# TELEMETRY AND TELECONTROL OF APPLIANCES FOR SMART HOME SYSTEM

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# TELEMETRY AND TELECONTROL OF APPLIANCES FOR SMART HOME SYSTEM

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***Abstract*— The use of electronic appliances in the home is influenced by user needs. Use of electronic appliances in the home is related with user needs that increased steadily, it will cause excessive power consumption. The result of excessive power consumption is short circuit that may cause conflagration. This can interfere with user's comfort and security. Among the high demand for feeling comfortable in the home, technology play a role to making it happens, for example with a Smart Home System. The purpose of manufacturer this system is enabled user to controls electronic equipment, monitoring power usage and the occurrence of power outages in the home. The result from implementation test is the system can reduces the possibility of electrical short circuit in the home.**

***Keywords*— Smart Home; Internet; Control; Monitoring; Power; Raspberry Pi; Arduino; Android.**

## I. INTRODUCTION

Electronics appliances used in the home have variation, when the electronic appliances are connected to the electrical lines, then the control of it commonly used in the home that is through the switch and infrared. For example lights are in the control of switch and air conditioner is controlled by infrared.

The large number of using electronic appliances in the home is affected by the needs of user. This may cause limit for the use of power energy of every home is not considered. The power usage limit of each home has a difference, according data from The Ministry of Energy and Mineral Resources Directorate General of Electricity in 2016 there are several types of power that are often used for home, for the use of 450 VA power it have 23.144.262 customers, and 900 VA with 23.044.543 customers[1].

The excessive power consumption is the occurrence of electrical short circuit that can cause conflagration. According to The Indonesian National Board for Disaster Management, in 2012 to 2015, there have been 646 conflagration disasters in the settlement due to electrical short circuit, therefore it is necessary to pay attention in the use of power electricity[2].

The smart home is a concept integrated from several services inside home used the same communication system, and ensure safety and comfort with high intelligent function[3].

The ease of using control and monitoring features can be used when inside home or outdoors using the internet network, user is enabled to telecontrol electronic appliances on the basis of switch control and infrared control base, to telemetry or monitoring the total of power usage at home, and also monitoring the situation if there is a power outage at home.

Smart home is a combine systems between network which is connected to electronic equipment and enabled to be control, monitor, and accessed from entire distance[4].

Data acquisition system is a system that used for taking, collecting and set up data and processed it as user wishes[5].

Monitoring is a cycle of activities, that consists of collecting, review, and action about information from a process that implemented[6].

Control systems are amount the physics component that connected one to another so it can interrupting, directing or governing another system[7]. Control system consists of sub system and process that can produce output and it can perform according input that has given[8].

Software engineering is a discipline that can produce error free software and sending amount of fund in real time and it makes the user satisfied[9]. Software engineering is the creation and use of the principles of engineering expertise to obtain economical software that is reliable, and works efficiently on the real machine[10].

With the Smart home System, the user can telecontrol the electronic appliances, telemetry the use of power electricity, and also the occurrence of power outage at home using application that runs on android operating system via internet.

## II. CONFIGURATION OF SMART HOME SYSTEM

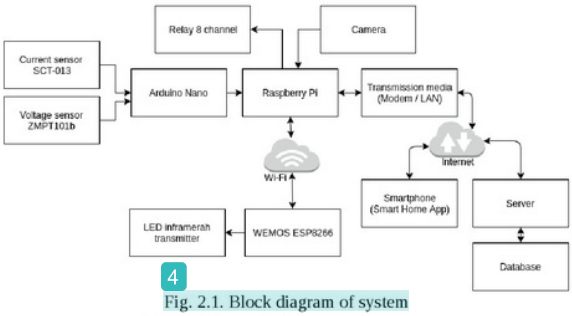


Fig. 2.1. Block diagram of system

Figure 2.1. shows flow of the system process that used in this research. At the current sensor block SCT-013 will measures the total current and the voltage sensor ZMPT101b will measures value of AC voltage (alternating current), both

sensors will measure on the main cable at home. Current and Voltage sensor will produce a parameter value for 10 bit ADC to be processed by arduino nano, the current and voltage values of both parameter will produce total power. From three parameters current, voltage and power obtained and calculated by arduino, then arduino will send the parameter data to raspberry pi using UART (Universal Asynchronous Receiver Transmitter) communication line.

On raspberry pi will record data sent by arduino using python programming language, python being used to record the status of 8 active relays on GPIO (general purpose input output) pins at raspberry that connected to switch based electronic devices based on switches implemented on the light, from these data will be forwarded by python to be sent to cloud storage through the internet network. Raspberry pi will enable the wireless access point feature, so WEMOS is used to control electronic equipment infrared based that is implemented in AC (air conditioner) connected to raspberry pi via wi-fi. From raspberry pi to AC (air conditioner) and relay controls, accessed via link from the server that will run the program to control it.

Raspberry pi uses GSM modem or LAN Cable transmission media to connect to the internet, so it can remote monitoring and control system, and also used as a medium between raspberry pi and cloud storage for data transmission.

## III. Hardware and Software Architecture of the Smart Home System

### A. Hardware

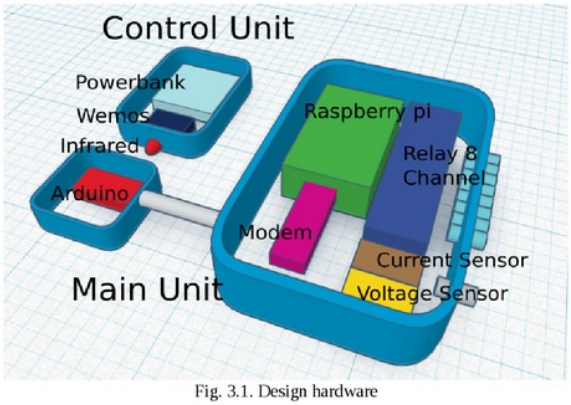


Fig. 3.1. Design hardware

*1) Design of main unit*

Main unit are perform data processing, data collection, data management, data transmission, and pass requested control processing. This unit consists of main of the tools mentioned except on the control unit. The main unit has a cube dimension which has 20 cm long, 13 cm width, and 3.5 cm high. The cube shaped parts of the main unit containe 10 se a plastic base material. The design for the main unit can be seen in figure 3.1.

*2) Design of control unit*

Control unit is the part that performs the infrared based control on the AC (Air Conditioner) to turn on to a pre-set degree and to turn the AC device off. The control unit can be used if one program for one same AC brand, so this type of control unit is not universal. The design for the control for the control unit can be seen in Figure 3.1.

### B. Software

*1) Software Raspberry Pi*

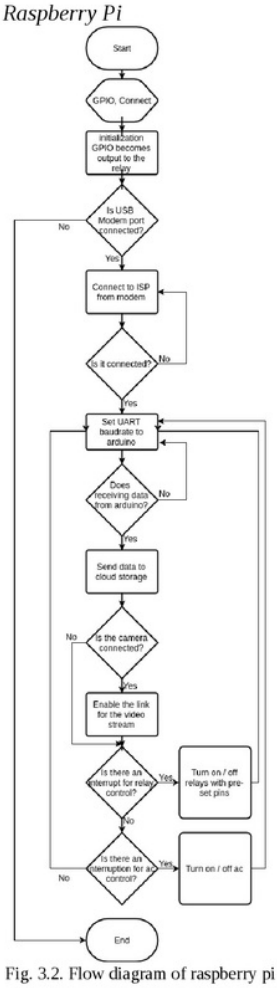


Fig. 3.2. Flow diagram of raspberry pi

Figure 3.2. describes the program design flow diagram on raspberry 9 by working when raspberry pi is turned on it will initialize GPIO (General Purpose Input Output) pin on raspberry pi into output to relay, when modem is connected to raspberry pi, raspberry pi will connect to ISP (Internet Service Provider), when it's connected it'll set the serial communication channel (UART) with the certain baudrate. After that it'll be repeated to receive data from arduino, the data will be sent to cloud storage, check the camera to activate

video stream link, then check the interrupt to controls the relay that connected to the lamp, and check the interrupt to controls the air conditioner (AC).

*2) Software Arduino Nano*

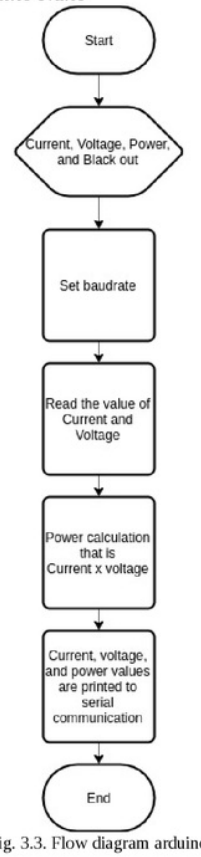


Fig. 3.3. Flow diagram arduino

Figures 3.3. describes the programming flow diagram of arduino nano, by means of which arduino will use a serial communication line (UART) with certain baudrate, arduino will read the values obtained from the current and voltage sensors, the value will be calculated into parameter that'll be use, there are power outage, voltage, current, power and after that arduino will send the data to raspberry pi using serial communication.

*3) Software WEMOS*

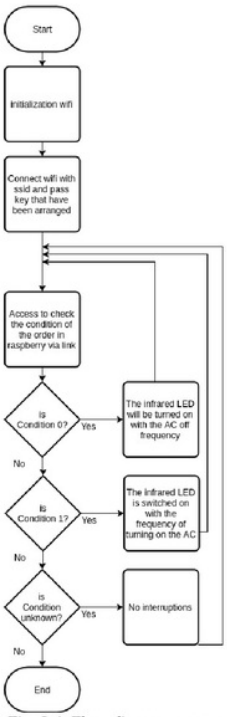


Fig. 3.4. Flow diagram wemos

Figure 3.4. describes the flow diagram of the design of WEMOS program, by working on wemos will connect to raspberry pi via wi-fi. Wemos will access the link on raspberry to search for given command, if the condition of command 0 means to turn off the AC, if the condition 1 means turn on AC with a certain degree, and if the condition is unknown it means there is no command.

*4) Software Android App RCKD*

Figure 3.6 describes the flow diagram of the application design on the android operating system, application that will connect to the internet, then the application will retrieve data from cloud storage, then the data that has been taken will be displayed on the application. The app will provide optional interruptions to view the video streams that will open the browser on a device, interrupt to control the AC and also lights.

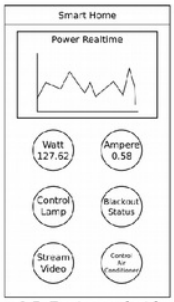


Fig. 3.5. Design android app

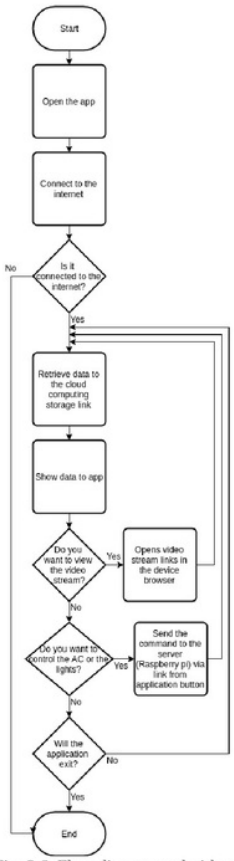


Fig. 3.6. Flow diagram android app

## IV. Features of The Smart Home System Implemented

The following test results from the features of the smart home system are:

Table 4.1 Smart Home Implemented

| No | Conditions Tested | Expected results | Success / Failed (√/x) |
|---|---|---|---|
| ***Device*** | | | |
| ***Test Goal: Smart House System*** | | | |
| 1 | Connected to the internet | Connected to GSM modem | √ |
| | | Connected to LAN | √ |
| 2 | Get sensor data | Get power value | √ |
| | | Get voltage value | √ |
| | | Get power outage condition | √ |
| 3 | Get the status of the switch | Get the status value on the switch | √ |
| 4 | Change the conditions on the switch | Change the switch condition to on or off | √ |
| 5 | Change the conditions on the | Change the conditions on the | √ |
| | on the infrared | AC becomes on or off | |
| 6 | Sending video over the internet | Displays videos over the internet | √ |
| ***User*** | | | |
| ***Test Goal: Smart Home App*** | | | |
| 1 | User's main dashboard | Displays the main dashboard | √ |
| 2 | Get sensor data | Displays power graph | √ |
| | | Displays power values | √ |
| | | Displays voltage values | √ |
| | | Displays status of power outage | √ |
| 3 | Get status data on the switch | Switch status no.1 | √ |
| | | Switch status no.2 | √ |
| | | Switch status no.3 | √ |
| | | Switch status no.4 | √ |
| | | Switch status no.5 | √ |
| | | Switch status no.6 | √ |
| | | Switch status no.7 | √ |
| | | Switch status no.8 | √ |
| 4 | Sending switch condition changes | Switch on / off no.1 | √ |
| | | Switch on / off no.2 | √ |
| | | Switch on / off no.3 | √ |
| | | Switch on / off no.4 | √ |
| | | Switch on / off no.5 | √ |
| | | Switch on / off no.6 | √ |
| | | Switch on / off no.7 | √ |
| | | Switch on / off no.8 | √ |
| 5 | Sending infrared condition changes | On/Off AC | √ |
| 6 | Get video streaming on camera | Displays live video conditions on the Camera | √ |

## V. Implementation of The Smart Home System

The following implementations of smart home system are:

*1) Smart home system implementation*

Fig. 5.1. Smart home system implementation

Implementation of smart home system, applied to miniature home that has installed lights in each room.

*2) Smart home system app*


Fig. 5.2. Implementation of smart home app in android

Smart home system application, have been given features to telemetry power monitoring, telecontrol switch on lamp and infrared on AC (air conditioner), and monitor the state of the home with video streaming.

*3) Telemetry power monitoring implementation*

Fig. 5.3. Telemtry power monitoring implementation


Fig. 5.4. Power monitoring graph display in app

Figure 5.4 the telemetry of power monitoring graph display in the app as the implementation of power monitoring, the accuracy of power calculation on the lights has been tested by switch from 1 to 8, if the lights on (1) and when it turned off (0). Accuracy is done by comparing the measured calculation value of smart home with power measurements tools.

Table 5.1 The result of comparison test of calculation value on smart home and power measurements tools.

| *No* | *Power Outage* | *Switch* | | | | | | | | *Current (Calc) Ampere* | *Current (Meas) Ampere* | *Power (Calc) Watt* | *Power (Meas) Watt* | *Error (%)* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* | | | | | |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 | 0.09 | 22 | 19.8 | 11.1 |
| 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 | 0.09 | 22 | 19.8 | 11.1 |
| 3 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0.12 | 0.12 | 26.4 | 26.4 | 0.0 |
| 4 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0.23 | 0.23 | 50.6 | 50.6 | 0.0 |
| 5 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0.29 | 0.3 | 63.8 | 66 | 3.3 |
| 6 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0.35 | 0.35 | 77 | 77 | 0.0 |
| 7 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.35 | 0.36 | 77 | 79.2 | 2.8 |
| 8 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0.4 | 0.43 | 88 | 94.6 | 7.0 |
| 9 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0.51 | 0.55 | 112.2 | 121 | 7.3 |
| 10 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| | | | | | | | | | | | | | Percent | 4.3 |

Calc : Calculation
Meas : Measurement

*4) Telecontrol switch implementation*

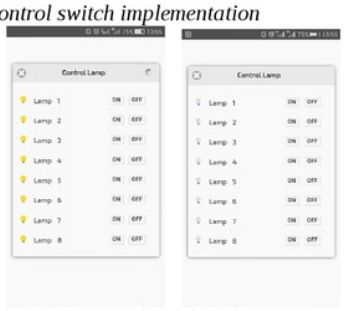


Fig. 5.5. Control Switch Implementation

At Telecontrol switch implementation, has been tested by turning on and off the lights on the miniature of the home.

*5) Telecontrol infrared implementation*

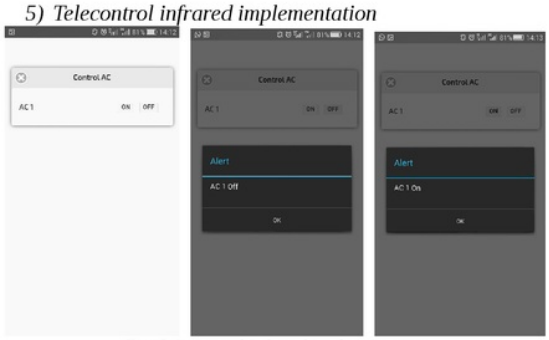


Fig. 5.6. Control Infrared implementation

Fig. 5.7. Condition of control unit on AC

Control infrared has been tested by turning on and off AC (air condition) in the room.

*6) Video Streaming implementation*

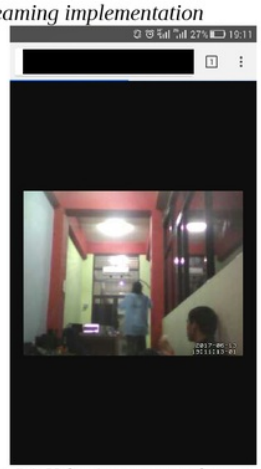

Fig. 5.8. Video Streaming implementation

Video streaming implementation has been tested by using modem and LAN on the video transferring.

## VI. Conclusion

This research presented the use of the internet of thing in a system called the smart home system. From the test results perform smart home system model by using raspberry pi, arduino nano, and others. The data has been sent to the user remotely and can be accessed via the internet network. So users can telemetry monitoring, telecontrol, and view videos about the state of the home. With that, excessive use of power can be minimized and control more efficient.

## Acknowledgment

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