DESIGN SYSTEMS CONTROL AND MONITORING HUMIDITY AND PH LAND FOR VEGETABLE "CAPSICUM ANNUM L"

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ABSTRACT

Capsicum Annum L or commonly called the big red pepper plant is a herbaceous plant that includes Family Solanaceae. This type of vegetables is one of the horticultural commodities that are cultivated by many farmers in Indonesia because they have a high selling price. In the cultivation of vegetable crops Annum L Capsicum farmers cultivate vegetable crops Capsicum Anum L by way of planting the crop without regard to the value of moisture and soil pH, farmers only see from experience and estimates. This can lead to planted plants that can not grow and develop well, this can also result in non-optimum production. There are already tools that can know the value of soil pH but tools that are still fairly expensive. This application is designed by combining arduino Uno microcontroller with soil pH sensor and soil moisture sensor which then sent into the website using SIM / GPRS Shield module, and on the website can monitor pH value and soil moisture. Based on the results of tests that have been done can be concluded that the application of control systems and monitoring of moisture and soil pH for vegetable crops Capsicum Annum L is enough to assist farmers in monitoring moisture and soil pH and also can control the land suitable for planting vegetable crop Capsicum Annum L. Further developments are expected to monitor pH and soil moisture at various points of the region.

Keywords : Plant, humidity, pH, Arduino, Control, Monitoring

1. INTRODUCTION

Department of Agriculture West Java Province Food Plant located on Jl. Surapati No. 71 is one of the offices or organizations responsible to the governor for the accurate and available presentation of data and information on Food Crops and Horticulture which are available when needed such as land area, planting area, harvested area, productivity and production and other data deemed important by user data in making planning and decision making. There are several sectors that exist in the Department of Agriculture Crops West Java Province one of them in the field of Horticulture One of the horticultural crops in Indonesia is the vegetable crop Capsicum Annum L.

Capsicum Annum L or commonly called red pepper plant is a strategic vegetable commodity, in certain season chili price increase is significant enough to affect the rate of inflation. Based on data from priangan.org the price of chili in Bandung from August to October is uncertain. To meet all the needs of chili is needed supply of chili sufficient. If the supply of chilli is less or lower than consumption there will be price increases. One of the factors that affect the supply of red pepper is the production of red pepper.

In the cultivation of the plant Capsicum Annum L soil serves as a planting medium and as a source of nutrients in which the roots of plants obtain nutrients or food. The main requirement of good planting medium is to contain enough nutrients needed by plants so that the plants are

able to grow well and produce maximally. Another important factor that is also very influential on the success of the business cultivation Capsicum Annum L plant is the level of soil acidity or soil pH. Where each soil has a different acidity (pH). In addition, soil moisture is also quite affecting on the growth of plants, if the soil in the planting Capsicum Annum L dry can cause the plant to die and the soil is too wet not good for Annum L Capsicum plants because it can cause the plant can not grow properly.

To increase soil pH, the farmer Capsicum Annum L performs liming process that is adding lime into the soil. The purpose of calcification is to increase the pH from acid pH to neutral pH. In calcifying the soil media, farmers still use the conventional way that farmers only use the estimation and experience. Applying estimation and experience methods, causing farmers unable to improve soil quality can even lead to infertile soil quality due to lack of lime or excessive chalking can lead to crops grown in the soil can not grow well and even cause the plant to die , so it can lead to crop failure.

There is now a way to measure the soil pH by using a pH meter tool. By using pH meter can be directly known how the scale of soil pH. But farmers Capsicum Annum L is still rare to use pH meter tools because of the expensive price. The pH meter device can only be monitored in the area that we measure the soil, so to keep the pH level of the equipment on the device can not be monitored remotely.

From these problems it needs a solution that can increase productivity in the cultivation of vegetable crops Capsicum Annum L, one solution is to involve technology. Therefore, a system is needed to control the pH levels of the soil suitable for planting the Annum L Capsicum and can monitor the soil moisture and pH from a distance at regular intervals.

Based on the description above it is necessary to build a system that can assist farmers in controlling and monitoring moisture and soil pH. In this thesis final project titled “Design Systems Control And Monitoring Humidity And PH Land For Vegetable "CAPSICUM ANNUM L"“

2. ISI PENELITIAN

2.1 Theoretical Basis

2.1.1 Definition Of Land

The soil is the accumulation of the outer body which occupies most of the surface of the planet, which can grow plants, and also has properties as an influence on climate and life acting on materials due to climatic influences and living bodies acting on the parent material in certain relief conditions over the certain time.

From this definition it can be concluded that the soil that is on the surface of the earth consists of crumbs and loose, the ground is the outermost layer of the earth's skin that is not solid, and has a noble thickness of membrane thin to more than 3 meters different from the material below as the color , physical properties, chemical makeup and ongoing chemical processes[1].

2.1.2 Capsicum Annum L

Vegetable plant Capsicum Annum L or commonly called red pepper plant is a shrub with a spicy fruit flavor caused by the content of capsaicin. Vegetable crop Capsicum Annum L has the condition to grow plants that can grow at an altitude of 0-1400 mdpl, the appropriate temperature of the plant is between 18◦C to 27◦C, for the appropriate humidity is 70-80%, while for acidity level pH the corresponding soil is 6 to 7[2].

2.1.3 Arduino

Arduino is a platform of physical computing that is open source. The Arduino uses a software called Integrated Development Environment (IDE) that serves to write programs, compile them into binary code and upload them into microcontroller memory[3].

2.1.4 Understanding Arduino Uno

Arduino Uno is an Atmega328 based microcontroller module. Arduino Uno has 14 input and digital output pins from samapi 13 which functions as input or output, has 6 pins ie 3.5,6,9,10,11 which serves as analog output pin where the output voltage can be set. The value of an analog output pin can be programmed between 0-255 diamanti arduino has a voltage value of 0-5V. Arduino has USB which serves to load programs from computer into arduino board and for serial communication between arduino board and computer. arduino has an analog pin impingement of 6 pins (-0-5) which serves to read the voltage generated by analog sensors, can read the input pin between 0-1023. For its own programming language arduino Uno uses simple C language [4].

In this study the arduino is used to control all the functions of the system. All components will be connected with arduino, in this study the components are directly connected to the arduino module SIM / GPRS Shield, soil pH sensor and soil moisture sensors.

2.1.5 Soil PH Sensor

Soil pH sensor is the acidity detector or alkaline (alkali) sensor. The pH scale that can be measured by this soil pH sensor has a range of 3.5 to 8. This sensor can be directly connected with arduino analog pins and other analog microcontroller pins [5].

In this research, soil pH sensor is used to obtain soil pH value, in making this system soil pH will monitor soil pH value from Lembang, Padalarang and Jatinangor so that monitoring result can be seen directly on website.

2.1.6 Soil Humidity Sensor

The soil moisture sensor consists of two electrodes that have a principle of action based on resistance, resistance itself which means the ability of an object to withstand the flow of electric current. The soil moisture sensor itself reads moisture of the soil around. The electric current flowing in both electrodes through the soil and the resistance to the soil will determine the soil moisture value.

This sensor module has 4 pins, namely GND (Ground), VCC (3.3 - 5Volt), AO (analog output to be read by Arduino), and DO (can be set sensitivity using knb regulator, and produce digital logic HIGH / LOW at level certain moisture). In this study the pins used only three pins to be used, namely GND, VCC and AO.

In this study, soil moisture sensors are used to measure soil moisture with the status of whether the soil is dry, wet soil or moist soil.

2.1.7 GSM/GRPS Shield

GSM / GPRS Shield is a feature of Arduino, function of GSM / GPRS Shield that can send SMS, voice call and connect with internet from / back to user.

The GSM / GPRS shield type used in the design of this application is GSM / GPRS shield SIMCOM SIM800L V2.0 GSM / GPRS Module is a GUI module QUAD BAND GSM / GPRS compatible with Arduino function to add GSM (voice call, SMS) and GPRS.

In this study SIM800L V2.0 GSM / GPRS is used to connect Arduino and send data from the soil moisture sensor and soil pH to the web service, and the data is stored into the database which is then displayed on the website.

2.1.8 Understanding PHP

PHP is short for PHP Hypertext Preprocessor, PHP language similar to C and Perl language that has simplicity in command. PHP can be used in conjunction with HTML making it easier to build web applications quickly. PHP is a programming language that is enabled to build a dynamic website.

Here is the PHP workflow:

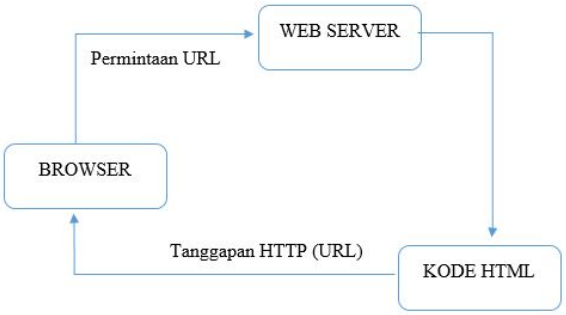


Figure 1. PHP Workflow

The first workflow is Server will read request from cient / browser then Search for page on server, after that server do instruction given by PHP to make modification on page or page, then result of modification will be returned to client / browser [6].

2.2 Analysis and Design

2.2.1 Problem Analysis

Control system and monitoring of soil moisture and soil pH for vegetable crops Annum L Capsicum is a mechanism that is designed starting from the problem that farmers do not have the method of land selection in Capsicum Annum L plant to determine the good soil to be planted and the absence of a system to monitor the humidity and pH land periodically. Based on the research conducted there are problems that occur so that needed a solution that can increase productivity in vegetable cultivation Capsicum Annum L. Therefore, it needs a control system and monitoring of humidity and soil pH which aim to control the pH level on the soil suitable for planted Capsicum Annum L vegetables and can monitor moisture and soil pH periodically.

2.2.2 System Analysis

The design of control system and moisture monitorng and soil pH on vegetable crops Capsicum Annum L is a mechanism that is designed from the problems that farmers have not been able to determine the appropriate soil for vegetable crops Capsicum Annum L and farmers do not have a tool to monitor the moisture and soil pH , usually the farmer only doing these activities with the experience and only perkiran. Based on the research, there are problems that occur so that the system is designed to design a build control system and monitoring the humidity and soil pH on the vegetable crop of Capsicum Annum L.

Therefore it needs a control and monitor of moisture and soil pH.

2.2.3 Soil Analysis

Soil analysis aims to determine the element of nutrients or pH on the soil. Soil containing optimum nutrients and free from toxic elements can be said to have chemical fertility. Therefore an initial soil pH analysis using a pH sensor was used to determine the value of the initial soil pH. The soil analyzed were Lembang, Padalarang and Jatinangor. Here are some parameters of the soil being analyzed:

Table 1. Initial Land Analysis

Soil	Type of Soil	High Place (mdpl)	Temp	pH
Lembang	Tanah Hitam (Andosol)	1236	24˚	5,89
Padalarang	Tanah Kapur	720	25˚	6,55
Jatinangor	Tanah Merah (Latosol)	902	27˚	5,83

2.2.4 Architectural Analysis System To Be Built

System Architecture Analysis is a system that will be built, application control and monitoring of moisture and soil pH for vegetable crops Annum L Capsicum communicate with microcontroller tool which is connected by web service by using JSON language exchange and displayed in website.

System Analysis is a process to describe the physical system to be built, the components of the system to be built include:

1. The pH sensor as the sensor used to measure soil pH.
2. The soil moisture sensor is used to measure moisture in the soil.
3. Arduino Uno is used to run the sensor and process sensor data.
4. SIM800L Ver.2 GSM / GPRS Module as a tool to request data from the web service and send it to Arduino for execution.
5. Web Service serves as an intermediary or bridge to connect or execute commands from the website so that orders can be received by arduino.
6. Store arduino data from sensor value.
7. Displays information on the pH value and soil moisture and controls the soil.

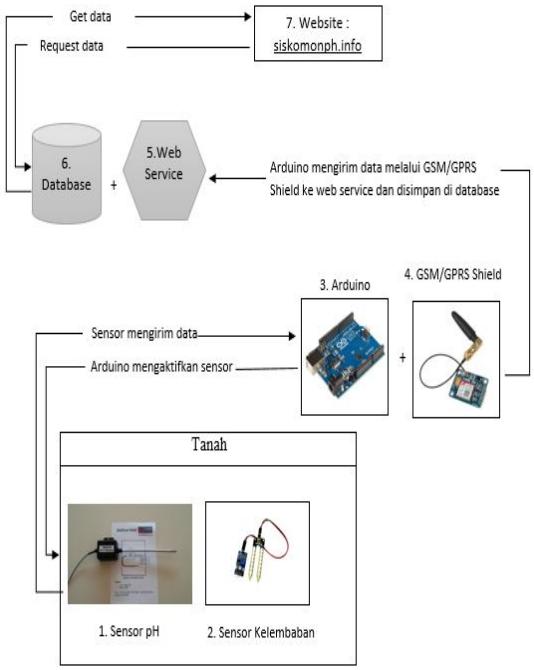


Figure 2. System Architecture

Explanation Of System Architecture

Here's an explanation of the architecture picture of humidity monitoring system and soil pH:

1. The pH and humidity sensor will take pH and soil moisture data, then the data is sent to Arduino UNO.
2. Arduino UNO processes the pH and soil moisture values previously sent by pH sensors and soil moisture sensors. Once processed by Arduino UNO, the data will be sent to the web service and stored in the database via GSM / GPRS Shield module.
3. Web sevice then performs get and request functions on the website.
4. The website will display results from pH data and soil moisture..

2.2.5 Device Communication Analysis

2.2.5.1 Arduino Uno Communication With GSM/GPRS Shield Modul

Arduino Uno communicates with GSM / GPRS Shield module via pin 2, pin 3, 5V and GND voltage. For more details can be seen in the picture below.

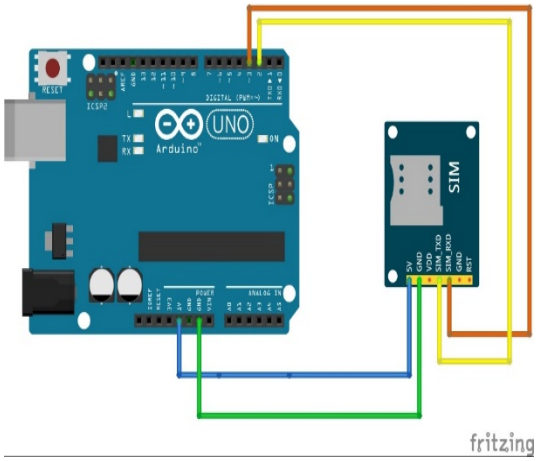


Figure 3. Arduino Uno With GSM/GPRS Shield

2.2.5.2 Arduino Uno Communication With Soil Humidity Sensor

Arduino Uno communicates with soil moisture sensors via analog A5, 5V and GND voltages. For more details can be seen in the picture below.

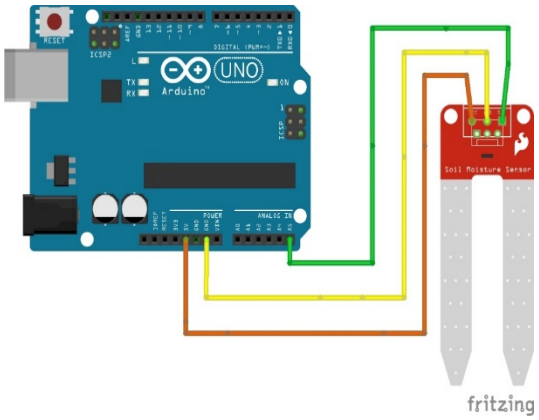


Figure 4. Arduino Uno with Soil Humadity Sensor

2.2.5.3 Arduino Uno Communication With Soil PH Sensor

Arduino Uno communicates with ground pH sensors via analog A0 and GND. For more details can be seen in the picture below.

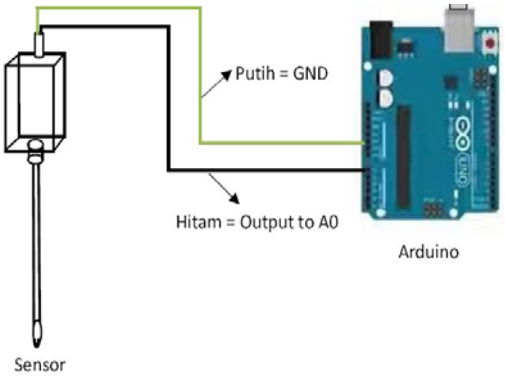


Figure 5. Arduino Uno With Soil pH Sensor

2.2.6 Analysis Of Mikrocontroller Hardware Requirements

Microcontroller used in this research is using Arduino Uno R3 microcontroller, GSM / GPRS Shield, soil pH sensor and soil moisture sensor..

2.2.6.1 Arduino Uno

The system in this study requires Arduino microcontroller as a tool to perform processing between input and output devices. Here are the Arduino Uno specifications:

Table 2. Arduino Uno Specification

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB

	(ATmega328P)
Clock Speed	16 MHz
LED_BUILTIN	13
Length	68.6 mm
Width	53.4 mm

2.2.6.2 GSM/GPRS Shield

The system created in this study requires a GSM / GPRS Shield module that serves as a liaison between Arduino with the website. Below is a GSM / GPRS Shield module specification:

Table 3. GSM/GPRS Shield Spesification

SIM800L	Spesification
Voltage Chip	3.7-4.2V (datasheet = 3.4-4.4V)
Voltage Module	5.0V (V limit = 4.8-5.2V)
Freq	QuadBand 850/900/1800/1900Mhz
Module size	4.0cm x 2.8cm
Transmitting Power	- GPRS multi-slot class 12/10 - GPRS mobile station class B
Temperature range Normal operation	40◦C -+ 85◦C

2.2.6.3 Soil pH Sensor

The system made in this study requires a soil pH sensor that serves to detect acidity or alkalinity (alkali). Here are the specifications of soil pH sensors:

Table 4. Soil pH Sensor Spesification

Soil pH Sensor	Spesification
Output	Analog ADC
mikrocontroller	Arduino, AVR, ARM, PIC dsb
Weight	panjang probe 16 cm
Heigh	500 gram

2.2.6.4 Soil Humidity Sensor

The system created in this study requires a soil moisture sensor that serves to detect moisture in the soil. Here are the soil moisture sensor specifications:

Table 5. Soil Humidity Sensor Specification

Soil Humidity Sensor	Spesification
Voltage	3.3-5V
Size	3.2cm x 1.4cm
Output sensor	Digital (0 / 1)

2.2.7 Functional Requirement Analysis

System modeling is done using UML (Unified Modeling Language) where the modeling stages in the analysis include Use Case Diagram, Use Case scenario, Activity diagram, Class diagram, and sequence diagram.

2.2.7.1 Use Case Diagram

In this study use case diagram is used to describe the actor with Use case contained in the control system and monitoring of moisture and soil pH.

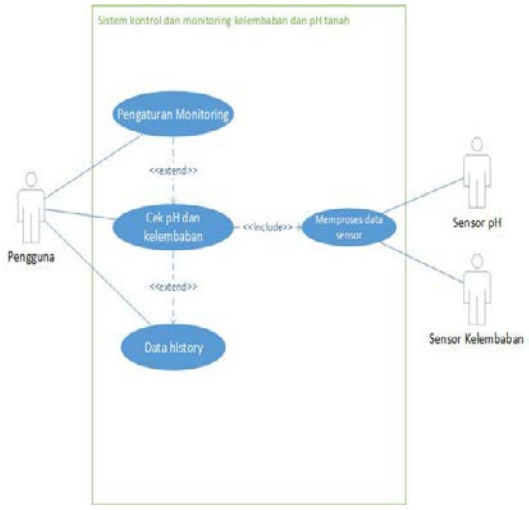


Figure 6. Use Case Diagram

2.2.7.2 Activity Diagram

Activity diagram modeling workflow or workflow flow of sequence of activities in a process that refers to the Use case diagram available.

Here is the activity diagram setting monitoring, activity diagram Check pH and humidity and activity diagram data history

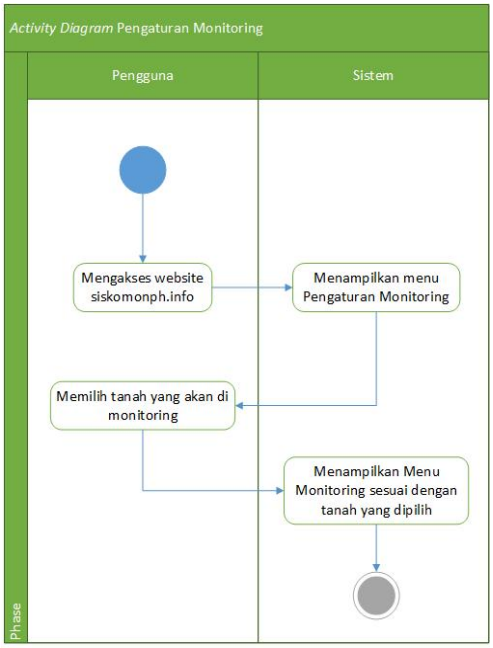


Figure 7. Activity Diagram Pengaturan Moni

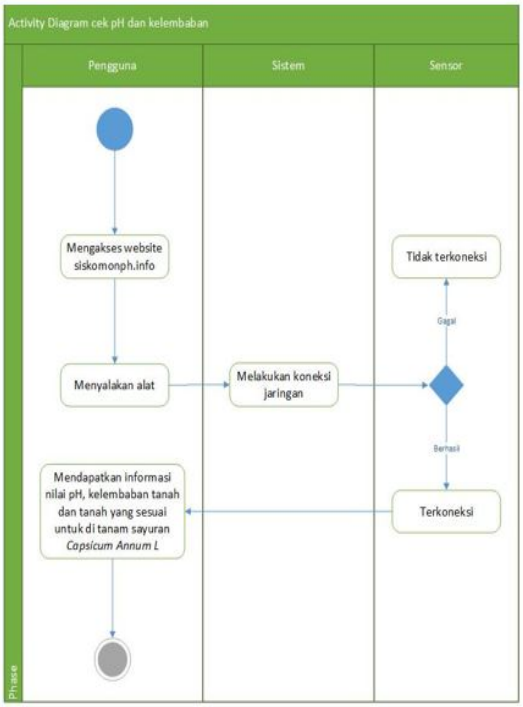


Figure 8. *Activity Diagram Of Check pH and Humidity*

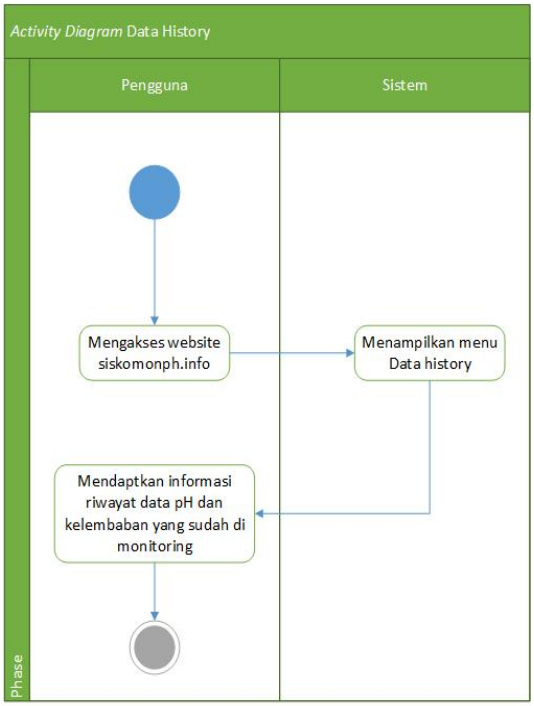


Figure 9. *Activity Diagram of* Data History

2.2.7.3 Class Diagram

Class Diagram is a specification of the fungionality that produces the object and is the core of the development of this application. Class diagram of Control and monitoring system of moisture and soil pH for vegetable crop Capsicum Annum L, For more details can be seen below:

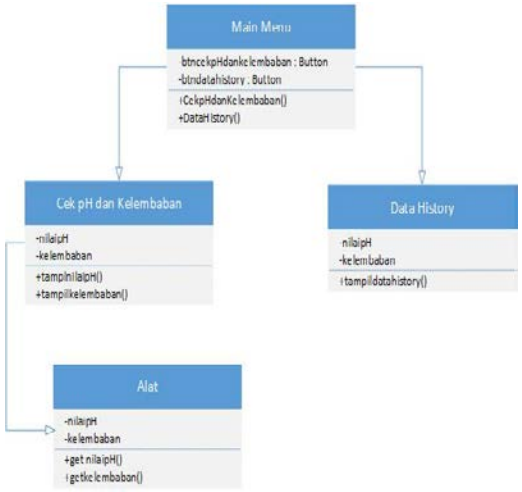


Figure 10. *Class Diagram*

2.2.7.4 Sequence Diagram

Sequance diagrams are used to describe the flow of work, the message conveyed, and how the elements in it work together over time to achieve a result. Sequence diagram of the system to be built can be seen in the following figures:

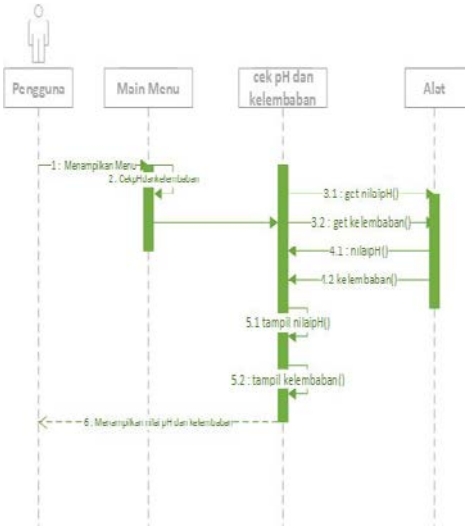


Figure 11. Sequence Diagram Cek pH dan Kelembaban

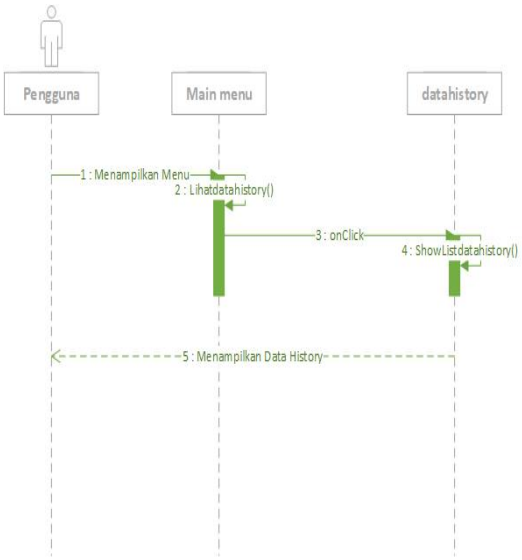


Figure 12. Sequence Diagram Data History

2.3 Results and Discussion

2.3.1 Hardware Implementation

Devices used in the design of control systems and monitoring of pH and soil moisture in vegetable crops of Capsicum Annum L are as follows:

Table 6. Hardware Specification

No	Hardware	Spesification
1	Mikrokontroler	Arduino Uno R3
2	GSM/GPRS Shield	Sim800l V2.0
3	Sensor pH	Sensor pH depoinovasi
4	Soil Humidty Sensor	YL-69

2.3.2 Software Implementation

Here is the software used in the design of control systems and monitoring of pH and soil moisture in vegetable crops Capsicum Annum L:

Table 7. Spesifikasi Perangkat Lunak

No	Software	Spesification
1	Operating System	Windows 10 64bit
2	Programming Language	C and PHP
3	Framework	Codeigniter v3.1.6
4	Code editor	Arduino IDE v1.6.13 dan Sublime text 3

2.3.3 Interface Implementation

Implementation of the interface is the interface display on Design and Control System pH Monitoring and Soil moisture in vegetable crops Capsicum Annum L is as follows

:

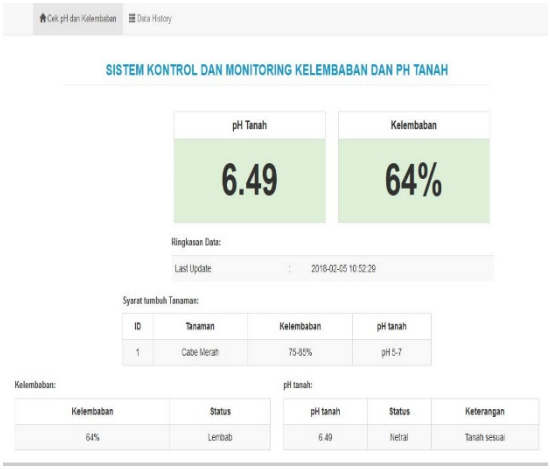
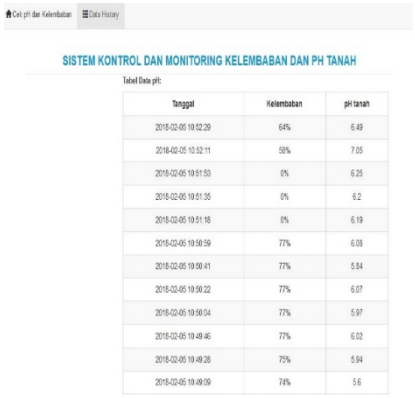


Figure 13. Interface pH and Humidity

In this menu the user can see the value of humidity and soil pH, the user can also see the status of moisture and soil pH.



Gambar 14. Display Menu Data History

In this menu Users can view the history of the data values of soil moisture and pH that have been monitored.

3. CLOSING

Conclusions from the results of research, analysis, system design, and implementation, can be drawn the following conclusions:

Control system and monitoring of soil pH and soil moisture on vegetable crops Capsicum Annum L can assist user especially farmer of cultivation of vegetable crop Capsicum Annum L in controlling and monitoring soil, so farmer can monitor soil and can determine what kind of land suitable for planting Capsicum Annum L , besides that even with the existence of this system is expected farmer can produce result of its harvest optimally.

BIBLIOGRAPHY

[1] N. K. Sugiharyanto, "DIKTAT Mata Kuliah Geografi Tanah," 06 2009. [Online]. Available: staffnew.uny.ac.id/upload/132319826/pendidikan/diktat-geografi-tanah.pdf.

[2] D. P. T. P. P. J. BARAT, BUDIDAYA CABE MERAH (Capsicum annum), Bandung, 2010.

[3] A. S., Rosa dan Shalahuddin, M. 2013. *Rekayasa Perangkat Lunak Terstruktur Dan Berorientasi Objek. Informatika*. Bandung.

[4] F. Djuandi, "Pengenalan Arduino," *www.tobuku.com*, 2011.

[5]"DATSHEET Sensor pH tanah," *www.depoinovasi.com*, 2017.

[6] M. Dzainal, "Pengertian mysql menurut para ahli," 27 01 2017. [Online]. Available: http://www.tentangit.com/2017/01/pengertian-mysql-menurut-para-ahli.html.