ARCHITECTING OF HOME AUTOMATION SYSTEM BASED INTERNET OF THINGS PROTOTYPE: A CASE STUDY AT HOTEL BUKIT JUANDA

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ABSTRACT

Home automation namely residence equipped with information technologies that can respond to the needs of the residents, by relying on automation, efficiency, comfort, safety. The construction of this system aims to measure electricity use every hotel rooms; can control electronic devices in hotel rooms become easier, as it can be controlled by the employees of the hotel outside the room; can provide notification when the room needs to be cleaned; as well as be able to provide such notification at the time of LPG gas leaks. The construction system using Arduino Pi and Raspberries, as well as a web-based application as the interface for hotel guests and employees of the hotel. Stage workmanship begins with building a web service Developed fire. This Web service will connect to a database. The Web service will accept data from guest home automation web application on Raspberries Pi and monitoring employee web applications which further data is stored on a database, then when applications need data that web service would send that data in accordance with its needs. From the results of the study showed that when using Raspberry Pi and Arduino concurrently, then the system will still work properly on the user side-although the internet network problems are occurring, since using a local web server from Raspberry Pi, but on the side of the user's staff for monitoring will be interrupted, because Pi Raspberry does not send data to the web service in the event of internet network problems.

Keywords: Arduino, Home Automation, Internet of Things, Raspberry Pi, Web

1. INTRODUCTION

The hotel business is one that is quite developed in Indonesia, particularly for areas that have a tourist attraction and visited by domestic and foreign tourists. As one of the newly built hotel and is developing in the area of Bandung, Hotels Bukit Juanda has extensive and easy access, close to several tourist attractions in the city of Bandung.

Hotel Bukit Juanda including the hotel still stands and is developing new, then the hotel expenses need to be minimized, particularly for electricity payments costs PLN. According to Mr. Devy Harryanto as Operations Manager mentioned that almost 3-to-4 of hotel guests there is still a turn on the electronic device, especially lights, television, and AC in hotel rooms on an ongoing basis at the time they were out of the room. Because of the lack of monitoring of the employees of the hotel that is, then it can result in the cost of electricity to PLN becomes large.

A healthy environment is a priority for creating wellness guests, especially in the hotel room. Therefore, monitoring needs to be done on each of his hotel room. Of that, part of the housekeeping always checking rooms one by one. According to Mr. Devy Harryanto said that such activities were judged less effective when carried out at any time, whereas they could have been still in the state are still clean.

From the statement then it needs a system that can deliver a notification to the housekeeping part in hotel rooms need to be cleaned after the level of dust content has reached maximum limit. According to the decision of the Minister of health No. 1405/Menkes/SK/XI/2002 States that the maximum content of dust in the air of the room in the measurement of the average 8 hours is the maximum concentration of dust with a total of 0.15 mg/m^3[1].

LPG gas leaks may occur, and can result in fire. Had happened to the phenomenon of a hotel caught fire due to gas leaks, that Teenaged hotel Pacitan, according to data obtained from the beritajatim.com, the hotel's kitchen is located on the street Panglima Sudirman originated from employees of explosive activity of cooking. But not aware that gas cylinder 12 kg commonly used cooking leaked [2]. From the phenomenon that is then needed a system capable of giving notification to the staff in case of a gas leak in the kitchen, which aims to do prevention quickly when it happens. According to the National Consumer Protection Agency (BPKN, 2010), LPG gas is non-toxic but if inhaled more than 1,000 ppm or 0.1% (100% = 1 million ppm) will cause the sleepy, dream later died. LPG gas can cause an explosion at a gas concentration of 18,000 ppm up to 100,000 ppm [3].

Of these problems, then can be utilized technology to home automation system installed in each room of the hotel. Home automation can be defined as a place to live that is equipped with a data computing and information technology which can respond to the needs of the residents or the hotel,

work by relying on efficiency, automation devices, comfort, security and savings.

Based on the above problem, then the solution that can be done is to "Architecting of Home Automation System Based Internet of Things Prototype (A Case Study at Hotel Bukit Juanda)".

Based on existing problems, then the meaning of the construction of this system is to build a prototype-based Home Automation system in Internet of Things (IoT) based on case study on Hotel Bukit Juanda, and provide comfort, security and convenience of the hotel guests or employees.

As for the goal that will be achieved from the construction of this system are as follows:

1 The use of electricity becomes more measurable for every hotel room.
2 Control of electronic devices in hotel rooms become easier, as it can be controlled by the employees of the hotel outside the room and electricity will automatically turns off when there is no movement in the room.
3 Housekeeping is more effective in cleaning hotel rooms, because it will provide notification to clean rooms in a State of hotel rooms has exceeded the prescribed levels of dust.
4 Monitoring of the hotel which includes LPG gas leaks or smoke becomes easier.

2. THE CONTENT OF RESEARCH

2.1 The Cornerstone of The Theory

The cornerstone of the theory of the construction of this system outlines the basic theories to the analysis process system and supports the process architecting of Home Automation System Based Internet of Things Prototype a Case Study at Hotel Bukit Juanda.

2.2.1 Home Automation

Home Automation can be described as the extension housing of "automation of building/building automation". This is related to the activities and work in the home are automatically done. Home Automation may include controls that were focused on lighting, HVAC (heating, ventilation and AC), equipment, and other systems, to provide comfort, security, energy efficiency and ease of a better [4]. Currently monitoring for home automation and remote control have been using the internet network, in other words home automation can be categorized as the utilization of the Internet of Things.

2.2.2 Raspberry Pi

Raspberry Pi, often abbreviated by the name of Anton, is a single-board computer (single-board circuit; SBC) are the same size as a credit card that can be used to run the Office program, computer game, and as the media player video up to high resolution. Raspberry Pi developed by non-profit foundations, Raspberry Pi Foundation, which a number of developers and computer experts from the University of Cambridge, United Kingdom [5].

Raspberry Pi using Linux kernel based operating systems. Raspbian is a Debian-based operating System that can be optimized for the hardware-free Raspberry Pi, which was released in July 2012. On February 19, 2012, the Foundation released a proof of concept of Pi Raspberry SD card image that can be loaded onto a SD Card to produce an operating system first. Image based on Debian 6.0 with LXDE desktop and Midori browser, plus a wide range of programming tools. the image runs on QEMU that allows Raspberry Pi would be emulated on various other platforms. Raspberry Pi is used for as the brain smart home system to control all the devices in the smart home [6].

2.2.3 Arduino

Arduino is an electronic kit or an electronic circuit board containing Open source there is a main component, namely a microcontroller chip with the kind of Versatile Advanced RISC (AVR) from Atmel company. That in itself is a microcontroller chip or integrated circuit (IC) that can be programmed using a computer. Purpose of the program on the microcontroller the electronic circuit is to be able to read input, process that input and then produce output as desired. So the microcontroller as the brain inputs, outputs and processes in an electronic circuit [4].

In General, the Arduino is divided from two parts, namely:

1 Hardware in the form of boards input/output (I/O) are Open source.
2 The Arduino software which is also Open source, including the Arduino IDE software for writing programs and drivers for connection with a computer.

Arduino Uno is a microcontroller Board based ATMEGA328 has 14 digital input/output pins, 6 such as used as the output Pulse Width Modulation (PWM), 6 analog inputs, clock speed 16MHz, USB connection, power Jack, ICSP header, and a reset button. This Board uses the power connected to the computer with a USB cable or external power adapter AC-DC or battery [4].

Arduino Uno is a good choice for the first time or novice who wants to know the Arduino. In addition to its reliability is also affordable price [4].

Table 1. Specifications Board Arduino Uno

Microcontroller	ATMEGA328
Operating voltage	5V
Input voltage	7-12V
Input voltage limit	6-20V
Digital I/O pin	14 (6 pin PWM)
The analog input pin	6
DC current per I/O Pin	40 mA
The current DC to pin 3.3 V	50 mA
Flash memory	32KB(ATmega328) 0,5 KB boot loader
SRAM	2KB (ATmega328)
EEPROM	1KB(ATmega328)
Clock	16MHz

The Arduino can be powered through the USB connection or with an external power supply. The resource is automatically selected. External resources (Non-USB) can be derived from AC to DC adapter or battery. This adapter can be connected to plug a power jack, can also be connected in Power pin (GND and VIN) [4].

Board Arduino Uno can operate on External supply from 6 to 20 volts. If the supplied 7V less. Although the pin 5V supply can be less than 5V, the board may not be stable. If you use voltage more than 12V, regular voltage can heat and damage the board. The range in suggest is 7 to 12 volts [4].

As for the power supply pin on the Arduino Uno is:

- **VIN.** Voltage input board Arduino when using resources (5volts of USB connection or from sources other regulators). You can supply the voltage on this pin, if the supply voltage via the power jack, can access through this pin.
- **5V.** This pin is the output of 5V from the regulator on board. Board can be supplied through pin 5V or 3 .3V regulator, bypasses can damage the board.
- **3v3**. 3.3-volt supply generated by the regulator on board. Maximum current of 50mA with interesting.
- **GND.** Pin ground.

2.2.4 Gas Sensor MQ-2

Sensitive material gas sensor MQ-2 is SnO2, with low conductivity in clean air. When there is a gar flammable, conductivity sensor higher along with the increase in the concentration of the gas. Gas sensor MQ-2 has a high sensitivity against LPG, propane and hydrogen, can also be used for methane and other combustible gas, with low cost and suitable for different applications [7].

2.2.5 Temperature Sensor DHT 11

DHT 11 is one of the sensors that can measure two environmental parameters at once, namely temperature and humidity (humidity). In this there is a thermistor sensor type NTC (Negative Temperature's) to measure the temperature, an 8-bit mikrokontroller that cultivate both the sensors and send the results to the output format is pin single-wire bi-directional (two-way single cable) [8].

2.2.6 PIR Sensor HC-SR501

PIR is a sensor-based infrared. However, unlike most of the infrared sensor, which consists of an IR LED and phototransistor. PIR does not emit any such IR LEDs. As the name implies "Passive", this sensor only responds to the energy of the beams passive infrared that is owned by any objects detected by him. Objects can be detected by these sensors are usually the human body [6].

2.2.7 Light Sensor

Light sensor is a device used to change a quantity of electrical magnitudes into light. One type of light sensor i.e. a LDR. Sensor LDR (Light Dependent Resistor) is an element which was conductive changeable depending on the intensity of light received at the surface of the element, but the output on the sensor is not synonymous with what is known from a theoretical and simulated results [9].

2.2.8 RFID Mifare RC522

Mifare RC522 RFID Reader Module is a module-based Philips IC MFRC522 that can read the RFID with ease of use and the price is cheap, because this module already contains the components needed by the MFRC522 to be working. This module can be used directly by MCU interface using SPI, with supply voltage of 3.3 Volts [10].

2.2.9 RFID Tag

This tag works when antennas get signals from RFID reader and the signal will be reflected again, this reflected signal is usually already added to the data owned by the tag. RFID tags can vary in size, generally small [10].

2.2.10 Dust Sensor Sharp GP2Y1010AU0F

GP2Y1010AU0F is the sensor dust with optical sensing system. Infrared transmitter diodes (IRED) and phototransistor are arranged diagonally to the device. It detects the reflected light of dust in the air. Especially, effective to detect very fine particles such as cigarette smoke. In addition, it can distinguish smoke from house dust with a pulse output voltage. This sensor can be applied to detect dust in the air, for example, used on the Air Purifier, air conditioning, air monitoring [11].

2.2.11 Buzzer

Buzzer is a tool that can convert the electrical signal into a signal sound. Generally used for buzzer alarm, because it’s pretty easy by providing the input voltage then the buzzer will emit. The frequency of the sound emitted by the buzzer that is between 1 and 5 kHz. In this final project using the buzzer as security on a smart House that will issue warnings such as sound or vibration alarm [6].

2.2.12 Relay

The relay is a Switch (Switch) which operated in electrical and Electromechanical Components (the term) which consists of 2 main sections namely Electromagnetic (Coil) and Mechanical (a set of Contact Switch/Switch). The relay uses the principle of Electromagnetic Switch Contacts so as to move with a small electrical current (low power) can conduct electricity are higher-voltage. For example, with the use of electromagnetic Relay 5V and 50 mA is able to drive the Armature Relay (which serves as the switch) to conduct electricity 220V 2A [6].

2.2.13 Solenoid

Solenoid is the equipment that is used to convert electrical signals or electrical current into mechanical motion. Solenoids are manufactured from coils and retractable iron core that functions as an actuator for automatic unlock on safe [6].

2.2.14 Current Sensor ACS712

Measurement of the current shunt resistor that is usually requires the resistor connected in series on the load and change current into a voltage. The voltage is usually fed to the current transformers in advance before entering into a series of signal conditions. The hall effect technology implemented by the company replaced the resistor and shunt Allegro current transformer into a sensor the size of a relatively much smaller[12].

2.2.15 Touch Sensor TTP223

TTP223-BA6 is touch-detector IC has 1 soft keys. Touch detection IC is designed to replace the switch with a wide array of the size of the pad. Low power consumption and voltage for the operation of the contact switch on the application of DC or AC [13].

2.2 Analysis of System

System analysis can be defined as the unravelling of an intact system into parts of its components with a view to identifying and evaluating problems, obstacles that occur and the expected needs.

2.2.1 Analysis of The Problem

Based on the results of the research that has been done, there are problems occurred so that the building of this system are as follows:

1. Electricity use that is not measurable in any room, because there is still a hotel guest turns on electronic devices, but are outside the room.
2. Hotel employees has limitations in controlling electronic devices in hotel rooms, if guests are on the outside of the room
3. Housekeeping job are less effective in cleaning the hotel room if the room was always cleaned every day, it happens because of the unavailability of tools monitor the cleanliness of the room.
4. Monitoring of the hotel which includes monitoring of LPG gas leaks or smoke is very limited, due to the unavailability of gas monitoring tools.

2.2.2 Analysis of System Architecture

Analysis of system architecture is the system to be built, the application of internet-based home automation it will communicate with the Raspberry Pi bridged by the web service using JSON, language exchange with regard to the design of the system to be built can be seen in Figure 1.

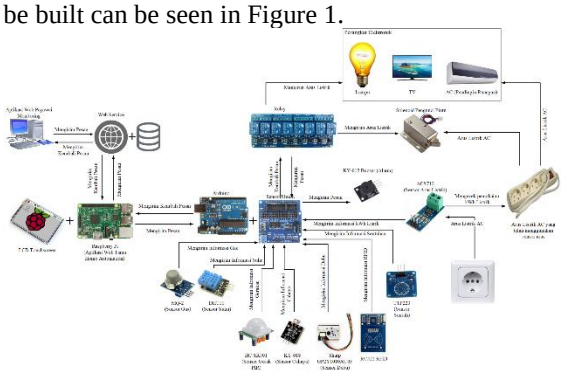


Figure 1. Design Of System Architecture

The following explanation of the image of architecting of Home Automation System Based Internet of Things Prototype a Case Study at Hotel Bukit Juanda.

Web applications on employee monitoring is used to register the guest id, which will be used to login on Raspberry Pi in a hotel room.

1. In addition to this application on the web can be used for monitoring employee monitoring and device status per hotel room.
2. Web service is used as the data exchange between web application monitoring employees and guest home automation web application on Raspberries Pi with a database on the server.
3. Raspberry Pi mounted in every room of the hotel as a guest for the user application interfaces with mounted LCD touch screen.
4. In addition, it Raspberry Pi is also useful for bridging data obtained from the Arduino to proceed to the web service.
5. An Arduino is used to read the value of both digital and analog sensors sensor by installing additional modules i.e. Arduino Sensor Shield, shield sensor module is used for easy installation because all sensors.
6. Electrical current Sensor used is ACS712, sensors are used to measure power consumption used by electronic devices in every hotel room. Power consumption in kWh data obtained from an electronic device that lights up or turns off is there in the hotel room. This data is useful to estimate the cost for electricity payments. Check the power consumption used by electronic devices.

7. Relay is used as switch automatically for electronic devices, in accordance with the input data on the Arduino, this relay will turn on the lights, television, air conditioner (AC), and turn on the solenoid.
8. Door lock Solenoid used to auto key lock on the door of the hotel room connected with the Relay, if relay flame then the solenoid it will unlock the door of the hotel room.
9. RC522 RFID used to verify RFID tags are able to enter the room or not. If this verify RFID RC522 RFID tags that are appropriate, then it will turn on the relay to open the solenoid. RC522 RFID is installed outside the room.
10. Touch Sensor used is TTP223, this sensor is used to power the relay to open the solenoid. The touch sensor is mounted inside a hotel room.
11. The PIR motion Sensor used is the HC-SR501, digital sensors are used to detect the movement of the guest, if guests were in the hotel room, then the Arduino will return the value of the status of guests inside. Conversely, if the guests are not in the room, then the Arduino will return the value of the status of the guests outside. If the status of the guests outside the hotel room exceeded 10 minutes, then the automatic electronic devices that are in the room will be extinguished all. PIR motion sensor is mounted inside a hotel room.
12. Gas Sensors used are MQ-2, analog sensor is used to monitor the quantity of gas, LPG gas with particular units of ppm. If the value of the sensor has exceeded the maximum, it will enable the buzzer as the alarm. Gas sensor MQ-2 is mounted inside a hotel room.
13. Temperature Sensor used is the DHT11, a digital sensor is used to monitor the temperature, with the units of °C. These sensors are also used to power the air conditioner (AC) if the temperature has exceeded the maximum limit, and put out the air conditioner (AC) if the temperature was lower than the minimum limit. DHT11 temperature sensor is installed in a hotel room.
14. Light Sensor used is KY-018, analog sensor is used to monitor the light outside of the room, with units of lux. In addition, the sensor is used to turn on the lights if light has exceeded the maximum, and put out the light if the light has been lower than minimum limit. KY-018 light sensor is mounted on the outside of the hotel room.
15. Dust Sensor used is the Sharp GP2Y1010AU0F, analog sensor is used to monitor the State of the dust on every hotel room with units of mg/m3. If the value of the sensor has exceeded the maximum, it will enable the buzzer as the alarm. Dust sensor is mounted inside a hotel room.

2.2.3 Analysis of Web Service

In the development of this web-based service Developed with JSON-based data exchange. This Web service will connect to a database. Web service that will be receiving data from web applications a guest home automation on Raspberry Pi and monitoring employee web applications which further data is stored on a database, then in the second application requires that data then the web service will transmit data according to the needs of the application. Here is a picture from the Groove web service data in Figure 2.

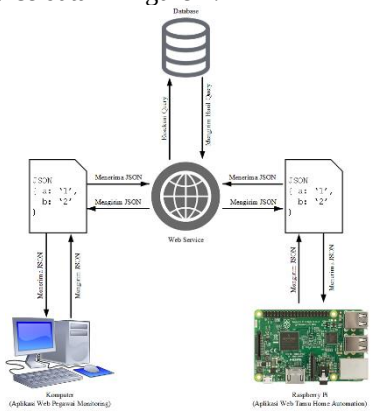


Figure 2. Data Flow In Web Service

2.2.4 Analysis of Data Communication

Data communication is a very important thing, because of the absence of communication of data, an application that is built will not be able to walk properly. Data communication used on the Internet-based Home Automation applications of Things this is to use for communication between Arduino Serial Arduino with Raspberry Pi, while for communication between Raspberry Pi or a computer with a web service using JSON data. The following is the flow of data communication between devices in Figure 3.

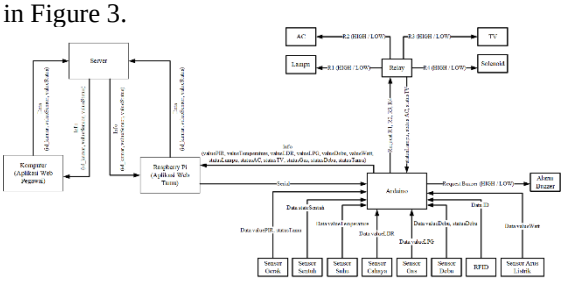


Figure 3. The Flow Of Data Communication

The following is an explanation of the flow of data communications include:

1. All the sensors send data value from each sensor is to the Arduino.
2. RFID send the data ID from RFID Tag that is affixed to the Arduino.

3. The Arduino will send a request to buzzer the Alarm Buzzer if any interaction or warning (HIGH or LOW).
4. The Arduino will send request R1, R2, R3, R4 to the Relay if there is a Serial that was included (HIGH or LOW).
5. The Arduino will send data with the JSON format for Raspberry Pi.
6. Accept the entered Serial Arduino from Raspberry Pi in accordance with interactions or conditions occur.
7. Raspberry Pi will submit periodic data (id_kamar, valueSensor, valueStatus) to the Server and vice versa Server also sends the info (id_kamar, valueSensor, valueStatus) to the Raspberry Pi if needed.
8. Computer Employees will receive periodic info (id_kamar, valueSensor, valueStatus) from the Server and vice versa also receives data Server (id_kamar, valueSensor, valueStatus) from a computer of employees.

2.2.5 Analysis of System Working Raspberry Pi, Arduino, Web Service in Home Automation

System working Raspberry Pi serves as a device for hotel guests who used run home automation applications, and as an interface for interaction with guest home automation web application. Arduino is used for controlling electronic device and send data from multiple sensors that will be processed by web applications in home automation guests Raspberry Pi. While the web service is used to bridge the data exchange between web application monitoring employees and guest home automation web application on Raspberries Pi with a database on the server. Here is a picture of the home automation system working analysis in Figure 4.

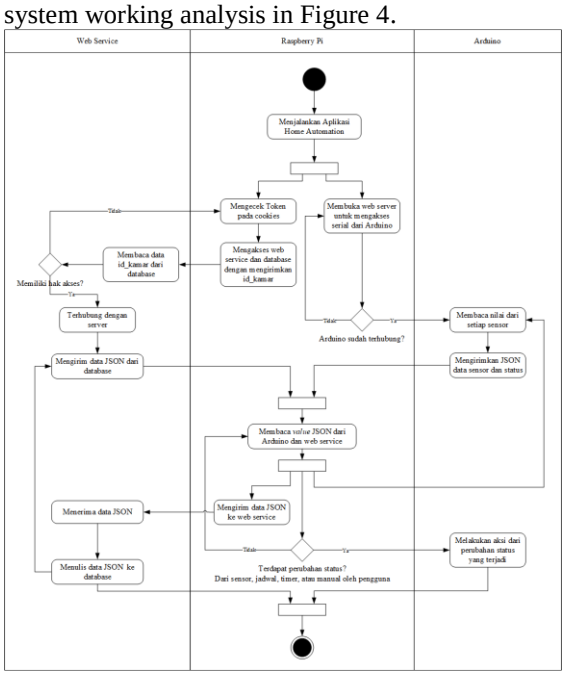


Figure 4. System working Raspberry Pi, Arduino, Web services in Home Automation

2.2.6 Analysis of Non-Functional Requirements

Nonfunctional needs analysis is the analysis required for the specification of system requirements. Non-functional requirements that are needed to build this system consists of three things, including hardware requirements, software requirements, and the needs of the user.

2.2.6.1 Analysis of Hardware Requirements

The hardware will be used based on the minimum requirements that must be met, namely:

1. Computers for Staff
2. Raspberry Pi 3 Type B for Hotel rooms
3. The Server Hosting
4. The Arduino Uno
5. Electrical current Sensor ACS712 30A
6. Relay
7. the Solenoid
8. RC522 RFID
9. Touch Sensor TTP223
10. Sensor PIR HC-SR 501
11. Gas Sensor MQ-2
12. Sensors DHT 11
13. Light Sensor KY-018
14. Dust Sensors Sharp GP2Y1010AU0F
15. The Alarm Buzzer KY-012

2.2.6.2 Analysis of Software Requirements

Software needs analysis is an analysis process more emphasis to the aspects of the utilization of the software. The minimum specification requirements the software on the computer that will be using this application can be seen in Table 2.

Table 2. The Minimum Specification Of Computer Software

Software	Minimum Requirement
Operating System	Microsoft Windows 7
Web Browser	Google Chrome

As for the minimum specifications of the software on a Pi Raspberry will use this application can be seen in Table 3.

Table 3. The Minimum Software Specifications Raspberry Pi

Software	Minimum Requirement
Operating System	Raspbian Jessie with PIXEL 2017.04.10
Web Browser	Chromium
Node JS Version	7.9.0

As well as minimum requirements for the specification of software on the server hosting the web application will be installed and monitoring employee web service can be seen in Table 4.

Tabel 4. The Minimum Specification Of The Hosting Server Software

Software	Minimum Requirement
cPanel Version	64.0 (build 19)
Apache Version	2.4.25
PHP Version	5.6.30
MySQL Version	10.0.30-MariaDB
Architecture	x86 / x64
Operating System	Linux
Perl Version	5.10.1
Kernel Version	2.6.32-673.26.1. lve1.4.22.el6.x86_64

2.2.6.3 Analysis of User Requirement

Analysis of the users intended to find out who the user is involved along with their characteristics so that it can be known the level of user experience and understanding of computers. The analysis of the needs of the user can be seen in Table 5.

Tabel 5. Analysis of User Requirement

No.	User	Specification
1	Front Office	Undergraduate Education Can use Windows operating system Can use web-based applications
2	Housekeeping	High School Education Can use Windows operating system Can use web-based applications
3	Guests of the hotel	Can use web-based applications

2.2.7 Analysis of Functional Requirements

Describe the process of functional needs analysis activities will be applied in the system and explains the requirements necessary in order that the system can be built properly and in accordance with the needs of the system.

Use case diagram is a diagram that shows the functionality of a system or class and how the system interacts with the outside world and explains the system is functionally a sighted user. From the identification of the actors involved in the above then use case diagrams can be seen in Figure 5.

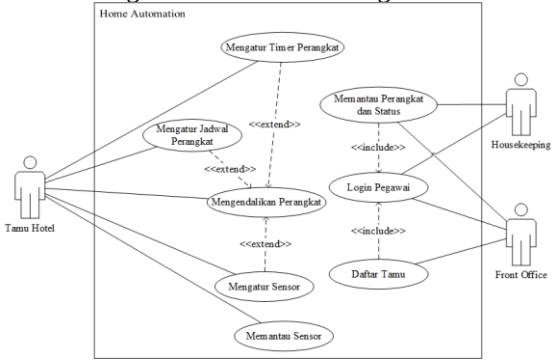


Figure 5. Use Case Diagram

2.2.8 Analysis of Database

Database analysis is activities to analyze the data that will be processed and stored in the database. This is represented in the analysis of where the data came from and the attributes of the data.

Entity Relationship Diagram (ERD) is a technique for describing information required in the system, and the relationship between the data, to describe it used some notation and symbols. In this system there are some entities, namely user, log, sensor, schedule, max_sensor, timer, status. As for the ERD on this data base system development can be seen in Figure 6.

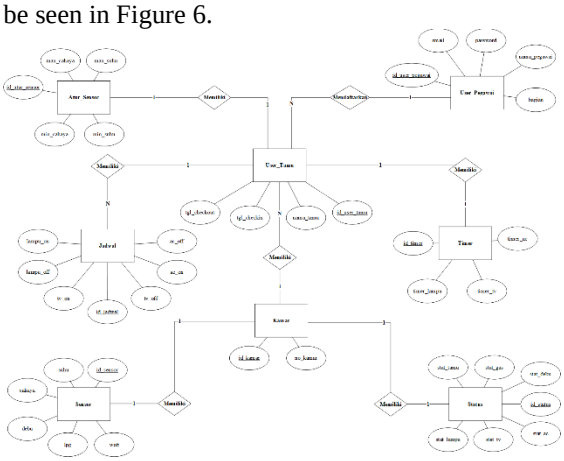


Figure 6. Entity Relationship Diagram

2.3 Testing the System

System testing is an important part in the cycle of software development. The purpose of the testing of this system was to find errors or deficiencies in the software tested. Testing conducted to know the software was built already meet the criteria in accordance with the purpose of designing the software. Testing is done to a sub Web Systems Monitoring Officer and Guest Home Automation Web.

2.3.1 Testing Sub Web System Monitoring Officer and Guest Home Automation Web

Based on testing against the second sub system functionality using black box has done, then it can be inferred that the system built worked in accordance with expectations.

2.3.2 Hardware Testing

Hardware testing aims to guarantee that the hardware can work and have a reliable quality.

2.3.2.1 Testing the Gas Sensor MQ-2

Testing the gas sensor MQ-2 aims to find out the distance sensitivity of LPG gas detection. Prior to testing, the sensor is connected to the Arduino to read analog output sensor that has been calibrated for LPG gas levels detected by the unit ppm. This test is performed on the ventilation room by room size 2x3x3 m3. Following the results of testing performed on the sensor MQ-2 can be seen in table 6.

Table 6. Testing the Gas Sensor MQ-2

No.	Distance	Time of Spray Gas	Sensor Response Time	Kadar Gas (ppm)
1	5 cm	00 sec 880 ms	01 sec 520 ms	1266
2	10 cm	01 sec 230 ms	03 sec 750 ms	1933
3	20 cm	03 sec 560 ms	04 sec 060 ms	9103
4	50 cm	02 sec 000 ms	02 sec 380 ms	6687
5	75 cm	04 sec 570 ms	05 sec 810 ms	239
6	100 cm	05 sec 320 ms	08 sec 620 ms	2751
7	150 cm	06 sec 120 ms	-	-

From the test results above, the distance sensitivity and gas levels are affected by time of large gas or gas spray was issued and the sensor response time is also affected by distance and time to spray gas. Optimal distance in the room with a size of 2x3x3 m3 is 1 meter with LPG gas is stored.

2.3.2.2 Testing the Dust Sensor Sharp GP2Y1010AU0F

Testing sensors sharp GP2Y1010AU0F dust aims to find out the distance sensitivity of detecting dust. Prior to testing, the sensor is connected to the Arduino to read analog output sensors that have been calibrated to detect dust with units of mg/m3. This testing is done at the room with open vents on the size of the room is 2x3x3 m3. Following the results of testing performed on the sensors Sharp GP2Y1010AU0F can be seen Table 7.

Table 7. Testing the Dust Sensor Sharp GP2Y1010AU0F

No.	Distance	The Level of Dust (mg/m^3)
1	5 cm	0.52
2	10 cm	0.52
3	20 cm	0.48
4	30 cm	0.43
5	40 cm	0.38
6	50 cm	0.33
7	60 cm	0.31
8	70 cm	0.27
9	80 cm	0.22
10	90 cm	0.16
11	100 cm	0.08

From the test results above, the distance sensitivity and dust levels are affected by distance from a given dust, other things that influence is a factor of air circulation. Optimal distance in the room with a size of 2x3x3 m3 is 90 cm can still detect the dust.

2.3.2.3 Testing the Current Sensor ACS712

Testing the sensor current ACS712 aims to compare the KWh used while using automation system with the system before using the automation. Prior to testing, the sensor is connected to the Arduino to read analog output sensors that have been calibrated to detect and convert electricity directly to the unit Wh, so that later it can be calculated how many KWh used. This testing is done by an electric load of 3 pieces of each lamp 3 Watts. Following the results of testing performed on the sensor ACS712 can be seen at Table 8.

Table 8. Testing the Current Sensor ACS712

No.	Time	KWh before automation	KWh after automation
1	12.00.00 – 13.00.00	0.06	0.03
2	13.00.00 – 14.00.00	0.06	0.03
3	14.00.00 – 15.00.00	0.06	0.03
4	15.00.00 – 16.00.00	0.09	0.06
5	16.00.00 – 17.00.00	0.09	0.06
6	17.00.00 – 18.00.00	0.06	0.06
7	18.00.00 – 19.00.00	0.06	0.06
8	19.00.00 – 20.00.00	0.06	0.06
9	20.00.00 – 21.00.00	0.06	0.06
KWh Total		6.00	4.5

From the test results above can be inferred by the presence of this system can measure electricity use, and large KWh of electricity used after using the system automation more efficient about 25% or 1.33 KWh compared to before using the automation system.

2.3.2.4 Testing Wireless Modem Connections

Wireless modem connection test aims to find out the distance which can be reached by free Wi-Fi from Raspberry Pi. Wireless modem connection testing done with Wi-Fi connect from Raspberry Pi with a modem via wireless so Raspberry can be connected with the internet and can perform the activity of sending and receiving data from a server (web service). Following the results of testing done on the wireless modem connections can be seen in Table 9.

Table 9. Testing Wireless Modem Connections

Distance Wireless Modem	Internet Connection	Can do the sending and receiving of data	Can perform automation and controlling
1 meter	Yes	Yes	Yes
2 meters	Yes	Yes	Yes
3 meters	Yes	Yes	Yes
4 meters	Yes	Yes	Yes
5 meters	Yes	Yes	Yes
6 meters	Yes	Yes	Yes
7 meters	Yes	Yes	Yes
8 meters	Yes	Yes	Yes
9 meters	Yes	Yes	Yes
10 m	Yes	Yes	Yes
11 m	No	No	Yes

From the results of testing the connection of wireless modem with Wi-Fi Pi Raspberry can be reached at a radius of 10 meters on the normal barriers with internet access is still available so that it can perform the sending and receiving of data with the server web service), but if over a radius of 10 meters, then the connection with the modem will be disconnected. As for the process automation and controlling although not connected to the modem or do not have internet connection will still be making your smoothly on the user side-although the internet network problems are occurring, since using a local web server from Raspberry Pi, but on the side of the user's staff for monitoring will be interrupted, because Pi Raspberry does not send data to the web service in the event of internet network problems.

2.3.3 Beta Testing

Based on the results of beta testing through interviews with the operational Managers, then it can be inferred that the Architecting of Home Automation System Based Internet of Things Prototype a Case Study at Hotel Bukit Juanda.

this is in compliance with the expected goal that is able to measure electricity use every hotel rooms; can control electronic devices in hotel rooms become easier, as it can be controlled by the employees of the hotel outside the room; can provide notification when the room needs to be cleaned, but should try to implement it in a hotel room to find out if task housekeeping in cleaning hotel rooms it is effective or not; as well as be able to provide such notification at the time of LPG gas leaks, but only needed in the kitchen space alone is not necessary in every hotel room.

While the results of beta testing through a questionnaire with a few respondents who tried the application implemented in a prototype hotel rooms, it can be inferred the respondents strongly agree that this application helps to control electronic equipment such as lights, TV, air conditioning and security warnings in a hotel room in case of gas leak; respondents strongly agree that app helps set usage time (menu timer) hotel room with electronic devices in a timely manner; respondents strongly agree that app helps organize time and flame goes out (menu scheduling) hotel room with electronic devices in a timely manner; respondents strongly agree that app it helps ease the flame and extinguish (sensor settings menu) electronic device hotel rooms in accordance with the conditions of the room using the automation mode; the respondent agrees that this application menu monitoring the condition of the room it helps in knowing the condition information hotel rooms.

3. CLOSING

3.1 Conclusion

Based on the results obtained from the research done in preparing the final project which refers to research purposes, then it can be inferred.

1. These prototypes already able to measure electricity use in every hotel room.
2. These prototypes already able to control electronic devices in hotel rooms become easier, as it can be controlled outside the room and electricity will automatically turns off when there is no movement in the room which indicates that hotel guests are on the outside of the room.
3. These prototypes already able to provide notifications to clean rooms in a State of hotel rooms has exceeded the prescribed levels of dust, but to streamline the work of the housekeeping need to try to implement it in a hotel room.
4. These prototypes already able to provide notification in case of LPG gas leaks, but we recommend that you only needed for kitchen space, need not be in every hotel room.

3.2 Advice

This home automation system prototype still need further development, including the following:

1. Prototype has yet to have a system that can do the settings of an electronic device, such as changing the setting temperature of the air conditioning, can move the TV channel without using the keyboard (remote) from the original device.
2. In implementing this prototype, the relay is used to switch the electronic tool should use Solid State Relay.
3. In implementing the prototype requires a deeper understanding of experts on high-voltage electricity in the building.

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