# CLIMATOLOGY STATION'S ARCHITECTURE PROTOTYPE AS A LEARNING SUPPORT IN SMK PERTANIAN PEMBANGUNAN NEGERI LEMBANG BASED ON INTERNET OF THINGS

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## ABSTRACT

SMK Pertanian Pembangunan Negeri Lembang is the institution which is engaged in agriculture. There are many facilities in this school, i.e. the climatology station that is used to help students to learn swakarya which is one of the academic subjects. But there are several problems that climatology station had like the teacher doesn't have time to observe the climatology station that causes data of climatology station is less complete and the lack of media to disseminate weather data to the students. This research aims to help teachers in observing the weather automatically so that the more complete data and the information from the climatology station can be accessed by students. This automatic climatology station is built with the Arduino as a microcontroller and a Raspberry as a mini PC to process data results from the sensor and then send to the database. The data stored in the database is displayed on the website so that the user can view the weather data. The result of this research is by implementing the concept of the internet of things into climatology station can assist a teacher in process of observation of weather elements and support the learning of students.

**Keywords:** Internet Of Things, Climatology station, Raspberry Pi, Arduino, Learning Support.

## 1. INTRODUCTION

SMK Pertanian Pembangunan Negeri Lembang is one of the educational institutions in the field of agricultural produce human resource who serves as the perpetrators of modern agricultural development insightful agribusiness. SMK Pertanian Pembangunan has two courses. First is the agri-food crops and horticulture (ATPH) and the second is the agricultural extension (TPHP). Both these courses are facilitated by the means and infrastructure repair that can support learning and activities performed by students. One of the facilities owned by the school is the Agricultural Climatology Stations.

Agricultural Climatology Station is a tool that is able to organize observations of weather elements in a long period of time as well as regular [1]. According to Mr. Cucun Suherman explains that the Climatology Station in the school is the station that gives the data elements of weather and climate in which the required observations or data retrieval intervals in a way observe any parameters that are in the product by the tool on the station. As for the observed element is air temperature, air humidity, air pressure, wind speed, wind direction, precipitation, evaporation of water, and the sun shines long. In a day of observation required three times i.e. at 07.00 AM,, 13.00 PM, and 17.00 PM. But every teacher or staff have the bustle yourself so that at any one time cannot do the record-keeping and the resulting weather data owned less complete.

In addition, data from climatology station needed by students while on a practice field or swakarya. Swakarya is one of the learning material of entrepreneurship where students would be given land for farming and were given the responsibility to manage the land from the beginning of the nursery until harvest. According to the results of the interview some of the students at the school explained that when making the planting plan, students are not given any data from the climatology station and just given the recommendation of plants that can be planted so that students only follow the recommendations without doing its own analysis in determining the types of plants that will be in the plant as well as the students don't apply the learning of climatology.

From the problem statement above, conducted research "Climatology Station's Architecture Prototype As A Learning Support In Smk Pertanian Pembangunan Negeri Lembang Based On Internet Of Things". Climatology Station that will be created is a class III automatic climatology station that can produce daily weather data elements that will be sent to the Web Service through the Raspberry. The data has been sent can be accessed by teachers, staff, and students concerned through a Personal Computer (PC) or Android Smartphone. The technology used is the Internet of things as well as a network of computers. A

computer network is a system that connects your computer to be able to share resources, communication, and access to information [2].

Based on the problems that have been described previously, then the meaning of the construction of this system is climatology station's architecture prototype as a learning support in smk pertanian pembangunan negeri lembang based on internet of things.

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

1 The elements of weather and climate data are complete because of the weather elements can be recorded automatically by the sensor.
2 Students who undertake activities swakarya can access climate data at any time so the students more independent in observing and determine a plan for planting and can apply subjects climatology.

# 2. CONTENT OF RESEARCH

## 2.1 Theoretical Basic

The cornerstone of the theory of the construction of this system is the basic theory that is intended to process analysis of the system and support the process of climatology station's architecture prototype as a learning support in smk pertanian pembangunan negeri lembang based on internet of things

### 2.1.1 Climatology Station

The climatology station can be said to be a location that can perform observations on weather conditions and factors of the physical environment in a particular area [3]. The observation activities must be carried out regularly each day. Observations can be carried on at 7 am, 1 pm and 5 pm. Climatology Station is required to represent wide agricultural areas where the placement of the stations should be directly in the areas of agricultural activity. One of the ideal locations for the climatology station is in a storage of crops. Other words from the climatology station is a weather plane. The parameters observed by agricultural climatology is the air temperature ($^{o}$C), the air pressure (MB), humidity (%), precipitation (mm), evaporation (mm), wind speed (m/s), and wind direction.

### 2.1.2 Raspberry Pi

Raspberry Pi or commonly referred to as Raspi is mini computers with a single Board (single-board circuit) that has a port that neatly composed as many as 40 pins [4]. Raspberry Pi has the size of a credit card but can run programs commonly used by the normal computer with high resolution. Raspberry production started at the Pi on the market in 2012 by Raspberry Pi Foundation.

Operating system Linux kernel-based Pi Raspberry. Raspbian is a Debian-based operating system that can be developed freely and can be used for hardware Raspberry Pi.

### 2.1.3 Arduino

Arduino is an open-source circuit board where the Board can create an interactive object which contained a major component that is a Versatile type of microcontroller chip Advanced RISC (AVR) [5]. The chip can be using a computer program. This microcontroller can be used stand-alone or connected to the computer. Arduino has two main interrelated components. The component is a hardware or hardware used to construct objects that connect sensor-sensor according to your needs. The second component of the Arduino is a software or software that is the Arduino IDE. This device used by a programmer to build a system that can meet the needs with programming language c. the system that has built the next uploads to the Arduino board so that the sensor has been on planes can move in accordance with the system that has been built.

One type of Arduino Arduino Uno is the R3 based ATMEGA328. The microcontroller is composed of 14 digital input output pin where 6 of them are used for Output Pulse Width Modulation (PWM), 6 analog inputs, 16 MHz clock speed, electric jack, USB connector, ICSP header, and a reset button. This Board uses the power from the computer using the USB cable or the power of DC-AC adapter or battery.

Table 1. Specification Of The Arduino Uno

| | |
|---|---|
| Mikrokontroller | ATMEGA328 |
| Operating Voltage | 5V |
| Input Voltage | 7-12V |
| Input voltage limits | 6-20V |
| Digital input | 14 (6 pin PWM) |
| analog input | 6 |
| DC current | 40 mA |
| *Flash memory* | 32KB(ATmega328)<br>0,5 KB bootloader |
| SRAM | 2KB (ATmega328) |
| EEPROM | 1KB(ATmega328) |
| *Clock* | 16MHz |

### 2.1.4 BME280 Sensor

BME280 sensor is a sensor that can measure the four parameters in one tool [6]. These parameters include temperature, humidity, air pressure, and elevation (altitude) somewhere. BME280 sensor has a size of 2.5 x 2.5 mm2

with a height of 0.93 mm. BME280 Sensor can be connected to an Arduino pin via I2C or SPI. Power Mode that can be used by the sensor has three kinds of sleep mode, i.e. forced mode, and normal mode. These three modes can be used as needed.

#### 2.1.5 BH1750 Sensor

The BH1750 sensor is a sensor used to measure the intensity of light [7]. The light that is detected by the sensors are converted into electrical quantities are then sent to the Arduino. The usefulness of this sensor is to measure the intensity of light in a room, in a very old agricultural climatology, detects the darkness, and so on.

#### 2.1.6 Tipping Bucket and Sensor Infrared LM393 Optocoupler

Tipping Bucket is one that is used on the climatology station which utilizes the tipping as a number of counters of water [1]. A component that belongs to the tipping bucket this is two water reservoirs formed as tipping. Water spilled into the expenses will count as one of which will be stored in one of the whole amounts of rainfall in millimeters. This tipping bucket has no standard of the size of rainfall, required calibration by using the measuring cup so that it can be known the size of rainfall in one of.

Tipping bucket used sensors Infrared LM393 Optocoupler. The sensor utilizing an infra-red sensor as [8]. The workings of these modules are when the infrared sensor is obstructed by an object, then the sensor will transmit signals depending on the pin that is used. When using the analog pin then will send an analog signal and a digital pin as well as which sends the values 1 and 0 to Arduino. the sensor in counter used for speed.

#### 2.1.7 Evaporating pan and sensors SR04-HC

Pan Evaporation is a measuring instrument used in those tools which climatological stations can measure evaporating in units of mm. the diameter of Pan evaporation can be varied between 20 cm to 120 cm [1]. usually, the pot used is with a diameter of 120 cm. There is a calculation to determine the evaporation of different pot sizes so that the results obtained are appropriate. The position of Pan evaporation must be at a location that is flat, the water level should be below the lip of the pot. Pan evaporation has a measuring component known as micrometers. The micrometer is shaped like a hook (Hook). The tool can be offered up and lowered.

In this study, the hook is replaced with sensors SR04-HC [9]. This sensor is a sensor that utilizes ultrasonic sound waves where the sound would be reflected by the water and then received back by the sensor. The speed of sound to be used by the sensor to obtain the distance or height from the water and sent to the Arduino.

#### 2.1.8 JL-FS02 Sensor

The JL-FS02 sensor is a sensor that can measure the wind speed at a particular area [10]. In addition to measuring the wind speed, the sensor can be used to measure the pressure of the wind. JL-FS02 sensor using 3 pieces of cables where cable has its own function. The red cable is wired for cable, operating voltage black for ground, yellow cable to the output which is an analog signal and sent to the Arduino. The physical form of the FS02 JL-namely sensors there is three small bowl of fruit that can be moved by the wind so that the rotating speed of the bowl can produce wind speed data. The size of the diameter of the sensor this FS02 JL-by 20 cm with each bowl has a radius of 10 cm.

#### 2.1.9 Wind Direction Sensor

Wind direction sensor is a sensor that can detect the wind direction. The concept of this sensor is to use the magnetic sensor which stored eight play. Wind direction sensor determines the direction the tool shaped like the signposts with the large tail where the tail function to drive the arrow in the direction accordingly. The output of the sensor is shaped with a single digital signal cable 1 piece cable ground, VCC, and 8 data output cable fruit which is connected to the Arduino.

### 2.2 System Analysis

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

#### 2.2.1 Analysis Of The Problem

Based on the results of the research that has been done, there are problems that occur until the building of the system of the automatic climatological station is as follows :

1. Data from the weather that required a less complete result from the bustle and obstruction of the teacher's so that it can not carry out observations to the climatology station.
2. Students do not earn monthly climate data when planning the crop plantings will do on the activities swakarya.

### 2.2.2 Analysis Of System Architecture

Analysis of system architecture to be built for this system of the automatic climatological station is an internet-based software where the sensors will transmit any weather data to the Arduino which is then forwarded to the Pi with Raspberry using JSON. Raspberry Pi will process data from the Arduino so it would produce weather information every minute. The information is then sent to the web service and ultimately stored in the database. Users of this system will access the weather data by making a request through the website which would later request will be sent to the web service and then executing the query to the database. The results of the execution will be sent back to the website and received by the user. Design of the system architecture can be seen in Figure 1.

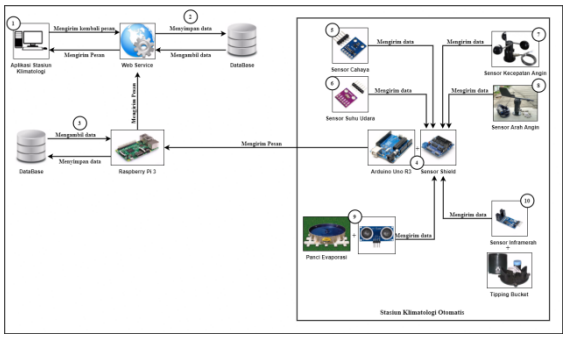



Figure 1. Design Of System Architecture

The following are the details of the description of the design of the system architecture on the automatic climatology station.

1. Application of automatic climatological station website is used to display the information generated by the sensor so that it can be used as media of instruction, students as well as other agricultural needs. In addition, the application website users to process data of the plant, swakarya group data, and so on.
2. The Web Service is part of the system that is used as a bridge between the website or Raspberry to the database. Communication between the subsystems using JSON. Requestor delivery of data sent to the web service will be executed and saved to the database by using a Query.
3. Raspberry Pi functions as a server that accepts data entered from the Arduino and then processed in advance. the form of JSON output that will be sent to the web service. Raspberry will send the data every 1 minute.
4. Arduino Uno serves as the microcontroller receives data results from the sensor. The data in the form of analog and digital signals. Both data are then packaged and delivered to the Raspberry using JSON.
5. BH1750 sensor light sensor is used to measure the sun shines long. The units generated by the sensor is to be converted into lux W/M2. If the sensor detects light as many as 12 W/M2 in one second, it will be counted as much as one second. Conversely, if the sensor does not detect of ambient/M2 in one second, then produce 0 seconds.
6. BME280 sensors are used to measure air temperature, air pressure, and humidity. Units used in temperature are Celsius ($^{o}$C).
7. Sensor the sensor is an FS02 JL-wind speed where the sensor can measure wind speed resulting from the gusts of air, the unit used is m/s.
8. Wind direction sensor is used to determine the direction of the wind is produced by blowing air. The eye of the wind that is owned by this sensor consists of eight, namely the West, Northwest, North, Northeast, East, Southeast, South, and Southwest.
9. Pan evaporation is used to measure evaporation that occurs in an area. This sensor i.e. HC-SR04.
10. Tipping bucket is a tool for measuring rainfall which utilizes the tipping as counters. Tipping bucket included by sensor Infrared LM393 Optocoupler. Where every happening 1 the tipping will produce a 0.6 mm.

### 2.2.3 Analysis Of Web Service

Web services on the system automatic climatological station are used as a bridge for the exchange of data between Raspberry or website to the database. As well as vice versa. Web Service connected to the main database will receive any request from Raspberry and website. Raspberry Pi will transmit weather data every minute to the Web service will then be executed and saved to the database. Furthermore, the website will do the request data that has been generated by a Raspberry to the web service and then will be displayed to the user through the interface. Here is a picture of the Groove web service data can be seen in Figure 2.

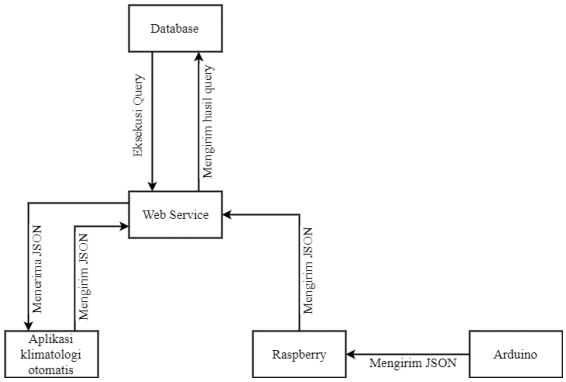



Figure 2. Data Flow In Web Service

### 2.2.4 Analysis Of Data Communication

Data communication is a plot of the data submitted by each subsystem. Beginning of the sensor toward the Arduino and so on until finally to the database. Data communications starting from Arduino to the Raspberry using Serial Arduino, next to communication between Raspberry Pi with web service using JSON that is then stored in the database. Here is a picture from the analysis of the data communication can be seen in Figure 3.

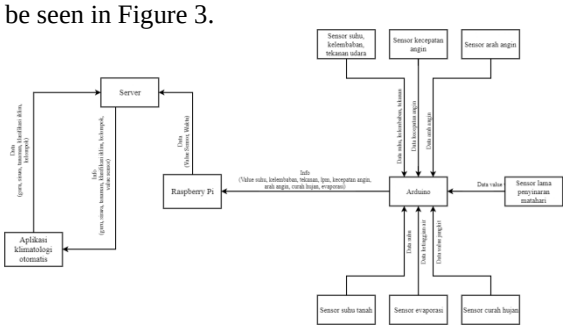



Figure 3. The Flow Of Data Communication

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

1. Each sensor will transmit data value data for analog or digital data to the Arduino.
2. The Arduino will transmit data to the sensor results, Raspberry, using JSON format.
3. Arduino received weather data are then processed. The results of such processing will be sent to the web service using the JSON format.
4. Application of automatic climatology station website will request data from the Raspberry through a web service that uses the JSON format.

### 2.2.5 System Analysis Of Raspberry Pi, Arduino, Web Service At The Automatic Climatology Station

The working system of the Raspberry is used to collect data from the Arduino every second. The data will be processed at regular intervals during the Raspberry is turned on. Next up is the work system of the Arduino microcontroller is as who receives data from any sensor in the form of digital and analog signals. The data are then packaged and then shipped to the Raspberry using serial. System web service is working as a connecting bridge between Raspberry and website to the database.

### 2.2.6 Non-Functional Requirements Analysis

Non-functional requirements analysis is analysis includes minimal specifications about required by the system of the automatic climatology station. In addition, there is the specification of the sensor used. This analysis is needed in order to analyze so that the system can work to its full potential. Non-functional requirements comprise of three things, namely the needs of hardware, software, and user needs.

#### 2.2.6.1 Analysis Of Hardware Requirements

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

1. Computer.
2. Raspberry Pi type B.
3. Server Hosting.
4. Arduino Uno
5. BME280 Sensor.
6. BH1750 Sensor.
7. Tipping Bucket and Optocoupler Infrared LM393 Sensor.
8. Evaporator Pan and HC-SR04 Sensor.
9. JL-FS02 Sensor.
10. Wind Direction Sensor.

#### 2.2.6.2 Analysis Of Software Requirements

Software needs analysis is an analysis that includes software that is used by each subsystem of the climatology station. The minimum specification requirements the software on the computer that will be used can be seen in table 2.

Table 2. The Minimum Specification Of Computer Software

| Software | Minimum Requirements |
|---|---|
| Operating System | Microsoft Windows 7 |
| Web Browser | Mozilla Firefox, Google Chrome |

the minimum requirements for the specification of software on Raspberry Pi can be seen in table 3.

Table 3. The Minimum Specification Of Raspberry Pi 3 Software

| Software | Minimum Requirements |
|---|---|

| | |
|---|---|
| Operating System | Raspbian Jessie |
| Web Browser | Chromium |
| Node JS Version | 7.9.0 |

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

Table 4. The Minimum Specification Of The Hosting Server Software

| Software | Minimum Requirements |
|---|---|
| cPanel Version | 64.0 (build 19) |
| Apache Version | 2.4.25 |
| PHP Version | 5.6.30 |
| MySQL Version | 10.0.30-MariaDB |
| Architecture | x86 / x64 |
| Operating System | Linux |
| Perl Version | 5.10.1 |

#### 2.2.6.3 Analysis Of User Needs

Analysis of user needs analysis is used to find out who will be using the system automatic climatological station. Experience and understanding of the needs of the users of the software used to access the system are required in order to use the system more than the maximum. The analysis of the needs of the user can be seen in table 5.

Table 5. Analysis Of User Needs

| No. | User | Specifications |
|---|---|---|
| 1 | The Teacher Section Of Kerumahtanggaan | - Undergraduate Education<br>- Understand The Climatology<br>- Understand how to use the Windows<br>- Understand how to use the browser |
| 2 | PDE Staff | - Undergraduate Education<br>- Understand how to use the Windows<br>- Understand how to use the browser |
| 3 | Teacher | - Understand how to use the Windows<br>- Understand how to use the browser |
| 4 | Student | - Understand how to use the Windows<br>- Understand how to use the browser |

#### 2.2.7 Functional Requirements Analysis

A functional needs analysis can describe a process that will be used or applied to the system so that the system can be constructed in accordance with the goals and needs of the user.

Use case diagram is a diagram that can indicate the functionality of the system or class of systems and how to communicate with the outside world. Use case diagram can describe the function of the system to users. From the identification of the actors involved in the above then use case diagrams can be seen in Figure 4.

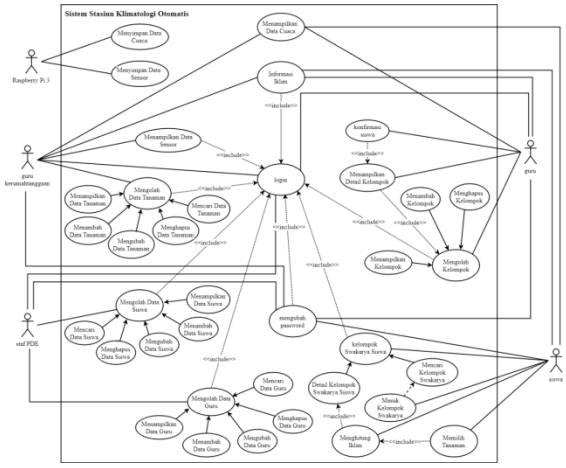



Figure 4. Use Case Diagram

#### 2.2.8 Analysis Of Database

The analysis of the database can be described as activities for analyzing the data used and processed on the database of the system. On this analysis explained how the flow of data and attribute data.

Entity Relationship Diagram (ERD) is a technique to describe the data required by the system as well as the relationship of any such data. ERD must use notation and symbols are easy to understand and comply with international standards. As for the ERD on this database system development can be seen in Figure 5.

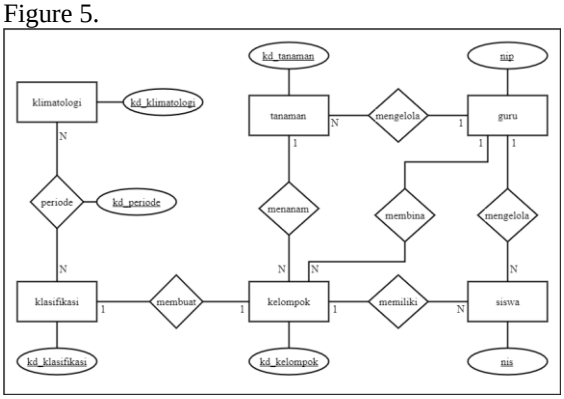



Figure 5. Entity Relationship Diagram

### 2.3 Testing The System

The testing system is part of the construction of the system of automatic climatology station. Testing the system aims to find errors and deficiencies that are present in the system. Testing is done to be able to note that the system of the automatic climatological station it already meets the criteria required and has achieved the expected objective. Testing is done on the entire part of the system of the automatic climatological station.

#### 2.3.1 Functional Testing

Based on the results of the functional testing that has been done on the system of automatic climatology station can be concluded that the system had been able to meet the needs and match the needs of the system that has been designed.

#### 2.3.2 Performance Testing

Performance Testing is testing where the size of the Web page and the page load speed will be tested. This testing is done using the web browser google chrome.

Based on the results of the testing that has been done on the system it can be concluded that the size of the pages of the website can be accepted where the size of the incentives amounted to 1.79 MB from the expected results that is less than 2 MB.

Next is the result of the test page is loaded IE not accepted because of the expected velocity is less than 5 seconds but the results obtained is amounting to 5.4 seconds.

#### 2.3.3 Hardware Testing

Hardware testing aims to test the sensor has been running fine and according to your needs.

##### 2.3.3.1 BME280 Sensor Testing

Testing of the sensor BME280 is a test that is done to adjust the data from sensors with a device that have been calibrated. In case of tool use this thermometer as a comparison. Following the results of testing performed on the temperature sensor, BME280 can be seen in table 6.

Table 6. Testing BME280 Temperature Sensor

| No. | Time | BME280 Sensor | Thermometer |
|---|---|---|---|
| 1 | 13:00 | 27 | 27 |
| 2 | 13:30 | 27 | 27 |
| 3 | 14:00 | 26 | 26 |
| 4 | 14:30 | 25 | 25 |
| 5 | 15:00 | 25 | 25 |
| 6 | 15:30 | 24 | 24 |
| 7 | 16:00 | 23 | 23 |

Next is testing the air humidity can be seen in table 7.

Table 7. BME280 Humidity Sensor Testing

| No. | Time | BME280 Sensor | Thermometer |
|---|---|---|---|
| 1 | 13:00 | 70 | 70 |
| 2 | 13:30 | 70 | 70 |
| 3 | 14:00 | 68 | 68 |
| 4 | 14:30 | 66 | 66 |
| 5 | 15:00 | 66 | 66 |
| 6 | 15:30 | 60 | 60 |
| 7 | 16:00 | 55 | 55 |

Next is testing air pressure where this test compared to the infrared thermometer is already calibrated. Testing the air pressure can be seen in table 8.

Table 8. BME280 Pressure Sensor Testing

| No. | Time | BME280 Sensor | Infrared Thermometer |
|---|---|---|---|
| 1 | 13:00 | 1070.8 | 1071.5 |
| 2 | 13:30 | 1068.1 | 1069.4 |
| 3 | 14:00 | 1072.2 | 1071.5 |
| 4 | 14:30 | 1075.1 | 1075.2 |
| 5 | 15:00 | 1069 | 1069.7 |
| 6 | 15:30 | 1068.6 | 1069.5 |
| 7 | 16:00 | 1065.4 | 1065.2 |

From the test results, it can be concluded that the sensor BME280 temperature section is in compliance with the tools that have been calibrated. So with the humidity of the air. But in testing the air pressure there are differences namely amounting to 0.7 MB.

##### 2.3.3.2 BH-1750 Sensor Testing

Testing sensors BH-1750 is testing that aims to find out that the tool connected to the Arduino and can receive sunlight for several hours. Following the results of testing performed on the BH-1750 sensor can be seen Table 9.

Table 9. Testing Sensors BH-1750

| No. | Time | The Sun Shines Long Results |
|---|---|---|
| 1 | 07:00 – 10:00 | 2 hours 13 minutes |
| 2 | 11:00 – 14:00 | 2 hours 32 minutes |
| 3 | 15:00 – 18:00 | 28 minutes |

From the test results, it can be concluded that the BH-1750 sensor can be used as a tool to calculate the sun shines long.

#### 2.3.3.3 Testing The Tipping Bucket

Testing of the tipping bucket is testing to measure how much water that can fit the waterfall to disposal resulting in 1 tipping occurs. This test included calibration of tipping bucket. Following the results of testing performed on the Tipping Bucket can be seen in Table 10.

Table 10. Testing The Tipping Bucket

| Experiment | Right | Left |
|---|---|---|
| 1 | 42 ml | 44 ml |
| 2 | 41 ml | 43 ml |
| 3 | 43 ml | 41 ml |
| 4 | 45 ml | 42 ml |
| 5 | 41 ml | 40 ml |
| 6 | 39 ml | 43 ml |
| 7 | 40 ml | 42 ml |
| 8 | 42 ml | 41 ml |
| 9 | 41 ml | 42 ml |
| 10 | 40 ml | 42 ml |
| Average | 41.4 ml | 42 ml |
| The results of calculations | (41.4 ml + 42 ml) / 2 = 41.7 ml = 41.7 $cm^3$ | |
| The Surface Area | 22 cm x 28 cm = 616 cm | |
| Result | 41.7 $cm^3$ : 616 $cm^2$ = 0.06 cm = 0.6 mm | |

From the test results, it can be concluded that the testing of the tipping bucket is an average of 10 times from right of trial of 41.4 ml 42 ml. and left it so that the calibration is performed where the result of 0.6 mm nature once the tipping.

#### 2.3.3.4 Evaporimeter Pan Testing

Testing of Pan evaporation is testing that aims to measure is done in field and test that the device is already connected to the Arduino. Testing of the evaporating Pan can be seen in table 11.

Table 11. Evaporimeter Pan Testing

| No. | Time | Evaporating |
|---|---|---|
| 1 | 07:00 – 10:00 | 1 mm |
| 2 | 11:00 – 14:00 | 2.1 mm |
| 3 | 15:00 – 18:00 | 0 mm |

From the test results, it can be concluded that the sensor can be used as a tool to calculate evaporation happens.

#### 2.3.3.5 JL-FS02 Sensor Testing

JL-FS02 sensors Testing is testing wind speed where the test measures the response time of the sensor. The following is a test of the JL-FS02sensors can be seen in table 12.

Tabel 12. JL-FS02 Sensor Testing

| No. | Initial Speed | The Final Speed | Response Time |
|---|---|---|---|
| 1 | 0 m/s | 2.9 m/s | 2023 ms |
| 2 | 0 m/s | 2.5 m/s | 2014 ms |
| 3 | 0 m/s | 1.5 m/s | 1924 ms |
| 4 | 0 m/s | 2.1 m/s | 2020 ms |
| 5 | 0 m/s | 2.7 m/s | 2031 ms |

Wind speed sensor test results it can be concluded that the response time to raise the initial speed right up to the final average speed takes as much as 2 seconds.

#### 2.3.3.5 Wind Direction Sensor Testing

Wind direction sensor testing is testing the speed of the sensor to respond to magnets that have approached each module. The module is divided into 8 parts to be done 8 times experiment. Here is the testing of wind direction sensor can be seen at table 13.

Table 13. Wind Direction Sensor Testing

| No. | Initial Wind Direction | The Final Wind Direction | Response Time |
|---|---|---|---|
| 1 | Northwest | North | 200 ms |
| 2 | North | Northeast | 1022 ms |
| 3 | Northeast | East | 230 ms |
| 4 | East | Southeast | 223 ms |
| 5 | Southeast | South | 245 ms |
| 6 | South | Southwest | 345 ms |
| 7 | Southwest | West | 210 ms |
| 8 | West | Northwest | 420 ms |

Wind direction sensor test results it can be concluded that the response speed of each module's average of 200ms module exception to the Northeast where it takes time for 1022ms. Next to wind direction Southwest and Northwest need the time of 345ms and 420ms.

### 2.4 Beta Testing

Based on the results of beta testing through interviews with the responsible part in observing climatology station this is in compliance with the expected purpose i.e. can help and ease in getting weather data at regular intervals; can help when the teacher cannot do the weather observation activities; can help teachers to save climate data as well as share these data with teachers and students; and can help his job as a teacher.

Further results of beta testing through interviews conducted to staff the provider of electronic data it can be concluded that in the management of accounts from students and teachers already be facilitated so that it can be implemented on the automatic climatology station system.

While the results of beta testing through the questionnaire to respondents to the student who has tried the application it can be concluded that the students strongly agree this application can help to get the data on climate and weather; students strongly agree this application helps to perform analysis climate data and determine which plants will be planted; students strongly agree this application can help students in doing swakarya; as well as the students could not agree when this application is used to help students in the activities of swakarya.

Further results of beta testing through a questionnaire to teachers who have tried the application it can be concluded that teachers agree this application can help students to get climate data and weather; teachers agree this application helps to monitor student activities when making the planting planning plant; and teacher agree when the application is applied to support the activities of swakarya.

## 3. CLOSING

### 3.1 Conclusion

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

1. This prototype already can help the teacher to get the data complete although teachers climatology has a bustle and cant come to observe to the climatology station.
2. This prototype was already able to provide data on climatology to students/students in the SMK Pertanian Pembangunan Negeri Lembang.

### 3.2. Advice

This climatology station prototype still needs further development, including the following :

1. This prototype is still the climatology station class III which can only reach the area around the school and haven't been able to reach out to one of the local areas.
2. This prototype still needs to be tested for accuracy in measuring evaporation because evaporation pans still use that have not been in accordance with the actual size.
3. A prototype of the system of the automatic climatological station only reaches planning planting plants, so that the necessary development to be encompassed the whole of the activities.

**BIBLIOGRAPHY**


[1] S. Rafi'i, *Meteorologi Dan Klimatologi*. Bandung: Angkasa, 1995.

[2] A. Setiyadi, "Implementasi Modul Network MITM Pada Websploit sebagai Monitoring Aktifitas Pengguna dalam Mengakses Internet," vol. 2017, pp. 113–120, 2017.

[3] G. Budiyanto, "Panduan praktikum klimatologi pertanian," pp. 1–36, 2016.

[4] D. Setiawan, "Mengenal Raspberry Pi," *Technology*, pp. 1–7, 2014.

[5] F. Djuandi, "Pengenalan Arduino," pp. 1–24, 2011.

[6] DFRobot, "Gravity: I2C BME280 Environmental Sensor (Temperature, Humidity, Barometer) SKU: SEN0236," 2017. [Online]. Available: https://www.dfrobot.com/wiki/index.php/Gravity:_I2C_BME280_Environmental_Sensor_(Temperature,_Humidity,_Barometer)_SKU:_SEN0236. [Accessed: 01-Jan-2017].

[7] DFRobot, "Light Sensor (SKU:SEN0097)," 2017. [Online]. Available: https://www.dfrobot.com/wiki/index.php/Light_Sensor_(SKU:SEN0097). [Accessed: 01-Jan-2017].

[8] Z. H. Salindri, M. A. R., and Darjat, "Rancang Bangun Mini Weather Station menggunakan Web Berbabis Arduino ATMega 2560," *Transient*, pp. 1–7, 2012.

[9] DFRobot, "URM37 V4.0 Ultrasonic Sensor (SKU:SEN0001)," 2017. [Online]. Available: https://www.dfrobot.com/wiki/index.php/URM37_V4.0_Ultrasonic_Sensor_(SKU:SEN0001). [Accessed: 01-Jan-2017].

[10] DFRobot, "Wind Speed Sensor Voltage Type(0-5V) SKU:SEN0170," 2017. [Online]. Available: https://www.dfrobot.com/wiki/index.php/Wind_Speed_Sensor_Voltage_Type(0-5V)_SKU:SEN0170. [Accessed: 01-Jan-2017].