THE CONSTRUCTION OF MONITORING AND CONTROLING DEVICE FOR EARTHWORM LIVESTOCK BASED ON INTERNET OF THINGS (IOT)

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ABSTRACT

Prototype Development and Control of Media Monitoring Tool Husbandry Earthworm built IOT Based aims to assist and facilitate the management Palalangon Farm in the monitoring and control of livestock farming earthworms media. To achieve the goal, this study uses the stage in the form of data collection and software development. Data collection is done by way of literature studies, interviews, and direct observation in Palalangon Farm. As for software development using prototyping methods. This research can monitor conditions of humidity, temperature, and pH media earthworm farming livestock and doing the watering and temperature regulation around livestock media. Deficiencies contained in this study include pH scale livestock monitored media is not accurate enough, and the lack of consistency. In addition, the watering is done rated less prevalent. That's because electricity is obtained by unstable soil pH sensor, as well as the waterway to make watering less reckoned with. Generally, this research can help managers Palalangon Farm in monitoring and controlling the media conditions of livestock farming earthworms, mesipun there are some drawbacks.

Keywords: monitoring system, control system, Media livestock, cultivation, earthworms, Internet of things, Prototyping.

1. PRELIMINARY

1.1. Background

Palalangon Farm is one of the goat farming and earthworms in Bandung. Located at the foot of the mountain Palasari, Palalangon Cipatat village, district Cilengkrang, Palalangon Farm was founded in 2011. Palalangon Farm has 5 main buildings are stables, feed processing, sewage treatment plant, the milk processing and production, warehouse and office. Goats were cultivated in Palalangon Farm goat species Etawa, while for earthworms are kind Lumbricius Rubellus and African Night Crawler. Worm production in Palalangon Farm typically used for various kerperluan such as animal feed, cosmetics raw materials, and raw materials. For marketing, Palalagon Farm sells directly to buyers or collectors who come to the place of production.

In the production of earthworms, it usually takes up to 40 days to harvest process, beginning with seed stocking, feeding, and maintenance. In the process of maintenance, there are some things to consider such as the amount of humidity, temperature, and pH of the media livestock. The optimal number of required media livestock is humidity of 50% to 70% so that the worm does not become dehydrated which can lead to worm out of the media livestock for soil moisture enough or the shrinking size of the worm, temperature of 15 ° C to 25 ° C so that the worms can breed well, as well as medium pH of 6 to 7.2 because if it does not correspond craw worm will become infected and swell until finally did die.

Based on the interview with Mr. Ari Saputra as the owner and manager of Palalangon Farm, the media watering livestock earthworms do in Palalangon Farm is by way of media meyiram cattle one by one. Often managers do watering late in the media resulting in media livestock cattle too dry or below the amount of moisture needed, this has resulted in media too wet cattle that have an impact on the increasing number of acid levels in the media so that livestock can lead to dead worms.

Another obstacle is the process of checking the cattle media. In the process of checking the cattle media, the manager only uses estimates and experience. The method of estimation and experience lead managers could not accurately determine the amount of moisture, pH, and temperature that exist in the media livestock. This resulted in manager can not improve the quality of cultivated earthworms or even can cause a lot of worms that die because the media livestock too wet or too dry, lime administration under or over, so the impact on the reduction or even crop failure.

Livestock media temperature settings also become one of the obstacles experienced. In Palalangon Farm, media livestock cultivation of earthworms placed in semi-permanent buildings without walls on the front, and use of asbestos as a building roof. As a result of the outdoor temperature will be very easy to get into the room, so that the amount of the temperature in the

room will be the same as the outdoor temperature. While the number of outdoor temperature does not necessarily correspond to the optimum temperature required number of livestock farming worms media at 15 ° C to 25 ° C. It can have an impact on the decrease in the amount of earthworms.

1.2. Purpose and objectives

Based on the identification of the problems described above, the purpose of this thesis is to build a monitoring system design and control media-based livestock farming earthworms internet of things. The purpose of this study is:

1. Help managers carry out watering and temperature regulation of livestock farming earthworms media automatically, by utilizing the controlling functions contained in the system is built.
2. Help managers gain accurate information about the condition of the amount of humidity, temperature, and pH so that livestock farming conditions earthworm media can correspond to optimal conditions.

2. THEORETICAL BASIS

2.1. Earthworms

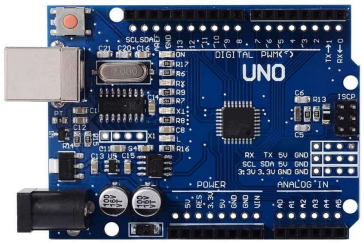
Earthworm is a worm with a tubular shape to and including the annelid phylum. Earthworms can be found in soil, they consume organic matter of life and death. Earthworms perform digestion by walking through the length of his body. Earthworms perform respiration through the skin. Earthworms have multiple transport system is of fluid that moves in the coelomic selim containing liquid and a simple closed circulatory system. Has the peripheral and central nervous system[1],

2.2. Internet of Things

Internet Of Things is a concept that has the purpose of extending the benefits of Internet connectivity are connected continuously. Internet Of Things is a technology that allows for monitoring, control, communications, cooperation with various hardware, data sharing, real virtualize everything through the internet jarngan. Internet Of Things refers to objects that can be uniquely identified as an Internet-based virtual representation. Internet Of Things originally suggested by Kevin Ashton in 1999 and became popular through the Auto-ID Center at MIT[2],

2.3. Arduino

Arduino is a popular type of electronic board to be learned or used in various electronics projects. The programming language used to configure arduino simplicity is the C programming language to learn is one of the key drivers of the increasing use arduino[3], Figure 1 shows an example of arduino.



Picture 1, Arduino Uno

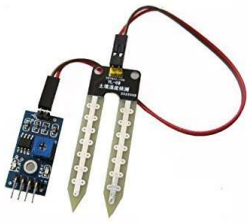
2.4. sensor DHT21

DHT21 sensors are sensors to measure humidity with a distance measurement between 0% to 100% and accuracy of ± 0.1%. In addition to providing information about the humidity, these sensors also measure temperatures between -40 ° C and 80 ° C with an accuracy of ± 0.1 ° C[3], Figure 2 shows an example of the sensor DHT21.

Picture 2, sensor DHT21

2.5. Sensor YL-100

YL-100 sensor is a sensor to measure soil moisture between 0% and 100%, and accuracy of about ± 3%. Sensor YL-100 requires an input of 3.3V to 5V and has two modes, namely digital output and analog. Figure 3 is a form of censorship YL-100.



Picture 3, Sensor YL-100

2.6. Soil pH sensor

Soil pH sensor is a sensor detecting the level of acidity (acid) or alkalinity (alkaline) soils. The pH scale that can be measured by the soil pH sensor has a range of 3.5 to 8. This sensor can be directly connected to the analog pin analog pin microcontroller arduino or more without having to use an additional amplifier modules[4], Gamber 4 is a form of soil pH sensor.

Picture 4, Soil pH sensor

3. DESIGN ANALYSIS

3.1. Problem analysis

Analysis of the problem is the assumption of the problem which will be described in the monitoring and control system development and media-based livestock farming earthworms internet of things. Analysis of problems of the current system at this time are:

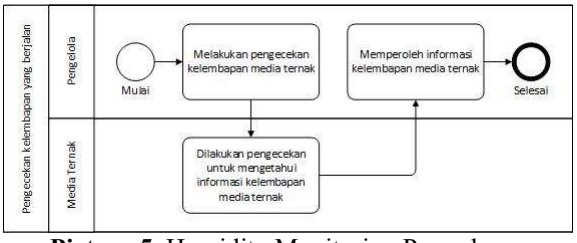
1. Business difficulties in obtaining accurate information about the condition of the amount of humidity, temperature, and pH of the media livestock because it still uses estimates and experience that resulted in conditions of livestock media does not correspond to the optimum condition.
2. Business media often melakaukan watering the cattle and have difficulty in regulating the humidity and the temperature is just right when, so the livestock media does not get enough moisture and temperature,

3.2. Analysis of the Current System

Analysis of the system running is stage or a picture to describe the system that is currently underway and aims to provide a more detailed picture of the workings of the system that is currently running.

1. Humidity Monitoring Procedures Media Husbandry Earthworm.

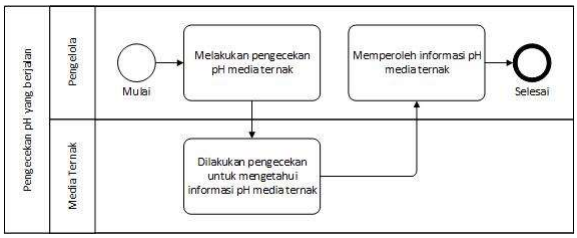
Procedures for monitoring the media moisture earthworm farming livestock can be seen in gamber 5.



Picture 5, Humidity Monitoring Procedures

2. PH Monitoring Procedures Media Husbandry Earthworm.

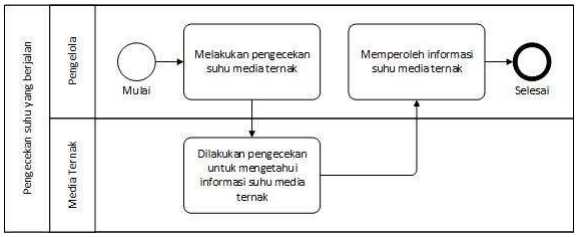
Media pH monitoring procedure earthworm farming livestock can be seen in gamber 6.



Picture 6, PH Monitoring Procedures

3. Temperature Monitoring Procedures Media Husbandry Earthworm.

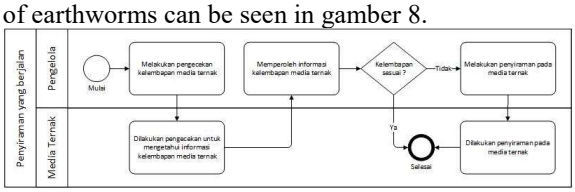
Media temperature monitoring procedure earthworm farming livestock can be seen in gamber 7.



Picture 7, Temperature Monitoring Procedures

4. Watering Media Husbandry Procedures Earthworm.

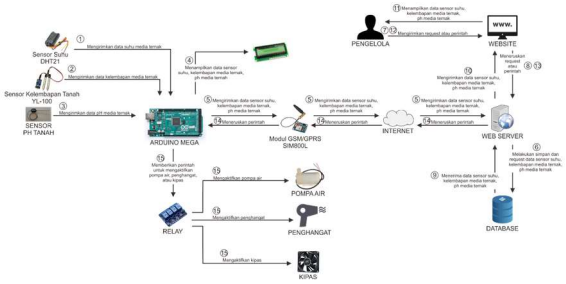
Procedure media watering livestock cultivation of earthworms can be seen in gamber 8.



Picture 8, Watering procedure

3.3. System Architecture Analysis

Analysis of system architecture is a process to describe the physical system to be built and also the components pedukungnya. Here is an overview of the system architecture to be built as in Figure 9.



Picture 9, System Architecture Analysis

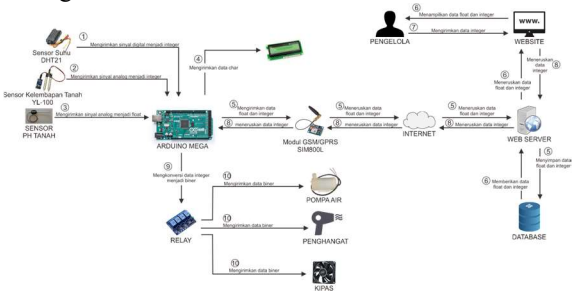
The following is an explanation of the monitoring and control system architecture media-based livestock farming earthworms IOT as shown in Figure 3-5.

1. DHT21 temperature sensor reading and transmit temperature data to the Arduino Mega.
2. Soil moisture sensors YL-100 reads and transmits data to the livestock media moisture Arduino Mega.

3. Soil pH sensor pH reading and transmit data to the Arduino Mega livestock media.
4. Mega Arduino microcontroller receives data as humidity, temperature, and pH livestock media, and display them on the LCD.
5. The data obtained will be processed and sent to the web server by GSM / GPRS module SIM800L through the Internet.
6. The web server will perform data storage media moisture livestock, livestock media temperature, and pH livestock media into the database.
7. Business system to request the data melalusi based websites.
8. Web-based systems continue to request data from a web server manager.
9. *database* mermberikan data to a web server.
10. Web server sends the data to the web-based system.
11. Web-based system displays the data being sent by the web server.
12. Management provides commands via the web-based system.
13. Web-based system sends a command to the web server.
14. GSM / GPRS module SIM800L receive commands from a web server and forwards it to the Arduino Mega.
15. Arduino Mega can process orders in and give orders to relay to turn on the water pump, heater, or fan.

3.4. Analysis of Data Communications

Analysis of data communication explaining how to communicate and transmit the data. Here is an overview of the system architecture to be built as in the figure 10.



Picture 10, Analysis of Data Communications

The following is an explanation of the data communication system of monitoring and control media-based livestock farming earthworms IOT as shown in Figure 3.6.

1. DHT21 sensor temperature reading in the form of a digital signal and sent to the Arduino Mega form of integer data.
2. YL-100 sensors read the moisture in the form of an analog signal and sent to the Arduino Mega form of integer data.
3. Soil pH sensor reading the pH of the soil in the form of an analog signal and sent to the Arduino Mega in the form of float data.
4. Arduino Mega float and integer converts data into data char and displayed via the LCD.
5. Arduino Mega store integer and float to the database by sending it through SIM800L using the Internet network.
6. Database float and integer transmit data to be displayed on web-based system which would then be accepted by the manager.
7. Management provides the command and converted by the web-based system into an integer data.
8. Web-based system sends data to the Arduino Mega integer through the Internet are received by SIM800L.
9. Arduino Mega converting integer data into binary data to enable the channel to the relay.
10. Relay sending binary data to activate the pump, fan, or heating.

3.5. Analysis of Non-Functional Requirements

Non-functional requirements analysis is the analysis to determine the system requirements specification. The specification also includes elements or components needed for the system to be built until the system is implemented.

1. Hardware needs Microcontroller

Microcontroller hardware requirements can be seen in Table 1.

Table 1, Hardware needs Microcontroller

hardware	*Details*
Arduino Mega	microcontroller
module SIM800L	Microcontroller connects to the Internet network
sensor DHT21	Air temperature sensor
Sensor YL-100	Soil moisture sensor
Soil pH Sensor	Soil pH sensor
relay	4 channel
Water pump	Watering livestock media
warmer	Warms media livestock
Fan	Cooling the livestock media

2. Hardware Client Needs

Client hardware requirements can be seen in Table 2.

Table 2, Hardware Client Needs

Type	Specification
processor	Intel Dual Core
RAM	1 GB
Hard Drive	320 GB
Mouse	serial PS2
keyboard	serial PS2
Network	LAN

3. Needs Server Hardware
Server hardware needs can be seen in Table 3.

Table 3, Needs Server Hardware

Type	Specification
Hard Drive	300 MB
physical Memory	512 MB

4. Client Software Requirements
Client software needs can be seen in Table 4.

Table 4, Software Requirements *client*

Software	Specification
system Oprasi	Microsoft Windows 7, Microsoft Windows 8, Microsoft Windows 10
Internet Browser	Google Chrome, Mozilla Firefox, Opera

5. Server Software Requirements
Server software needs can be seen in Table 5.

Table 5, Software Requirements *server*

Software	Specification
system Oprasi	Linux
web Server	Apache 2.4.37
Programming language	PHP 7.2.13
DBMS	MySQL 7.5.25

4. IMPLEMENTATION AND TESTING

4.1. Implemantasi Hardware

Hardware implementation explain what hardware is implemented for the development needs of the system.

1. Hardware Implementation Microcontroller
Implemenrasi microcontroller hardware can be seen in Table 6.

Table 6, Hardware Implementation Microcontroller

Hardware	Information
microcontroller	Arduino Mega
The temperature sensor	DHT21
Soil moisture sensor	YL-100
Soil pH sensor	Soil pH sensor
Internet module	SIM800L v2
LCD modules	I2C module 16x2
Relay module	Relay Module 4-channel

2. Hardware Implementation Client
Implemenrasi client hardware can be seen in Table 7.

Table 7, Hardware Implementation *client*

Hardware	Specification
processor	Intel Celeron Quad Core
memory	2 GB
Hard Drive	500 GB
Mouse	USB
keyboard	*serial PS2*
Network	LAN

3. Server Hardware Implementation
Implemenrasi server hardware can be seen in Table 8.

Table 8, Hardware Implementation *server*

Hardware	Specification
Hard Drive	300 MB
Phtsical Memory	512 MB

4.2. Implemantasi Software

Implementation of the software explains what software used to implement Monitoring and Control Systems Media Husbandry Earthworm Based IOT.

1. Client Software Implementation
Implemenrasi client software can be seen in Table 9.

Table 9, Software Implementation *client*

Software	Specification
Operating system	Windows 10 64 bit
browser	Google Chrome

2. Server Software Implementation
Implemenrasi server software can be seen in Table 10.

Table 10, Software Implementation *server*

Software	Specification
Operating system	Linux
web Server	Apache 2.4.37
Programming language	PHP 7.2.13
DBMS	MySQL 7.5.25

4.3. Sensor Testing YL-100

YL-100 sensor is a sensor used to detect humidity earthworm farming livestock media. YL-100 sensor testing performed with the initial

condition that cattle in the dry state media, and livestock watering to the media to know the readings from sensors YL-100. The test results YL-100 sensor can be seen in Table 11.

Table 11, Sensor Testing Results YL-100

Condition	result
Media condition of livestock in the dry state (before watering)	38%
Condition of livestock media in damp state (after watering)	73%

4.4. Sensor Testing DHT21

DHT21 sensor is a sensor used to detect the temperature around media livestock cultivation of earthworms. DHT21 sensor testing performed with the initial condition that DHT21 sensor is not influenced or brought closer to anything, then flame of a candle brought closer to DHT21 sensor to determine changes in the sensor readings. The test results of DHT21 sensor can be seen in Table 12.

Table 12, Sensor Testing Results DHT21

Condition	result
DHT21 sensor is not influenced or brought closer to anything.	32° C
Sensor DHT21 brought closer to the fire.	36° C

4.5. Soil pH Sensor Testing

Soil pH sensor is a sensor used to detect the amount of media pH on livestock farming earthworms. Testing the soil pH sensor is done by plugging into the soil pH sensor earthworm farming livestock media. Results of testing soil pH sensor can be seen in Table 13.

Table 13, Soil pH Sensor Testing Results

Time	result
14:11:23	-1.97
14:30:15	7.8
14:33:38	8.64
14:34:45	8,43

4.6. Testing Water Pump

The water pump is a device used to perform the media watering livestock farming earthworms. Testing the water pump is done with the initial conditions that the water pump was turned off. Initial conditions testing the water pump can be seen in Figure 11.

Picture 11, Non-Active Water Pump

Furthermore, the pump is activated via the system by pressing the button on, the pump will do the watering of the livestock media. In figure 12 is shown the end of pump testing conditions with the state of the water pump has been activated.

Picture 12, Active Water Pump

4.7. testing fans

The fan is a device used to lower the temperature around media livestock cultivation of earthworms. Tests carried out by the initial condition of the fan is the fan is turned off.Furthermore, the fan is activated through the system by pressing the button is active, the fan will be active. 13. In the image shown in the condition of the fan in the active state.

Picture 13, Active fan

4.8. testing heater

Heater is a device used to raise the temperature around media livestock cultivation of earthworms. Testing is done by heating the initial conditions that heating is turned off.Furthermore, heating is activated via the system by pressing the button is active, the heating will be active. Results of testing warmers can be seen in Table 14.

Table 14, Testing Results heater

Condition	result
Button and the system status shows "Non-Active"	Non-active
Button and the system status shows "Active"	Active

5. FINALE

5.1. Conclusion

Berdasarkan results of testing software and hardware that has been created, it can produce the conclusion that the system has been built to monitor the conditions of humidity, temperature, and pH media ternak.Selain worm livestock farming, a system that has been built can make settings livestock media conditions cultivation of earthworms in the form of watering and temperature regulation.

The system has been built still needs to be done to kedepanya development, with the aim of the system has been built to work better, As for suggestions for the development of a system built in the form of the system can provide information on the conditions of pH on media livestock cultivation of earthworms with more accurate and consistent, the system can do watering the media livestock cultivation of earthworms to more evenly, add functionality to the system to be able to do setting conditions of pH on worm farming livestock media, and the system can perform remote monitoring and control of more than one media livestock cultivation of earthworms.

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