

**DEVELOPMENT OF INTERNET OF THINGS BASED WEATHER  
SENSOR**

**THESIS**

**Submitted to International Program Industrial Engineering Department in Partial  
Fulfillment of Requirement for Bachelor Degree of Industrial Engineering  
Universitas Islam Indonesia**



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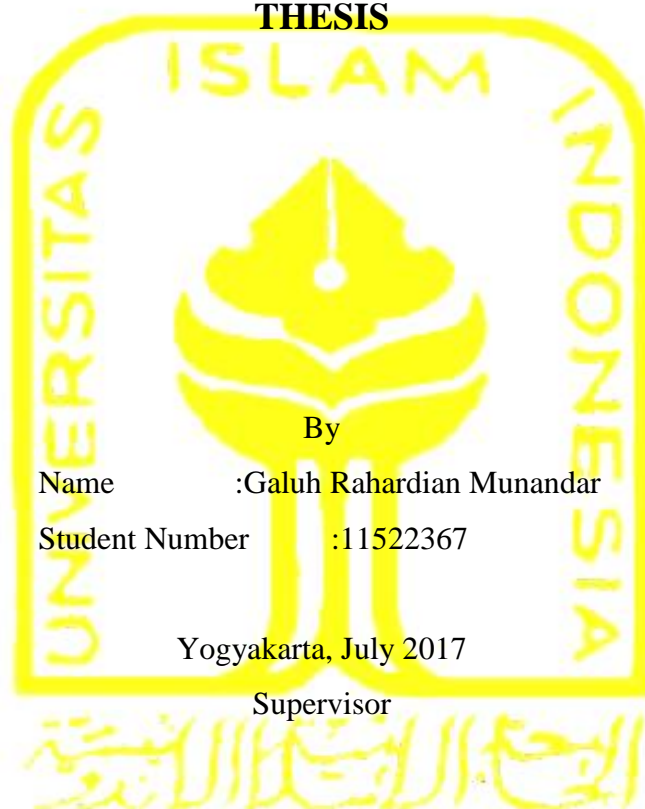
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INDUSTRIAL ENGINEERING DEPARTMENT  
FACULTY OF INDUSTRIAL TECHNOLOGY  
UNIVERSITAS ISLAM INDONESIA  
YOGYAKARTA  
2017**

**THESIS APPROVAL OF SUPERVISOR**

**DEVELOPMENT OF INTERNET OF THINGS BASED WEATHER  
SENSOR**

**THESIS**



**(Muhammad Ridwan Andi Purnomo, ST., M.Sc., Ph.D)**

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**DEVELOPMENT OF INTERNET OF THINGS BASED WEATHER  
SENSOR**

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## **AUTHENTICITY STATEMENT**

By the name of Allah SWT, I declared that this research is conducted of my own efforts. All of the summaries study used have the source to be cited correctly. If in further my statement is proven to be at fault and violated the legal rules in writings and intellectual copyrights or proven plagiarism, I am ready to give up back my graduate degree on Universitas Islam Indonesia.

Yogyakarta, July 2017

Galuh Rahardian Munandar

## DEDICATION

*I dedicate my final project for my beloved parents, brothers, and my friends.*

*I have to thank my parents for the support, taking care and anything they gave to me.*

*I also thank my brothers and friends for the support and motivation.*

## MOTTO

*You deserve what you want when you're trying your best to fight for it, no one can take that right from you – 10 Things I Hate About You*

*You don't need to hide yourself because you're afraid of what others think of you. You have the choice to live your own life – Harry Potter and the Chamber of Secrets*

*Everyone sees different things – Shutter Island*

*Sometimes it's the very people who no one imagines anything of who do the things no one can imagine – The Imitation Game*

*Don't ever let someone tell you that you can't do something. Not even me. You got a dream, you gotta protect it. When people can't do something themselves, they're gonna tell you that you can't do it. You want something, go get it. – Pursuit Of Happiness*

*There should be no boundaries to human endeavor. We are all different. However bad life may seem, there is always something you can do, and succeed at. While there's life, there is hope – Stephen Hawking*

## PREFACE

*Assalamu 'alaikum wr.wb.*

*Alhamdulillahirabbil 'alamin.* Praise to Allah SWT the most glorious and the most merciful. Shalawat and Salam toward our adoration Prophet Muhammad SAW along with his family and followers. The guidance of Allah allows the author to finish this thesis. The accomplishment of this thesis is inseparable from the support of all parties. Therefore, the author profusely convey with great and gratitude to:

1. Mr. Dr. Drs. Imam Djati Widodo, M.Eng.Sc as dean of the faculty of industrial technology
2. Mr. Muhammad Ridwan Andi Purnomo ST., M.Sc., Ph.D. as my Thesis Supervisor who given supervision and guidance in writing this thesis.
3. My beloved parents, brother and sister for their never ending prayers and supports.
4. Miss Diana, Mbak Devi, and all of my friends in International Program of Industrial Engineering 2011 that help me to conduct this thesis.
5. All of my friends in international program of Industrial Engineering 2012 especially Hafidzah Haryo that help me to conduct this thesis.
6. All my beloved friends that I cannot mention one by one.

The author realized as human being is not perfect and also this thesis is far from perfection. Therefore, suggestion and constructive criticism from all parties will be accepted as reference for improvement in the near future. Hopefully this thesis can be useful for further research and for anyone who need it.

*Wassalamu 'alaikum wr. Wb.*

Yogyakarta, July 2017

Galuh Rahardian Munandar

## ABSTRACT

*Weather is a complicated condition that is influenced by many factors and can react in different ways. If the weather patterns are relatively stable, persistence methods of forecasting will provide a relatively useful technique to predict the weather for the next day. Modern method calculates the current weather as input of mathematical model. A mathematical model will be simulated in a computer system. Hardware to predict the weather is microcontroller and sensor. Microcontroller that will be used is Arduino, sensor that will be used is DHT 22, and Water sensor. This research proposes developed IoT based weather sensor. There are 3 kind of variable to forecast the weather there are temperature, humidity, and rain. There are 8 steps to develop weather forecast system. First, identification of system requirement, definition of feature, hardware schematic design, hardware development, microcontroller programming, web server programming, and last system testing. After identifying ways to develop IoT based weather sensor, then the testing of IoT based weather sensor will be carried out. The result will become basic to predict the weather for next day.*

**Keywords :** *Weather Forecasting, Automation, Arduino, DHT22 Sensor, Water sensor,.*

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# CHAPTER I

## INTRODUCTION

### 1.1 Background

These days, people are not aware on climate change. The state of the weather is changing and uncertain. Therefore, the states of weather conditions are needed to be known, because the weather can be affected in human's productivity. Weather is a complicated condition that is influenced by many factors and can react in different ways. If the weather patterns are stable, persistence methods of forecasting will provide a relatively useful technique to predict the weather for the next day. For examples, if it is hot and sunny in one day, and then weather forecast would predict conditions for the next day will be sunny. However, weather conditions in some regions of the world are more unpredictable and changing. Especially the weather conditions at the equator that its change quite high. There are so many theories about weather forecasting.

The weather forecast is a method to predict the state of atmospheric conditions for the future. Methods of weather forecasting are made by collecting data on temperature, humidity, rainfall levels, the wind and atmospheric processes. Weather forecasts are used to determine the weather is going to happen in the future. Long term forecasts are less accurate than short term forecast. This research explains basic definition of type of weather forecasts based on time. Several definition of forecast:

- a. Short term forecast is the forecast made for a period of up to 48 hours.
- b. The extended forecast is for periods exceeding three days or more (i.e. a period of three to five days) from the day of issuance.
- c. The medium-term forecast is addressed for a period that extends from about three days to seven days earlier.

Long-term forecasts for a period longer than seven days in advance, but there is no absolute limit to the period. Short term forecast is prediction of a period today until tomorrow (min 48 hours). Actually, short term forecast is more accurate than the long term forecast. Because there is no benefit using data from more than two or three years ago, that is because the weather will turn too fast and could not be linked with the past data.

Theories to forecast weather are divided into two methods which are traditional and modern methods. The traditional method such as sees the cloud, observe the air and the wind and see the animal behavior. The result of the traditional method is different. The differences of result could not be used as a reference to determine which method is correct. Because lack of consistency in traditional method, the results can be presumed right or wrong depend on which method used. Modern method is calculated the current weather as input into mathematical model. A mathematical model will be simulated in a computer system. Technology is developed, various ways are discovered to predict or forecast the weather, which is using certain applications and signals to identify weather forecasting results and connected with internet application. Application and signal are intended as an intermediary for collection of weather data that occurred at that time, to calculate weather forecasting that will about to come and then sent a result to user. Internet of Things (IoT) is a fake term to describe objects that can communicate over the internet. IoT has been created on Internet preprint sensor (temperature, pressure, vibration, light, etc.). It will allow for being more proactive and less reactive. Typically, IoT is expected to offer advanced connectivity of devices, systems, and services that go beyond communication machine-to-machine and includes a variety of protocols, domains and applications, the device (e.g. sensor) continuously connected to Internet and data will be together. Therefore, IoT will have hundreds of billions of sensors to read at any time. Companies are reliance on weather forecast since it will affect productivity of labors. Several examples of works that depend on weather forecasting are activities that related to aircraft, agriculture, and much more.

Weather forecasts have some limitations though the use of modern technology and techniques for predicting weather forecast should be improved. Weather forecasts have expired accuracy of weather forecast methods. A significant degree of accuracy of

the weather forecast is more than 10 days. Actually, weather forecast is a complex method and level of accuracy is not always true, especially for the future. The level of accuracy is not always true because weather can unexpectedly change. The weather's changes have implications for agriculture through changes of temperature, precipitation, carbon dioxide levels in the air, solar radiation and interactions all of the elements. Agriculture is the most vulnerable sector to climate change. Agro industries depend with climate or weather changes, because agro industries need to fulfill demand of customer. Weather changes can affect production of plant. The water supply will be important to maintain agricultural production and food supplies. One limiting factor that affects plant growth and production is high temperature stress. High temperatures are a threat to crop production of agriculture. Even in tropical climates, excessive radiation and high temperatures are often limiting factors for plant growth and yield. High temperatures can cause pre and postharvest damage, including burning symptoms of leaves and twigs, function in leaves, increased root tip resistance, breakage and discoloration of fruit and reduction of yield. The meaning and usefulness of weather forecasts will generally provide information to air condition in the next day and if already know the information will be better prepared to prevent loss anticipation morally and materially higher.

The agricultural sector is very vulnerable to climate change because it has an effect on cropping pattern, planting time, production, and yield quality. The good agriculture concept which among others is characterized by agribusiness system is agriculture that is able to produce optimally, stable (stable) and sustain which is profitable economically and able to conserve resources and environment. Agricultural operations require more accurate and quantitative weather / climate forecasts in daily, weekly, monthly or seasonal periods. This can be done through the development or application of systems analysis and engineering weather forecasts and more quantitative climate estimates with statistical models. Therefore, climate risk analysis is not only aimed on protecting crops from climate hunting, but also effectively protecting and converting land resources in an anticipatory manner (Hidayati, 2015). The effectiveness and efficiency of the use of pesticides and herbicides to control pests, diseases and weeds are also highly determined by rainfall, temperature and humidity. Climate closely related to climate change and global warming can reduce agricultural production

between 5-20 percent. The upper limit of the deadly temperature of the activity of plant cells ranges from 120 to 140 ° F but this value varies according to the type of plant and its growth rate. Air temperature in Indonesia can act as a control on the effort to weigh the rice plants in the area that has a height that is high above sea level most of the types of superior rice grow and well-powered to a height of 700 m above sea level. Air humidity affects the evaporation of the soil surface and evaporation on the leaves. Air humidity will affect the rate of evaporation or transpiration. If the humidity is low, then the transpiration rate increases and the absorption of water and mineral substances also increases. In addition, high humidity will cause the growth of fungi that can damage or rot the roots of plants. And if low humidity will cause pests that can damage the plant.

Rice plant can be maximized on transition period of harvest, because still can get enough light from the sun and water from the rain. Farmer needs to oversee the plant everyday when nursery period, nursery period for rice plant is 12-14 days. Old style farmer just see the sun and water for their plant with not knowing the temperature, humidity, and water. Old farmer just planting the plant and see after nursery period, how many percentage of the result. Nowadays, farmer should know the temperature, humidity, and availability of water to maximize the rice plant production. Technology will be updated every day, after farmer identifies the temperature, humidity, and availability of water then another researcher can give solution to manipulate the temperature, and humidity. Because of that the purpose of this research can be the initiation of technology in agricultural sector.

Weather forecast use data mining to collect data. Data mining is divided into 2 types, which are statistical and dynamic data. Statistical data have representative characteristics and objective, examples of statistics data are population, land area, and questionnaires. Dynamic data are usually changed randomly, such as time, speed, and weather changes. This research focused on dynamic data, because the nature of data in weather forecasting is frequently changing, infinite, and distribution of data is not uniform. Therefore, to record dynamic data, another tool is required to be able to measure needed data.

Nowadays, weather forecast uses hardware and software to predict the condition of weather. Hardware to predict the weather is microcontroller and sensor. There are several microcontrollers which are Arduino, Raspberry Pi, Banana Pi, Intel NUC, and Beagle Bone Black. From kind of microcontroller above, Arduino is easy to get and use. Because Arduino programming language is C language, that is simple and easier program for beginners. C Language specifically created with the aim that programmer can access all internal registers, I / O slots and the absolute address of a computer. Kind of sensor to predict the weather is a thermal sensor. The thermal sensor is a sensor used to detect the symptoms of change in a certain area.

One microcontroller that is inexpensive and has many benefits is Arduino. Arduino is a microcontroller that is often used by developers. Arduino offers an easy system to be modified according to user needs and to be used as the basis for new products in different scenarios (Wong & Kerkez, 2016). Ease Arduino supported by many existing data libraries in Arduino. This paper presents a platform Arduino provides a wide range of development boards circuits, some of which utilize 8-bit microcontroller Atmel CMOS low power based on the AVR enhanced RISC architecture, the microcontroller is capable of computing about 300,000 lines of code per second, which is more than enough for most applications input and output to the required timescale data collection distinctive buildings (eg, seconds or minutes), Arduino provides an integrated development environment (IDE) that is capable of running on all major operating systems and has support for a simplified programming language. In electronics, an Analog to Digital Converter (ADC) is a device for converting an analog signal (current, voltage etc.) to a digital code, usually binary. In the real world, most of the signals sensed and processed by humans are analog signals. Analog-to-Digital conversion is the primary means by which analog signal is converted into digital data that can be processed by computers for various purposes.

This research, one of the tools for measuring the data is a sensor. The sensor is something that is used to detect changes in the physical or chemical environment. Types of thermal sensor are temperature, humidity, and rain sensors. Temperature is usually used to sense the amount of energy, it can be gasses, liquid, air, and solids. Humidity is usually used to define the moisture vapor in the air. Rain sensor is usually used to give

signal there is rain or not. All of sensors will be developed with Arduino. The temperature will be used to measure condition of air, humidity will be used to measure humidity condition, and rain sensor will be used to detect rain. All of those sensors require a time series to record data that already exists. Time series is depiction of time from seconds, minutes, and hours. Sensor and time series are needed in this research. Because after a sensor measuring weather, time series is used to check the time when sensors are measuring weather and will continue to count until weather forecast program is stopped.

This research is conducted to develop weather forecast using Arduino system based on IoT and use a temperature, humidity, and rainfall as a factors. The factors before are the basic concept of forecast the weather. Arduino is an open-source electronics platform. IoT is a concept that aims to extend the benefits of Internet connectivity are connected continuously and share data. The concept of this research is to provide information as early as possible for users to plan activities according to the weather that has been predicted. Weather is difficult to predict because of fluctuated, sometimes the weather is very sunny but it sometimes extreme weather may also occur. Extreme weather may result in landslides, floods, and fires.

Based on the purpose of this research, there are 3 factors that effect on weather forecast there are temperature, humidity and rain level sensors. Sensors are hardware to determine the state of the weather. In this research using wireless sensor network to determine the state of the weather and develop with Arduino. The major obstacles for sensor network technology are difficulties in long term deployment, operation, and maintenance especially by nonengineering practitioners (Ferdoush & Li, 2014). A rain sensor is used to detect the intensity of rain and to give different signals for different rainfall intensity to the controller. Large number of sensors and the high quality device has a custom library Arduino and active support from the manufacturer to the platform. The Arduino platform has been successfully used in several efforts to collect similar data included embedding wireless sensor network for temperature and monitoring of moisture in the concrete structure, monitoring of human activities and integration through Wi-Fi networks, and to enclose the heating system parameters to retrofit analysis using sensor data of the building. This study and others have shown reliability

and ease of use Arduino platform for data collection, making it a viable option to develop a prototype sensor.

## **1.2 Problem Formulation**

Based on the problem identification above, this research will fulfill two questions below:

1. How to develop Arduino system for temperature, humidity, and rain sensor data based on Internet of Things?

## **1.3 Research Objectives**

Based on the problem formulation above, objective of this research:

1. To understand and develop data of Arduino system for temperature, humidity, and rain sensor data based on Internet of Things.

## **1.4 Research Benefit**

This study is expected to provide benefits to the parties involved. The benefits are:

1. For Author  
This study was conducted to obtain a degree in Industrial Engineering.
2. For another party  
The results of the study can be used as additional knowledge, consideration, and comparison for future research.

## **1.5 Problem Limitation**

Problem limitation is to make a border to the research in order to keep the research inside the scope. There are some limitations as follows:

1. Development of weather forecast in Internet of Things system using Arduino model.
2. The developed model can only cover an area of about 400 m.

## **1.6 Systematical of Thesis Writing**

This research is created systematically that conducted with chapters as shown below:

### **CHAPTER I INTRODUCTION**

This chapter consists of a background of research, problem formulation, the scope of research, research objective, the benefit of research, and systematical of thesis writing.

### **CHAPTER II LITERATURE REVIEW**

This chapter will elaborate the deductive and inductive study. Inductive study is important to determine previous literature research and shows the knowledge that added in this research. Deductive study becomes supporting the theory that is used as a basis for solving the existing problems and answers the problem formulation.

### **CHAPTER III RESEARCH METHODOLOGY**

This chapter will describe the methodology by elaborating steps of research in the form of flow process of research that used for describing the process of problem-solving.

**CHAPTER IV DATA COLLECTING AND PROCESSING**

This chapter will elaborate data that have been obtained and will be processed in accordance with the research methods to achieve the objectives of the research.

**CHAPTER V RESULT AND DISCUSSION**

This chapter will discuss and analyze the result of data processing. The discussion will present the result of data processing and analyze it by referring to the theory and flow of research that have been presented.

**CHAPTER VI CONCLUSION AND SUGGESTION**

The chapter will provide conclusion from the result and the suggestion for the company and future research.

**REFERENCES****APPENDIX**

## **CHAPTER II**

### **LITERATURE REVIEW**

This chapter will explain about the literature studies on automation. This research is conducted based on previous researches and that papers that will be used for the recent study. From previous researches, state of the art will be resumed on finding. The basic concept of automation is technology.

Early in the development of manufacturing industry, companies used manpower for the production process. The production process was run manually. Cost on manual technique is very expensive because companies must spend more money in order to fulfill customer demand. As time goes by, the companies have begun to find a way to reduce production costs and can fulfill customer demand by using automation techniques.

Automation is the use of machines, control systems, and information technology for the optimization of production and delivery of goods and services. If the result of production is compared with human labors, automation is faster in terms of quantity and quality. Technology is evolving from human labor into automation technique. The main factor of change is amassed of production that should be achieved because customer's needs always increase and changed. Based on the factor above, companies begin to build a tool to fulfill customer's needs. The change from traditional to automation is usually called as industrial electronics era.

#### **2.1 Deductive**

This research combines the automation system and application of web services system. The industry is seeking faster and more accurate methods of production, with the use of electronics equipment. Industrial electronics is semi-automatic equipment that used in

the production process in the industry. In the 1960s, the company is already installed electronic equipment to give a better operation on all aspects of the production process.

After automation installed electronic devices can do as human do. Electronic devices can sense, and think. To representative human behavior into electronic devices is an electrical signal (Chute & Chute, 1985). The way of electrical signal to represent electronic devices is a programming language. The level of success on the electronic device is depending on the programming language. If the programming language is true, it will be easier to translate in order to stimulate electronic devices into action. The basic behavior of robot is following the instruction based on programming language. Figure 2.1 will show the behavior diagram of the robot. Behavior diagram is a graphical tool that representative of robot work (Jones & Roth, 2004).

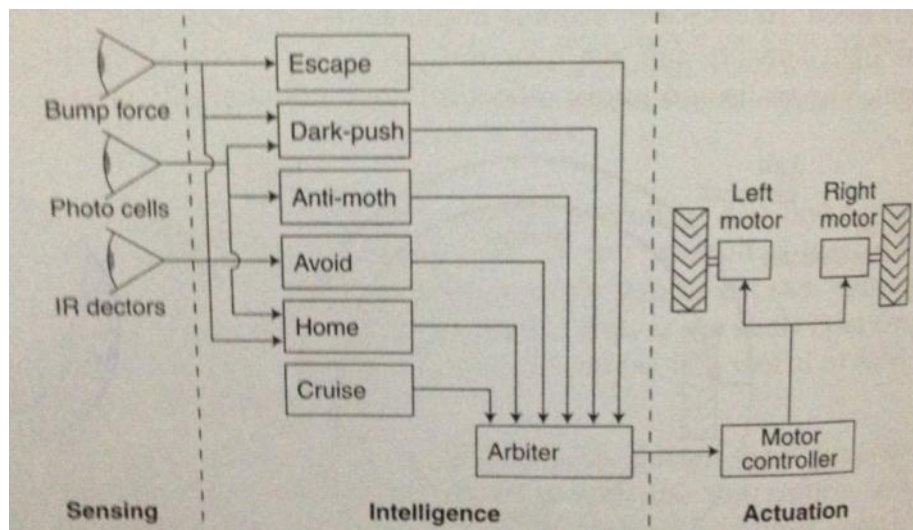


Figure 2.1 Behavior Diagram

The usability of tube or transistor can change the performance of the entire circuit, especially high-speed operation. The transistor is a semiconductor device used as an amplifier, switching, voltage stabilization, and the modulation signal. The function of transistor is an electric faucet. It means, be able to regulate the current and voltage inputs. Industrial electronic circuits are used in a wide variety of applications including rectification, motor control, amplification, regulation, and process control (Simpson & College, 1996). From the explanation above, there is any coherence between production mass and electricity to manufacture products.

Nowadays, the mass of production can be adjusted by a computer, which means, the process of production will be controlled by a computer. The result of production will be more efficient and faster. Human labors begin to decrease to taking control in the production process. Now, Human labors transferred into supervisor on a production process. In industrial system, the developer can give a command in software to sequence the machine system and PLC's software. PLC is an industrial computer control system that continuously monitors the state of input devices and makes decisions based upon a custom program to control the state of output devices. Field of robotic began developed around mid-20th century. In the beginning, the task of the robot is spray painting, welding, assembly, and material handling. Robots are generally classified by their lifting capacity, type of control is used, power supply, and the type of motion produced.

In the development of automation, automation has the ability to sense the environment. To have the ability to sense the environment, it takes a manipulator so that users and automation system can communicate. Automation development is very fast, firstly is used only for the assembly, spray painting, welding and material handling. Now automation use external mechanism that makes automation can interact with the environment in a flexible manner. This kind of automation called robot sensing. Functions of robot sensing are seeing, touch, and feel. The visual sensing system can be based on anything from the traditional camera, sonar, and laser.

Kind of automation is developed to set the command code or instructions that tell the devices mechanical and electronic systems. The automation is used to perform autonomous tasks. There are several ways to communicate with a robot, and the three major approaches to achieve it are discrete word recognition, teach and playback, and high-level programming languages (Fu, et al., 1987).

An Early task of automation is for welding, spot welding, and paint spraying. However, lately the automation has new task such as weather forecast, playing games, and 3d machine. The efficient way to communicate between robot and human is

a computer. This robot generally controlled by a computer to send and receive task that given to the robot.

Firstly, the automation has limitation recognizes a word that makes user should give one task then take pause the program to make another task. Now, the automation is developed to recognize words in real time, the speed of reading the programming languages, and efficient processing algorithms. The automation is requiring a large memory to store the data and period of training to improve the action.

Automation is developing, the difference between early and mid development of automation is in execution. In the mid of developing automation, automation make program for plan and problem solver, robot intelligence is the result. To controlling the robot as it executes the commands necessary to achieve those actions.

Decide on the action of automation means an action plan on the automation that will perform that action. Automation will achieve some of the objectives that have been programmed at the beginning. It depends on how the program languages give task to robot intelligence to execute that command. Robot intelligence in other word means robot planner or robot problem-solving. A robot planner attempts to find a path from our initial robot world to a final robot world that means the path consists of a sequence of operation that is considered primitive to the system. For real-time robot applications, those still need powerful and efficient planning algorithms that will be executed by high speed and special purpose computer system.

Above already mention about development of automation. The automation always integrated with computer-based manipulators. The way to convert from analog to digital is ADC or Analog to Digital converter. The Analog-to-Digital Converter (ADC) allows conversion of an analog input signal to a 10-bit binary representation of that signal (Sobuj, et al., 2012). Analog signals are directly measurable quantities. Digital signals only have two states. For  $v$  digital computer, we refer to binary states, 0 and 1. Microprocessors can only perform complex processing on digitized signals. When signals are in digital form they are less susceptible to the deleterious effects of additive

noise such as illustrated in Figure 2.2. ADC Provides a link between the analog world of transducers and the digital world of signal processing and data handling.

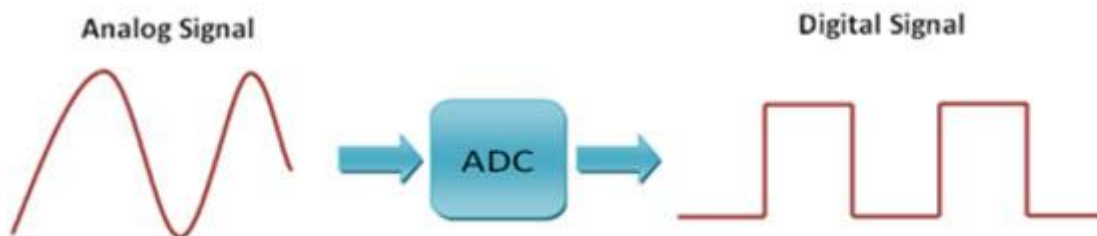


Figure 2.2 ADC

Therefore, the algorithm is a way to communicate between automation and users. The algorithm is usually implanted in the controlling software modules. There are several ways to communicate with automation that are discrete word recognition, teach and payback, and high-level programming languages. In here wants more focus on high-level programming languages because high-level languages provide a more general approach to solving the human-robot communication problem. High-level programming itself divided into two categories: robot oriented programming and task-level programming.

Robot problem solving requires the capability for representing, retrieving, and manipulating sets of statements. The languages of expert should be interpretation to therobot through logic words, can be used to express a wide variety of statements. The logical formalism is appealing because it immediately suggests a powerful way of deriving new knowledge from old such a mathematical deduction. New knowledge in this system or in the logic system should represent the logic statements such as it is sunny means sunny, can use logic if\_ then\_ rules to achieve the goals or completed the task.

Logic words or system cannot be acquired if there no experts execute it. Because of that, the system should be executed first to run the robot. There are 4 qualifications for anexpert to run the program those are (Fu, et al., 1987):

- a. There must be at least by a human expert who is acknowledged to perform the task well.

- b. The primary sources of the expert's abilities must be special knowledge, judgment, and experience.
- c. The expert must be able to articulate that special knowledge, judgment, and experience and also explain the methods used to apply it to a particular task.
- d. The task must have a well-rounded domain of application.

Automation can be integrated with web service. The example is application, games online, search engine. Application of web service will use to storage of sensor data. Web service is a service offered by an electronic device to another electronic device, communicating with each other via the World Wide Web. In a Web service, Web technology such as HTTP, originally designed for human to machine communication. Web technology is utilized for the machine to machine communication, more specifically for transferring machine-readable file formats such as XML and JSON. In practice, the web service typically provides an object oriented web-based interface to a database server. The utilized for example by another web server, or by a mobile application, that provides a user interface to the end user. Another common application offered to the end user may be a mash-up, where a web server consumes several web services at different machines and compiles the content into one user interface.

The Hypertext Transfer Protocol is an application protocol for distributed, collaborative, and hypermedia information systems. HTTP is the foundation of data communication for the World Wide Web (Guruge, 2004). HTTP functions as a request-response protocol in the client-server computing model. A web browser, for example, may be the client and an application running on a computer hosting a website may be the server. HTTP is designed to permit intermediate network elements to improve or enable communications between clients and servers. High-traffic websites often benefit from web cache servers that deliver content on behalf of upstream servers to improve response time. HTTP is an application layer protocol designed within the framework of the Internet protocol suite.

In computing, Extensible Markup Language (XML) is a markup language that defines a set of rules for encoding documents in a format that is both human-

readable and machine-readable. The design goals of XML emphasize simplicity, generality, and usability across the Internet. It is a textual data format with strong support via Unicode for different human languages. The design of XML focuses on documents, the language of design is widely used for the representation of arbitrary data structures such as those used in web services. JSON or Javascript object notation is an open-standard format that uses human-readable text to transmit data objects consisting of attribute value pairs. A developer using a bottom-up model writes implementing classes first and then uses a WSDL generating tool to expose methods from these classes as a web service. This is simpler to develop but may be harder to maintain if the original classes are subject to frequent change. A developer using a top-down model writes the WSDL document first and then uses a code generating tool to produce the class skeleton, to be completed as necessary. This model is generally considered more difficult but can produce cleaner designs and is generally more resistant to change. As long as the message formats between sender and receiver do not change, changes in the sender and receiver themselves do not affect the web service. The technique is also referred to as contract first since the WSDL (or contract between sender and receiver) is the starting point

## **2.2 Inductive**

### **2.2.1. Related Work**

Nowadays ability to provide accurate weather forecast in agriculture, oceanic, and air traffic is needed. In order to improve the accuracy of the load simulation without relying on historical load records, weather forecast parameters are used to correct hourly weather data of the following day in the meteorological library is used to simulate cooling load for the following day, then the name of the proposed methods to simulate the next day(Li et al., 2015). Regarding the above, although the temperature-based model reasonable results, weather type and wind scale are also contained in public forecast, weather type and wind scale forecasts are original forecast data that cannot be directly applied as inputs and they are also unable to evaluated in a quantitative manner, however, through the analytical method (Cai et al., 2007). Weather type and wind scale can be respectively converted into sunshine duration and wind speed and their

forecasting performance can be measured through quantitative method, if the weather type and wind scale are accurately forecasted (Yang et al., 2016).

The statement weather forecast spawns new ideas and paved the way for rethinking and reinterpreting foundational technologies such as the Internet, driving efforts towards the Internet of Things (IoT), or service engineering on the basis of the Cloud computing (Distefano et al., 2015). Internet of Things can be realized in three paradigms internet oriented, things oriented and semantic oriented, although this type of delineation is required due to the interdisciplinary nature of the subject, the usefulness of IoT can be unleashed only in an application domain where the three paradigms intersect (Gubbi et al., 2013). IoT can be viewed as a highly dynamic and widely distributed network system. In other words, it is a system comprising many identifiable components that are able to communicate and to interact, either among themselves or with end users or other entities in the network, home automation, by way of smart devices that sense physical occurrences and translate them into a stream of information data, maximizes safety, security, comfort, convenience and energysavings(Vujovic & Maksimovic, 2014).

Internet of things can be integrated with web service. The architecture of Web Services is based on the interaction between three roles provider, register center and requester. The objective of web service is to convert the web data into computer driven based readable data which can be stored efficiently. On the other hand, web services enabled self-driven or automatic reusability of stored web data. Among all available services, Variety of single level component services are unable to satisfy the criteria which meets user demands and request therefore some advanced web services mechanisms like discovery, selection, mediation, matchmaking (Khamparia & Pandey, 2014). It can be a browser and controlled by user or just program without user interface. Web Service can run from simple requests to complicated business processes, it depend on the request. The other Web Service applications can discover and invoke it to deploy the service(Qiang et al., 2011). Web services can be considered as the component of IoT programming. The application layer handles all business logics and computes the information which is used to build responses with dynamically generated content(Mohamed et al., 2009). These researches propose the dynamic system because

weather forecasts connect with another user. The dynamic web-based system is connected to the clients through wide area network. Therefore, the dynamic web-based system fit with the purpose of dynamic system. The other uses of web service is providing high technology enterprises with online information and information related services for making decision (Guo, 2009). The examples of providing the information are information retrieval, information publication, and business consulting. IoT middleware and connectivity protocols are being developed and the number is increasing each day (Ngu et al., 2016). The IoT with the web service have many implementations such as GPS, monitor air, water pollution. Which is specified in XML and implemented with a corresponding wrapper, is provided as the main abstraction for developing and connecting a new IoT device.

The trend of IoT becomes a role model of application with web services basis. The increasing interaction between embedded devices and Web based services, as envisioned by the Internet of Things, requires interfaces that provide Internet based access from and to services in the embedded network (Sommer et al., 2009). The architecture is based on Cloud computing which provides storage and computing resources to implement Web applications. More importantly, Cloud services can be accessed anytime and anywhere. The Web application is mainly responsible for reading sensors, storing readings, and monitoring home appliances over the internet (Soliman et al., 2013). The popularity of applications on the web, along with its open standards and accessibility across a broad range of devices such as desk- top computers, laptops, mobile phones, and gaming consoles make the Web an ideal universal platform for future IoT applications (Han & Crespi, 2017). Unlike traditional Web services and applications, which are mainly virtual entities, smart object services provide real time data about the physical world. The problem of web service are produced mainly for scalability reasons, Web services can have many service consumers sending many service requests at the same time (Zela Ruiz & Rubira, 2016). The purpose of web service is to provide self-driven handling of simplex and complex web services.

For integrating weather forecast and IoT, researcher should use tools to provide them in this research. Arduino is used as tools to execute the data of weather forecast using IoT. An Arduino datalogging shield was also used to have a real time record of

the weather flow on clouds. This eliminates the need for using a laptop computer in the field while the data could be used later for retrieval and could be easily imported into conventional processing and plotting software like Excel. The applied data-logging shield has a real time clock (RTC) with a battery backup that keeps the time even when the Arduino is not being supplied with power. It also has an onboard 3.3 v regulator that works as a reference voltage for the microcontroller and AD converters and at the same time, supplies power to activate the SD memory card (Fatehnia, et al., 2016). Weather forecast uses Arduino as hardware program and the data input will be saved in IoT system, since the weather uses sensors of temperature, humidity, and rain. To calculate the direct data in real time online, Arduino will send the data to IoT home base and it can forecast the weather for a few hours, days, month, and years ahead.

### **2.2.2. Comparison of Previous Research**

There are many types of research that related with weather forecasting and Internet of Things (IoT). Weather can be predicted from the change in atmosphere, so the forecast using real-time data that calculate the change in atmosphere (Gómez et al., 2014). In others research, it already used a microcontroller to predict the weather, DHT11 became the sensor to calculate the weather and the data were taken by the sensors are recorded in satellite-based system which communicates through wireless data transmission system and displayed either on a television or in the internet broadcasting media (Laskar et al., 2016). Things oriented (sensors) and semantic-oriented (knowledge), although this type of delineation is required due to the interdisciplinary nature of the subject, the usefulness of IoT can be unleashed only in an application domain. The Internet of Things (IoT) paradigm, the objects in the environment can be connected with one form and another. Radio Frequency Identification (RFID) and sensor network technologies will be combined to become data information that can be collected to stored, cloud computing can be integrated with a monitoring device, storage devices, and analytics tools (Gubbi et al., 2013).

From the comparison above, this research will purpose the function of sensors and Internet of Things (IoT) that implemented in the weather forecast such as described in table 2.1. Sensors and WIFI will be connected with a microcontroller. Sensors that will use in microcontroller are humidity, temperature, and rain sensor. WIFI will transfer

data that record by sensors to clouds. Arduino will be used as a microcontroller. The WIFI becomes a bridge between data that recorded with IoT. IoT can be viewed as a highly dynamic and widely distributed network system. In other words, it is a system comprising many identifiable components that are able to communicate and to interact, either among themselves or with end-users or other entities in the network, home automation, by way of smart devices that sense physical occurrences and translate them into a stream of information data, maximizes safety, security, comfort, convenience and energy savings (Vujovic & Maksimovic, 2014).

Nowadays, Microcontroller usually combined with Internet of Things. Not the entire microcontroller being combined, it depends on the purpose of usability. Arduino is sometimes being combined with IoT for few projects such as web server that connects with application in Smartphone. In few journals above, Arduino is combined with sensors to forecast the weather, but not combined with IoT. Sensors that used to forecast the forecast used temperature and humidity. Therefore, this research purpose is to combine microcontroller with sensors and IoT system. Sensors that will be used are temperature, humidity and rain.

Table 2.1 Comparison

(Vujovic & Maksimovic, 2014)	(Gubbi et al., 2013)	(Laskar et al., 2016).	(Gómez et al., 2014)	Research Proposed 2017
------------------------------	----------------------	------------------------	----------------------	---------------------------

---

IoT Developed with microcontroller	Yes	Yes	No	No	Yes
IoT Developed with Weather Forecast	Yes	No	No	No	Yes
Sensor Developed with IoT	Yes	Yes	No	No	Yes
Sensor Developed with Microcontroller	Yes	No	Yes	Yes	Yes
Sensor developed with Weather Forecast	No	No	Yes	Yes	Yes
Microcontroller developed with Weather Forecast	No	No	Yes	Yes	Yes

## **CHAPTER III**

### **RESEARCH METHODOLOGY**

#### **3.1 Focus of research**

This research focuses on weather forecast in real time because many researches discuss about habit of weather through surface of atmosphere. Forecasting often being used due to the desire of knowing things future is high. The weather is very influential on the activities of people in doing something, such as traveling, flying, planting, and productivity. Actually there are no big different between real time and surface of atmosphere. Which makes the difference between real time and the surface of the atmosphere is a way of doing forecasting.

This research has three variables as output from weather forecast those are temperature, humidity, and rain. Those variables are chosen because their affect to productivity in human life. Temperature has an effect on activity, if the temperature is hot it will be easier to get exhausted and makes human lazy to do something productive. Humidity can affect the comfort in the work. Rain can effect on flexibility in conducting some works outside.

#### **3.2 Data Requirements**

In this research, two types of data collecting are implemented:

##### **1. Direct Observation**

The observation is conducted to get the data which are needed for the weather forecast process. The observation is directly conducted in Karangwaru Lor TR II Yogyakarta.

## 2. Experiment

The Experiment is a systematic and scientific approach to research in which want to manipulate one or more variables, control and measure any changes in other variables. This research is designated to develop the microcontroller. Hence, the experiment is the method to prove the work of microcontroller. Experiment is conducted in Karangwaru Lor TR II Yogyakarta.

### 3.3 Schematic

In this section, Arduino is used as a place for sensors and WIFI to measure and send the calculation to IoT. Sensors will be measure the state of weather and WIFI will be sent it to IoT. To connect the sensors and WIFI, Arduino needs to modify become new PCB (printed computer board) because Arduino cannot balance the voltage of ESP 8266 and needs more holes of voltage to plug in ESP 8266. AT mega 328 is part of Arduino and regulator IC 7805 and lm317 will be placed in new PCB. Regulator IC 7805 will provide 5-volt sensor, which are water sensor and ESP8266, and lm317 will provide sensor that requires 3.5 volt that is DHT22, as illustrated in Figure 3.1. Schematic will be illustrated in Figure 3.2 and the IoT based water sensor will be illustrated in Figure 3.3.

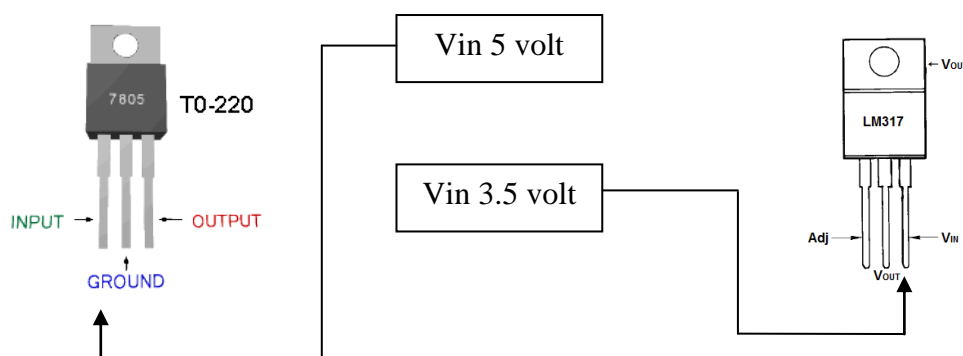


Figure 3.1 Simple schematic of sensor Vin

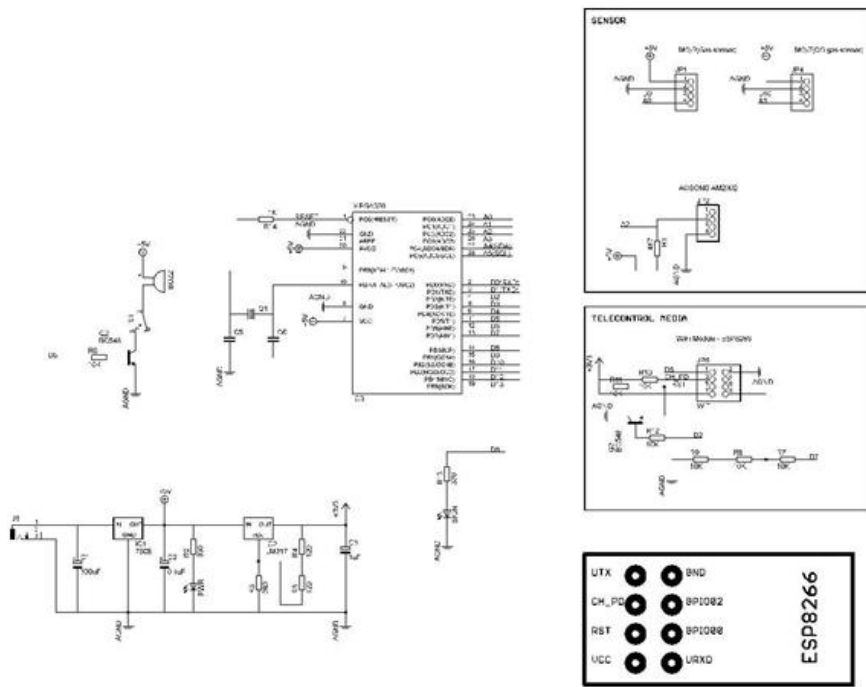


Figure 3.2 Schematic

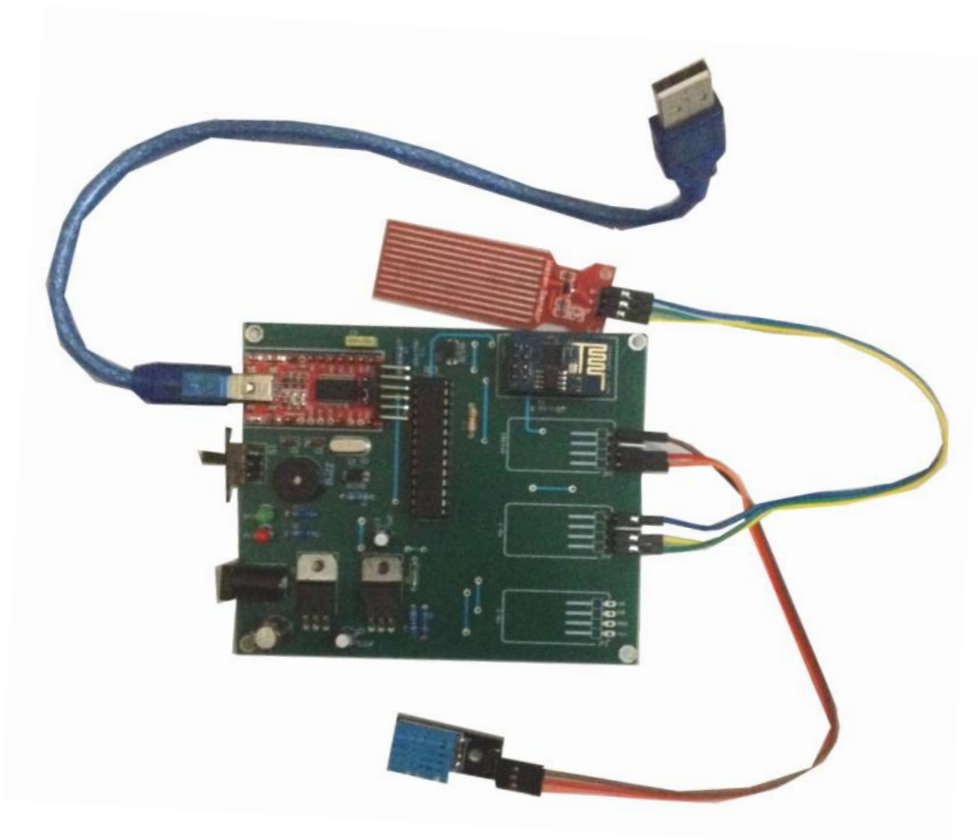


Figure 3.3 IoT based water sensor

The model cannot be used in case of rain. Therefore, the model will be equipped with box cover. Not all of part PCB is water resistant, since only rain sensor as part of PCB is water resistant. Below will be illustrated box without upper cover in Figure 3.4 and 3.5, and box with upper cover will be illustrated in Figure 3.6.

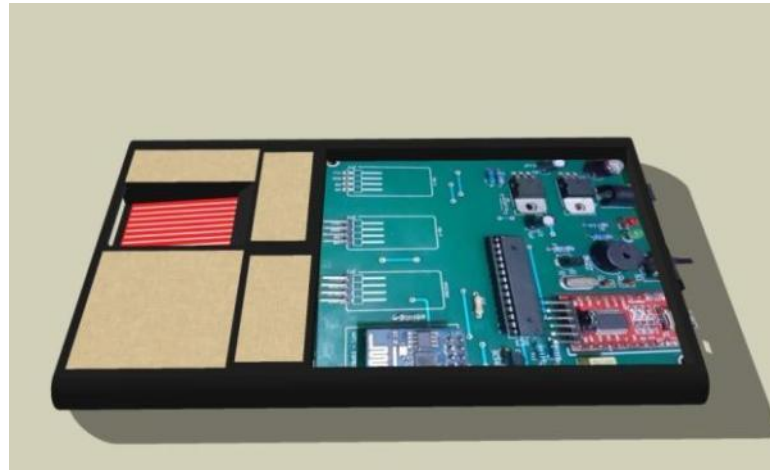


Figure 3.4 Box without Cover in PCB

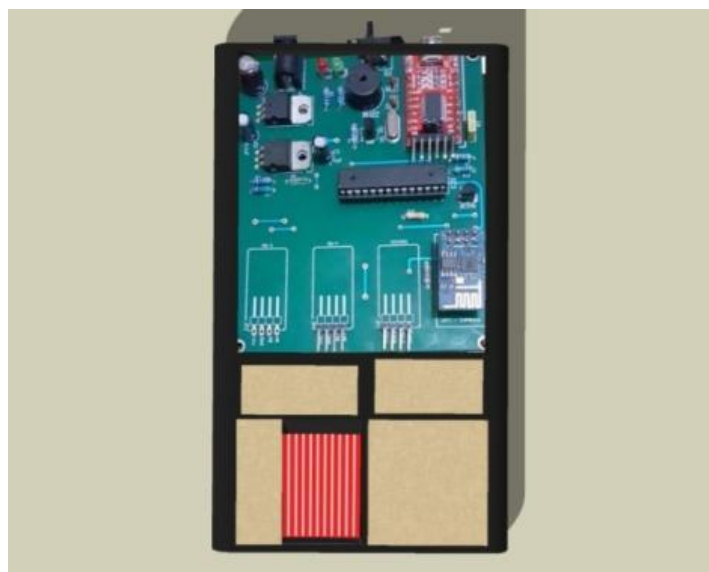


Figure 3.5 Box without Cover in PCB

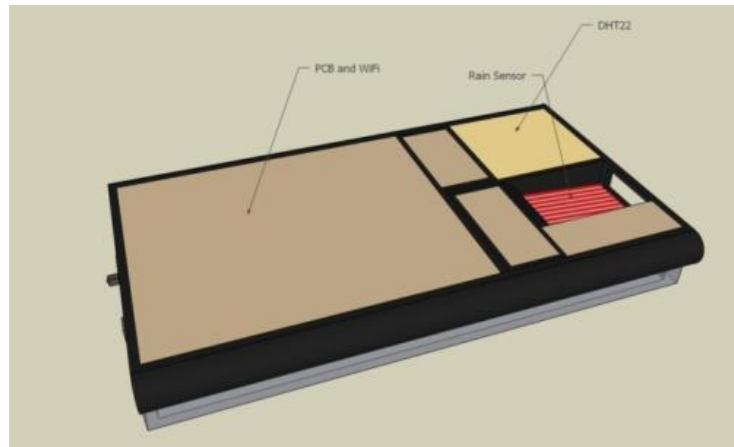


Figure 3.6 Box with Cover in PCB

The box will cover the PCB from water, but not all of parts will covered by box because rain sensor needed to detect rain such as illustrated in Figure 3.5. The design of box in part rain sensor will be designed with sloping shape, because the slope makes water flow from above of box until front of box or the edge such as illustrated in Figure 3.7.

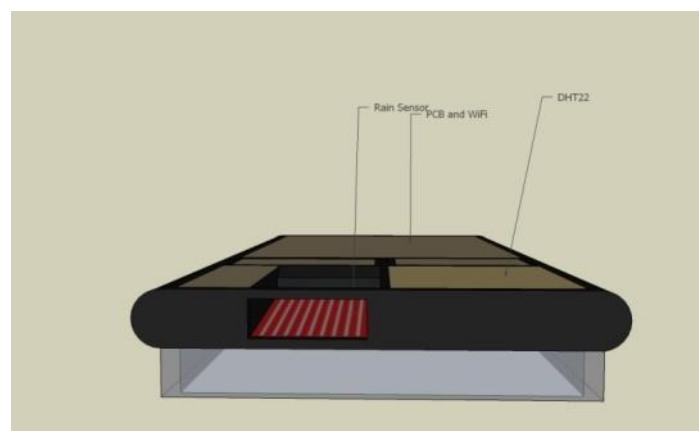


Figure 3.7 Slope in Rain Sensor

Under of the box, a hole will be placed for DHT or temperature and humidity sensor. The sensor works as sense of the environment, if the sensor is being closed, it will affect the result of environment sensing. To maximize the result of DHT, a hole will be equipped on the design of box, not just maximize the work of rain sensor, it also maximizes DHT. In every edge of box will be given buffer for box that designated to avoid disturbances on the DHT work as Illustrated in Figure 3.8

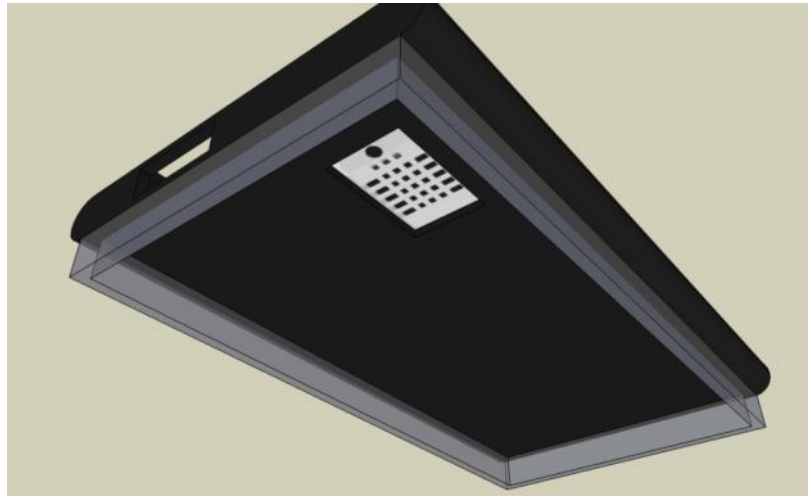


Figure 3.8 Box with Hole and Buffer for DHT Sensor

### 3.4 Flow of IoT Based Water Sensor

Flow of model is method on how the program will run as illustrated in Figure 3.9

#### 1. Sensor data

DHT22 and Rain sensor will detect the weather condition. After detecting the condition, the sensor will send the data to processor.

#### 2. Processor

Processor as brain of the model will receive the weather condition from sensor. In this research processor that will be used is Arduino. Arduino is an open source platform that contains ATMEL AVR processor.

#### 3. WIFI Module

WIFI module in this research uses ESP 8266. WIFI module will send data from sensor to web browser as intermediary from processor to web server.

#### 4. Web Service

Web browser serves to receive and present information resources on the Internet. An information resource is identified by a uniform source identifier that can be a web page, image, video, or other type of content. Web browser will present information to client

and application that used by user which obtained from web server. In this research, web browser as intermediary between sensor data and web server.

#### 5. Web Server

Web server is storage data from sensor. Data obtained from sensor will saved in web server. After saved in web server, web server will send the data to web browser.

#### 6. Client Application

Client is the receiving device that will display and run the application and server is a device that provides and acts as an application manager, data, and security.

#### 7. Bayesian Model

Bayesian is the probability of an event, based on prior knowledge of the conditions that might be related to the event. Formulation of Bayesian Model is:

$$\text{Bayes theorem } P(A|B_i) = \frac{P(A \cap B_i)}{P(A)}$$

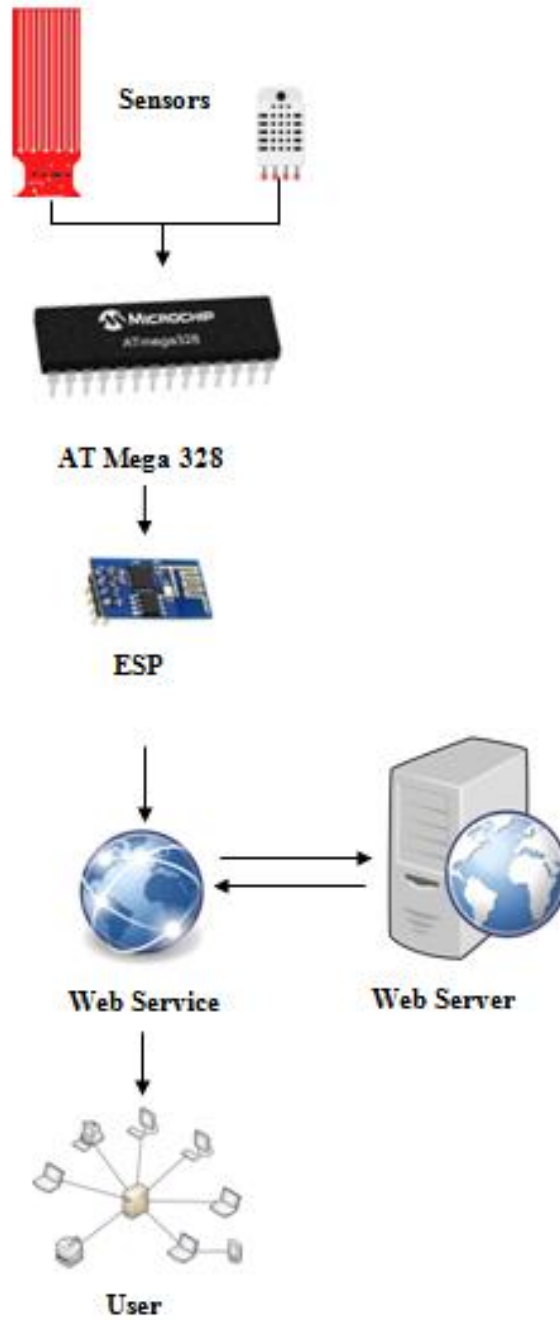


Figure3.9 Flow of IoT based water sensor

### 3.5 Tools

For solving the problem, there are four tools which will be implemented, those are:

#### 1. Arduino

Arduino is an open source electronics platform. Arduino becomes microcontroller as a place for the sensors.

#### 2. DHT 22

DHT 22 is a basic, low-cost digital temperature and humidity sensor. The DHT 22 will measure temperature and humidity.

#### 3. Rain Sensor

Rain sensor is a switching device activated by rainfall. Rain sensor will detect the rain.

#### 4. Arduino Software

Arduino software makes it easier for user to write code and upload it to the board. Arduino software will be written in the logic for the hardware can understand.

### 3.6 Variables

There are three variables as output of the weather forecast, those are:

1. Temperature is a measure on a state of a material's quality. The quality may be regarded as a more abstract entity than any particular temperature scale that measures it. It is measured by a thermometer, several scales and units exist for measuring temperature, the common are Celsius (denoted °C; formerly called centigrade), Fahrenheit (denoted °F), and, especially in science, Kelvin (denoted K).

2. Humidity is the amount of water vapor in the air. Water vapor is the gaseous state of water and is invisible. Humidity indicates the likelihood of precipitation, dew, or fog. Higher humidity reduces the effectiveness of sweating in cooling the body by reducing the rate of evaporation of moisture from the skin. There are three main measurements of humidity: absolute, relative and specific. Absolute humidity is the water content of air at a given temperature expressed in gram per cubic meter. Relative humidity, expressed as a percent, measures the current absolute humidity relative to the maximum (highest point) for that temperature. Specific humidity is a ratio of the water vapor content of the mixture to the total air content on a mass basis.
  
3. Rain is liquid water in the form of droplets that have condensed from atmospheric water vapor and then precipitated that is, become heavy enough to fall under gravity. Rain is a major component of the water cycle and is responsible for depositing most of the fresh water on the earth. It provides suitable conditions for many types of ecosystems, as well as water for hydroelectric power plants and crop irrigation.

### **3.7 Research Procedure**

Procedure of this research is such as described in Figure 4.0.

#### **1. Literature Review**

Literature review is conducted in order to get basic theory and concept of the industrial electronics, robotics, and including recent related researches that have been investigated by previous researches. Divided by two kinds that are deductive and inductive, deductive is basic theory of industrial electronics and inductive is recent researches that have related with web server and development of microcontroller. The objective of literature review is to get a deep understanding about the basic knowledge and to identify the novelty of this research.

## **2. Problem Identification and Formulation**

This stage aims to determine which problem that will be conducted. The problem is related to resource allocation and it will be identified and formulated. This problem considers the development of microcontroller and sensor use for forecasting the weather by habit of real-time series that stored in IoT (Internet of Things). The variables of weather forecast are temperature, humidity, and rain sensors.

## **3. Data Collection**

After the model is created, the model is needed to run with Arduino software. Software is needed to give commands for the sensors and WIFI by providing programming logic. The programming logic will provide the logic for sensors to be able to measure the weather conditions, and for the WIFI, programming logic will provide the logic to WIFI in order to transmit the data from sensors to the cloud of IoT.

## **4. Data Processing**

The model is constructed from components and variables that affect the logic. Variables indicated by the type of data required. After data acquired then the data need to forecast using Bayesian theorem.

## **5. Result Analysis**

The output analysis will present the processing data associated with journals that related to this research problem and the literature about basic theoretical information that probably required. A comparison will be executed to identify the differences between the previous result and the result after the optimization.

## 6. Conclusion and Recommendation

The last step will be the conclusion that is useful to summarize the final results and answer the problem formulations. Recommendation is useful for further research by giving some suggestions to improve the current performance.

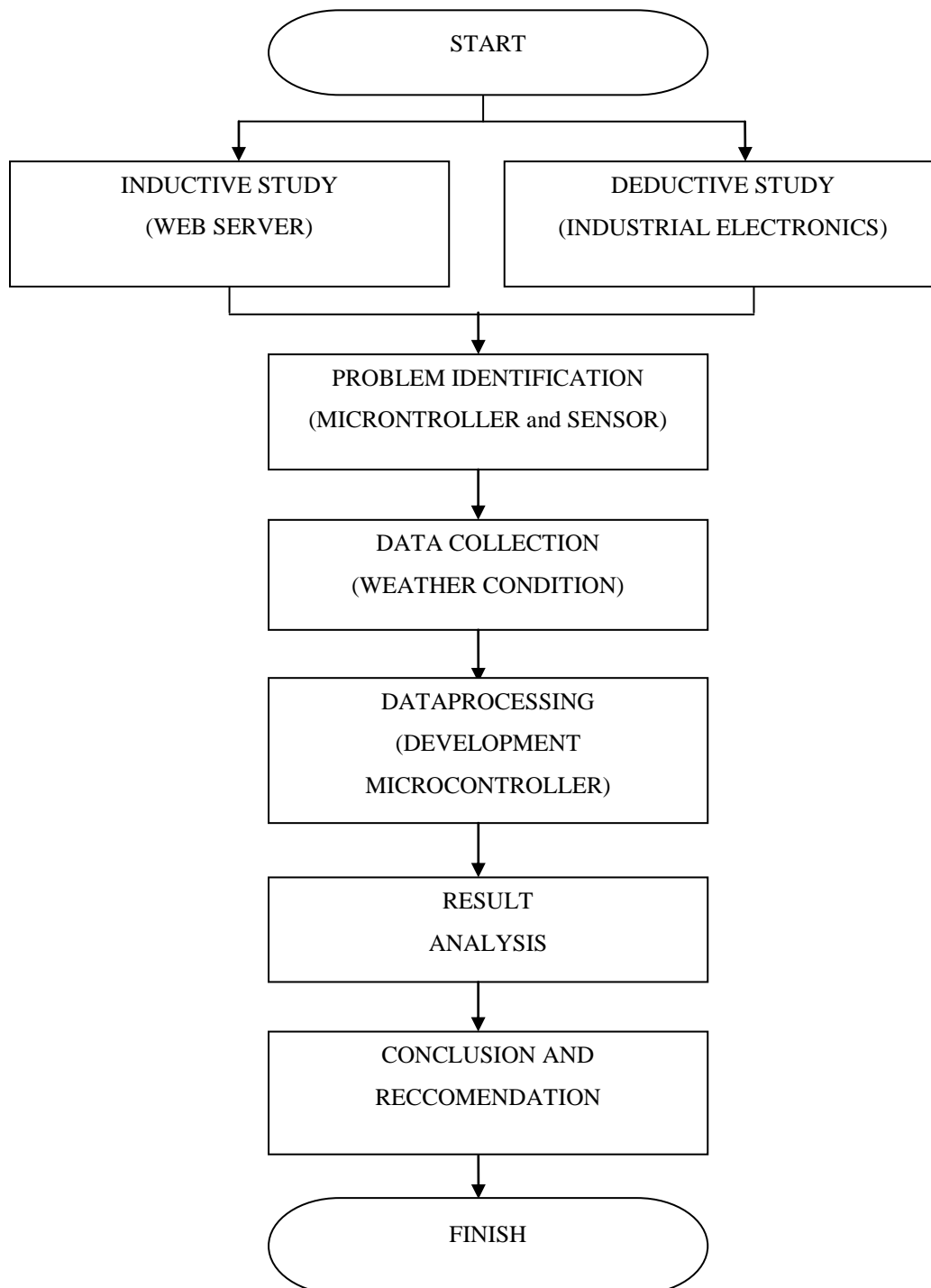


Figure 4.0 Flowchart

## CHAPTER IV

### HARDWARE DEVELOPMENT AND TESTING

#### 4.1 Collecting Data Method

##### 4.1.1 Observation

The research was conducted in Karangwaru Lor TR II Yogyakarta, to observe the weather condition. Thus, the proposed model for the weather forecast that uses sensor and microcontroller performance assessment can be executed in this area. To obtain the performance assessment the following observation is conducted. This is kind of the initial step to get the data which is needed to be processed based on the methodology that has been developed. Based on the observation, several data are obtained. Those data collected by primary data and secondary data. The primary data is acquired by the logic programming and secondary data is acquired by weather condition. These data are in the form of coding logic and historical data that in the further will be processed for the assessment as well as the performance improvement. Coding logic of the data is task or command of human logic to represent the tools, and historical data are result data from command of coding logic.

##### 4.1.2 Primary Data

The primary data are divided into several kinds of data that are needed for fulfilling the goal of the research. The primary data contain the result of weather condition.

#### 1. Source and Server

Source in this research is command of pseudo code that will active when code input in computer system. Pseudo code or logic will represent the work of sensors into the

words. Server is storage of data from sensors. Server will upload data to web service that will be used by user.

### **4.1.3 Secondary Data**

The secondary data is already provided by the observation, so those can be directly acquired. Here, the secondary data is in the form of the historical data that in further will be used to conduct the performance assessment by using Bayes theorem. There is also the data about weather condition. That data will be implemented to the performance improvement, so the target might be achieved by the observation.

#### **1. Weather Condition**

Weather condition is proposed to generate the information which can be acquired by direct observation as well as the historical data. The weather condition consists of several aspects to understand the condition of the weather in certain areas.

## **4.2 Data Processing**

### **4.2.1 Pseudo Code**

Pseudo code is an informal and concise high level description of computer programming algorithms that use structural conventions over a programming language, and is intended to be read by humans and not by machines. Pseudo code is a code similar to the actual programming. Pseudo code comes from the word Pseudo which means imitation, similar, or resembles a programming language code. Pseudo code writing style indicates no standard rules, therefore pseudo code is usually written based on programming language that will be used, for example Basic, Pascal, C, Fortran and others. Therefore, it is more appropriately used to describe the algorithm that will be communicated to the programmer.

Basic is family of general purpose, high level programming languages in which design philosophy emphasizes ease of use. C is a general purpose, imperative computer programming language, supporting structured programming, lexical variable scope and recursion, while a static type system prevents many unintended operations. Pascal is an imperative and procedural programming language, as a small, efficient language intended to encourage good programming practices using structured programming and data structuring. Fortran is a general purpose, imperative programming language that is especially suited to numeric computation and scientific computing.

The structure part of pseudo code is a notation for representing six specific structured programming constructs such as sequence, while, if-then-else, repeat-until, for, and case. Each of these constructs can be embedded inside any other construct. These construct represent the logic, or flow of control in an algorithm. It has been proven that three basic constructs for flow of control are sufficient to implement any proper algorithm.

1. Sequence is a linear progression where one task is performed sequentially after another.
2. While is a loop (repetition) with a simple conditional test at its beginning.
3. If-then-else is a decision (selection) in which a choice is made between two alternative courses of action.

Although these constructs are sufficient, it is often useful to include three more constructs:

1. Repeat-until is a loop with a simple conditional test at the bottom.
2. Case is a multi-way branch (decision) based on the value of an expression. Case is a generalization of if-then-else.
3. For is a counting loop.

There are 2 types of pseudo code in order to finish the task of weather forecast, first pseudo code for weather forecasting, and second pseudo code for data sending in web service will be described in Figure 4.1.

```

Begin
    Checking the system;
    Connect with WIFI;
    Sense the humidity, temperature, and rain;
End;
Begin;
    Read the data;
    Save the data in database;
    Display in browser;
    Refresh browser;
End;

```

Figure 4.1 Pseudo Code for Weather Forecast

Pseudo code is a written description of a program in language not in code or basic language. Source code is written in program language, pseudo code make easier for user that cannot use program of coding or logical programming. In this research, has two type of pseudo. First pseudo is command for weather program, how to process the program of PCB from sensor sense the environment and connect with WIFI. First step of pseudo is checking the system, after all part gather then checking the system of module is ready for run the system. Second step is give command the sensor, after turning on then give command the sensor for sense environment from temperature until rain. For temperature sense the degree of condition, humidity sense contains of water and rain sense the rain. Third connect with WIFI, after sense environment then give command to connect with WIFI because data should send to web service for user can collect and save the data.

Second pseudo is command for sending the data to web service, after data collected from sensor then data need storage to store the data. In here, web server as storage the data, because of that role of pseudo is to express how the data to be sent to

web service. First step is reading the data, after sensor collects the data then they should be read by command program, it is same with command or not because if data not same with command system will error. Second step is saving the data in database, after system reads the data then they will be saved in database or web server, before being displayed in browser or web service, the data should be saved first. Third step is displaying in browser, after data being saved, later they will be displayed in web service, all data cannot be displayed in browser since browser has limit page to display the data. Fourth step is refreshing the browser, after data were displayed in browser then browser is refreshed for upgrading the data from system to be displayed in browser, browser always refreshed automatically per minute because sensor sense the condition per minute. After all of processes have been resumed, then user can read and predict the weather condition.

#### 4.2.2 Interface and Classification of plant

After providing command in system, Then website that will upload the data can be created. Data that were sent from Arduino system to web service will be uploaded in <http://www.logikation-ems.com/iot/iotpage.php> and classification in interface is number of data successfully sent, temperature, humidity, rain status, and time stamp or time of data uploaded such as illustrated in Figure 4.2.

Data ID	Temperature	Humidity	Rain Status	Time Stamp
376	22	62	0	2017-07-07 03:29:56
375	22	63	0	2017-07-07 03:28:57
374	23	70	0	2017-07-07 02:53:39
373	24	72	0	2017-07-07 02:46:30
372	24	71	0	2017-07-07 02:45:31
371	24	71	0	2017-07-07 02:44:31
370	26	71	0	2017-05-30 16:20:03
369	26	71	0	2017-05-30 16:19:03
368	26	71	0	2017-05-30 16:18:04
367	26	72	0	2017-05-30 16:14:02
366	26	72	0	2017-05-30 16:13:03
365	25	73	0	2017-05-30 16:12:03
364	25	72	0	2017-05-30 16:08:01
363	25	72	0	2017-05-30 16:00:57
362	25	72	0	2017-05-30 15:56:54
361	25	72	0	2017-05-30 15:51:52
360	25	72	0	2017-05-30 15:50:52
359	25	74	0	2017-05-30 15:33:35
358	25	74	0	2017-05-30 15:32:36
357	25	73	0	2017-05-30 15:28:32
356	25	73	0	2017-05-30 15:27:33
355	25	73	0	2017-05-30 15:26:34
354	25	73	0	2017-05-30 15:25:34
353	25	73	0	2017-05-30 15:19:33
352	25	73	0	2017-05-30 15:17:34

Figure 4.2 Interface

After user can use the website, then user can maximize the result of plant. Classifications for plant itself are (Hidayati, 2015):

**1. Hot / tropical area**

Place height: 0 - 600 m above sea level.

Temperature: 26.3° C - 22° C.

Plants: rice, corn, coffee, tobacco, sugar cane, rubber, coconut, chocolate.

**2. Medium area**

Place height: 600 m - 1500 m above sea level.

Temperature: 22° C - 17.1° C.

Plants: rice, tobacco, tea, coffee, chocolate, quinine, vegetables.

**3. Cool area**

Place height: 1500 - 2500 m above sea level.

Temperature: 17.1° C - 11.1° C

Plants: coffee, tea, quinine, vegetables.

**4. Cold area**

High place: more than 2500 m above sea level.

Temperature: 11.1° C - 6.2° C.

Plants: No cultivated plants.

After asking the expert to change the humidity and temperature, it will be maximal if it carried out in greenhouse, plant that could grow perfectly in greenhouse are flowers such as rose and orchid, fruits such as grape, tomato, and strawberry, vegetable such as mushroom.

## CHAPTER V

### RESULT AND ANALYSIS

Based on data that processed in chapter IV, the problem formulation of this research that was determined earlier will be discusses in this chapter. Furthermore, the result that obtained from data processing would be discussed. The data collected from direct observation that obtained from May 29, 2017 until May 30, 2017 such as describe in Table 5.1.

Table 5.1 Weather Condition

No	Time	Condition		
		temperature	humidity	rain
1	15:20	26.0	71.9	0
2	16:20	26.0	70.0	0
3	17:20	25.6	82.6	1
4	18:20	25.0	84.1	1
5	19:20	25.0	72.2	0
6	20:20	25.0	67.3	0
7	21:20	25.0	67.3	0
8	22:20	25.0	68.0	0
9	23:20	25.0	68.0	0
10	0:20	25.0	68.0	0
11	1:20	25.0	68.0	0
12	2:20	25.0	67.4	0
13	3:20	25.0	69.0	0
14	4:20	25.0	71.4	0
15	5:20	25.0	73.0	0
16	6:20	25.0	73.0	0
17	7:20	25.0	73.0	0
18	8:20	25.0	73.0	0
19	9:20	25.0	72.3	0
20	10:20	25.0	71.0	0
21	11:20	25.0	71.5	0
22	12:20	25.0	72.2	0
23	13:20	25.0	74.2	0
24	14:20	25.0	72.6	0

## 5.1 Assessment of Weather Forecast

The condition of weather is already known, and the weather condition should be measured for the next condition of weather. The condition divided into same frequency such as shown in Table 5.2 for temperature, Table 5.3 for humidity, and Table 5.4 for rain.

Table 5.2 Frequency Table of Temperature

Frequency Table	
temperature	Freq
26	2
25.6	1
25	21
Total	24

Table 5.3 Frequency Table of Humidity

Frequency Table	
Humidity	Freq
67-73	21
73.1-78	1
78.1-84	2
Total	24

Table 5.4 Frequency Table of Rain

Frequency Table	
Rain	Freq
1	2
0	22
Total	24

Table 5.2, 5.3, and 5.4 above show the majority condition of weather on that day is dry. Since the temperature of 25°C dominates the frequency, it means that tomorrow will be quite hot and suitable for rice, corn and tobacco. For the humidity condition, water in the air will be normal because the humidity with 67-73 will dominate the frequency. The higher the humidity is, closer to the saturation point (saturation point 100%). It means that water in the air is overwhelming, because of that condition, chance of rain will higher (Ajadi, 2013). After the frequency table is identified, then

calculation of the likelihood of the weather condition is shown in Table 5.5 for temperature, Table 5.6 for humidity, and Table 5.7 for rain.

Table 5.5 Likelihood Table of Temperature

Temperature	Freq			Likelihood Table
	26	25.6	25	
	2	1	21	1.00
Total	2	1	21	24
	0.08	0.04	0.88	

Table 5.6 Likelihood Table of Humidity

Humidity	Freq			Likelihood Table
	67-73	73.1-78	78.1-84	
	21	1	2	1.00
Total	21	1	2	24
	0.88	0.04	0.08	

Table 5.7 Likelihood Table of Rain

Rain	Freq		Likelihood Table
	Yes	No	
	2	22	1.00
Total	2	22	24
	0.08	0.92	

Table 5.5, 5.6, and 5.7 above is table likelihood. Table likelihood is an index or value used to determine the degree of occurrence of a random event. There are 3 conditions of likelihood:  $p=0$  means there no chance to occur,  $0 < p < 1$  means there any chance to occur, and  $p=1$  means the event absolute occurs (Sahoo, 2013). Probability of rain is 0.08 and not rain is 0.92. The chance of rain next day is 8% that means chance of not rain for the next day will be high. The condition of weather dominated by 25°C, the probability of 25°C for next day is 88%. Calculation the next of weather condition is using naïve bayes theorem as shown in Table 5.8 for temperature, Table 5.9 for humidity, and Table 5.10 for rain

Table 5.8 Probability of Temperature

Probability	
Temperature	Freq
26°	0.08
25.6°	0.04
25°	0.88

Table 5.9 Probability of Humidity

Probability	
Humidity	Freq
67-73	0.88
73.1-78	0.04
78.1-84	0.08

Table 5.10 Probability of Rain

Probability	
Rain	Freq
Yes	0.08
No	0.92

Tables 5.8, 5.9, and 5.10 have same result with likelihood table that since probability table has 1 result or 1 day data. Probability can combine the result such as probability for temperature 25°C with humidity 67-73 is 0.70 that means chance for temperature 25°C with humidity 67-73 is 70% it can be easier for farmer to see the result than see result separately. Prediction for weather next day for temperature is 25°, humidity is 67-73, and not rain. In Table 5.1, humidity has an effect on rain, with humidity high chance of rain will be as high as explained in frequency table. Table of probability above means that the condition will be dominated by dry on the next day.

## 5.2 Reliability of Developed Sensor Based on Data Sending

Reliability is a measure of reliability obtained by administering the same test twice over a period of time to a group of individuals. The cause of data cannot be sent is internet connection, if the connection is not good enough then data cannot be sent and vice versa. ESP 8266 needs fast connection in order to send the data, because of that

provider, personal hotspot, and public hotspot should fast enough in order to send the data. From Table 5.11 not all of data can be sent and the percentage of data sending is:

$$\frac{46}{60} \times 100\% = 76.67\%$$

Table 5.11 Reliability data sending

No	Temperature	Humidity	Rain	data sending
1	71	25	0	Data sent
2	71	25	0	Data sent
3	71	25	0	Data sent
4	71	25	0	Data sent
5	71	25	0	Data sent
6	71	25	0	Data sent
7	71	25	0	Data sent
8	71	25	0	Data sent
9	71	25	0	Data sent
10	71	25	0	Data sent
11	71	25	0	Data sent
12	71	25	0	Data sent
13	71	25	0	Data sent
14	71	25	0	Data sent
15	71	25	0	Data sent
16	71	25	0	Data sent
17	72	25	0	Data sent
18	73	25	0	Data sent
19	72	25	0	Data sent
20	71	25	0	Data not sent
21	71	25	0	Data not sent
22	71	25	0	Data not sent
23	71	25	0	Data sent
24	71	25	0	Data sent
25	71	25	0	Data sent
26	71	25	0	Data not sent
27	71	25	0	Data sent
28	71	25	0	Data sent
29	71	25	0	Data sent
30	71	25	0	Data sent
31	71	25	0	Data sent
32	71	25	0	Data not sent
33	71	25	0	Data not sent
34	71	25	0	Data not sent
35	71	25	0	Data not sent
36	71	25	0	Data sent

No	Temperature	Humidity	Rain	data sending
37	71	25	0	Data sent
38	71	25	0	Data sent
39	72	25	0	Data sent
40	72	25	0	Data sent
41	72	25	0	Data sent
42	71	25	0	Data sent
43	71	25	0	Data sent
44	71	25	0	Data not sent
45	72	25	0	Data not sent
46	72	25	0	Data not sent
47	72	25	0	Data not sent
48	73	25	0	Data sent
49	73	25	0	Data sent
50	73	25	0	Data sent
51	72	25	0	Data sent
52	72	25	0	Data sent
53	72	25	0	Data not sent
54	72	25	0	Data sent
55	73	25	0	Data not sent
56	73	25	0	Data sent
57	73	25	0	Data sent
58	73	25	0	Data sent
59	73	25	0	Data sent
60	73	25	0	Data sent

### 5.3 Analysis of Weather Prediction

The weather forecasting is hard to predict or has same result with the reality of weather condition. From the result of weather prediction in chapter before, weather condition is random result. The prediction of short term is more accurate than long term. Short term forecasting is the forecasting made for a period of up to 48 hours. From the data on May 29, 2017 and May 30, 2017 the weather dominated by dry condition. Temperature not always has an effect with rain, humidity has an effect with the rain, and more high humidity chance of rain will be high. Actually, wind is needed in weather prediction for understanding the temperature. Because from the data above, condition of humidity has more random data compared temperature and rain.

Cloudy depends on humidity as it contains water, but not affect the temperature. Mostly, data show that it is sunny because the climate shows dry condition these days.

Even, in drying climate, it is possible for weather to change to rain, such as in a day 29<sup>th</sup> May at 17.45 recorded as rainy with high humidity. System should active for 24 hours because humidity will get higher, it can affect the plant. Plant sensitive with temperature and humidity, temperature can arrange to maintain the productivity. Humidity has no direct effect with the plant, because humidity just asses water in the air, but has important indirect affect. It is possible to change the productivity of plant if it processed indoor, if plant is placed outdoor, it cannot cause the productivity with maximum result. This system can affect the productivity from result of weather condition and support the agriculture business.

#### **5.4 Analysis of Hardware Development**

The development of microcontroller and sensor can be used to forecast the weather condition. Below are steps of develop the microcontroller:

##### **1. Identification of system requirement**

System requirement for farmer or user are temperature and humidity, temperature means checking the solar heat for the plant and humidity means checking the water in air, actually, water in soil is needed for the plant, because the water from inside will affect the plant to grow. The requirement for the system is by fulfilling the requirement of the farmer. Requirement for temperature and humidity is DHT 22 and water from inside cannot use the sensor since in the early development, this research used rain sensor to check the water. Beside the sensor, the system needs processor to run and give command to the sensor and WIFI. WIFI is needed, because data that collected from the sensors will be sent to web server for user to see.

##### **2. Definition of feature**

The definition of processor can be resumed as brain of the system, because processor becomes basic thing to run the system. Processor gives command to sensors and WIFI, for sensors can sense the environment. WIFI had been given the commands to send the data to web server that are collected from sensors.

### 3. Identification of component

The component for processor will be used AT MEGA or usually used by Arduino, for WIFI it applies ESP8266, for sensors temperature and humidity applies DHT22, and rain will use rain sensor.

### 4. Hardware schematic design

Hardware schematic design, first sensor will sense the environment then sends the data to processor, processor will forward the data to WIFI, and then WIFI will upload the data to web service.

### 5. Hardware development

The early development, the IoT based weather sensors proposes Arduino as a module, but the voltage from Arduino cannot require it. Actually, Arduino can give the external voltage to fulfill it, but that make the IoT based weather sensors cannot be used in rain condition because the plate and external voltage make it complicated to be used. Then to make it easier for the common user, the IoT based weather sensors proposes PCB to fulfill the requirement of the voltage, which is of ESP8266 and part that used from Arduino is AT mega or the processor.

### 6. Microcontroller programming

Processor, sensors, and WIFI will be given commands from user to perform the IoT based weather sensors such as described in pseudo code.

### 7. Web server programming

Web server programming will display the temperature, humidity, and rain status.

### 8. System testing

After all of above steps are performed, then the IoT based weather sensors will be tested.

For further research, on the interface can be added information for plant that is suitable in certain circumstance and automatic forecasting. Because the information in web service for now is sketchy, web service for this research now only can display the current status, and for the forecasting, it still uses manual calculation.

## CHAPTER VI

### CONCLUSION AND RECOMMENDATION

#### 6.1 Conclusion

The development of microcontroller and sensor can be used to forecast the weather condition. There are 8 steps to develop the microcontroller, first identification system requirement, second definition of feature, third identification of component, fourth hardware schematic design, fifth hardware development, sixth microcontroller programming, seventh web server programming eighth system testing, after all of step before done then the IoT based weather sensors can be run and can check it in <http://www.logikation-ems.com/iot/iotpage.php>.

After running the IoT based weather sensor, the tools should be tested by uploading the data to web service. The reliability is 76.67% that means result not good enough, since it cannot reach 90%. Data that already acquired will be forecasted to identify condition on the next day. Result of forecast for temperature is 25oC with probability 0.88, for humidity with range 67-73 with probability 0.88 and for rain, it is predicted as not rain with probability 0.92. Weather conditions for next day cannot be the same with data that already forecasted manually. Forecasting will be conducted manually because this research not focused on forecasting but on developing the IoT based weather sensor.

## **6.2 Recommendation**

After conducting the program and assessment, researcher suggests several things to further research that are:

1. Further research can be developed by using LAN (local area network) connection for maintaining the bandwidth.
2. Further research can be developed by using wind and water in soil sensor for more accurate weather forecast and discover of availability water in soil.
3. Further research can give more commands to forecast automatically in the system.

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**APPENDIX**

Data ID	Temperature	Humidity	Rain Status	Time Stamp
1	26	70	0	15:20
2	26	70	0	15:21
3	26	71	0	15:22
4	26	69	0	15:23
5	26	69	0	15:24
6	26	69	0	15:25
7	26	69	0	15:26
8	26	69	0	15:27
9	26	69	0	15:28
10	26	69	0	15:29
11	26	71	0	15:30
12	26	70	0	15:31
13	26	71	0	15:32
14	26	71	0	15:33
15	26	72	0	15:34
16	26	71	0	15:35
17	26	73	0	15:36
18	26	73	0	15:37
19	26	73	0	15:38
20	26	74	0	15:39
21	26	80	0	15:40
22	26	80	0	15:41
23	26	80	0	15:42
24	26	77	0	15:43
25	26	78	0	15:44
26	26	80	0	15:45
27	26	80	0	15:46
28	26	86	0	15:47
29	26	70	0	15:48
30	26	70	0	15:49
31	26	71	0	15:50
32	26	69	0	15:51
33	26	69	0	15:52
34	26	69	0	15:53
35	26	69	0	15:54
36	26	71	0	15:55
37	26	70	0	15:56
38	26	71	0	15:57
39	26	71	0	15:58
40	26	72	0	15:59
41	26	70	0	16:00
42	26	70	0	16:01
43	26	70	0	16:02

Data ID	Temperature	Humidity	Rain Status	Time Stamp
44	26	70	0	16:03
45	26	71	0	16:04
46	26	71	0	16:05
47	26	71	0	16:06
48	26	71	0	16:07
49	26	71	0	16:08
50	26	71	0	16:09
51	26	71	0	16:10
52	26	71	0	16:11
53	26	72	0	16:12
54	26	72	0	16:13
55	26	72	0	16:14
56	26	72	0	16:15
57	26	71	0	16:16
58	26	71	0	16:17
59	26	70	0	16:18
60	26	70	0	16:19
61	26	69	0	16:20
62	26	69	0	16:21
63	26	69	0	16:22
64	26	69	0	16:23
65	26	69	0	16:24
66	26	69	0	16:25
67	26	69	0	16:26
68	26	69	0	16:27
69	26	69	0	16:28
70	26	69	0	16:29
71	26	69	0	16:30
72	26	69	0	16:31
73	26	69	0	16:32
74	26	69	0	16:33
75	26	69	0	16:34
76	26	69	0	16:35
77	26	69	0	16:36
78	26	72	0	16:37
79	26	69	0	16:38
80	26	69	0	16:39
81	26	69	0	16:40
82	26	69	0	16:41
83	26	69	0	16:42
84	26	69	0	16:43
85	26	70	0	16:44
86	26	70	0	16:45
87	26	70	0	16:46

Data ID	Temperature	Humidity	Rain Status	Time Stamp
88	26	70	0	16:47
89	26	70	0	16:48
90	26	70	0	16:49
91	26	67	0	16:50
92	26	70	0	16:51
93	26	70	0	16:52
94	26	70	0	16:53
95	26	70	0	16:54
96	26	70	0	16:55
97	26	70	0	16:56
98	26	70	0	16:57
99	26	70	0	16:58
100	26	70	0	16:59
101	26	70	0	17:00
102	26	70	0	17:01
103	26	70	0	17:02
104	26	70	0	17:03
105	26	70	0	17:04
106	26	70	0	17:05
107	26	71	0	17:06
108	26	71	0	17:07
109	26	72	0	17:08
110	26	75	0	17:09
111	26	71	0	17:10
112	26	71	0	17:11
113	26	72	0	17:12
114	26	71	0	17:13
115	26	72	0	17:14
116	26	71	0	17:15
117	26	72	0	17:16
118	26	72	0	17:17
119	26	72	0	17:18
120	26	72	0	17:19
121	26	72	0	17:20
122	26	72	0	17:21
123	26	73	0	17:22
124	26	73	0	17:23
125	26	73	0	17:24
126	26	73	0	17:25
127	26	73	0	17:26
128	26	73	0	17:27
129	26	74	0	17:28
130	26	80	0	17:29
131	26	80	0	17:30

Data ID	Temperature	Humidity	Rain Status	Time Stamp
132	26	80	0	17:31
133	26	79	0	17:32
134	26	79	0	17:33
135	26	78	0	17:34
136	26	77	0	17:35
137	26	78	0	17:36
138	26	79	0	17:37
139	26	77	0	17:38
140	26	75	0	17:39
141	26	76	0	17:40
142	26	79	0	17:41
143	26	78	0	17:42
144	26	80	0	17:43
145	26	80	0	17:44
146	26	83	1	17:45
147	26	83	1	17:46
148	26	84	1	17:47
149	26	85	1	17:48
150	26	86	1	17:49
151	26	86	1	17:50
152	26	86	1	17:51
153	26	85	1	17:52
154	26	86	1	17:53
155	26	86	1	17:54
156	26	86	1	17:55
157	25	88	0	17:56
158	25	88	0	17:57
159	25	88	0	17:58
160	25	88	0	17:59
161	25	88	0	18:00
162	25	88	0	18:01
163	25	88	0	18:02
164	25	88	0	18:03
165	25	88	0	18:04
166	25	88	0	18:05
167	25	88	0	18:06
168	25	88	0	18:07
169	25	88	0	18:08
170	25	88	0	18:09
171	25	89	0	18:10
172	25	90	0	18:11
173	25	87	0	18:12
174	25	87	0	18:13
175	25	87	0	18:14

Data ID	Temperature	Humidity	Rain Status	Time Stamp
176	25	87	0	18:15
177	25	87	0	18:16
178	25	87	0	18:17
179	25	87	0	18:18
180	25	89	0	18:19
181	25	89	0	18:20
182	25	89	0	18:21
183	25	89	0	18:22
184	25	89	0	18:23
185	25	87	0	18:24
186	25	88	0	18:25
187	24	91	0	18:26
188	25	90	0	18:27
189	25	90	0	18:28
190	25	90	0	18:29
191	25	90	0	18:30
192	25	90	0	18:31
193	25	90	0	18:32
194	25	90	0	18:33
195	25	89	0	18:34
196	25	86	0	18:35
197	25	88	0	18:36
198	25	85	0	18:37
199	25	85	0	18:38
200	25	83	0	18:39
201	25	83	0	18:40
202	25	83	0	18:41
203	25	83	0	18:42
204	25	83	0	18:43
205	25	83	0	18:44
206	25	83	0	18:45
207	25	83	0	18:46
208	25	82	0	18:47
209	25	82	0	18:48
210	25	82	0	18:49
211	25	82	0	18:50
212	25	82	0	18:51
213	25	82	0	18:52
214	25	82	0	18:53
215	25	82	0	18:54
216	25	82	0	18:55
217	25	82	0	18:56
218	25	82	0	18:57
219	25	82	0	18:58

Data ID	Temperature	Humidity	Rain Status	Time Stamp
220	25	82	0	18:59
221	25	82	0	19:00
222	25	82	0	19:01
223	25	82	0	19:02
224	25	82	0	19:03
225	25	82	0	19:04
226	25	82	0	19:05
227	25	82	0	19:06
228	25	82	0	19:07
229	25	82	0	19:08
230	25	81	0	19:09
231	25	80	0	19:10
232	25	82	0	19:11
233	25	82	0	19:12
234	25	82	0	19:13
235	25	82	0	19:14
236	25	81	0	19:15
237	25	81	0	19:16
238	25	81	0	19:17
239	25	79	0	19:18
240	25	79	0	19:19
241	25	79	0	19:20
242	25	79	0	19:21
243	25	79	0	19:22
244	25	78	0	19:23
245	25	78	0	19:24
246	25	78	0	19:25
247	25	78	0	19:26
248	25	78	0	19:27
249	25	78	0	19:28
250	25	78	0	19:29
251	25	76	0	19:30
252	25	76	0	19:31
253	25	77	0	19:32
254	25	75	0	19:33
255	25	75	0	19:34
256	25	75	0	19:35
257	25	74	0	19:36
258	25	74	0	19:37
259	25	72	0	19:38
260	25	72	0	19:39
261	25	71	0	19:40
262	25	71	0	19:41
263	25	71	0	19:42

Data ID	Temperature	Humidity	Rain Status	Time Stamp
264	25	71	0	19:43
265	25	71	0	19:44
266	25	72	0	19:45
267	25	72	0	19:46
268	25	72	0	19:47
269	25	72	0	19:48
270	25	72	0	19:49
271	25	72	0	19:50
272	25	72	0	19:51
273	25	72	0	19:52
274	25	72	0	19:53
275	25	71	0	19:54
276	25	71	0	19:55
277	25	70	0	19:56
278	25	70	0	19:57
279	25	70	0	19:58
280	25	69	0	19:59
281	25	69	0	20:00
282	25	69	0	20:01
283	25	69	0	20:02
284	25	69	0	20:03
285	25	69	0	20:04
286	25	69	0	20:05
287	25	69	0	20:06
288	25	69	0	20:07
289	25	69	0	20:08
290	25	69	0	20:09
291	25	69	0	20:10
292	25	69	0	20:11
293	25	69	0	20:12
294	25	69	0	20:13
295	25	69	0	20:14
296	25	69	0	20:15
297	25	69	0	20:16
298	25	68	0	20:17
299	25	68	0	20:18
300	25	68	0	20:19
301	25	68	0	20:20
302	25	68	0	20:21
303	25	68	0	20:22
304	25	68	0	20:23
305	25	68	0	20:24
306	25	68	0	20:25
307	25	68	0	20:26

Data ID	Temperature	Humidity	Rain Status	Time Stamp
308	25	68	0	20:27
309	25	68	0	20:28
310	25	68	0	20:29
311	25	69	0	20:30
312	25	69	0	20:31
313	25	69	0	20:32
314	25	69	0	20:33
315	25	69	0	20:34
316	25	69	0	20:35
317	25	69	0	20:36
318	25	69	0	20:37
319	25	69	0	20:38
320	25	69	0	20:39
321	25	69	0	20:40
322	25	69	0	20:41
323	25	69	0	20:42
324	25	68	0	20:43
325	25	68	0	20:44
326	25	68	0	20:45
327	25	68	0	20:46
328	25	68	0	20:47
329	25	68	0	20:48
330	25	68	0	20:49
331	25	68	0	20:50
332	25	68	0	20:51
333	25	67	0	20:52
334	25	67	0	20:53
335	25	67	0	20:54
336	25	66	0	20:55
337	25	66	0	20:56
338	25	66	0	20:57
339	25	66	0	20:58
340	25	66	0	20:59
341	25	66	0	21:00
342	25	66	0	21:01
343	25	66	0	21:02
344	25	66	0	21:03
345	25	66	0	21:04
346	25	66	0	21:05
347	25	66	0	21:06
348	25	66	0	21:07
349	25	66	0	21:08
350	25	66	0	21:09
351	25	66	0	21:10

Data ID	Temperature	Humidity	Rain Status	Time Stamp
352	25	66	0	21:11
353	25	66	0	21:12
354	25	66	0	21:13
355	25	66	0	21:14
356	25	65	0	21:15
357	25	65	0	21:16
358	25	65	0	21:17
359	25	65	0	21:18
360	25	65	0	21:19
361	25	65	0	21:20
362	25	65	0	21:21
363	25	65	0	21:22
364	25	65	0	21:23
365	25	65	0	21:24
366	25	65	0	21:25
367	25	65	0	21:26
368	25	66	0	21:27
369	25	66	0	21:28
370	25	67	0	21:29
371	25	67	0	21:30
372	25	67	0	21:31
373	25	67	0	21:32
374	25	67	0	21:33
375	25	67	0	21:34
376	25	69	0	21:35
377	25	69	0	21:36
378	25	69	0	21:37
379	25	69	0	21:38
380	25	69	0	21:39
381	25	68	0	21:40
382	25	68	0	21:41
383	25	68	0	21:42
384	25	68	0	21:43
385	25	68	0	21:44
386	25	68	0	21:45
387	25	68	0	21:46
388	25	68	0	21:47
389	25	68	0	21:48
390	25	68	0	21:49
391	25	68	0	21:50
392	25	68	0	21:51
393	25	68	0	21:52
394	25	68	0	21:53
395	25	68	0	21:54

Data ID	Temperature	Humidity	Rain Status	Time Stamp
396	25	68	0	21:55
397	25	68	0	21:56
398	25	68	0	21:57
399	25	68	0	21:58
400	25	68	0	21:59
401	25	68	0	22:00
402	25	68	0	22:01
403	25	69	0	22:02
404	25	69	0	22:03
405	25	69	0	22:04
406	25	69	0	22:05
407	25	69	0	22:06
408	25	65	0	22:07
409	25	65	0	22:08
410	25	65	0	22:09
411	25	65	0	22:10
412	25	65	0	22:11
413	25	65	0	22:12
414	25	65	0	22:13
415	25	67	0	22:14
416	25	67	0	22:15
417	25	68	0	22:16
418	25	68	0	22:17
419	25	68	0	22:18
420	25	68	0	22:19
421	25	68	0	22:20
422	25	68	0	22:21
423	25	68	0	22:22
424	25	68	0	22:23
425	25	68	0	22:24
426	25	68	0	22:25
427	25	68	0	22:26
428	25	68	0	22:27
429	25	68	0	22:28
430	25	68	0	22:29
431	25	68	0	22:30
432	25	68	0	22:31
433	25	68	0	22:32
434	25	68	0	22:33
435	25	68	0	22:34
436	25	68	0	22:35
437	25	68	0	22:36
438	25	68	0	22:37
439	25	68	0	22:38

Data ID	Temperature	Humidity	Rain Status	Time Stamp
440	25	68	0	22:39
441	25	68	0	22:40
442	25	68	0	22:41
443	25	68	0	22:42
444	25	68	0	22:43
445	25	68	0	22:44
446	25	68	0	22:45
447	25	68	0	22:46
448	25	68	0	22:47
449	25	68	0	22:48
450	25	68	0	22:49
451	25	68	0	22:50
452	25	68	0	22:51
453	25	68	0	22:52
454	25	68	0	22:53
455	25	68	0	22:54
456	25	68	0	22:55
457	25	68	0	22:56
458	25	68	0	22:57
459	25	68	0	22:58
460	25	68	0	22:59
461	25	68	0	23:00
462	25	68	0	23:01
463	25	68	0	23:02
464	25	68	0	23:03
465	25	68	0	23:04
466	25	68	0	23:05
467	25	68	0	23:06
468	25	68	0	23:07
469	25	68	0	23:08
470	25	68	0	23:09
471	25	68	0	23:10
472	25	68	0	23:11
473	25	68	0	23:12
474	25	68	0	23:13
475	25	68	0	23:14
476	25	68	0	23:15
477	25	68	0	23:16
478	25	68	0	23:17
479	25	68	0	23:18
480	25	68	0	23:19
481	25	68	0	23:20
482	25	68	0	23:21
483	25	68	0	23:22

Data ID	Temperature	Humidity	Rain Status	Time Stamp
484	25	68	0	23:23
485	25	68	0	23:24
486	25	68	0	23:25
487	25	68	0	23:26
488	25	68	0	23:27
489	25	68	0	23:28
490	25	68	0	23:29
491	25	68	0	23:30
492	25	68	0	23:31
493	25	68	0	23:32
494	25	68	0	23:33
495	25	68	0	23:34
496	25	68	0	23:35
497	25	68	0	23:36
498	25	68	0	23:37
499	25	68	0	23:38
500	25	68	0	23:39
501	25	68	0	23:40
502	25	68	0	23:41
503	25	68	0	23:42
504	25	68	0	23:43
505	25	68	0	23:44
506	25	68	0	23:45
507	25	68	0	23:46
508	25	68	0	23:47
509	25	68	0	23:48
510	25	68	0	23:49
511	25	68	0	23:50
512	25	68	0	23:51
513	25	68	0	23:52
514	25	68	0	23:53
515	25	68	0	23:54
516	25	68	0	23:55
517	25	68	0	23:56
518	25	68	0	23:57
519	25	68	0	23:58
520	25	68	0	23:59
521	25	68	0	0:00
522	25	68	0	0:01
523	25	68	0	0:02
524	25	68	0	0:03
525	25	68	0	0:04
526	25	68	0	0:05
527	25	68	0	0:06

Data ID	Temperature	Humidity	Rain Status	Time Stamp
528	25	68	0	0:07
529	25	68	0	0:08
530	25	68	0	0:09
531	25	68	0	0:10
532	25	68	0	0:11
533	25	68	0	0:12
534	25	68	0	0:13
535	25	68	0	0:14
536	25	68	0	0:15
537	25	68	0	0:16
538	25	68	0	0:17
539	25	68	0	0:18
540	25	68	0	0:19
541	25	68	0	0:20
542	25	68	0	0:21
543	25	68	0	0:22
544	25	68	0	0:23
545	25	68	0	0:24
546	25	68	0	0:25
547	25	68	0	0:26
548	25	68	0	0:27
549	25	68	0	0:28
550	25	68	0	0:29
551	25	68	0	0:30
552	25	68	0	0:31
553	25	68	0	0:32
554	25	68	0	0:33
555	25	68	0	0:34
556	25	68	0	0:35
557	25	68	0	0:36
558	25	68	0	0:37
559	25	68	0	0:38
560	25	68	0	0:39
561	25	68	0	0:40
562	25	68	0	0:41
563	25	68	0	0:42
564	25	68	0	0:43
565	25	68	0	0:44
566	25	68	0	0:45
567	25	68	0	0:46
568	25	68	0	0:47
569	25	68	0	0:48
570	25	68	0	0:49
571	25	68	0	0:50

Data ID	Temperature	Humidity	Rain Status	Time Stamp
572	25	68	0	0:51
573	25	68	0	0:52
574	25	68	0	0:53
575	25	68	0	0:54
576	25	68	0	0:55
577	25	68	0	0:56
578	25	68	0	0:57
579	25	68	0	0:58
580	25	68	0	0:59
581	25	68	0	1:00
582	25	68	0	1:01
583	25	68	0	1:02
584	25	68	0	1:03
585	25	68	0	1:04
586	25	68	0	1:05
587	25	68	0	1:06
588	25	68	0	1:07
589	25	68	0	1:08
590	25	68	0	1:09
591	25	68	0	1:10
592	25	68	0	1:11
593	25	68	0	1:12
594	25	68	0	1:13
595	25	68	0	1:14
596	25	68	0	1:15
597	25	68	0	1:16
598	25	68	0	1:17
599	25	68	0	1:18
600	25	68	0	1:19
601	25	68	0	1:20
602	25	68	0	1:21
603	25	68	0	1:22
604	25	68	0	1:23
605	25	68	0	1:24
606	25	68	0	1:25
607	25	68	0	1:26
608	25	68	0	1:27
609	25	68	0	1:28
610	25	68	0	1:29
611	25	68	0	1:30
612	25	68	0	1:31
613	25	68	0	1:32
614	25	68	0	1:33
615	25	68	0	1:34

Data ID	Temperature	Humidity	Rain Status	Time Stamp
616	25	68	0	1:35
617	25	68	0	1:36
618	25	68	0	1:37
619	25	68	0	1:38
620	25	68	0	1:39
621	25	68	0	1:40
622	25	68	0	1:41
623	25	68	0	1:42
624	25	68	0	1:43
625	25	68	0	1:44
626	25	68	0	1:45
627	25	68	0	1:46
628	25	68	0	1:47
629	25	68	0	1:48
630	25	68	0	1:49
631	25	68	0	1:50
632	25	68	0	1:51
633	25	68	0	1:52
634	25	68	0	1:53
635	25	68	0	1:54
636	25	68	0	1:55
637	25	68	0	1:56
638	25	68	0	1:57
639	25	68	0	1:58
640	25	68	0	1:59
641	25	68	0	2:00
642	25	68	0	2:01
643	25	68	0	2:02
644	25	68	0	2:03
645	25	68	0	2:04
646	25	68	0	2:05
647	25	68	0	2:06
648	25	68	0	2:07
649	25	68	0	2:08
650	25	68	0	2:09
651	25	68	0	2:10
652	25	68	0	2:11
653	25	68	0	2:12
654	25	68	0	2:13
655	25	68	0	2:14
656	25	68	0	2:15
657	25	68	0	2:16
658	25	68	0	2:17
659	25	68	0	2:18

Data ID	Temperature	Humidity	Rain Status	Time Stamp
660	25	68	0	2:19
661	25	68	0	2:20
662	25	68	0	2:21
663	25	68	0	2:22
664	25	68	0	2:23
665	25	68	0	2:24
666	25	68	0	2:25
667	25	68	0	2:26
668	25	68	0	2:27
669	25	68	0	2:28
670	25	68	0	2:29
671	25	68	0	2:30
672	25	68	0	2:31
673	25	68	0	2:32
674	25	68	0	2:33
675	25	68	0	2:34
676	25	68	0	2:35
677	25	68	0	2:36
678	25	68	0	2:37
679	25	68	0	2:38
680	25	68	0	2:39
681	25	68	0	2:40
682	25	68	0	2:41
683	25	68	0	2:42
684	25	68	0	2:43
685	25	67	0	2:44
686	25	67	0	2:45
687	25	67	0	2:46
688	25	67	0	2:47
689	25	67	0	2:48
690	25	67	0	2:49
691	25	67	0	2:50
692	25	67	0	2:51
693	25	67	0	2:52
694	25	67	0	2:53
695	25	67	0	2:54
696	25	67	0	2:55
697	25	67	0	2:56
698	25	67	0	2:57
699	25	67	0	2:58
700	25	67	0	2:59
701	25	67	0	3:00
702	25	67	0	3:01
703	25	67	0	3:02

Data ID	Temperature	Humidity	Rain Status	Time Stamp
704	25	67	0	3:03
705	25	67	0	3:04
706	25	67	0	3:05
707	25	67	0	3:06
708	25	67	0	3:07
709	25	67	0	3:08
710	25	67	0	3:09
711	25	67	0	3:10
712	25	67	0	3:11
713	25	67	0	3:12
714	25	67	0	3:13
715	25	67	0	3:14
716	25	67	0	3:15
717	25	67	0	3:16
718	25	67	0	3:17
719	25	67	0	3:18
720	25	67	0	3:19
721	25	67	0	3:20
722	25	67	0	3:21
723	25	67	0	3:22
724	25	67	0	3:23
725	25	67	0	3:24
726	25	67	0	3:25
727	25	67	0	3:26
728	25	68	0	3:27
729	25	68	0	3:28
730	25	68	0	3:29
731	25	68	0	3:30
732	25	68	0	3:31
733	25	68	0	3:32
734	25	68	0	3:33
735	25	68	0	3:34
736	25	68	0	3:35
737	25	68	0	3:36
738	25	68	0	3:37
739	25	68	0	3:38
740	25	68	0	3:39
741	25	68	0	3:40
742	25	68	0	3:41
743	25	68	0	3:42
744	25	68	0	3:43
745	25	68	0	3:44
746	25	68	0	3:45
747	25	68	0	3:46

Data ID	Temperature	Humidity	Rain Status	Time Stamp
748	25	68	0	3:47
749	25	68	0	3:48
750	25	68	0	3:49
751	25	68	0	3:50
752	25	68	0	3:51
753	25	68	0	3:52
754	25	70	0	3:53
755	25	70	0	3:54
756	25	70	0	3:55
757	25	70	0	3:56
758	25	70	0	3:57
759	25	70	0	3:58
760	25	70	0	3:59
761	25	70	0	4:00
762	25	70	0	4:01
763	25	70	0	4:02
764	25	70	0	4:03
765	25	70	0	4:04
766	25	70	0	4:05
767	25	70	0	4:06
768	25	70	0	4:07
769	25	71	0	4:08
770	25	71	0	4:09
771	25	71	0	4:10
772	25	71	0	4:11
773	25	71	0	4:12
774	25	71	0	4:13
775	25	71	0	4:14
776	25	71	0	4:15
777	25	71	0	4:16
778	25	71	0	4:17
779	25	71	0	4:18
780	25	71	0	4:19
781	25	71	0	4:20
782	25	71	0	4:21
783	25	71	0	4:22
784	25	71	0	4:23
785	25	71	0	4:24
786	25	71	0	4:25
787	25	72	0	4:26
788	25	72	0	4:27
789	25	72	0	4:28
790	25	72	0	4:29
791	25	72	0	4:30

Data ID	Temperature	Humidity	Rain Status	Time Stamp
792	25	72	0	4:31
793	25	72	0	4:32
794	25	72	0	4:33
795	25	71	0	4:34
796	25	71	0	4:35
797	25	71	0	4:36
798	25	71	0	4:37
799	25	71	0	4:38
800	25	71	0	4:39
801	25	71	0	4:40
802	25	71	0	4:41
803	25	71	0	4:42
804	25	71	0	4:43
805	25	71	0	4:44
806	25	71	0	4:45
807	25	71	0	4:46
808	25	71	0	4:47
809	25	71	0	4:48
810	25	71	0	4:49
811	25	71	0	4:50
812	25	71	0	4:51
813	25	71	0	4:52
814	25	71	0	4:53
815	25	71	0	4:54
816	25	71	0	4:55
817	25	71	0	4:56
818	25	71	0	4:57
819	25	71	0	4:58
820	25	71	0	4:59
821	25	71	0	5:00
822	25	71	0	5:01
823	25	71	0	5:02
824	25	71	0	5:03
825	25	71	0	5:04
826	25	71	0	5:05
827	25	71	0	5:06
828	25	71	0	5:07
829	25	71	0	5:08
830	25	72	0	5:09
831	25	72	0	5:10
832	25	72	0	5:11
833	25	72	0	5:12
834	25	73	0	5:13
835	25	73	0	5:14

Data ID	Temperature	Humidity	Rain Status	Time Stamp
836	25	73	0	5:15
837	25	73	0	5:16
838	25	73	0	5:17
839	25	73	0	5:18
840	25	72	0	5:19
841	25	73	0	5:20
842	25	73	0	5:21
843	25	73	0	5:22
844	25	73	0	5:23
845	25	73	0	5:24
846	25	73	0	5:25
847	25	73	0	5:26
848	25	73	0	5:27
849	25	73	0	5:28
850	25	73	0	5:29
851	25	73	0	5:30
852	25	73	0	5:31
853	25	73	0	5:32
854	25	73	0	5:33
855	25	73	0	5:34
856	25	73	0	5:35
857	25	73	0	5:36
858	25	73	0	5:37
859	25	73	0	5:38
860	25	73	0	5:39
861	25	73	0	5:40
862	25	73	0	5:41
863	25	73	0	5:42
864	25	73	0	5:43
865	25	73	0	5:44
866	25	73	0	5:45
867	25	73	0	5:46
868	25	73	0	5:47
869	25	73	0	5:48
870	25	73	0	5:49
871	25	73	0	5:50
872	25	73	0	5:51
873	25	73	0	5:52
874	25	73	0	5:53
875	25	73	0	5:54
876	25	73	0	5:55
877	25	73	0	5:56
878	25	73	0	5:57
879	25	73	0	5:58

Data ID	Temperature	Humidity	Rain Status	Time Stamp
880	25	73	0	5:59
881	25	73	0	6:00
882	25	73	0	6:01
883	25	73	0	6:02
884	25	73	0	6:03
885	25	73	0	6:04
886	25	73	0	6:05
887	25	73	0	6:06
888	25	73	0	6:07
889	25	73	0	6:08
890	25	73	0	6:09
891	25	73	0	6:10
892	25	73	0	6:11
893	25	73	0	6:12
894	25	73	0	6:13
895	25	73	0	6:14
896	25	73	0	6:15
897	25	73	0	6:16
898	25	73	0	6:17
899	25	73	0	6:18
900	25	73	0	6:19
901	25	73	0	6:20
902	25	73	0	6:21
903	25	73	0	6:22
904	25	73	0	6:23
905	25	73	0	6:24
906	25	73	0	6:25
907	25	73	0	6:26
908	25	73	0	6:27
909	25	73	0	6:28
910	25	73	0	6:29
911	25	73	0	6:30
912	25	73	0	6:31
913	25	73	0	6:32
914	25	73	0	6:33
915	25	73	0	6:34
916	25	73	0	6:35
917	25	73	0	6:36
918	25	73	0	6:37
919	25	73	0	6:38
920	25	73	0	6:39
921	25	73	0	6:40
922	25	73	0	6:41
923	25	73	0	6:42

Data ID	Temperature	Humidity	Rain Status	Time Stamp
924	25	73	0	6:43
925	25	73	0	6:44
926	25	73	0	6:45
927	25	73	0	6:46
928	25	73	0	6:47
929	25	73	0	6:48
930	25	73	0	6:49
931	25	73	0	6:50
932	25	73	0	6:51
933	25	73	0	6:52
934	25	73	0	6:53
935	25	73	0	6:54
936	25	73	0	6:55
937	25	73	0	6:56
938	25	73	0	6:57
939	25	73	0	6:58
940	25	73	0	6:59
941	25	73	0	7:00
942	25	73	0	7:01
943	25	73	0	7:02
944	25	73	0	7:03
945	25	73	0	7:04
946	25	73	0	7:05
947	25	73	0	7:06
948	25	73	0	7:07
949	25	73	0	7:08
950	25	73	0	7:09
951	25	73	0	7:10
952	25	73	0	7:11
953	25	73	0	7:12
954	25	73	0	7:13
955	25	73	0	7:14
956	25	73	0	7:15
957	25	73	0	7:16
958	25	73	0	7:17
959	25	73	0	7:18
960	25	73	0	7:19
961	25	73	0	7:20
962	25	73	0	7:21
963	25	73	0	7:22
964	25	73	0	7:23
965	25	73	0	7:24
966	25	73	0	7:25
967	25	73	0	7:26

Data ID	Temperature	Humidity	Rain Status	Time Stamp
968	25	73	0	7:27
969	25	73	0	7:28
970	25	73	0	7:29
971	25	73	0	7:30
972	25	73	0	7:31
973	25	73	0	7:32
974	25	73	0	7:33
975	25	73	0	7:34
976	25	73	0	7:35
977	25	73	0	7:36
978	25	73	0	7:37
979	25	73	0	7:38
980	25	73	0	7:39
981	25	73	0	7:40
982	25	73	0	7:41
983	25	73	0	7:42
984	25	73	0	7:43
985	25	73	0	7:44
986	25	73	0	7:45
987	25	73	0	7:46
988	25	73	0	7:47
989	25	73	0	7:48
990	25	73	0	7:49
991	25	73	0	7:50
992	25	73	0	7:51
993	25	73	0	7:52
994	25	73	0	7:53
995	25	73	0	7:54
996	25	73	0	7:55
997	25	73	0	7:56
998	25	73	0	7:57
999	25	73	0	7:58
1000	25	73	0	7:59
1001	25	73	0	8:00
1002	25	73	0	8:01
1003	25	73	0	8:02
1004	25	73	0	8:03
1005	25	73	0	8:04
1006	25	73	0	8:05
1007	25	73	0	8:06
1008	25	73	0	8:07
1009	25	73	0	8:08
1010	25	73	0	8:09
1011	25	73	0	8:10

Data ID	Temperature	Humidity	Rain Status	Time Stamp
1012	25	73	0	8:11
1013	25	73	0	8:12
1014	25	73	0	8:13
1015	25	73	0	8:14
1016	25	73	0	8:15
1017	25	73	0	8:16
1018	25	73	0	8:17
1019	25	73	0	8:18
1020	25	73	0	8:19
1021	25	73	0	8:20
1022	25	73	0	8:21
1023	25	73	0	8:22
1024	25	73	0	8:23
1025	25	73	0	8:24
1026	25	73	0	8:25
1027	25	73	0	8:26
1028	25	73	0	8:27
1029	25	73	0	8:28
1030	25	73	0	8:29
1031	25	73	0	8:30
1032	25	73	0	8:31
1033	25	73	0	8:32
1034	25	73	0	8:33
1035	25	73	0	8:34
1036	25	73	0	8:35
1037	25	73	0	8:36
1038	25	73	0	8:37
1039	25	73	0	8:38
1040	25	73	0	8:39
1041	25	73	0	8:40
1042	25	73	0	8:41
1043	25	73	0	8:42
1044	25	73	0	8:43
1045	25	73	0	8:44
1046	25	73	0	8:45
1047	25	73	0	8:46
1048	25	73	0	8:47
1049	25	73	0	8:48
1050	25	73	0	8:49
1051	25	73	0	8:50
1052	25	73	0	8:51
1053	25	73	0	8:52
1054	25	73	0	8:53
1055	25	73	0	8:54

Data ID	Temperature	Humidity	Rain Status	Time Stamp
1056	25	73	0	8:55
1057	25	73	0	8:56
1058	25	73	0	8:57
1059	25	73	0	8:58
1060	25	73	0	8:59
1061	25	73	0	9:00
1062	25	73	0	9:01
1063	25	73	0	9:02
1064	25	73	0	9:03
1065	25	73	0	9:04
1066	25	73	0	9:05
1067	25	73	0	9:06
1068	25	73	0	9:07
1069	25	73	0	9:08
1070	25	73	0	9:09
1071	25	73	0	9:10
1072	25	73	0	9:11
1073	25	73	0	9:12
1074	25	73	0	9:13
1075	25	73	0	9:14
1076	25	73	0	9:15
1077	25	73	0	9:16
1078	25	73	0	9:17
1079	25	73	0	9:18
1080	25	73	0	9:19
1081	25	73	0	9:20
1082	25	73	0	9:21
1083	25	73	0	9:22
1084	25	73	0	9:23
1085	25	73	0	9:24
1086	25	73	0	9:25
1087	25	73	0	9:26
1088	25	73	0	9:27
1089	25	73	0	9:28
1090	25	73	0	9:29
1091	25	73	0	9:30
1092	25	73	0	9:31
1093	25	73	0	9:32
1094	25	73	0	9:33
1095	25	73	0	9:34
1096	25	73	0	9:35
1097	25	73	0	9:36
1098	25	73	0	9:37
1099	25	73	0	9:38

Data ID	Temperature	Humidity	Rain Status	Time Stamp
1100	25	73	0	9:39
1101	25	73	0	9:40
1102	25	73	0	9:41
1103	25	73	0	9:42
1104	25	73	0	9:43
1105	25	73	0	9:44
1106	25	73	0	9:45
1107	25	73	0	9:46
1108	25	73	0	9:47
1109	25	73	0	9:48
1110	25	73	0	9:49
1111	25	73	0	9:50
1112	25	73	0	9:51
1113	25	73	0	9:52
1114	25	73	0	9:53
1115	25	73	0	9:54
1116	25	73	0	9:55
1117	25	73	0	9:56
1118	25	73	0	9:57
1119	25	73	0	9:58
1120	25	73	0	9:59
1121	25	71	0	10:00
1122	25	71	0	10:01
1123	25	71	0	10:02
1124	25	71	0	10:03
1125	25	71	0	10:04
1126	25	71	0	10:05
1127	25	71	0	10:06
1128	25	71	0	10:07
1129	25	71	0	10:08
1130	25	71	0	10:09
1131	25	71	0	10:10
1132	25	71	0	10:11
1133	25	71	0	10:12
1134	25	71	0	10:13
1135	25	71	0	10:14
1136	25	71	0	10:15
1137	25	71	0	10:16
1138	25	71	0	10:17
1139	25	71	0	10:18
1140	25	71	0	10:19
1141	25	71	0	10:20
1142	25	71	0	10:21
1143	25	71	0	10:22

Data ID	Temperature	Humidity	Rain Status	Time Stamp
1144	25	71	0	10:23
1145	25	71	0	10:24
1146	25	71	0	10:25
1147	25	71	0	10:26
1148	25	71	0	10:27
1149	25	71	0	10:28
1150	25	71	0	10:29
1151	25	71	0	10:30
1152	25	71	0	10:31
1153	25	71	0	10:32
1154	25	71	0	10:33
1155	25	71	0	10:34
1156	25	71	0	10:35
1157	25	71	0	10:36
1158	25	71	0	10:37
1159	25	71	0	10:38
1160	25	71	0	10:39
1161	25	71	0	10:40
1162	25	71	0	10:41
1163	25	71	0	10:42
1164	25	71	0	10:43
1165	25	71	0	10:44
1166	25	71	0	10:45
1167	25	71	0	10:46
1168	25	71	0	10:47
1169	25	71	0	10:48
1170	25	71	0	10:49
1171	25	71	0	10:50
1172	25	71	0	10:51
1173	25	71	0	10:52
1174	25	71	0	10:53
1175	25	71	0	10:54
1176	25	71	0	10:55
1177	25	71	0	10:56
1178	25	71	0	10:57
1179	25	71	0	10:58
1180	25	71	0	10:59
1181	25	71	0	11:00
1182	25	71	0	11:01
1183	25	71	0	11:02
1184	25	71	0	11:03
1185	25	71	0	11:04
1186	25	71	0	11:05
1187	25	71	0	11:06

Data ID	Temperature	Humidity	Rain Status	Time Stamp
1188	25	71	0	11:07
1189	25	71	0	11:08
1190	25	71	0	11:09
1191	25	71	0	11:10
1192	25	71	0	11:11
1193	25	71	0	11:12
1194	25	71	0	11:13
1195	25	71	0	11:14
1196	25	71	0	11:15
1197	25	71	0	11:16
1198	25	71	0	11:17
1199	25	71	0	11:18
1200	25	71	0	11:19
1201	25	71	0	11:20
1202	25	71	0	11:21
1203	25	71	0	11:22
1204	25	71	0	11:23
1205	25	71	0	11:24
1206	25	71	0	11:25
1207	25	71	0	11:26
1208	25	71	0	11:27
1209	25	71	0	11:28
1210	25	71	0	11:29
1211	25	71	0	11:30
1212	25	71	0	11:31
1213	25	71	0	11:32
1214	25	71	0	11:33
1215	25	71	0	11:34
1216	25	71	0	11:35
1217	25	71	0	11:36
1218	25	71	0	11:37
1219	25	71	0	11:38
1220	25	71	0	11:39
1221	25	71	0	11:40
1222	25	71	0	11:41
1223	25	71	0	11:42
1224	25	71	0	11:43
1225	25	71	0	11:44
1226	25	71	0	11:45
1227	25	71	0	11:46
1228	25	71	0	11:47
1229	25	71	0	11:48
1230	25	71	0	11:49
1231	25	71	0	11:50

Data ID	Temperature	Humidity	Rain Status	Time Stamp
1232	25	72	0	11:51
1233	25	72	0	11:52
1234	25	72	0	11:53
1235	25	72	0	11:54
1236	25	72	0	11:55
1237	25	72	0	11:56
1238	25	72	0	11:57
1239	25	72	0	11:58
1240	25	72	0	11:59
1241	25	72	0	12:00
1242	25	72	0	12:01
1243	25	72	0	12:02
1244	25	72	0	12:03
1245	25	72	0	12:04
1246	25	72	0	12:05
1247	25	72	0	12:06
1248	25	72	0	12:07
1249	25	72	0	12:08
1250	25	72	0	12:09
1251	25	72	0	12:10
1252	25	72	0	12:11
1253	25	72	0	12:12
1254	25	72	0	12:13
1255	25	72	0	12:14
1256	25	72	0	12:15
1257	25	72	0	12:16
1258	25	72	0	12:17
1259	25	72	0	12:18
1260	25	72	0	12:19
1261	25	72	0	12:20
1262	25	72	0	12:21
1263	25	72	0	12:22
1264	25	72	0	12:23
1265	25	72	0	12:24
1266	25	72	0	12:25
1267	25	72	0	12:26
1268	25	72	0	12:27
1269	25	71	0	12:28
1270	25	71	0	12:29
1271	25	71	0	12:30
1272	25	71	0	12:31
1273	25	71	0	12:32
1274	25	71	0	12:33
1275	25	71	0	12:34

Data ID	Temperature	Humidity	Rain Status	Time Stamp
1276	25	71	0	12:35
1277	25	71	0	12:36
1278	25	71	0	12:37
1279	25	71	0	12:38
1280	25	71	0	12:39
1281	25	71	0	12:40
1282	25	71	0	12:41
1283	25	71	0	12:42
1284	25	71	0	12:43
1285	25	71	0	12:44
1286	25	71	0	12:45
1287	25	71	0	12:46
1288	25	72	0	12:47
1289	25	72	0	12:48
1290	25	73	0	12:49
1291	25	73	0	12:50
1292	25	73	0	12:51
1293	25	73	0	12:52
1294	25	73	0	12:53
1295	25	73	0	12:54
1296	25	73	0	12:55
1297	25	73	0	12:56
1298	25	72	0	12:57
1299	25	72	0	12:58
1300	25	73	0	12:59
1301	25	73	0	13:00
1302	25	73	0	13:01
1303	25	73	0	13:02
1304	25	73	0	13:03
1305	25	73	0	13:04
1306	25	73	0	13:05
1307	25	73	0	13:06
1308	25	73	0	13:07
1309	25	73	0	13:08
1310	25	73	0	13:09
1311	25	73	0	13:10
1312	25	73	0	13:11
1313	25	73	0	13:12
1314	25	73	0	13:13
1315	25	73	0	13:14
1316	25	73	0	13:15
1317	25	73	0	13:16
1318	25	73	0	13:17
1319	25	73	0	13:18

Data ID	Temperature	Humidity	Rain Status	Time Stamp
1320	25	74	0	13:19
1321	25	76	0	13:20
1322	25	76	0	13:21
1323	25	76	0	13:22
1324	25	76	0	13:23
1325	25	76	0	13:24
1326	25	75	0	13:25
1327	25	75	0	13:26
1328	25	75	0	13:27
1329	25	75	0	13:28
1330	25	75	0	13:29
1331	25	75	0	13:30
1332	25	76	0	13:31
1333	25	76	0	13:32
1334	25	74	0	13:33
1335	25	74	0	13:34
1336	25	74	0	13:35
1337	25	74	0	13:36
1338	25	74	0	13:37
1339	25	74	0	13:38
1340	25	74	0	13:39
1341	25	74	0	13:40
1342	25	74	0	13:41
1343	25	74	0	13:42
1344	25	74	0	13:43
1345	25	74	0	13:44
1346	25	74	0	13:45
1347	25	74	0	13:46
1348	25	74	0	13:47
1349	25	74	0	13:48
1350	25	74	0	13:49
1351	25	74	0	13:50
1352	25	73	0	13:51
1353	25	74	0	13:52
1354	25	74	0	13:53
1355	25	74	0	13:54
1356	25	74	0	13:55
1357	25	74	0	13:56
1358	25	74	0	13:57
1359	25	73	0	13:58
1360	25	73	0	13:59
1361	25	73	0	14:00
1362	25	73	0	14:01
1363	25	73	0	14:02

Data ID	Temperature	Humidity	Rain Status	Time Stamp
1364	25	73	0	14:03
1365	25	73	0	14:04
1366	25	74	0	14:05
1367	25	74	0	14:06
1368	25	74	0	14:07
1369	25	74	0	14:08
1370	25	74	0	14:09
1371	25	74	0	14:10
1372	25	74	0	14:11
1373	25	74	0	14:12
1374	25	74	0	14:13
1375	25	74	0	14:14
1376	25	74	0	14:15
1377	25	74	0	14:16
1378	25	73	0	14:17
1379	25	73	0	14:18
1380	25	73	0	14:19
1381	25	73	0	14:20
1382	25	73	0	14:21
1383	25	73	0	14:22
1384	25	73	0	14:23
1385	25	73	0	14:24
1386	25	73	0	14:25
1387	25	73	0	14:26
1388	25	73	0	14:27
1389	25	73	0	14:28
1390	25	73	0	14:29
1391	25	73	0	14:30
1392	25	73	0	14:31
1393	25	74	0	14:32
1394	25	74	0	14:33
1395	25	73	0	14:34
1396	25	73	0	14:35
1397	25	73	0	14:36
1398	25	73	0	14:37
1399	25	73	0	14:38
1400	25	73	0	14:39
1401	25	74	0	14:40
1402	25	74	0	14:41
1403	25	74	0	14:42
1404	25	74	0	14:43
1405	25	73	0	14:44
1406	25	73	0	14:45
1407	25	73	0	14:46

Data ID	Temperature	Humidity	Rain Status	Time Stamp
1408	25	72	0	14:47
1409	25	73	0	14:48
1410	25	72	0	14:49
1411	25	72	0	14:50
1412	25	72	0	14:51
1413	25	72	0	14:52
1414	25	72	0	14:53
1415	25	72	0	14:54
1416	25	72	0	14:55
1417	25	73	0	14:56
1418	25	72	0	14:57
1419	25	72	0	14:58
1420	25	72	0	14:59
1421	25	72	0	15:00
1422	25	72	0	15:01
1423	25	72	0	15:02
1424	25	72	0	15:03
1425	25	72	0	15:04
1426	25	72	0	15:05
1427	25	73	0	15:06
1428	25	72	0	15:07
1429	25	72	0	15:08
1430	25	72	0	15:09
1431	25	72	0	15:10
1432	25	72	0	15:11
1433	25	72	0	15:12
1434	25	72	0	15:13
1435	25	72	0	15:14
1436	25	72	0	15:15
1437	25	72	0	15:16
1438	25	72	0	15:17
1439	25	72	0	15:18
1440	25	72	0	15:19

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