer | A DC offset may saturate core material. For high currents a large core cross sectional area is required to avoid saturation. In high voltage applications the winding isolation becomes crucial. A high winding ratio leads to increased parasitic capacitance, which reduces the measurement bandwidth and common mode noise rejection. |
| Hall Effect | AC currents with high frequency can overheat the core material. An overcurrent incident does introduce a magnetic offset that can only be eliminated with a degaussing cycle. Distinct thermal drift that has to be compensated. |

**Table 2: Specifications of Current Sensors**

| | Bandwidth | DC Capable | Range | Power Loss |
|---|---|---|---|---|
| Shunt Resistor | kHz-MHz | Yes | mA – A | mW – W |
| Rogowski Coil | kHz-MHz | No | A –MA | mW |
| Current Transformer | kHz-MHz | No | A – kA | mW |
| Hall Effect | KHz | Yes | A – kA | mW |

The researchers have come up to a resolution of having the Non-invasive Current Transformer as the sensor for the project because based on the given specifications, this sensor is suitable in terms of high current load manipulation, high accuracy of the adapted measure of ampere and inexpensive enough to have multiple sensors for the outlets. Therefore, Non-invasive Current Transformer can be a huge help for the project.

### B. System Considerations

Arduino Uno microcontroller board is used in the system. It is based on the ATmega328 microcontroller chip, it has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. Its specification suffices the desired output program of the system.

SSRs (Solid State Relays) were used for switching purposes. SSRs, employ semiconductor switching elements, such as thyristors, triacs, diodes, and transistors. They provide high-speed, high-frequency ON/OFF switching operations. SSRs are used for a variety of electric machines and devices such as home electronics. The SSR is capable of switching the AC (Alternating Current) with repetitions in a high current load. The specification fits the desired standards of the researchers. The ampere rating of the circuit breaker for the outlets is 20A and for the air conditioner circuit breaker is 30A. The target for the prototype's SSR is to have an ampere rating which is close to that of a circuit breaker so proponents used 25A SSR for the two outlets and 40A for the air conditioner.

An android application is used in the project for controlling and monitoring the outlets contained in the system. The Group decided on using the MIT App inventor for creating the android application. The application can be installed by downloading the .apk from the mit app inventor data base.

**Table 3: Load Schedule**

| LOAD SCHEDULE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| CIRCUIT NO. | Load Description | Quantity | VA | Volts | Current (Amp) | CB Size (A-t) | Wire Size (sq mm) | Conduit |
| 1 | 180W Convenienc e Outlet | 2 | 360 | 230 | 1.57 | 15 | 3-3.5 sq. mm THHN | 20mmØ |
| 2 | 1HP ACU | 1 | 184 0 | 230 | 8.00 | 30 | 2-5.5 sq. mm THHN | 20mmØ |
| Total Connected Load, IFL | | | 220 0 | | 9.57 | | | |

| | |
|---|---|
| ICB = 9.57+1.5(8) | Iwire=9.57+0.25(8) |
| ICB = 21.57 Ampere | Iwire= 11.57 Ampere |
| USE: 30 AT, Bolt-on Type CB, 2P | USE: 2-5.5 sq. mm THHN wire + 3.5 sq. mm TW ground in 15/20mm diameter RSC |

Schedule of load is an estimate of the instantaneous operating electrical loads, in terms of active, reactive and apparent power. The parameters were used to identify and facilitate the necessary values and rating of the equipment to be used in an electrical installation. The data given in the schedule of loads were backed by calculation based on a well settled electrical principles and code requirements.

$$I = \frac{VA}{V} \qquad \textit{Equation (1)}$$

Equation 1, is used to calculate the Current (Amperes) which is necessary to determine the (CB) Circuit Breaker, wire and conduit size to be used in our electrical design.

### C. Instrument and System Interface

The conceptual framework of the study is shown in Figure 1. The current sensor readings determine the state of the appliances whether it is working or not. Voltage sensor is connected on the AC supply to diagnose if power interruption occurs. GSM module is the medium that establish communication between the microcontroller and android application. The application generates SMS based on the user's command by tapping the corresponding button that controls the outlets state and sends it to the GSM. The Microcontroller then decodes the SMS that is received by the GSM module into a command that controls the relay of the outlets. The application displays the status of the appliances (working / not working) and notifies when power outage occurs and when power resumes.

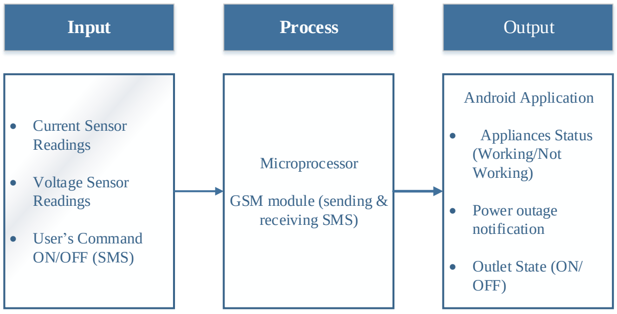



**Figure 1: Conceptual Framework**

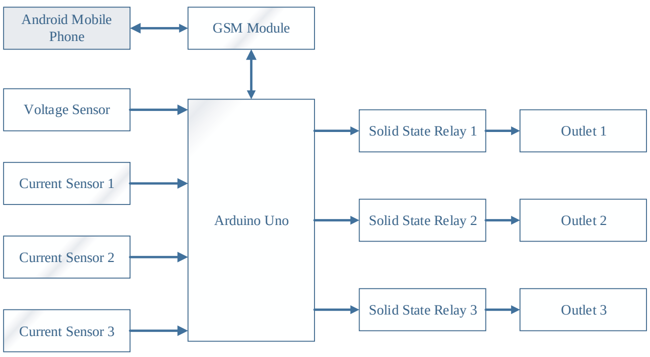
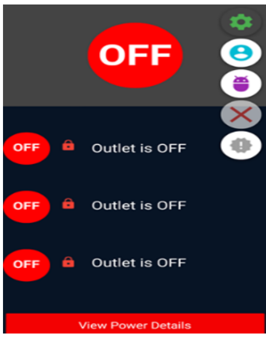



**Figure 2: Systems Block Diagram**

In figure 2, the appliances are linked to the current sensors which are connected to the microcontroller to monitor their condition (ON/OFF). A voltage sensor is coupled to the outlet to monitor home electricity. Relays are used to administer the outlets and the as per the requirement or command of the user, facilitated by the application.



**Figure 3: Start Up Screen** **Figure 4: ON State**



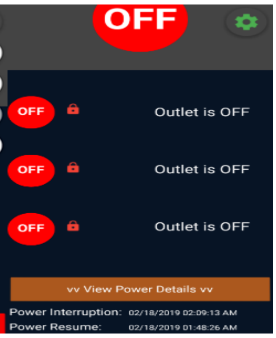




**Figure 5: OFF State** **Figure 6: Power Details**

Figure 3 shows the start-up screen of the android application while the Figure 4 shows that the outlets are ON state. Figure 5 shows that the outlets are on OFF state within the application interface. Figure 6 shows the power details happen in the system.

## III. RESULTS & DISCUSION

### A. Relay Response Test

The purpose of this test is to check the response of the relay by sending notification and the time delay.

**Table 4: Relay (ON/OFF) Testing on Outlet 1 with an Electric Fan**

| Number of Test | Send Notification (ON) | Time Delay (ON) *Seconds* | Send Notification (OFF) | Time Delay (OFF) *Seconds* |
|---|---|---|---|---|
| 1 | ✓ | 6.21 | ✓ | 7.43 |
| 2 | ✓ | 7.39 | ✓ | 8.25 |
| 3 | ✓ | 7.40 | ✓ | 7.36 |
| 4 | ✓ | 8.15 | ✓ | 8.46 |
| 5 | ✓ | 7.39 | ✓ | 8.08 |
| 6 | ✓ | 7.98 | ✓ | 8.00 |
| 7 | ✓ | 6.77 | ✓ | 7.63 |
| 8 | ✓ | 7.37 | ✓ | 7.31 |
| 9 | ✓ | 7.88 | ✓ | 7.93 |
| 10 | ✓ | 7.64 | ✓ | 47.31 |
| 11 | X | 0.00 | ✓ | 7.39 |
| 12 | ✓ | 7.74 | ✓ | 14.04 |
| 13 | ✓ | 7.11 | ✓ | 7.93 |
| 14 | ✓ | 7.69 | ✓ | 7.93 |
| 15 | ✓ | 8.40 | ✓ | 7.11 |
| 16 | ✓ | 6.68 | ✓ | 20.32 |
| 17 | ✓ | 9.00 | ✓ | 7.89 |
| 18 | ✓ | 7.91 | ✓ | 7.83 |
| 19 | ✓ | 6.87 | ✓ | 7.48 |
| 20 | ✓ | 23.80 | ✓ | 7.13 |

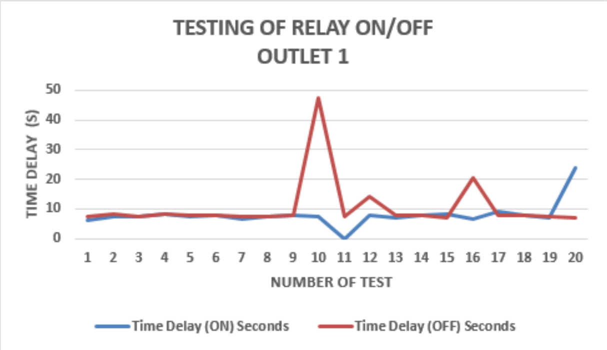



**Figure 7: Relay (ON/OFF) Testing on Outlet 1 with an Electric Fan**

In table 4 and figure 7 shows the testing of relay response (ON/OFF) on OUTLET 1 using the electric fan with a duration of one (1) minute before and after switching. In table 4 shows the time delay notification of the late received text messages of GSM when operating the system.

In table 5 and figure 8 shows the testing of relay (ON/OFF) on OUTLET 2 using the electric fan with a duration of one (1) minute before and after switching. In the table 5 shows the time delay notification of the late received text messages of GSM when operating the system.

**Table 5: Relay (ON/OFF) Testing on Outlet 2 with an Electric Fan**

| Number of Test | Send Notification (ON) | Time Delay (ON) *Seconds* | Send Notification (OFF) | Time Delay (OFF) *Seconds* |
|---|---|---|---|---|
| 1 | ✓ | 7.20 | ✓ | 7.89 |
| 2 | ✓ | 8.11 | ✓ | 7.78 |
| 3 | ✓ | 6.80 | ✓ | 8.13 |
| 4 | ✓ | 6.18 | ✓ | 12.95 |
| 5 | ✓ | 7.37 | ✓ | 8.21 |
| 6 | ✓ | 43.77 | ✓ | 8.11 |
| 7 | ✓ | 7.18 | ✓ | 8.08 |
| 8 | ✓ | 7.68 | ✓ | 7.68 |
| 9 | ✓ | 8.50 | ✓ | 7.76 |
| 10 | ✓ | 8.12 | ✓ | 7.99 |
| 11 | ✓ | 8.38 | ✓ | 7.98 |
| 12 | ✓ | 8.30 | ✓ | 15.68 |
| 13 | ✓ | 8.92 | ✓ | 9.83 |
| 14 | ✓ | 48.77 | ✓ | 6.25 |
| 15 | ✓ | 40.12 | ✓ | 6.81 |
| 16 | ✓ | 8.42 | ✓ | 7.39 |
| 17 | ✓ | 6.15 | ✓ | 12.50 |
| 18 | ✓ | 22.55 | ✓ | 12.98 |
| 19 | ✓ | 15.11 | ✓ | 7.92 |
| 20 | ✓ | 8.58 | ✓ | 7.88 |

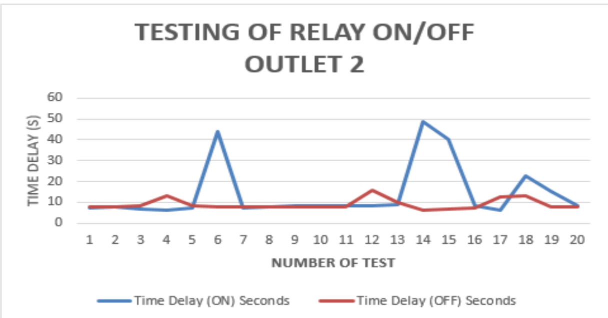



**Figure 8: Relay (ON/OFF) Testing on Outlet 2 with an Electric Fan**

In table 5 and figure 8 shows the testing of relay (ON/OFF) on OUTLET 2 using the electric fan with a duration of one (1) minute before and after switching. In the table 5 shows the time delay notification of the late received text messages of GSM when operating the system.

Based on the series of testing for the Relay in Outlet 1 and Outlet 2 using electric fan as the load, it was found that the shortest time delay (ON) recorded for both outlet was 6.15 seconds, while the longest time recorded was 48.77 seconds. For the time delay (OFF), the shortest time recorded was 6.25 seconds, while the longest is 47.31 seconds. The average time delay (ON) for both outlets was 12.22 seconds while in the time delay (OFF) it is 9.81 seconds. Therefore, based on the test shown above, the system was able to notify the user, and that indicates the success of sending and receiving of data.

### B. Current Sensor Response Test

The purpose of this test is to check the response of the current sensor and time delay.

In table 6 and figure 9 shows the testing of current sensor (WORKING/NO LOAD) on OUTLET 1 using the electric fan with a duration of one (1) minute before and after switching. In the table 6 shows the time delay notification of the late received text messages of GSM when operating the system.

**Table 6: Current Sensor Testing on Outlet 1 with an Electric Fan**

| Number of Test | Label Update (PLUGGED) | Time Delay (WORKING LOAD) *Seconds* | Label Update (UNPLUGGED) | Time Delay (NO LOAD) *Seconds* |
|---|---|---|---|---|
| 1 | ✓ | 9.11 | ✓ | 9.70 |
| 2 | ✓ | 9.22 | ✓ | 8.12 |
| 3 | ✓ | 10.20 | ✓ | 8.79 |
| 4 | ✓ | 18.95 | ✓ | 9.30 |
| 5 | ✓ | 12.60 | ✓ | 7.43 |
| 6 | ✓ | 9.97 | ✓ | 7.60 |
| 7 | ✓ | 11.9 | ✓ | 18.36 |
| 8 | ✓ | 12.24 | ✓ | 8.68 |
| 9 | ✓ | 11.15 | ✓ | 8.98 |
| 10 | ✓ | 16.48 | ✓ | 8.76 |
| 11 | ✓ | 13.72 | ✓ | 9.33 |
| 12 | ✓ | 10.48 | ✓ | 7.10 |
| 13 | ✓ | 11.37 | ✓ | 7.58 |
| 14 | ✓ | 12.04 | ✓ | 8.55 |
| 15 | ✓ | 15.42 | ✓ | 8.97 |
| 16 | ✓ | 16.67 | ✓ | 7.98 |
| 17 | ✓ | 16.00 | ✓ | 8.74 |
| 18 | ✓ | 7.90 | ✓ | 22.43 |
| 19 | ✓ | 8.51 | ✓ | 8.40 |
| 20 | ✓ | 25.95 | ✓ | 8.03 |

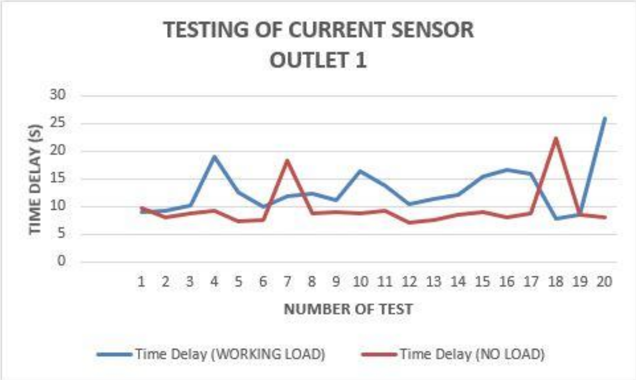



**Figure 9: Current Sensor Testing on Outlet 1 with an Electric Fan**

In table 7 and figure 10 shows the testing of current sensor (WORKING/NO LOAD) on OUTLET 2 using the electric fan with a duration of one (1) minute before and after switching. In the table 7 shows the time delay notification of the late received text messages of GSM when operating the system.

Based on the series of testing for the current sensors in Outlet 1 and Outlet 2 using electric fan, it was found that the shortest time delay (Working load) recorded for both outlet was 7.46 seconds, while the longest time recorded was 34.56 seconds. For the time delay (No Load), the shortest time recorded was 7.10 seconds, while the longest is 26.47 seconds. The average time delay (Working Load) for both outlets was 13.79 seconds while in the time delay (No Load) it is 14.52 seconds. Therefore, based on the test shown above, the system was able to notify the user, and that indicates the success of sending and receiving of data.

**Table 7: Current Sensor Testing on Outlet 2 with an Electric Fan**

| Number of Test | Label Update (PLUGGED) | Time Delay (WORKING LOAD) *Seconds* | Label Update (UNPLUGGED) | Time Delay (NO LOAD) *Seconds* |
|---|---|---|---|---|
| 1 | ✓ | 9.11 | ✓ | 7.34 |
| 2 | ✓ | 10.19 | ✓ | 8.65 |
| 3 | ✓ | 20.10 | ✓ | 8.32 |
| 4 | ✓ | 12.20 | ✓ | 7.92 |
| 5 | ✓ | 23.17 | ✓ | 10.19 |
| 6 | ✓ | 8.95 | ✓ | 10.38 |
| 7 | ✓ | 7.46 | ✓ | 11.65 |
| 8 | ✓ | 15.11 | ✓ | 9.52 |
| 9 | ✓ | 16.87 | ✓ | 7.22 |
| 10 | ✓ | 12.34 | ✓ | 8.41 |
| 11 | ✓ | 23.12 | ✓ | 9.56 |
| 12 | ✓ | 18.90 | ✓ | 17.44 |
| 13 | X | 0.00 | ✓ | 26.47 |
| 14 | ✓ | 11.09 | ✓ | 12.88 |
| 15 | ✓ | 11.50 | ✓ | 17.09 |
| 16 | ✓ | 12.89 | ✓ | 9.55 |
| 17 | ✓ | 13.5 | ✓ | 9.98 |
| 18 | ✓ | 10.00 | ✓ | 15.16 |
| 19 | ✓ | 11.71 | ✓ | 22.68 |
| 20 | ✓ | 8.98 | ✓ | 8.55 |

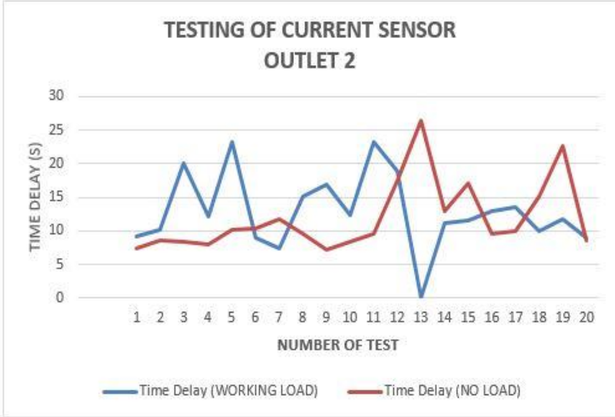



**Figure 10: Current Sensor Testing on Outlet 2 with an Electric Fan**

### C. Distance Response Test

The purpose of this test is to check the response of the project in terms of distance through sending notification and the time delay.

Table 8 and figure 11 shown above are the data gathered in testing the relay (ON/OFF) on OUTLET 1 in long-range distance using the electric fan with a duration of one (1) minute before and after switching. In the table 8 shows the time delay notification of the late received text messages of GSM when operating the system.

**Table 8: Relay response (ON/OFF) testing in long-range for Outlet 1**

| No. of Test | Send Notification (ON) | Time Delay (ON) *Seconds* | Send Notification (OFF) | Time Delay (OFF) *Seconds* |
|---|---|---|---|---|
| 1 | ✓ | 11.87 | ✓ | 10.05 |
| 2 | ✓ | 26.62 | ✓ | 9.01 |
| 3 | ✓ | 27.65 | ✓ | 34.72 |
| 4 | ✓ | 5.95 | ✓ | 14.36 |
| 5 | ✓ | 5.01 | ✓ | 5.71 |

Location: From SM Downtown, San Fernando Pampanga, Philippines (user) to Bacolor Pampanga, Philippines (prototype) with a distance of 11.1 km

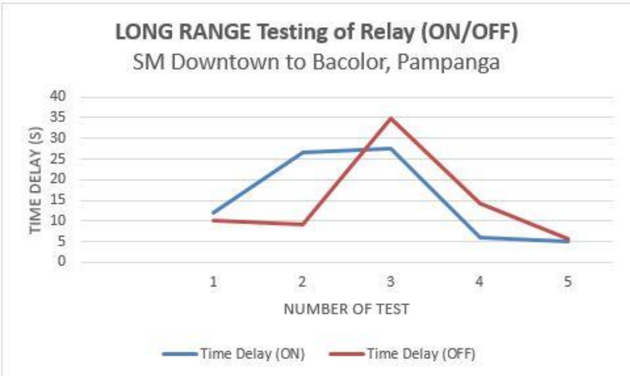



**Figure 11: Relay response (ON/OFF) testing in long-range for Outlet 1**

Table 9 and figure 12 shown above are the data gathered in testing the relay (ON/OFF) on OUTLET 2 in long-range using the electric fan with a duration of one (1) minute before and after switching. In the table 9 shows the time delay notification of the late received text messages of GSM when operating the system.

Based on the series of long-range testing from Bacolor, Pampanga to SM Downtown, San Fernando for the Relay in Outlet 1, and Outlet 2 using electric fan, it was found that the shortest time delay (ON) recorded for both outlet was 5.01 seconds, while the longest time recorded was 27.65 seconds. For the time delay (OFF), the shortest time recorded was 4.91 seconds, while the longest is 34.72 seconds. The average time delay (ON) for both outlets was 14.613 seconds while in the time delay (OFF) it is 14.004 seconds. Therefore, based on the test shown above, the system was able to notify the user, and that indicates the success of sending and receiving of data.

**Table 9: Testing of Relay response (ON/OFF) in long-range for Outlet 2**

| No. of Test | Send Notification (ON) | Time Delay (ON) *Seconds* | Send Notification (OFF) | Time Delay (OFF) *Seconds* |
|---|---|---|---|---|
| 1 | ✓ | 7.22 | ✓ | 25.99 |
| 2 | ✓ | 17.83 | ✓ | 8.38 |
| 3 | ✓ | 9.58 | ✓ | 11.00 |
| 4 | ✓ | 19.71 | ✓ | 15.91 |
| 5 | ✓ | 14.69 | ✓ | 4.91 |

Location: From SM Downtown, San Fernando Pampanga, Philippines (user) to Bacolor Pampanga, Philippines (prototype) with a distance of 11.1 km

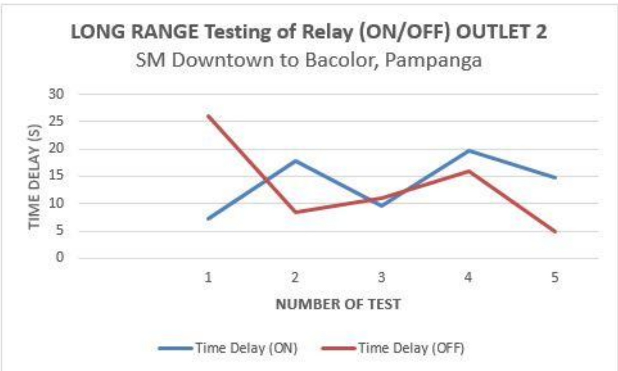



**Figure 12: Relay response (ON/OFF) testing in long-range for Outlet 2**

## D. Testing of Uninterruptable Power Supply

In table 10 shows the Uninterruptable Power Supply almost run at 11 hours and 8 minutes

**Table 10: Working hours testing of Uninterruptable Power Supply**

| Time *(Hours)* | Condition (Running) |
|---|---|
| 1 | Good |
| 2 | Good |
| 3 | Good |
| 4 | Good |
| 5 | Good |
| 6 | Good |
| 7 | Good |
| 8 | Good |
| 9 | Good |
| 10 | Good |
| 11 | Good |
| 12 | Not Good |

## E. Testing of Delays during Power Interruption

**Table 11: Testing of delays during Power Interruptions**

| Number of Testing | Notification during Power Interruptions | Turned OFF all the Outlets | Delay (seconds) | Notification when power Resumes | Delay (seconds) |
|---|---|---|---|---|---|
| 1 | ✓ | ✓ | 7.02 | ✓ | 8.71 |
| 2 | ✓ | ✓ | 12.32 | ✓ | 9.44 |
| 3 | ✓ | ✓ | 9.08 | ✓ | 9.65 |
| 4 | ✓ | ✓ | 6.24 | ✓ | 7.04 |
| 5 | ✓ | ✓ | 7.89 | ✓ | 7.78 |
| 6 | X | ✓ | 0.00 | ✓ | 11.92 |
| 7 | ✓ | ✓ | 8.89 | ✓ | 12.02 |
| 8 | ✓ | ✓ | 8.91 | ✓ | 8.64 |
| 9 | ✓ | ✓ | 9.35 | ✓ | 7.01 |
| 10 | ✓ | ✓ | 11.12 | ✓ | 8.32 |
| 11 | ✓ | ✓ | 8.21 | ✓ | 7.13 |
| 12 | ✓ | ✓ | 7.56 | ✓ | 7.45 |
| 13 | ✓ | ✓ | 7.06 | ✓ | 7.66 |
| 14 | ✓ | ✓ | 8.12 | ✓ | 8.90 |
| 15 | ✓ | ✓ | 8.23 | ✓ | 8.02 |
| 16 | ✓ | ✓ | 8.90 | ✓ | 7.16 |
| 17 | ✓ | ✓ | 9.06 | ✓ | 6.45 |
| 18 | ✓ | ✓ | 9.89 | ✓ | 6.92 |
| 19 | ✓ | ✓ | 8.11 | ✓ | 9.77 |
| 20 | ✓ | ✓ | 8.11 | ✓ | 9.40 |
| 21 | ✓ | ✓ | 7.67 | ✓ | 8.24 |
| 22 | ✓ | ✓ | 6.54 | ✓ | 8.36 |
| 23 | ✓ | ✓ | 6.23 | ✓ | 7.67 |
| 24 | ✓ | ✓ | 9.22 | ✓ | 10.12 |
| 25 | ✓ | ✓ | 8.13 | ✓ | 9.05 |

Table 11 shows testing when power interruption occurs. A 3-minutes duration was set to consider if power interruption occurs and before the system will turn off all the outlets. Notification such as delays, power interruptions and power resumes should be monitored in this test.

A Notification pops up in the mobile android application during power outages, and pops up when power returns. A 50-trials was conducted to determine the successive rate of the application. At the end, 49 out of 50 notification pops up having a successful rate of 98%.

## IV. CONCLUSION

All the data gathered are from the testing of the system to prove the reliability of the study. The project was efficient in terms of receiving all the data for the functionality of the system. The test results for the working appliances complemented the performance of the prototype wherein the system suitably accessed appliance that are plugged in. Base on the average time delays of transferring information, the time delay test results did not exceed 20 seconds.

In switching the outlets ON/OFF the prototype receives a successful rate of 99.375%. The application also indicates whether the appliance is working or not working by means of SMS and trials are conducted to test if the application is responsive. It has a successful rate of 98.75% based on the data gathered which indicates if the appliance is working or not. Another feature of the project is that a notification which shows the date & time of the power interruption and when power resumes pops up and is recorded to the power details button in the android application. It has a successful rating of 98% based on the results of the trials performed to prove its effectiveness.

## RECOMMENDATIONS

For future works, the researchers recommend to place the project above reaching ability of a person to prevent it from getting tampered. As for the Android Application, "plug-and-play system" can be added to the project wherein, a system can detect a new device activated and would send a notification to the Application enabling it to control by the phone/tablet. Another innovation for the application would be the additional users account. Using of accounts can make the project be able to serve to an authorized person only. The researchers might also implement the Activity Log where the user can view the recent logs of all the dates listed when it was interrupted by the Power Outages.

## REFERENCES


1. Manila Bulletin, (2018). P2.5-M property damaged in 8 Davao
2. fire incidents. Retrieved from August 25, 2018
3. https://news.mb.com.ph/2018/04/05/p2-5-m-property-damaged-in-8-davao-fire-incidents/
4. Philippine Star, (2015). 10,000 families homeless as 12-hour fire hit Manila. Retrieved from August 25, 2018 https://www.philstar.com/headlines/2015/03/03/1429699/update-10000-families-homeless-12-hour-fire-hit-manila.
5. Dandge, P. J. A., Shirwadkar, R., Gite, P., Odhekar, N., & Kakad, C. (2016). Electric Switch on / Off System Using Android App via Wi-Fi, 3(3), 1278–1282.
6. Sachin Kishor Khadke. (2014). Home Appliances Control System Based On Android Smartphone. IOSR Journal of Electronics and Communication Engineering (IOSR-JECE), 9(3), 67–72. http://doi.org/10.9790/2834-09336772


## AUTHORS PROFILE

**Mark Anthony A. Castro**., College Instructor under the Electronics Engineering Department of Don Honorio Ventura State University (DHVSU). A licensed Electronics Engineer and Electronics Technician. Currently enrolled at Nueva Ecija University of Science and Technology (NEUST) with a degree of Master of Engineering Management (MEnM). A Regular Member, Institute of Electronics Engineers of the Philippines. His research works focus mostly in alternative energy systems, acoustic engineering, & industrial automation.

**Sherwin V. Mallari**., College Instructor under the Electrical Engineering Department of Don Honorio Ventura State University. A licensed Electrical Engineer and Master Electrician. Currently enrolled at Nueva Ecija University of Science and Technology (NEUST) with a degree of Master of Engineering Management (MEnM). He focuses in academic-related and research-related subjects such as Electrical Engineering Circuits and Research.

**Russell John M. Torres**., College Instructor under the Electrical Engineering Department of Don Honorio Ventura State University. A licensed Electrical Engineer and Master Electrician. Currently enrolled at Nueva Ecija University of Science and Technology (NEUST) with a degree of Master of Engineering Management (MEnM). He focuses in Electrical Layout, Renewable Energy and Electrical Engineering Circuits.

**Romy A. Manese,**. A Graduate of Electronics and Communications Engineer at Holy Angel University, Angeles City. A licensed Electronics Engineer and currently enrolled at Nueva Ecija University of Science and Technology (NEUST) with a degree of Master of Engineering Management (MEnM). His expertise is on test engineering, instrumentation and control and industrial automation.

**Lorinda E. Pascual,** is a Professor at the Electrical Engineering Department of the Nueva Ecija University of Science and Technology, a state university in Cabanatuan city Philippines. She holds Master's degree in Engineering Education major in Electrical Engineering and a Ph. D. in Mathematics Education.