ARCHITECTURE TOOLS PROTOTYPES BASED ON VEGETABLE CROP RECOMMENDATIONS PH AND SOIL TYPE BASED IOT

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ABSTRACT

In vegetable cultivation techniques, factors that directly affect growth, one of which is the factor of land. The quality of the different land caused the farmers did not know for certain the quality of farm land. Processing of inappropriate agricultural land pushing increasingly declining quality of a land. Not least the farmers suffered suboptimal outcomes of agriculture due to not fitting in to cultivate farmland. Optimization of agricultural land is urgently needed in the modern era, see the current farmland is increasingly limited. The growth of plants on a land depends on the quality of the soil is used on farmland. The importance of knowing the ph and soil type that is suitable for the plant in order to produce optimal by using Raspberry Pi. Raspberry Pi was used as a communications center data on arduino are used as controller at soil pH sensors, temperature, and humidity information to know the ground for soil pH, temperature and humidity in order for optimal crop later data on raspberry pi will be accessible to farmers through internet-based Website. This system is urgently needed because it can recommend the vegetable crops to farmers to land that will be used vegetable cultivation.

Keyword: Vegetables, Soil, Plant Recommendations, pH, Raspberry Pi, Microcontroller.

1. INTRODUCTION

Indonesia is an agrarian country with an area of 39.594.536.91 Ha farm. As many as 60% of the community made their living in agriculture. The use of the agricultural region of indonesia is divided into agricultural fields, orchards, fields and areas that have not been used for farming. According to the extent of the land pertahian in indonesia and geographical conditions, climate, weather and other factors that give rise to the quality of agricultural land in indonesia. On agriculture, soil quality is also an important factor in the process of agriculture.

Based on the notion of land is growing media for plants and is a form of dynamic ecosystem composed of various essential components such as water, minerals, organic materials, micro-organisms as well as the air. The effort is to improve soil fertility and crop yield can be done with the awarding of the organic fertilizer. Organic fertilizer is used for the cultivation of vegetables is manure, green manure, compost, bokashi, and kascing [1]. Talking about the cultivation of vegetables, then plant the vegetables go into the horticulture.

Horticulture is one of the range of agriculture administered intensive in cultivating a wide range of plants. In general the hortilkutura includes the cultivation of flowers, fruit and vegetables [2]. Vegetables are commodities which have many more benefits, because it takes a day-day and his request are likely to continue to increase as other types of horticultural crops, most plants vegetables have a high enough value. This fact can be understood because the vegetables can be consumed at any time. In the technique of cultivation of vegetables, to be aware of the factors that directly affect growth, one of which is the factor of land.

According to research conducted by Hutagaol (2006), in his research explained that the survey is important because land kemasaman mapping to find out the extent to which the level of kemasaman the soil can affect the potential of agriculture. The main purpose of the survey the land is made all the specific information that is important about each kind of land against its use and other properties so that it can be determined pengelolaanya [3].

The quality of the different land caused the farmers did not know for certain the quality of farm land. Processing of inappropriate agricultural land pushing increasingly declining quality of a land. Not least the farmers suffered suboptimal outcomes of agriculture due to not fitting in to cultivate farmland. Optimization of agricultural land is urgently needed in the modern era, see the current farmland is increasingly limited. The growth of plants on a land depends on the quality of the soil is used on farmland.

Based on explanation above about the importance of knowing the ph and soil type that is suitable for the plant in order to produce optimal then created a prototype tool vegetable recommendations based on ph and soil type by using the method of classification that is right. And it is then the author intends to do

"Architecture Tool Prototypes based on Vegetable Crop Recommendations Ph and soil type Based Iot".

2. THEORETICAL BASIS
2.1 The Definition Of Land
Soil that is on the Earth's surface consists of crumbs and loose, land is the most outer layer of the Earth that is not convenient, and has a thick noble from a thin membrane to more than 3 meters with different materials such as color, below physical properties, chemical composition and chemical processes that are taking place [4].

2.2 Soil pH
According to the (Foth, 1994) on neutral soil reaction, i.e. pH 6.5 – 7.5 then the nutrient elements available in a sufficient amount of lots (optimal). On a soil pH of less than 6.0 then the kertersediaan elements – elements of phosphorus, potassium, sulfur, calcium, magnesium and molibdium decreased rapidly. While the soil pH greater than 8.0 there will be elements of nitrogen, iron, manganese, copper and zinc ketersediannya borium relatively so little. Soil texture effect on very easy or whether the pH can be changed. Clay harder neutralized from the sand on the ground as it has more surface area to diabsorsi, holding and supplying the Hydrogen ions in the soil.

2.3 Raspberry Pi
Raspberry Pi is a single board computer (Single Circuit Board/SBC) or mini computer which has the size of a credit card. Raspberry Pi is very useful for various purposes, such as spreadsheets, games, play high definition video. Raspberry Pi developed by foundation nirbala. Raspberry Pi Foundation managed developer and computer experts from the University of Cambridge, United Kingdom [5].

Figure 1. Raspberry Pi 3

Raspberry pi had set the USB host allows the communication with external devices such as a mouse or keyboard, in addition there is also the HDMI port and Composed A/V 3, 5 mm Jack as the audio video interface. Port LAN and wifi, and bluetooth can be used to connect with a network of communications, Camera and Display Serial Interface serial interface can be used as an alternative interface of the camera and the monitor.

Table 1. Spesifikasi Raspberry Pi 3

Soc	Broadcom BCM2837
CPU	4x ARM Cortex-A53, 1.2 Ghz
GPU	Broadcom VideoCore IV
RAM	1GB LPDDR2 (900 Mhz)
Networking	10/100 Ethernet, 2.4Ghz 802.11n wireless
Bluetooth	Bluetooth 4.1 Classic, Bluetooth Low Energy
Storage	microSD
GPIO	40-pin header, populated
Ports	HDMI, 3.5mm analogue audio-video jack, 4x USB 2.0, Ethernet, Camera Serial Interface (CSI), Display Serial Interface (DSI)

2.4 Arduino Uno
Arduino is a popular type of electronic boards to be learned or used in a variety of electronics projects. A programming language that is used to configure the arduino programming language is c. Simpleness to learn is one of the key drivers of the development of the use of the Arduino [6].
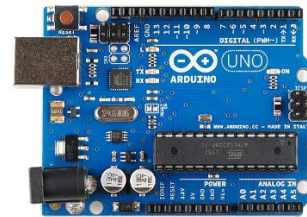
Figure 2. Arduino Uno

The following is a specification from ardunio uno or also called mikrokontroller ATmega328P on here.

Table 2. Spesifikasi Arduino Uno

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pin	14 (of which 6 provide PWM output)
PWM Digital I/O Pin	6
Analog Input Pin	6
DC Current per I/O Pin	20 mA
Flash Memory	50 mA
SRAM	32 KB of which 0.5KB used by bootloader
EEPROM	2KB
Clock Speed	16 MHz
Leght	68.6 mm
Width	53.4 mm
Weight	25 g

2.5 Sensor
The sensor is a device used to detect or measure a value on natural occurrences such as gas, heat, smoke

and turn it into a representation of the value of the analog or digital depending on the type of sensor being used [6].

2.5.1 Sensor pH

Sensor detection sensor soil pH is acidity (acid) or basicity (alkaline) soils. The pH scale that can be measured by the sensor has a soil pH range of 3.5 to 8. These sensors can be directly connected with pin or pin analog arduino analog mikrokontroller [7].

2.5.2 Sensor YL-100

YL-100 sensor is a sensor for measuring the humidity of soil between 0% and 100% as well as the thoroughness of about ± 3%. YL-100 sensors require the input of 3, 3V to 5V and has 2 modes of the output that is digital and analog [8].

2.5.3 Sensor DHT-11

DHT11 sensor is a sensor for measuring the humidity of the air at a distance measurement between 0% and 100% as well as the thoroughness of about ± 0.1%. In addition to providing information, humidity sensors also measure temperature between-40 ° C and 80 ° C with an accuracy of ± 0.1 ° C [9].

2.5.4 LCD 16x2 Module I2C

Electronic display is one of the electronic component that serves as a data display, good characters, fonts or graphics. The LCD (Liquid Cristal Display) is one type of electronic display made with logic CMOS technology that works with do not generate light but reflects the light that exists around him against the front-lit or transmits light from back-lit. The LCD (Liquid Cristal Display) functions as a viewer data in the form of characters, letters, numbers or graphs [10].

3. DISCUSSION

3.1 Analysis of System Architecture To Be Built

Analysis of system architecture is a process to describe the physical system to be built and also components pedukungnya. Here's an overview of the system architecture to be built.

Figure 3. Architecture System

The following is a description of the system architecture based on vegetable crop recommendations ph and soil type based ito as in Figure 3 as follows:

a. pH Sensor reading and sending data to the soil pH to the arduino uno.
b. Sensor YL-100 reading and sending data soil moisture to the arduino uno.
c. Sensor DHT-11 read the temperature data and submitting it to the arduino uno.
d. the Arduino Mega as the microcontroller receives data humidity, temperature, and pH of media, and display it on the LCD.
e. Data acquired will be processed and posted to the web server through wireless Raspberry Pi.
f. Data obtained are forwarded to the web server through the internet network.
g. Web server will perform data storage temperature, humidity, pH levels into the database.
h. Results of sensor readings would be classified by the system, which is where the trainer data already exists in the database.
i. Results of the tool Then this recommendation is displayed on the website which can be accessed through the desktop.
j. Raspberry Pi 3 as a media recipient data from the arduino and the media as the sender of the data in JSON format to the web service via wifi hotspots that are connected to the internet.

3.2 Analysis of Data Communication

Data communication is a very important thing, because of the absence of communication of data, an application that is built will not be able to walk properly or optimally. The following explanation of the 3 main elements part on data communication system as follows:

1. Data source
   Soil pH sensors, Humidity sensors, YL-100, Temperature Sensor, the DHT-11, Arduino UNO.
2. Transmission Media
   Raspberry Pi 3, Wifi Hotspot, Web Service.
3. Recipient Data
   Website.

3.3 Analysis of Tool Working Systems

System working tool used to describe, simplifying processes or procedures so that it is easy to understand and easy to be seen based on the sequence of steps from a process.

The following is the information workflow of prayer generally. On the pH sensor, temperature and humidity are mounted on the ground will read media information then data sensor pH, temperature and humidity are read will be accepted by microcontroller Raspberry Pi 3 henceforth stored on the database server. Then the shapes in the flowchart as follows.
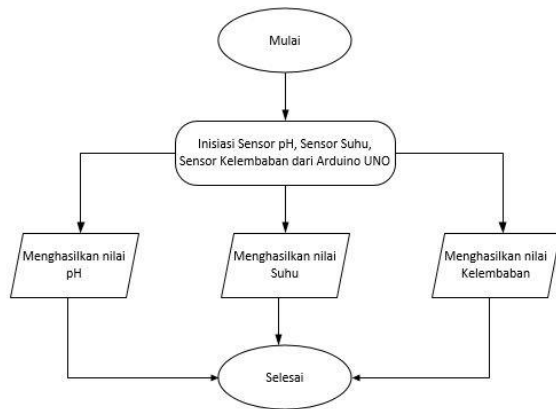
Figure 4. Analysis of Tool Working Systems

3.4 Functional Needs Analysis

System modeling is done using UML (Unified Modelling Language) where the stages of modeling in the analysis of, among others, Use Case Diagram, Use Case Scenario, Activity diagrams, Class diagrams and Sequence Diagrams.

3.4.1 Use Case Diagram

Use Case Diagram is modeling for information systems is to be made, the following in Figure 5.
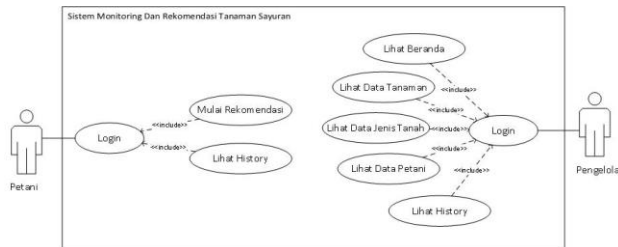

Figure 5. Use Case Diagram

3.4.2 Activity Diagram

Activity diagrams model the workflow or workflow from the sequence of activities in a process based on the Use case diagram. Here is an Activity diagram start recommendations in Figure 6.
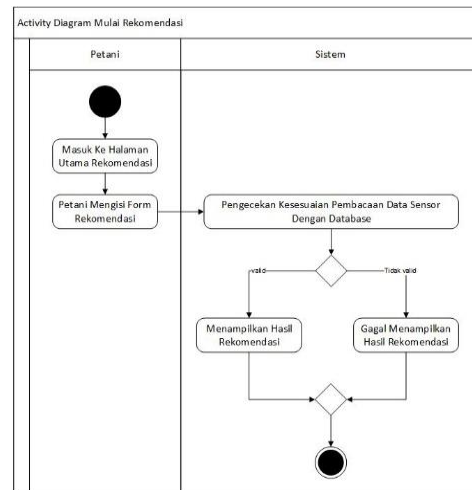
Figure 6. Activity Diagram Start Recommendation

3.4.3 Class Diagram

The class Diagram is a specification of the functionality that generates objects and is the core of the development of this application. Class diagram of the recommendation system based on vegetation and soil type, ph for more details can be seen in Figure 7.
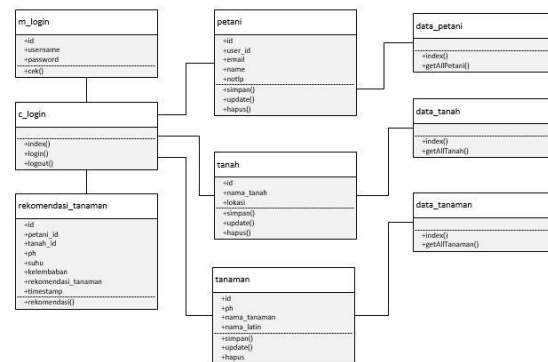
Figure 7. Class Diagram

3.4.4 Sequence Diagram

Sequence diagrams are made aiming to describe the interactions between object on the use case, can be seen in Figure 8.
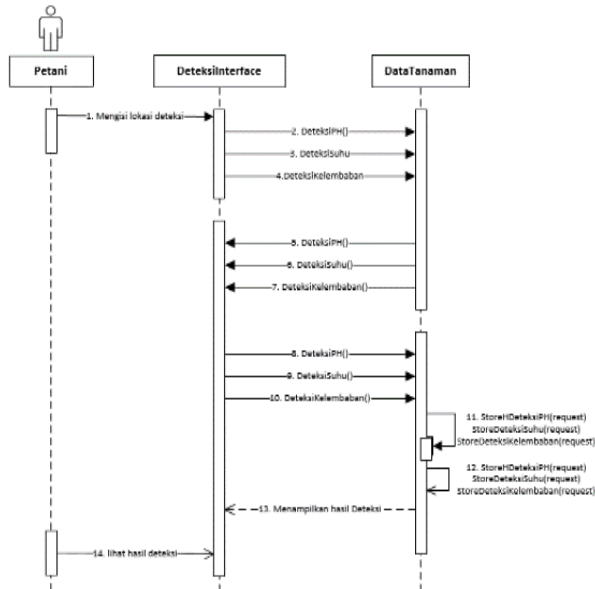
Figure 8. Sequence Diagram

3.5 Hardware Implementation
3.5.1 Computer Hardware
This section discusses the hardware used to run the system for monitoring temperature, humidity and vegetable crop recommendations based on ph and soil type. The details of the hardware that is used can be seen in the following table.

Table 3. Computer Hardware Used

Hardware	Specification
Processor	2.2Ghz
Hardisk	500 GB
VGA	2 GB
RAM	4 GB
Mouse	Oprical Mouse
Keyboard	Standard
Network	Connection Internet

3.5.2 Controller Hardware
The controller hardware is a device consisting of a microcontroller and sensor. Controller specifications can be seen in the following table.

Table 4. Controller Harware Used

Hardware	Description
Arduino Uno	MiCrocontroller
Raspberry Pi 3	Mini Pc
Sensor pH Tanah	Soil Ph Sensor
DHT-11	Air Temperature Sensor
YL-100	Soil Moisture Sensor

3.6 Software Implementation
In order to run a vegetable-based recommendation system IoT, computers used already installed the required software can be seen at the following.

Table 5. Computer Software

Software	Specificasi
System Operation	Windows 10
Browser	Google Crome, Mozilla
Internet	Connection Internet

3.7 Testing Hardware Controller
Installation of the tools have been made on the implementation of the hardware controller. To find out if the equipment goes in accordance with the draft early, needed a testing. Testing was done with pH, temperature sensor sensor DHT-11, humidity sensor YL-100, LCD 16x2 and the overall work tool.

3.7.1 Testing Soil pH Sensor
Soil pH sensor is a sensor used to detect the magnitude of pH values in media land. Testing soil pH sensor do with soil pH sensor plugged into media farmland. As for one of the test results conducted by as much as 10 times the testing can be seen in Figure 9.

Figure 9. Testing Soil pH Sensor

So that you can see more clearly the test results as much as 10 times the testing in the following table.

Table 6. pH Sensor Test Result

Time	The Results
18:53:00	-26,6
18:54:52	4,9
19:00:17	3,8
19:01:08	1,2
19:05:24	2,1
19:28:44	4,0
19:29:32	2,2
19:30:43	7,4
19:31:35	4,1
19:32:18	4,1

3.7.2 Testing Sensor YL-100
YL-100 sensor is a sensor used to detect soil moisture in farmland medium. Testing this sensor in the initial conditions i.e. 42% can be seen in Figure 10.

Figure 10. Initial Condition Test

Then in order to find out the sensor is running well, then watering the soil is done to get the final result, then the final value is 63% as shown in Figure 11.

Figure 11. Final Condition Test

3.7.3 Testing Sensor DHT-11

The DHT-11 sensor is used to detect the temperature of the surrounding agricultural land. Testing the sensor for the initial conditions is 30.60 ° C as shown in Figure 12.

Figure 12. Initial Condition Test

Then in order to find out the sensor runs fine, then do the ignition near the sensor in order to get the end result, then obtained the final value of 46.10 ° C as shown in Figure 13.

Figure 13. Final Condition Test

3.7.4 Overall System Testing

The whole system testing is intended to test the work of pH, temperature and humidity sensors that have been integrated with the web as a control. The web as a control here means that the web is used to view log data, the overall sensor readings can be seen in Figure 14.

Figure 14. Overall System Testing

Following the results of the overall data log sensor readings in Figure 15.

Figure 15. Logs The Result of The Overall Sensor

3.8 Beta Testing

The beta test is done to find out the assessment of the recommendation system based on vegetable plants pH and soil type based IoT constructed by the method of interview.

Table 7. Interview Beta Testing

Question	Answer
Whether using vegetable-based recommendation system IoT is you as the owner of the land media can know vegetable crop recommendations based on soil type and pH levels?	Yes, it works pretty well but for the pH sensor I think it's still not accurate to know the pH value and the recommended crop yield.
Whether using vegetable-based recommendation system IoT can help you to do the monitoring of temperature and humidity	Yes, quite helpful for temperature and humidity information goes well, with like that so I can know whether dry or

around the media ground?	moist soil and can also find out the current temperature quickly.
What is vegetable-based recommendation system IoT can be used easily and fit the purpose or necessity?	Yes, in accordance with the conditions of the farmers ' needs and easy to use.

4. FINALITY

4.1 Conclusion

Conclusion from the results of research, analysis, system design and implementation, it can be concluded that the vegetable crop recommendation system based on pH and IoT-based soil types can help farmers get information on vegetable crop recommendations seen from the media of their farms and find out additional information in the form of air temperature and humidity of agricultural land.

4.2 Suggestion

The system has been made still need to be developed more to future, so that the system that has been built can work even better.

As for the suggestions to the development of software that is built, namely the system can provide information on media pH condition of soil with more accurate and consistent, developing a platform that can be supported by other software, given the time This only supports the web alone, the system can perform soil media watering when the soil moisture conditions were declining, and wear sensors are actually able to walk properly, in order to obtain satisfactory results.

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