IMPLEMENTATION OF HOME AUTOMATION USING WIRELESS COMMUNICATION

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CERTIFICATION OF APPROVAL

IMPLEMENTATION OF HOME AUTOMATION USING WIRELESS COMMUNICATION

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_____

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TRONOH, PERAK

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CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

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ABSTRACT

Home automation offers convenience in enhancing the quality of life. Its specialty in having centralized control system with capability to solve complex problems in controlling and monitoring home environment and appliances draws the attention of the researchers and home industries to create home automation products with consideration of many aspects such as low cost home automation system, easy access system and etc. The implementation type of home automation system can be either wired or wireless. The wired types are power line and wired home automation while wireless home automation comes with different technologies. The technologies used in wireless home automation such as Wi-Fi, Infrared (IR), Bluetooth, Zigbee and Global System for Mobile communication (GSM). Each of these technologies offers advantages in term of flexibility and reliability but limited to their communication range. Taking advantage of the technologies and rapid development of home automation system, a low cost home automation system using wireless communication is designed and implemented involving both software and hardware. This project is designed consist of one server and three client nodes that communicate through Wi-Fi communication. The server is directly connected to a computer via Universal Serial Bus (USB). Meanwhile, each of client node is attached with various sensors to detect home temperature and humidity, light intensity and body heat radiation which will provide data back to the user. The data are transferred wirelessly using Wi-Fi communication from client nodes to the server and the information of the sensed data can be monitored through a Thingspeak web page. This project is designed using a low cost hardware components to meet a purpose of low cost home automation. For this, the components used in this project include ESP8266 Wi-Fi modules to provide wireless communication between client nodes and server while Arduino UNO is an open source microcontroller board for program and control purpose. Various type of sensors are used such as DHT11 to sense current humidity and temperature level, Light Dependent Resistor (LDR) used to sense the intensity of light while Passive Infrared (PIR) sensor to detect human body heat radiation. All these sensor are connected to Arduino UNO board and controlled using program created.

ACKNOWLEDGMENT

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CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

This chapter provides an overview of the project including the background, problem statement, objectives and the scope of study.

1.1 BACKGROUND

In these recent years, the development of home automation system is rapidly increasing in home industries as it provide convenience not only limited to control home appliances and monitoring home environment but also tighten home security. Plus, people nowadays are highly aware the important of home automation due to its professional capability to solve complex problems in preservation of comfort and enhance the quality of life.

In this project, a low cost home automation system in designed and implemented using wireless communication. The design consist of one server and three client nodes to perform automatic control of home appliances and monitoring humidity level, temperature level and light intensity.

The system is built involving both software and hardware. For the software, an Arduino IDE software is used to create a program that enable the hardware to perform control and feedback purpose. Meanwhile, the hardware part used ESP8266 Wi-Fi module to provide Wi-Fi communication between client nodes and the server. Besides, Arduino UNO board is an open source microcontroller board based on ATmega328p. It has 14 digital input/output pins and six analog pins that used to connect sensors for to perform control and monitor purpose. The sensors connected to the microcontroller board are DHT11, PIR and LDR sensor. DHT11 is used to sense the humidity and temperature level in the house while LDR sensor is to sense the light intensity. PIR sensor mainly used to detect the presence of human in the house by detecting the body heat temperature. The data sensed by the sensors are then used as feedback for automatic control of home appliances. The DHT11 humidity and temperature sensor is set to two minutes for continuous update of humidity and temperature reading. The reading then

checked and compared to control the fan speed according to the range limited. While, the same method is applied for automatic light dimmer by using the range of light intensity sensed by LDR sensor. Meanwhile, ON and OFF state of light is automatically control by PIR sensor once it detect the presence of human within its coverage area. The detection of human body heat will trigger the relay to close circuit for ON state while the circuit remain open when no detection occurred.

All the sensed data can be monitor through a Thingspeak web page. Thingspeak is a web page that accepts input through GET and POST linked via API key that included in the program created. To publish the data to Thingspeak, a server first need to recognize the address from which client node has sent the data. After the recognition of client node is made, the server will upload the data to Thingspeak for update.

1.2 PROBLEM STATEMENT

The advancement in home automation using existing technologies offers convenience and enhance the quality of life. Its ability to perform complex and centralize control system gives the opportunities to increase energy efficiency and safety enhancement. Although, home automation system offers such various advantages to its user but due to high cost of the commercial home automation products has prevented the products to be made available in every home. Currently, there are two existing types to implement home automation which are wired and wireless communication. A wired home automation system available with high cost of implementation because of the system requires to be wired the whole home to centralize control system. High cost is measured referred to long term period as the user need to maintain good functionality of the system. For instance, if one of the system goes malfunction can affect the whole system. Compare to wireless implementation, the limitation of its functionality is limited range of communication. If the malfunction occurred on one of the system, it will not affect the whole system. Therefore, concerning with the problems, this project proposes low cost home automation system using wireless communication to control home appliances and monitor home environment.

1.3 OBJECTIVE

The objective of this project is to implement a low cost home automation system using Wi-Fi communication to control home appliances and monitor home humidity, temperature and light intensity via Thingspeak web page.

1.4 SCOPE OF STUDY

The scope of study has been outline in order to achieve the objective. This project of home automation using wireless communication requires both software and hardware implementation. The scopes are:

- Implement home automation control and monitoring system using Arduino IDE software and interfacing Arduino UNO microcontroller board with ESP8266 Wi-Fi module, sensors and appliances.
- Develop wireless network communication between the server and client nodes using ESP8266 Wi-Fi module.
- Display data using Thingspeak web page.

CHAPTER 2

LITERATURE REVIEW

2.0 HOME AUTOMATION

The revolutions in home automation system using existing technologies turns the system applicable in every home while enhancing the quality life. In 1984, American Association of House builders introduced the term “smart house” with primary intention to fulfill the promise of socially appropriate and timely assistance in improving the lifestyle of families. Currently, using the same concept of smart house, home automation received rapid acknowledgement as it is reliable to professionally perform complex task while providing convenience and comfort to the user. Based on an automatic operation, home automation system capable to control electrical appliances and electronic devices in home or even through wireless communication. For example, automatic dimming or ON and OFF state of lamp can be automatically control using sensor.

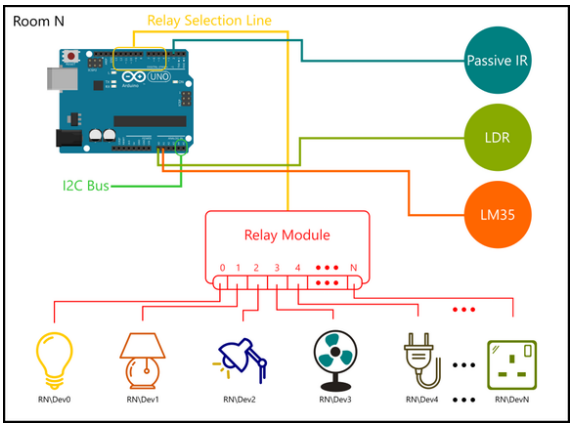


FIGURE 1. Home automation system structure

The system is mainly equipped with sensor, microcontroller and controlling devices as shown in FIGURE 1. The sensors are used to sense the anticipated event and the data will trigger the operation of controlling devices.

Generally, home automation implementation can be either wired or wireless connection. Power line and bus cable home automation falls into wired type implementation. The difference between these two types is power line automation does not require additional cable for transferring information instead it uses power line to transfer the data. Meanwhile, all home appliances are connected to a main controller through a communication cable in bus cable home automation. The entire operations are centralized by the computer that continuously communicate to the main controller.

2.1 MAJOR COMPONENT IN MAIN CONTROLLER

As illustrate in FIGURE 2, the main controller is made up of four major components including power unit, sensing unit, processing and transmission unit.

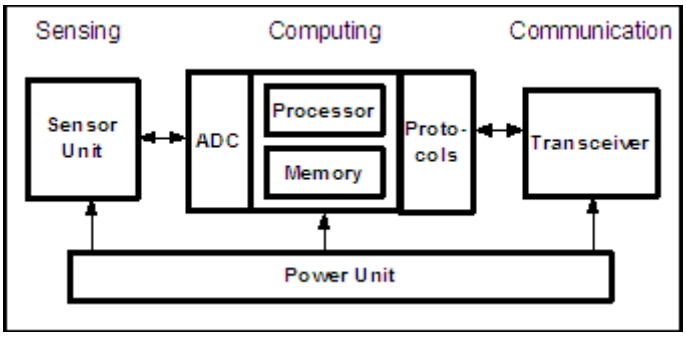


FIGURE 2.Major components in sensor node

A **power unit** is considered as power supply to the other components in sensor node. It powered up by a storage battery as the sensor node consume low power to perform the operation. Meanwhile, **sensing unit** is equipped with several type of sensor to detect the interest event while the analogue signal in converted to digital form by using Analog-to-Digital converter (ADC) .A **processing unit** is a microcontroller or microprocessor as it drives the overall operations in the node. It is responsible to control the sensors, execute the communication protocols and process algorithm signal received by the sensor [1]. The receiving data from the processing unit is transmitted to the base station via **transmission unit** using a wireless medium.

2.2 WIRELESS TECHNOLOGIES IN HOME AUTOMATION

Nowadays, the advancement in technologies shows wireless communication capable to replace conventional wired home automation system. There are various wireless technologies applied in home automation system such as Wi-Fi, Bluetooth, IR, Zigbee and etc [1]. In table blow shows the respective technologies characteristic and application.

Standard	**Transmission frequency**	**Transmission speed**	**Power consumption**	**Stronghold**	**Application**
Zigbee	2.4 Ghz	250Kbps	Medium	Low cost Long life (battery)	-Remote control -Battery operated products
Bluetooth	2.4 Ghz	1Mbps	Low	Cable replacement	Wireless USB Handset and headset
Wi-Fi	2.4 Ghz	11Mbps	High	High data range	-Internet browsing -PC networking

TABLE 1. Wireless technologies

Table above shows the most common wireless technologies use nowadays. These three technologies using the same transmission frequency of 2.4 GHz. However there are different transmission speed as the Zigbee has the lowest speed of 250Kbps compare to Bluetooth and Wi-Fi which has transmission speed of 1Mbps and 11Mbps respectively. From all these three technologies, Wi-Fi transmission required high power consumption as it has the highest transmission speed. There wireless technologies can be apply on various application such as remote control application using Zigbee, wireless USB, handset and headset using Bluetooth while Wi-Fi allow the user to browse the internet and PC networking.

2.3 PREVIOUS TECHNOLOGIES IN HOME AUTOMATION

Upgrading the system using existing technologies allow home automation system being applicable to perform it specific task. There are various projects of home automation focusing on specific objectives created to the real world. For instance, a smart power home automation [2] and [3] using Zigbee technology were developed focusing on power consumption of appliances. This project is aiming to reduce energy consumption of electrical appliances.

R.A Ramlee et al. [4] has implemented the HAS using wireless Bluetooth technology. The system has extended by keeping the physical switches where the conventional switches were replaced with 5V switches that ensure no electric shock could happen. This is to guarantee for safety is the main concern for the system in home. The project used Bluetooth module with 2400 Hz measured frequency and having range of connectivity up to 100 meters at speed rate of 3Mbps. However, the controlled devices are limited to seven unit to be interface in a Picante.

The application of GSM is designed and implemented in home automation [5] and [6]. The advantages of using GSM is it solely implemented using Short Message Service (SMS) that make it available at any places as the user will be automatically updated on the current condition of home. In this paper [6], the user is not provided with a graphical interface and require to remember specific AT commands to control the devices.

Wi-Fi based home control system using Personal Computer (PC) based web server has been implemented to manage and control the connected home devices [7]. The advantages of using Wi-Fi connection is it has the range of connectivity up to 100 meter with the data transfer rate up to 11Mbps. However, due to large coverage area and high speed, Wi-Fi technology consumed high power compare to the other types of technology.

CHAPTER 3

METHODOLOGY

3.0 INTRODUCTION

This chapter provides an elaboration regarding steps taken and designing a system for smart home monitoring and controlling.

3.1 PROJECT DESCRIPTION

In this project a fully automated home control and monitoring is design to provide flexibility for the user. The considered places to deploy the node include the bedroom, kitchen and toilet in the house.

The parameters of project include in sensing the temperature that will update real time data of current temperature which the user able to monitor through web browser whenever the nodes is connected to the Wi-Fi. Besides, the speed of fan is control through temperature reading by setting a certain value of temperature to specific speed. The fan is operates when the PIR sensor detected the present of heat from human body.

The other controlled parameter is automatic lamp using PIR sensor in which the lamp will turn on while it detected the present of human body heat. During the turn on state of the lamp, the LDR sensor is triggered and read the current light intensity. The light is able to dim according to the set value of LDR reading.

Meanwhile, an ultrasonic sensor is used to trigger the lamp and fan specific in the toilet. When the object is moved towards the sensor by a certain value, the sensor will trigger the lamp and stay at the on states until the PIR sensor sensed no human body heat and turn off both lamp and fan.

3.2 SYSTEM ARCHITECTURE

A low cost home automation for monitoring and controlling system architecture is divided into three layers which are home environment, home gateway and remote environment.

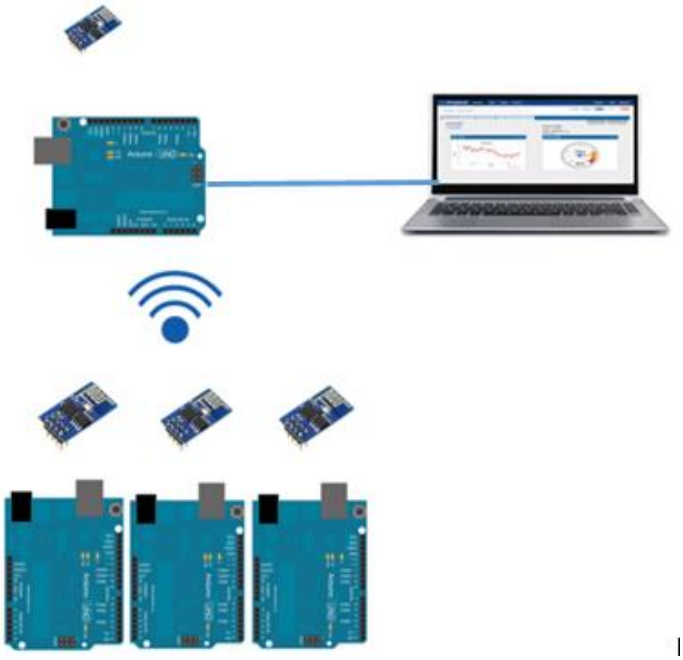


FIGURE 3. System architecture

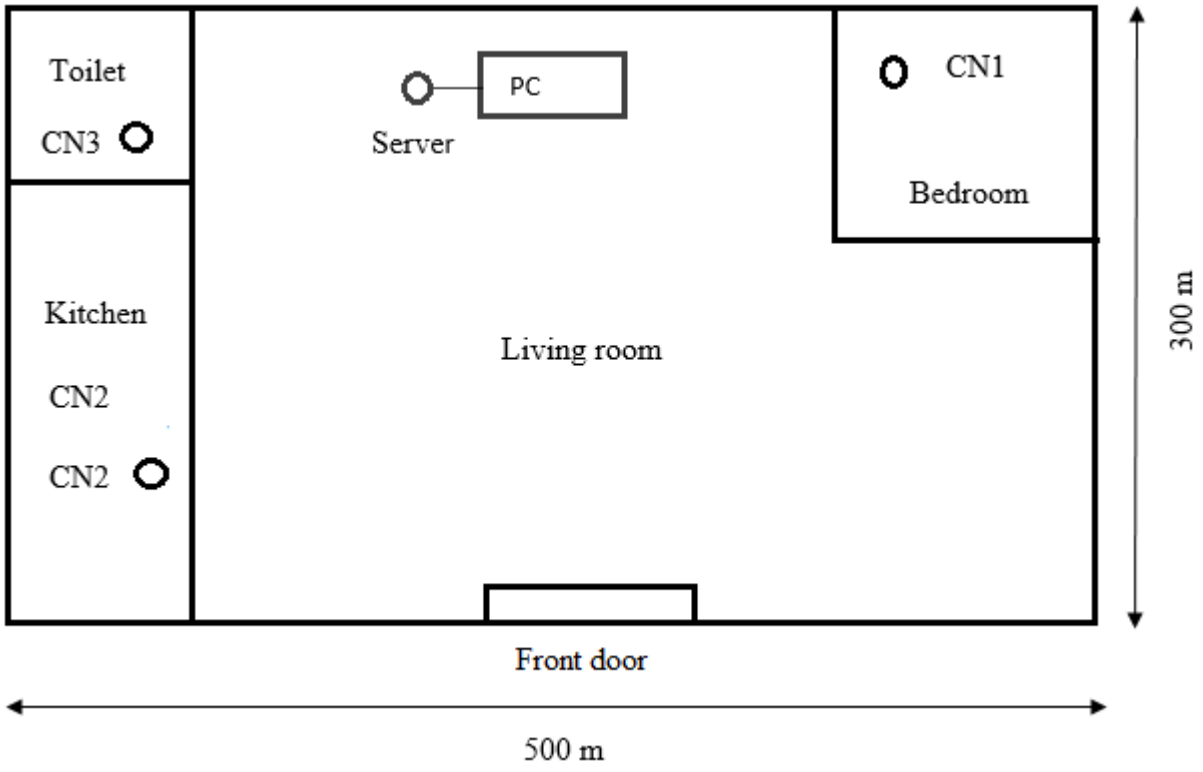
Home environment layer consist of hardware interface to monitor the interest event and directly connected to the sensors and actuator. Therefore, a server is connected directly to PC using a cable while wirelessly communicate with the client nodes for data transfer. The three client nodes are attached with several sensors to detect respective interest event.

Home gateway layer composed of wireless data transmission control or server. The task of this layer is to manage and control the data that enables the hardware module executes the assigned task by reporting the sensed interest event to the server.

Remote environment is an authorized user that allowed accessing the system using Personal Computer (PC) via wireless connection or Wi-Fi.

3.3 IMPLEMENTATION STRATEGIES

In this home automation project, one server and three client nodes are used for automatic control and monitor home environment. The data sensed by the sensors will be transferred using Wi-Fi connection between the nodes and server.



CN1	Client node 1
CN2	Client node 2
CN3	Client node 3

From the illustration above, the area of the home is by 500m in length and 300m width. The client nodes are placed in the bedroom, toilet and kitchen. These three nodes are wirelessly communicate with a server via Wi-Fi connection to transfer the data sensed by the sensors attached. Meanwhile, the server is directly connected to a PC using a cable.

Server

A server is directly connected to a PC using a cable to transfer the data sensed by the client nodes. Meanwhile, it is wirelessly communicate with the client nodes using Wi-Fi connection. The connection provides a wireless data transfer between the client nodes and server. In this case, the client node is attached with several sensors to detect the interest event. Once the sensor of the client node detected its interest event, the data from the client node will be wirelessly transfer to the server. The server will verify the data is coming from which node and after the verification is made, the data will be available to be monitor at PC.

Client Nodes

Client node is attached with a microcontroller together with sensors. A 9V battery is used to supply power to the node. It is built to perform detection and sensing home environment using the sensors attached to the microcontroller. The gathered data is transmit wirelessly via Wi-Fi connection to the server.

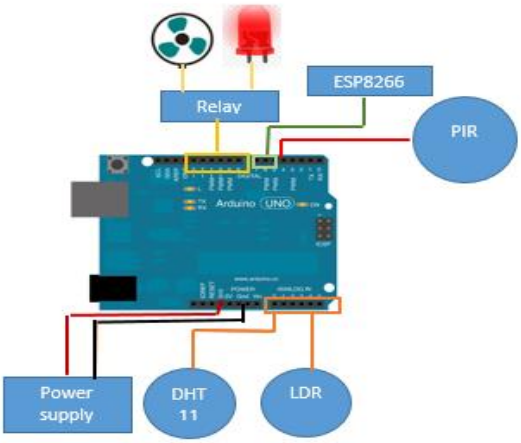


FIGURE 4. Client node

PC software

Main function of PC software is to configure the algorithm into the hardware modules. Besides, it is used to display data collected from the sensors. An Arduino IDE software is used to create an algorithm for each client nodes and server to perform their specific function. Meanwhile, a Thingspeak web application is used display the data obtained from the client nodes. The data is displayed using a graph for light intensity, humidity and temperature level. Using Thingspeak web application allows the user to monitor home environment regardless of time and place as it is accessible via internet connection.

Wi-Fi connection

A Wi-Fi module is attached to the server and each client nodes to provide wireless connection between server and client nodes. The data is gathered at the client nodes and forward through Wi-Fi connection to the server.

3.4 COMPONENT SELECTION

Components used are selected based on the requirements in this project. Specific type of sensor is used to detect presence of human, light intensity, humidity and temperature level. While a microcontroller used to control the function of the node. The details of each components are discussed as below.

Microcontroller

FIGURE 5. Arduino UNO

Arduino UNO (Figure 3.4.1) is an open source microcontroller board based on ATmega328p. It has 14 digital input/output pins and six analog inputs which is enough to be connected with the entire subsystem for controlling purpose. This board has low power consumption as it requires 5V operating voltage with tolerance up to 12V.The board can be powered via the USB connection or with an external power supply. The code that created in Arduino IDE software is downloaded into the microcontroller to control the whole program of the system.

ESP8266 Wi-Fi Module

FIGURE 6. ESP8266 Wi-Fi module

ESP8266 is a highly integrated Wi-Fi chip that provides Wi-Fi communication. The module is designed with complete and self-contained Wi-Fi networking solution that allow either application host or offload the Wi-Fi networking function from another application processor. It has powerful on board storage and processing capabilities that allow the sensor directly to be integrated through General Purpose Input Output (GPIO) pins. The chip is built with integrated TCP/IP protocol stack using 802.11 b mode. It requires low power 32-bit CPU with 3.3V to operate. The power supplied to the chip must not exceeded 3.3V as the chip have no voltage tolerance more than 3.3V which may damage the module.

DHT11 Humidity and Temperature Sensor

FIGURE 7. DHT11 sensor

DHT11 is a sensor used to sense humidity and temperature level in the home. It is a composite digital sensor calibrated with digital signal output of humidity and temperature. Application of the sensor dedicate to sensing technology to ensure it has high reliability and long term stability. The sensor is equipped with resistive sense of wet components and Negative Temperature Coefficient (NTC) measurement devices that connected to 8-bit high performance microcontroller. The sensor features a low cost, lone term stability, relative humidity and temperature measurement, fast response and precise calibration.

PIR sensor

FIGURE 8. PIR sensor

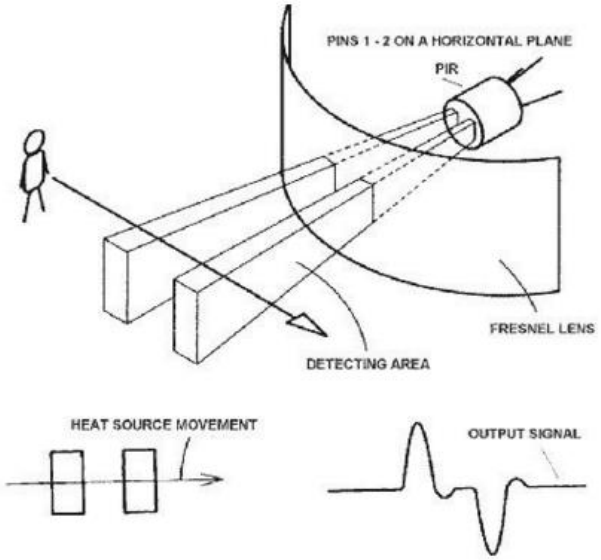


FIGURE 9. PIR sensor coverage area

PIR sensor covered with Fresnel lens where the actual sensor inside used for detection. The low cost and high coverage area up to 6m has two slot that made from special material with high sensitivity to IR. When the sensor is in idle state both slots detect the same amount of IR that the ambient amount radiated by the room or the wall. When there is warm body crossed within its coverage area as shown in Figure 3.4.5, the sensor detected the IR release by the body until the body leaves the sensing area.

Light Dependent Resistor (LDR) sensor

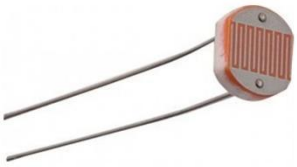


FIGURE 10. LDR sensor

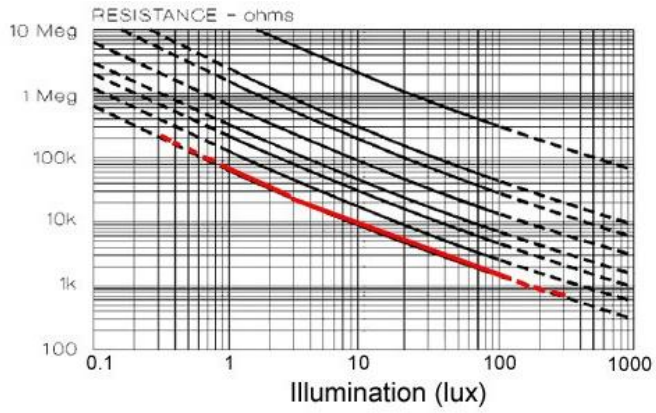


FIGURE 11. Graph of resistance vs. illumination

LDR sensor (FIGURE 10) is a photocells sensors that detects light intensity. It is inexpensive with small in size, low-power and reliable for a long time period. Basically, photocells is a resistor that changes its resistive value (ohm) depending on how much light intensity detected. When the light intensity the resistor change into very high resistive value and went down when light intensity increases. The graph (FIGURE 11) above shows the approximate resistive value according to the light intensity.

3.5 CLIENT NODE CONFIGURATION

The figures below shows the hardware components interfaced on the Arduino UNO board for each placement of the node.

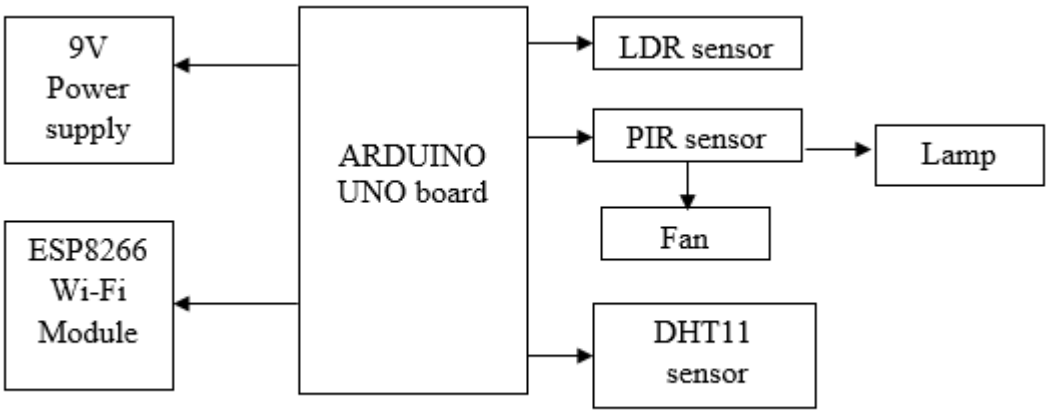


FIGURE 12. Client node 1 (Bedroom client node)

Client node 1 is powered up with 9 volt power supply and attached with ESP8266 Wi-Fi module to provide wireless communication with server node. Besides, LDR is connected to check light intensity and DHT11 sensor is used to sense humidity and temperature level in the bedroom. Meanwhile a PIR sensor used to detect human presence which will result in automatic turn ‘ON’ and ‘OFF’ of lamp and fan.

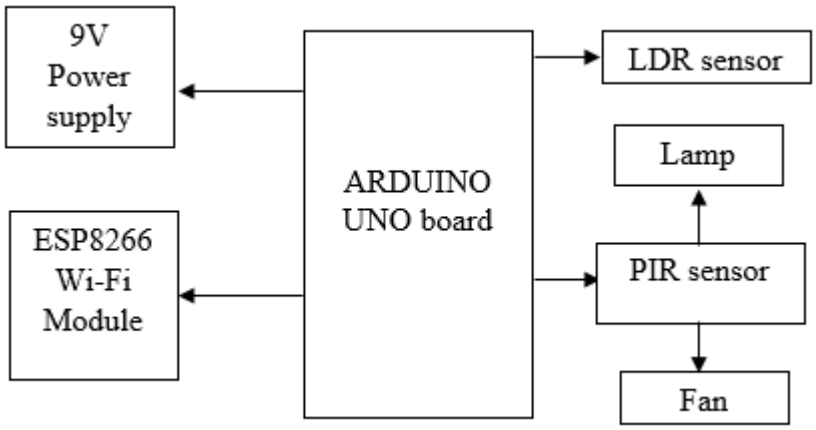


FIGURE 13. Client node 2 (Kitchen client node)

Client node 2 is attached with 9V power supply to power up the node and ESP8266 used to provide wireless communication between the node and server. LDR sensor is connected to check the light intensity in the kitchen while a PIR sensor used to detect the presence of human in the kitchen which will automatically turn 'ON' and 'OFF' the lamp and fan.

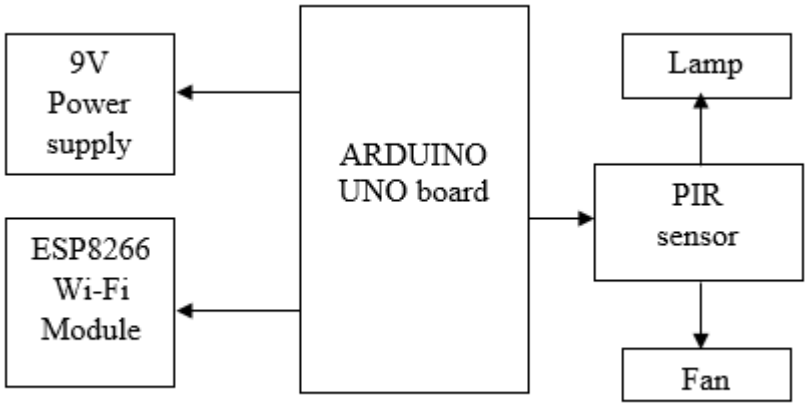


FIGURE 14. Client node 3 (Toilet client node)

Client node 3 is attached with 9V power supply to power up the node and ESP8266 used to provides wireless communication between the node and server. A PIR sensor is used to detect the presence of human in the kitchen which will automatically turn ‘ON’ and ‘OFF’ the lamp and fan.

The table below show the function of each components that attached to the Arduino UNO board.

Components	**Explanation**
Arduino UNO board	Provides a microcontroller that allow downloaded program to control the each part connected.
Power Supply	9V DC battery is use to supply power to the node
ESP8266 Wi-Fi Module	A standalone Wi-Fi module
Relay	-Act as switch in the circuit. -The switch contact will move to Normally Open (NO) or Normally (NC) when HIGH signal is triggered.
LED	A controlled electrical home appliance
DC Fan	A controlled electrical home appliance
DHT11 humidity and temperature sensor	A sensor detects current humidity and temperature level with digital output.
PIR sensor	Detect human body heat (infrared)
LDR sensor	To detect the light intensity level

TABLE 2. List of components and function

3.6 SYSTEM IMPLEMENTATION

Light intensity level (ohm)	Lamp dimming	Discussion
Below than 40	Dim 1	When the value of light intensity level falls below than 40, the lamp is set to be at dim 1 which means, the owner needs the light to light up the room.
Below than 20	Dim 2	When the value of light intensity falls below than 20 ohm, the lamp is set at dim 2 as the owner needs a brighter light to light up the room.

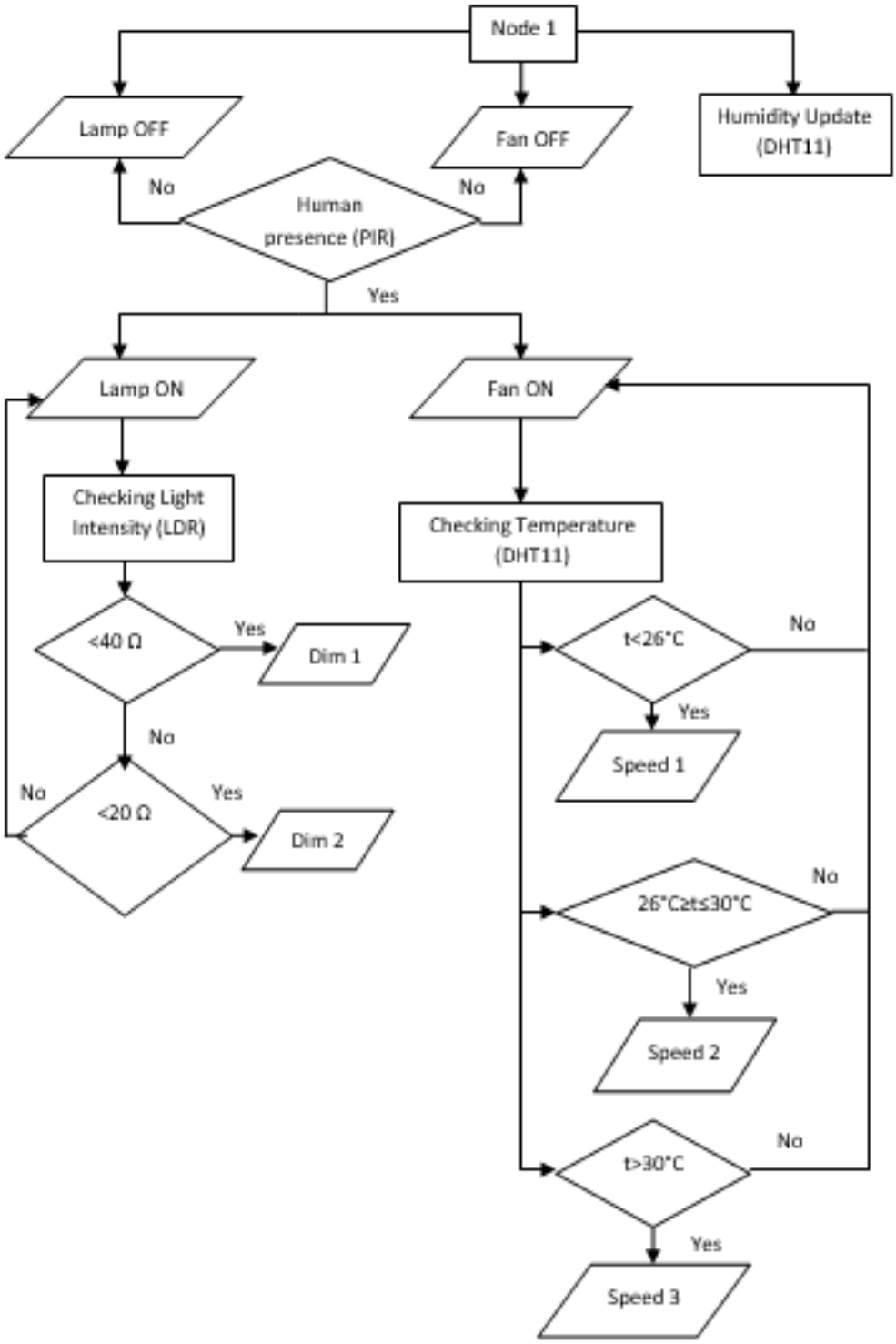
TABLE 3. Light intensity level and effect

Temperature (°C)	Fan speed	RPM value	Explanation
Below than 26	Speed 1	150	When the temperature value is below than 26 °C, the fan speed is set at speed 1 which controlled by setting the RPM value at 150 in the algorithm.
Within 27 to 30	Speed 2	200	When the temperature reading is within 27 to 30 degree, the fan speed is set at speed 2 by setting the RPM value at 200 in the algorithm.
Above 30	Speed 3	255	When the temperature reading is above 30 degree, the speed of the fan is set to speed 3 which having the maximum value of RPM at 255 in the algorithm.

TABLE 4. Temperature level and effect

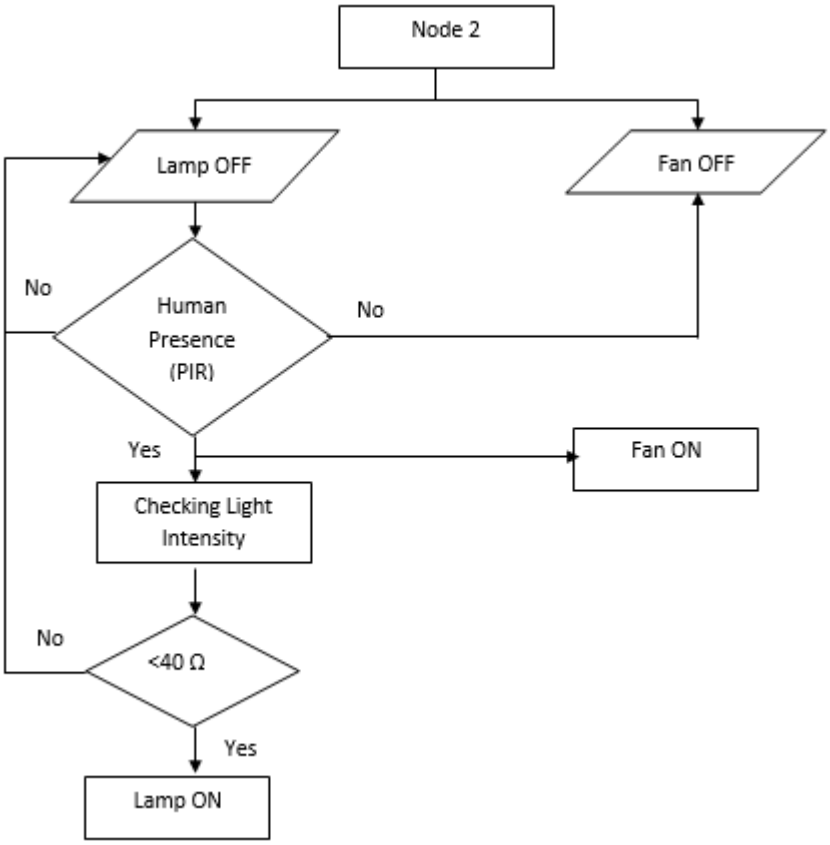
The flow charts below shows the working system of client node 1, client node 2 and client node 3.

Client node 1



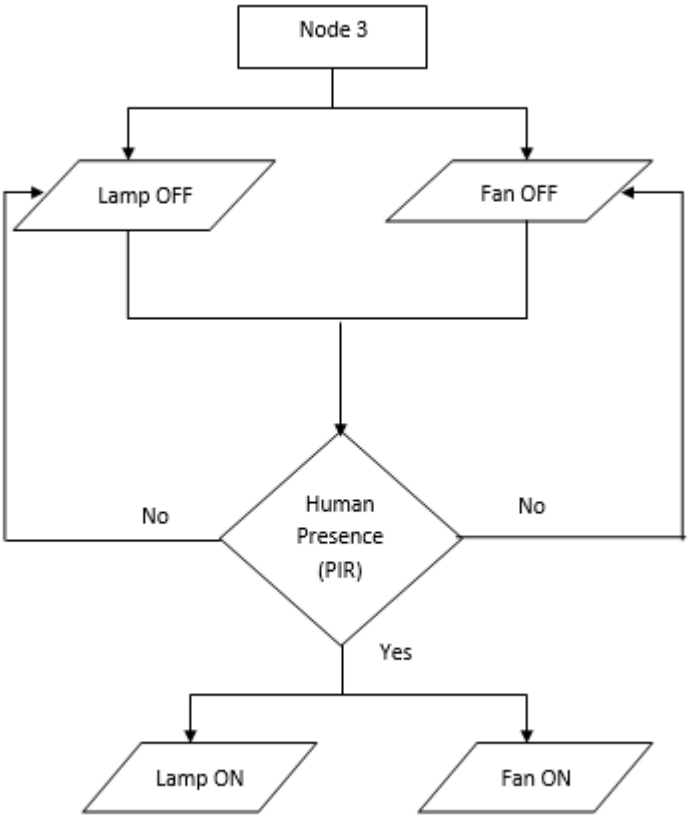
At client node 1, both lamp and fan originally are off and only turn on when PIR sensor detected the presence of human in the bedroom. After the lamp is on, the LDR sensor immediately compare the level of light intensity. When the light intensity falls below 40 Ω, the value is used to dim the lamp at Dim 1 and when the light intensity falls below than 20 Ω, the lamp is set at Dim 2 which means the room is dark and requires brighter light to light up the room. The same situation goes to the fan where the speed of the fan is controlled using the temperature level. The fan automatically turn on when PIR sensor detected the presence of human in the room and DHT11 sensor immediately compare the temperature value for speed controlling. When DHT11 sensor read the temperature value below than 26°C, the fan speed is set at speed 1 using RPM value of 150. While, speed 2 is control when the temperature value within 26°C to 30°C with 200 RPM. Speed 3 is set using maximum value of RPM at 255 when the sensor read the value above 30°C. If the temperature value is not within the range, the fan is on using the normal speed that used RPM value of 70. The humidity level in the bedroom is keep updated and monitor through the PC.

Client node 2



Client node 2 is placed in the kitchen. Both lamp and fan are originally turn off. When the PIR sensor detected the presence of human in the kitchen, fan automatically will turn on. While the lamp is turn on only if the presence of human detected and LDR sensor sensed the light intensity falls below than 40 Ω.

Client node 3



At client node 3, both lamp and fan are off until the PIR sensor detected the presence of human in the toilet. When human is detected, both of lamp and fan will automatically on until PIR sensor detects no human present in the toile

3.7 PROJECT PROGRESS, GANTT CHART AND KEY MILESTONE

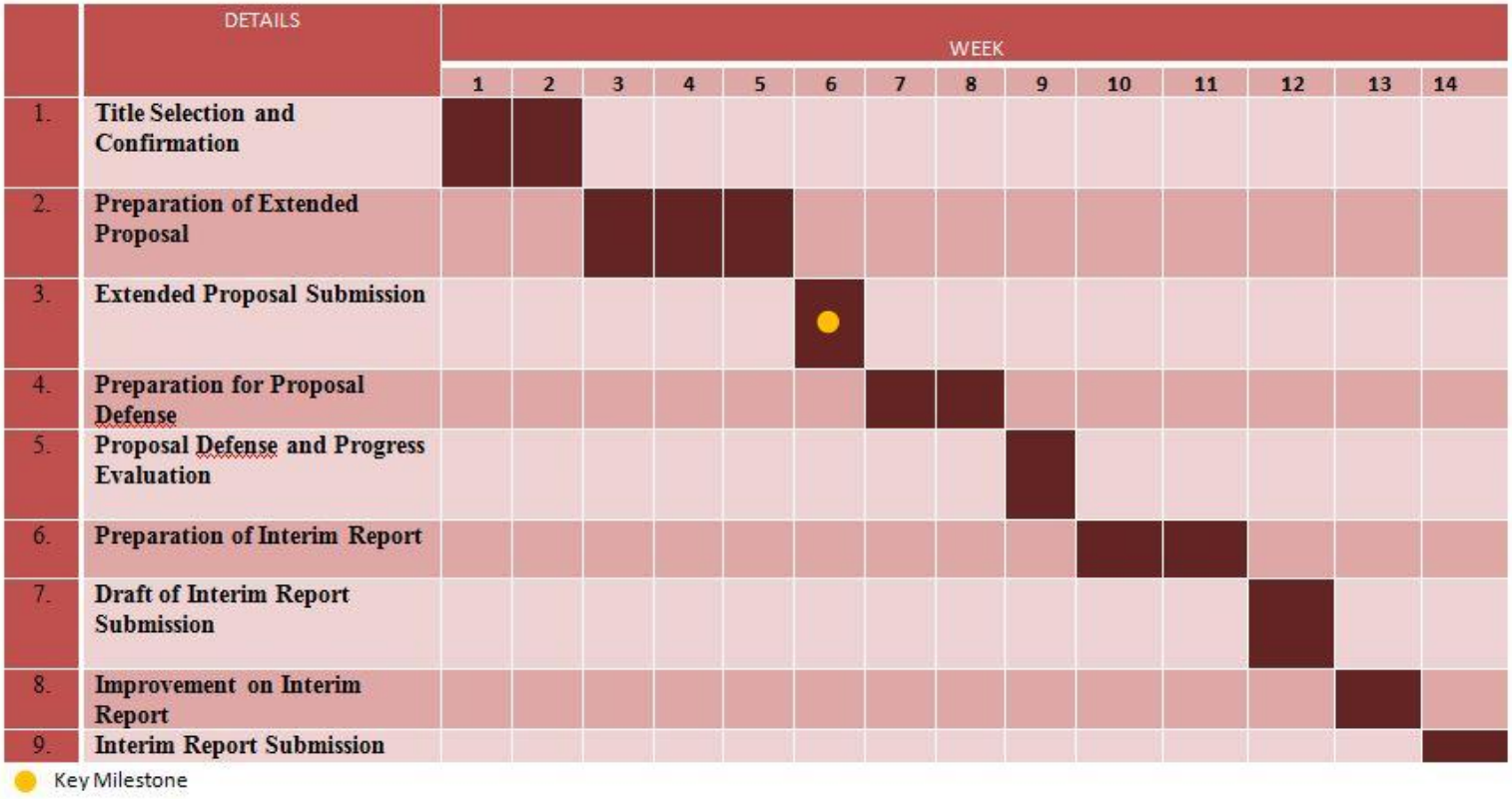


TABLE 5. FYP 1 Gantt chart

Details	Week														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Components selection and purchase															
Component testing															
Project work															
Progress report															
Poster presentation															
Draft final report															
Final report & technical paper															
Viva															

TABLE 6. FYP 2 Gantt

CHAPTER 4

RESULT AND DISCUSSION

4.0 SMART LAMP CONNECTION

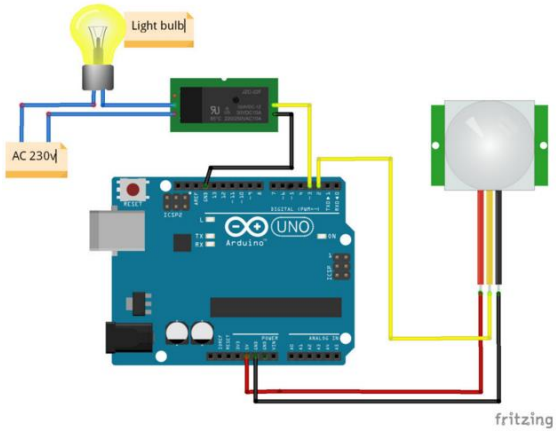


FIGURE 15. Smart lamp connection

The above circuit in FIGURE 15 shows a testing on circuit functionality for smart lamp using Fritzing software. The circuit is built for the automation of lighting bulb when PIR sensor detected a motion and giving its output to switch relay. The relay is triggered when it receive an input, therefore it will turn ON the LED.

The algorithm downloaded to the microcontroller for checking the interest event. Arduino will check for every 10ms if the pin 2 is on HIGH due to the setup of PIR sensor output pin is HIGH when it detect the motion. When detection is occurred, the HIGH is triggered the relay to turn ON the bulb.

4.1 RESULT OF LIGHT INTENSITY FROM LDR SENSOR

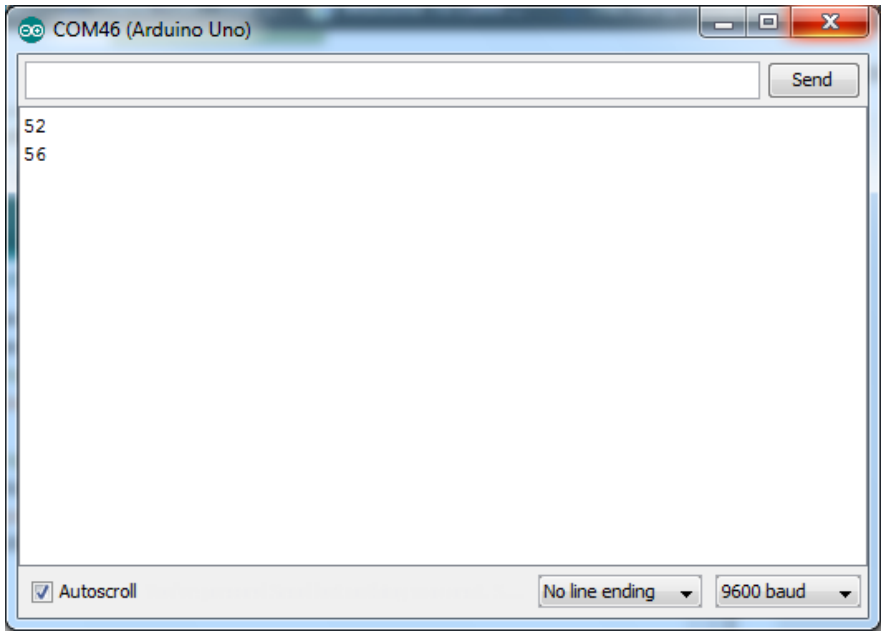


FIGURE 16. LDR sensor reading

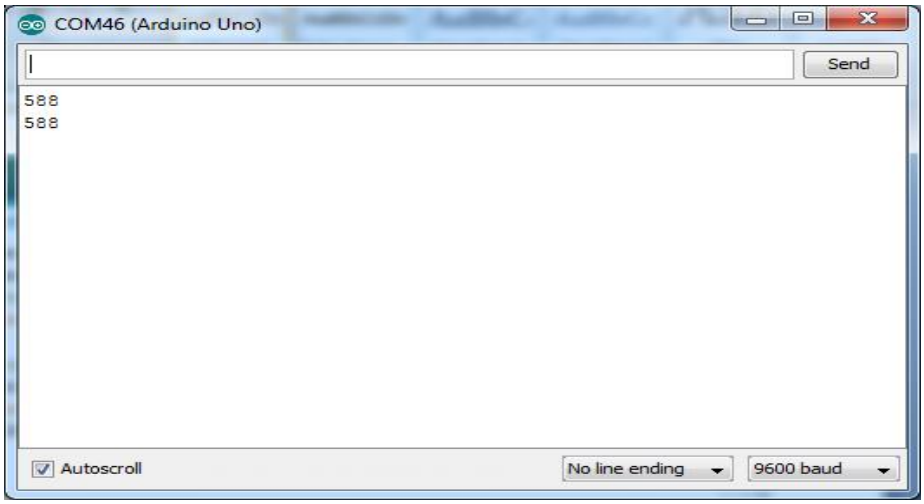


FIGURE 17. LDR sensor reading

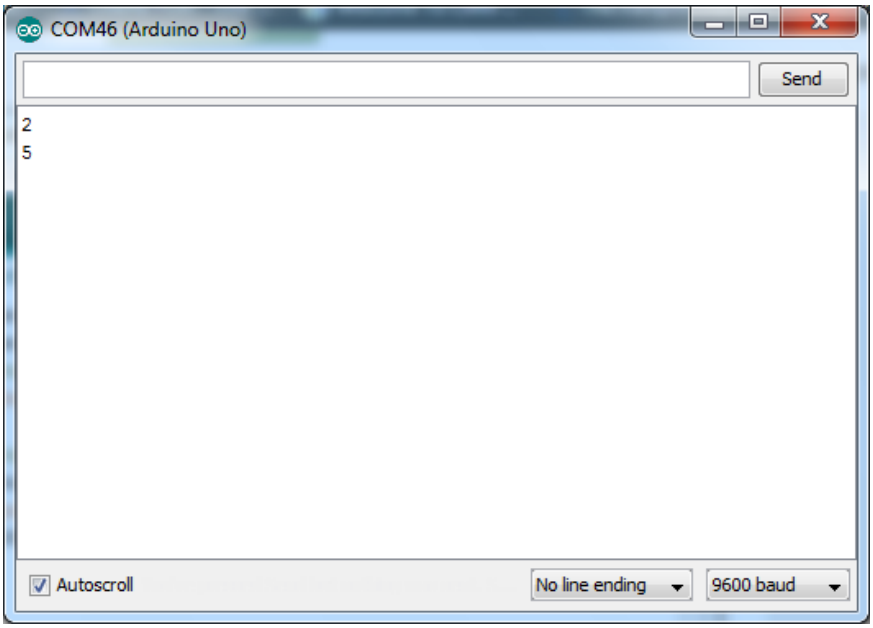


FIGURE 18. LDR sensor reading

Discussion

FIGURE 16 shows the reading of the light intensity in the room during normal condition. The level of light intensity range from 52 to 56 ohm when the room is opened to the sunny day with light off. While, in FIGURE 17 shows the value of light intensity during the LDR is opened to the bright sunlight. The level of light intensity sensed to 588 ohm when the LDR sensor is exposed directly to the sunlight. FIGURE 18 shows the lowest value of light intensity which drop to 2 ohm when the surface of the LDR sensor is fully covered with black paper.

From the values of light intensity level shown above, the resistive value of the LDR sensor increases when the sensor exposed to the sunlight while the value decreases in darker condition. From the value of light intensity, the dimming of the lamp is set to be at Dim 1 and Dim 2 according to the range of the intensity level which set in the algorithm to control the dimming effect.

4.2 HUMIDITY AND TEMPERATURE LEVEL FROM DHT11 SENSOR

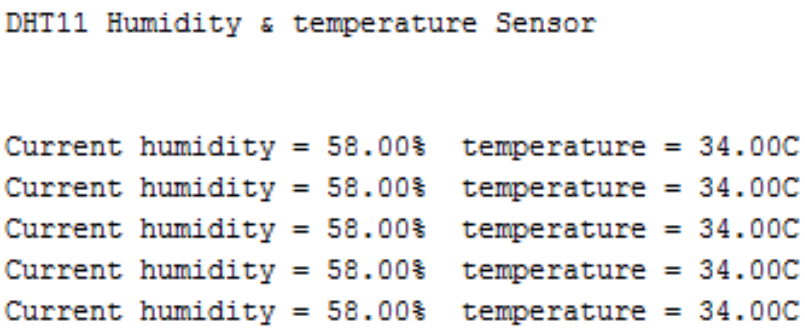


FIGURE 19. Humidity and temperature level

Discussion

Current humidity and temperature level in the bedroom is 58% and 34 °C respectively by using DHT11 sensor. The reading of temperature level is used to control the fan speed as shown in the methodology section.

4.3 RESULT OF AT COMMAND FOR ESP8266 WI-FI MODULE

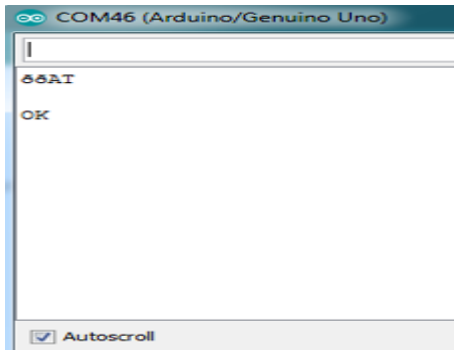


FIGURE 20. Communication between the software and module

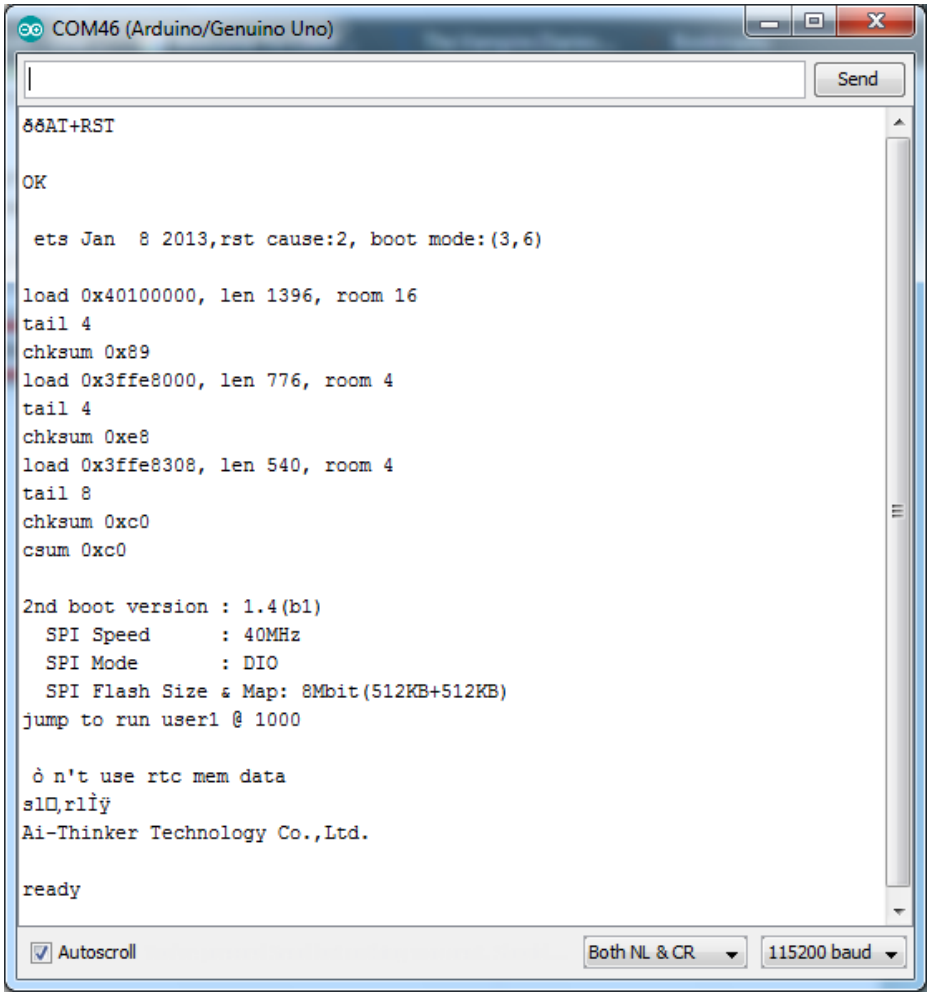


FIGURE 21. Reset module

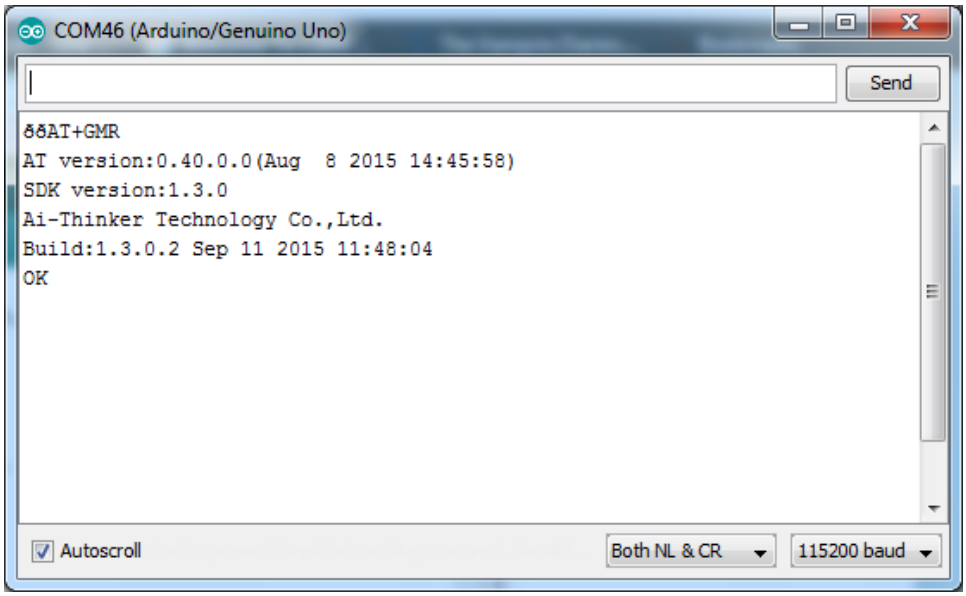


FIGURE 22. Firmware version

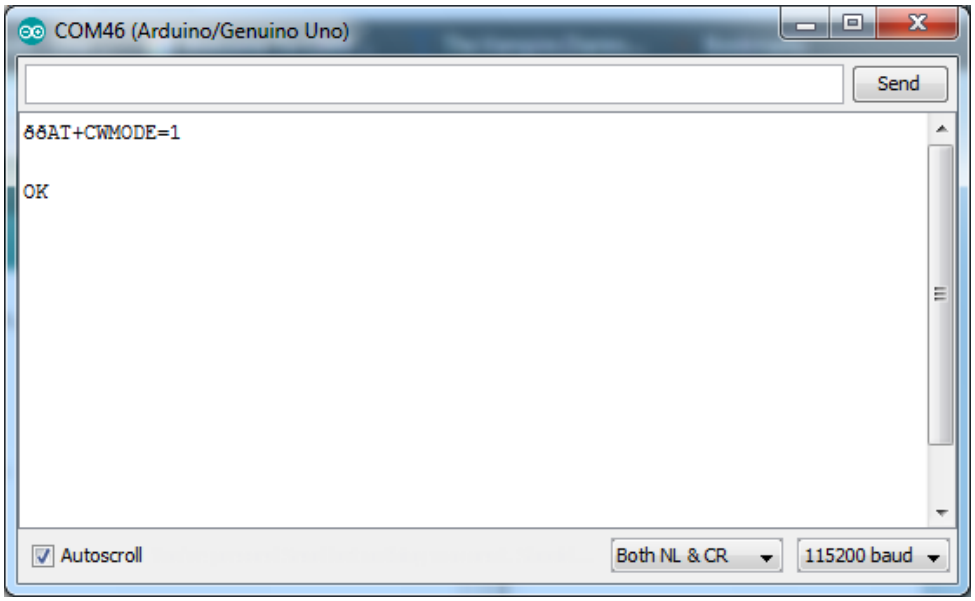


FIGURE 23. Reset mode on ESP8266 Wi-Fi module

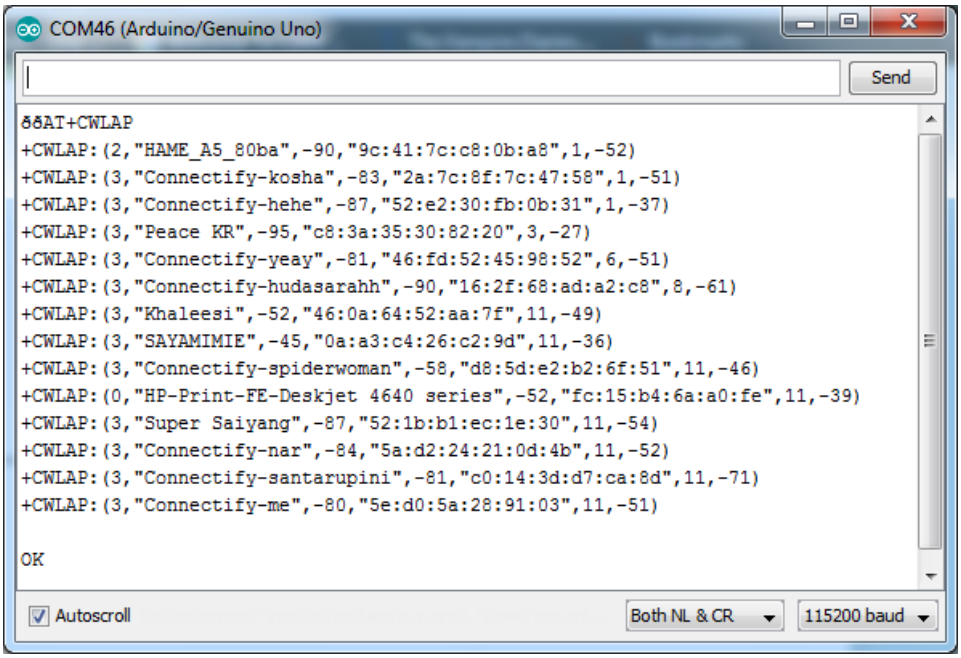


FIGURE 24. Available Wi-Fi network

Discussion

The above figures shows the command required for ESP8266 Wi-Fi module setting. In FIGURE 20 shows the AT command is used at the serial monitor to check the communication between the Arduino IDE and ESP8266 Wi-Fi module and the communication is successful by received a respond ‘OK’ from the module. While, FIGURE 21 shows an AT+RST is command to the module. This command is used to check whether the module allow the software to reset it. Figure 22 shows the firmware version is checked using ‘AT+GMR’ command and FIGURE 23 shows the Mode is set to 1 (station) and allowed by the module as it replied ‘OK’. Lastly, FIGURE 24 shows the available Wi-Fi network near the ESP8266 module by showing the detail of all networks available. The available Wi-Fi can be connected by entering SSID and password directly in the algorithm for ESP266 Wi-Fi module.

4.4 UPDATING ESP8266 WI-FI MODULE FIRMWARE VERSION

4.4.1Checking Default firmware version

The first step in using ESP8266 Wi-Fi module is checking the default firmware before using it in the project. Therefore, the pin connection is connected as according to table below by using an ESP8266 Wi-Fi module and Arduino UNO.

ESP8266 wiFi module	ARDUINO UNO
GND	GND
GPIO_2	No connection
GPIO_0	3.3V
RX	RX
TX	TX
CH_PD	3.3v
RST	3.3v
VCC	3.3v

Connect the ESP 8266 Wi-Fi module to Arduino Uno board as shown in table above.

i. Open Arduino IDE program and select Tools > Board > Generic ESP 8266 Module
ii. Select COM port and open serial monitor.
iii. Set the baudrate 115200 on serial monitor.
iv. Use AT command to communicate with the module.
v. The ESP 8266 Wi-Fi module replied “OK”
vi. Use “AT+GMR” command to check the default firmware version.
vii. After these step is done, proceed with the second connection.

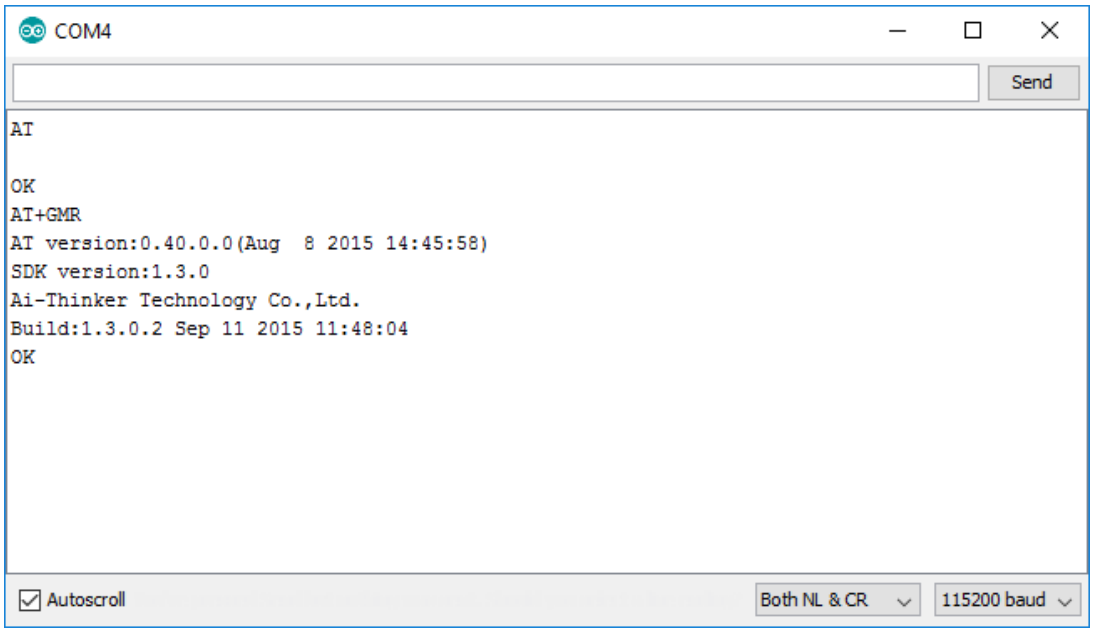


FIGURE 25. Default firmware version

4.4.2 Flashing ESP8266 Wi-Fi module firmware version

ESP8266 wiFi module	ARDUINO UNO
GND	GND
GPIO_2	No connection
GPIO_0	GND
RX	RX
TX	TX
CH_PD	3.3v
RST	3.3v
VCC	3.3v

i. Unplug Arduino UNO board from PC

ii. Connect ESP 8266 Wi-Fi module pins to Arduino Uno board as stated in Table

iii. plug the Ardunio UNO board back to PC

iv. Open Arduino IDE program and select Tools > Board > Generic ESP 8266 Module

v. Open and load updated firmware flasher.

vi. Select appropriate files in “Download Path Config” section in flasher tool and read the “readme” file that came with firmware.

vii. Select COM port on Arduino IDE and set baudrate 115200 on serial monitor.

viii. Press start on firmware flasher.

ix. Wait unitl the “FINISH” is shown.

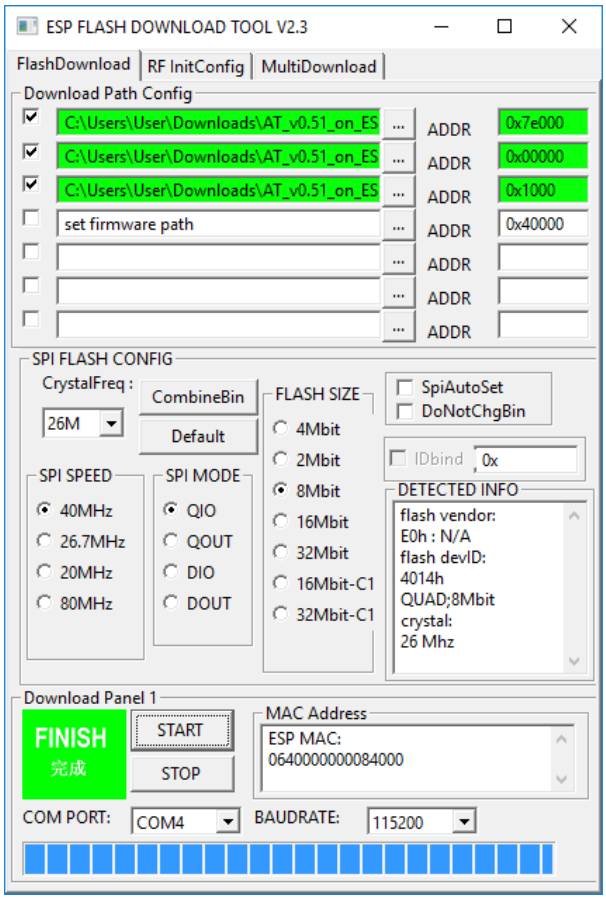


FIGURE 26. Flashing to update ESP 8266 firmware version

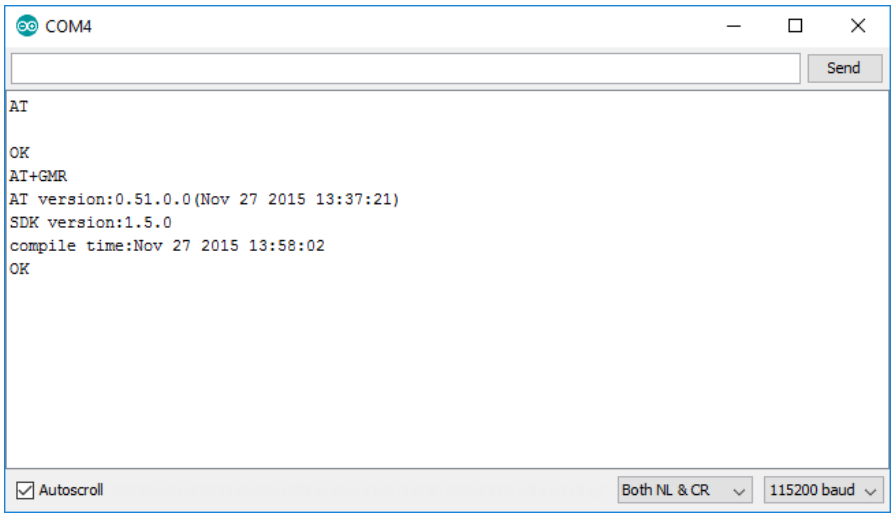


FIGURE 27. Updated firmware version

Discussion

FIGURE 25 shows the default firmware version of ESP8266 Wi-Fi module. The version is 0.40.0.0. An AT command is required to ensure two way communication between the software (Arduino IDE) and the module. By following the step to update the firmware version, FIGURE 26 shows the chosen path configuration and detected info while downloading the updated version. Lastly, after finish updating firmware version, the updated firmware version is checked using 'AT+GMR' command which shows the updated firmware version is 0.51.0.0 as in FIGURE 27. After finishing this step, an ESP8266 Wi-Fi module can be used for the project.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

In this project the implementation of low cost home automation system using wireless communication does offer a low cost of home automation as the system is using low cost hardware and self-created program using Arduino IDE software. The objective is achieved by minimizing the cost while maximizing the output data to monitor home environment and control appliances purpose. An open source of Arduino UNO microcontroller board input output pin is used to connect the sensor while collected data monitor via Thingspeak web page. Although, wired and wireless home automation gives various benefits but its complexity and high cost of implementation and maintenance create the drawbacks upon the system.

Overall, as this project involved design and implementation course enabled the student to work and solve real world problem and relate the work to real world application. The information regarding previous projects are studied and compared for depth understanding while using the information to improve the design and implementation regarding low cost home automation. The selection of sensor types also required high consideration and understanding upon its working style in order to ensure the data collected are reliable to b monitor and control the appliances. As for the software, the program created must be very thorough and its functionality is applicable to implement in home automation system. To meet the objective, all necessary steps are outline in the progress chart to ensure the project development always in track within the period of time.

The recommendation for home automation using Wi-Fi connection is to create a stable and reliable home automation system. It does mean that, the algorithm created for server and client nodes must be stable enough to make remain operative under certain specific conditions such as the client node not have enough power supply and lost connection with the server. The data provided by the client nodes must be reliable and according to the specific command created in the algorithm.

Besides, using Wi-Fi connection requires high power consumption due to high speed data rate of 11Mbps. Therefore, the continuation of this project should also focus on low power consumption which in return will decreased the maintenance issue on power supply.

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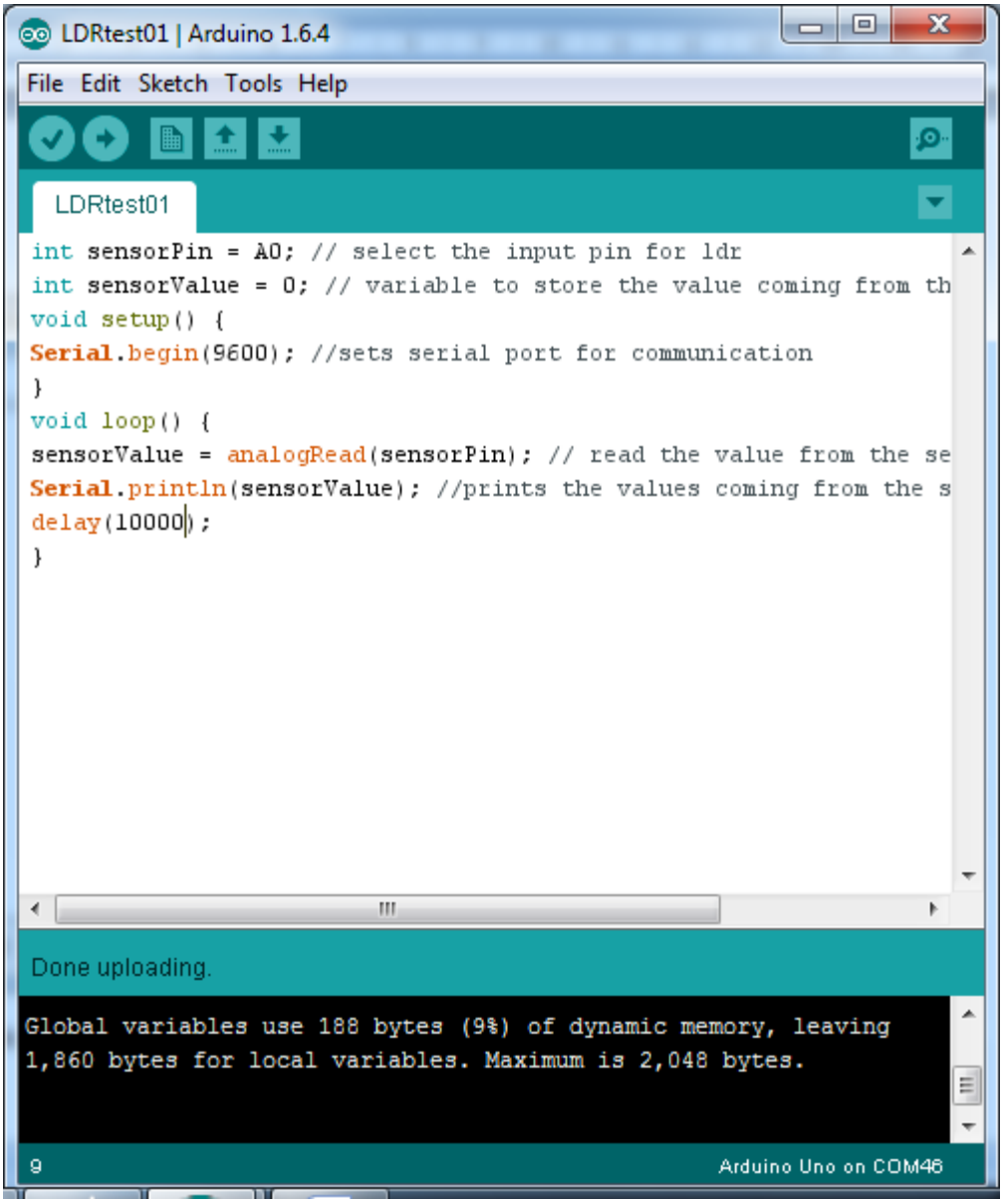
APPENDICES

Appendix 1 Code of light intensity level



Appendix 2 Code of humidity and temperature level

temp___humidity_sensor_data §

```
#include <dht.h>
#include <DHT.h>
#define dht_apin A0 // Analog Pin sensor is connected to

dht DHT;

void setup(){

  Serial.begin(9600);
  delay(500);//Delay to let system boot
  Serial.println("DHT11 Humidity & temperature Sensor\n\n");
  delay(1000);//Wait before accessing Sensor

}//end "setup()"

void loop(){
  //Start of Program

    DHT.read11(dht_apin);
    Serial.print("Current humidity = ");
    Serial.print(DHT.humidity);
    Serial.print("%  ");
    Serial.print("temperature = ");
    Serial.print(DHT.temperature);
    Serial.println("C  ");

    delay(5000);//Wait 5 seconds before accessing sensor again.
```