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Modeling an Intelligent Agriculture System Simulation Based on Mobile Cloud Internet of Things (IoT)

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Intelligent systems based on the Internet of Things (IoT) used for analysis and monitoring needs are present in all areas of human life and agriculture. Through the smart system was created, it can provide recommendations for management and also improving for agricultural and livestock production. Monitoring is done by collecting data (data collecting) and being modeled from several temperatures, humidity, gas, distance measurement, light indicators. The concept of E-Agriculture (Electronic Agriculture) is limited to monitoring environmental conditions of agricultural production and also provides an overview of E-Agriculture or E-Farm modeling on a larger scale. The E-AgriFarm intelligent system simulation using Arduino Controller and Blynk's Cloud IoT has a temperature measurement range of 26 - 31 ^{0}C, Relative humidity (RH) from 47% - 64%, and detection of a water level of at least 40-50 cm meters for drinking containers for each livestock with a capacity of 20 liters, and the systems can detect the level of pollution of gas leaks. Thus the E-AgriFarm smart system can provide management recommendations and increase the livestock production system to be better monitored and controlled.

Keyword : Smart System, *E-Farm*, *Blynk*, *Internet of Things* (*IoT*)

1. Introduction. The rapid development of the times and the need for food for humans force us to continue to think and innovate for appropriate technology and provide many benefits to human life. Especially for Indonesia, where the average economy of the population in rural areas works as farmers and ranchers, needs a smart system that can help them improve the management and production of agricultural land and livestock that they manage, it is time for them to be introduced to a smart system for managing agricultural land and livestock is even better. One of them needs to be recommended a system that can provide real-time data, in order to make it easier for farmers and breeders to monitor agricultural irrigation systems, room temperature conditions in agricultural or livestock production areas, to monitoring lighting conditions and room humidity. The data generated from the results of monitoring / monitoring can later be reviewed and analyzed for materials to consider improving the management and process of agricultural and livestock production.

2. Theory. Internet of Things (IoT) is a concept that expands the benefits of technology and internet connectivity, and has the ability to share data (data sharing), remote control between various areas of human life. Some

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applications of IoT technology: Smart Home: internet technology-based smart home system, Smart Industry: Intelligent industrial process control and monitoring system, Smart Agriculture / Farm: a smart system of monitoring and control on agriculture / livestock, Smart Health: Intelligent health monitoring and control system, Smart Transportation: Intelligent system for monitoring and controlling information as well as transportation traffic management. In every control system, basically 2 basic components are needed, namely:

a. Sensor
   Sensors are used to detect desired physical variables such as temperature, distance measurement, readings of gaseous materials, etc. The sensor / transducer is also used to convert physical variables into an alternative quantity (usually an electric voltage) which can be interpreted as a measured variable value.
b. Actuator
   The actuator is a piece of hardware used to convert the controller command signal into physical parameters.

Electronic Agriculture is a concept and implementation that was introduced in the field of agriculture and animal husbandry to monitor and control agricultural production systems from nurseries to management of agricultural production. Temperature measurement used for knowing the condition of air temperature in the production area and also livestock. Humidity measurement is to determine the level of air wetness (the amount of water contained in the air) expressed as a percentage relative to the saturation point. The unit of humidity that is commonly used is RH, which is Relative Humidity. RH is a unit of measurement that represents the number of water droplets in the air at a certain temperature compared to the maximum number of water droplets that can be contained in the air at that temperature.

RH is expressed as a percentage value. Hot air can store more water droplets than cold air. The higher the RH value, the higher the condensation. 100% RH means that the addition of droplets of water in the air will immediately condense. The ideal humidity level is 50-55% RH. 50% RH indicates that the air is half filled with the maximum capacity of water that can be held in the air.

3. Method. Research conducted using simulation modeling that represents a real process to understand how the system works and performs an experimental test method from a model of test equipment designed to find solutions to agricultural and livestock needs, especially monitoring the environmental conditions of agriculture and livestock. The control system

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used is an open loop control system where the output value has no effect on the control action.

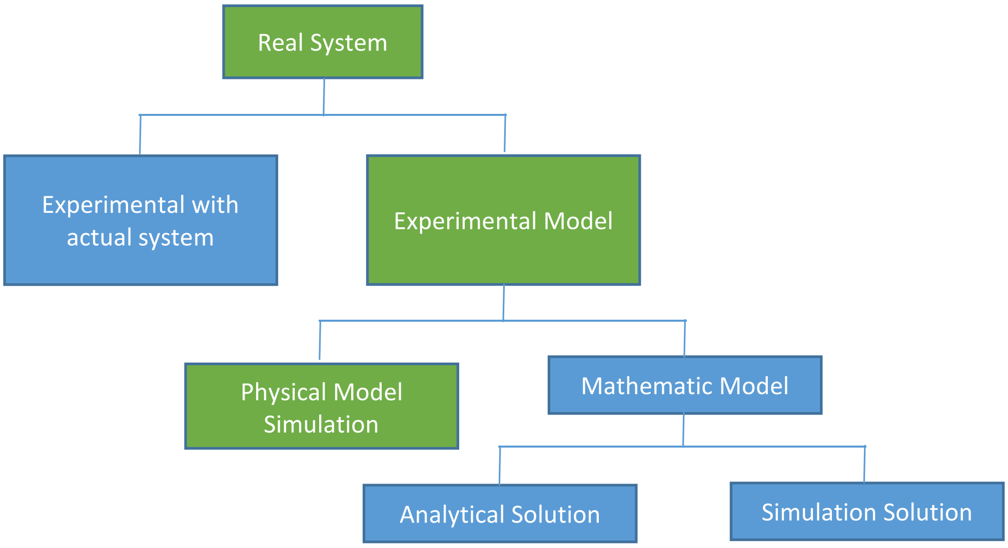

Figure 1. E-AgriFarm simulation research method

In conducting simulations, steps are needed to formulate the problem until its application is in accordance with the results of field experiment tests.

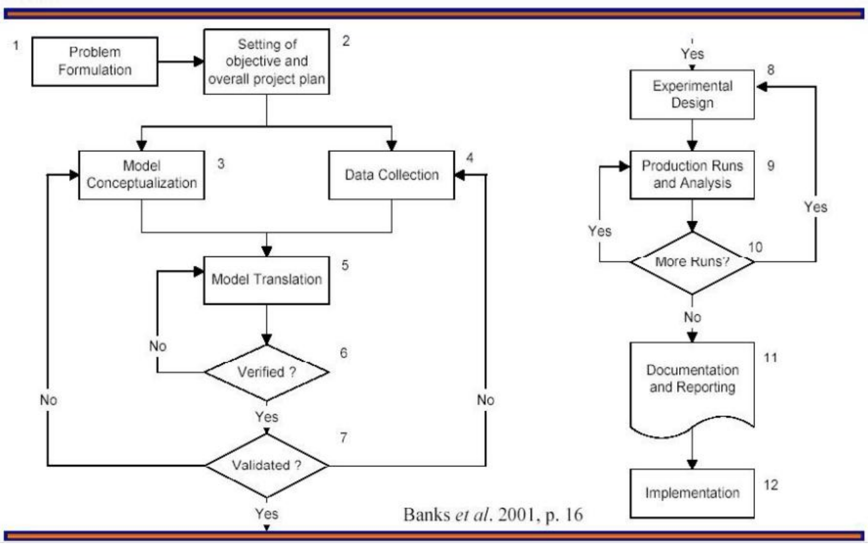

Figure 2. Simulation Study Steps (Bank et al. 2001, p. 16)

To ensure that the system model works well at a certain scale, a test kit consisting of: Arduino Uno R3, 16x2 LCD, Blynk Cloud IoT, Temperature

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sensor, Humidity Sensor, Ultrasonic Sensor (Range/Level Detection), Gas Sensor (Gas Leak Detection), ESP8266 LAN Wifi Modem.

4. Testing & Analysis. The description of the simulation model used in this study consists of 4 important parts including the irrigation system, nursery area, production area and monitoring center.

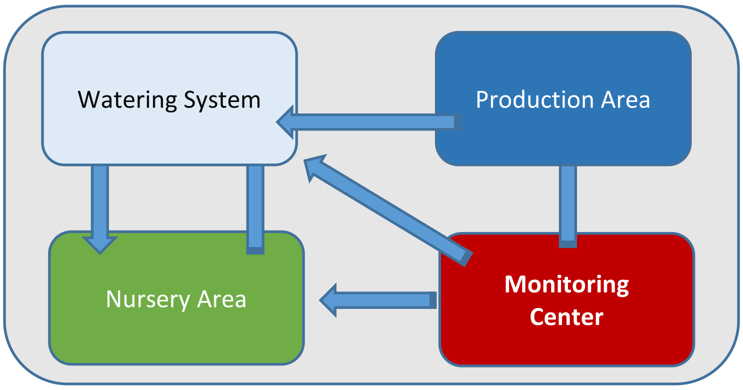

Figure 3. E-AgriFarm Smart System Simulation Schema

The Smart System Monitoring Tool will detect several parameters of real system modeling with the following details: a) At the same time all sensor devices are activated, namely temperature sensors, ultrasonic sensors to detect incoming / moving objects, gas sensors, alarm detection of object movements and gas leaks, monitoring devices for lighting conditions in agricultural / livestock production areas. b) Each of these control and detection devices will send information via the LCD display and also the Blynx application installed on the Android smartphone for realtime monitoring. c) All monitoring data will be sent and stored into the database via a WIFI LAN network connection installed in the agricultural and livestock environment.d) Monitoring data will be reviewed and analyzed in an effort to manage and increase agricultural and livestock production yields.

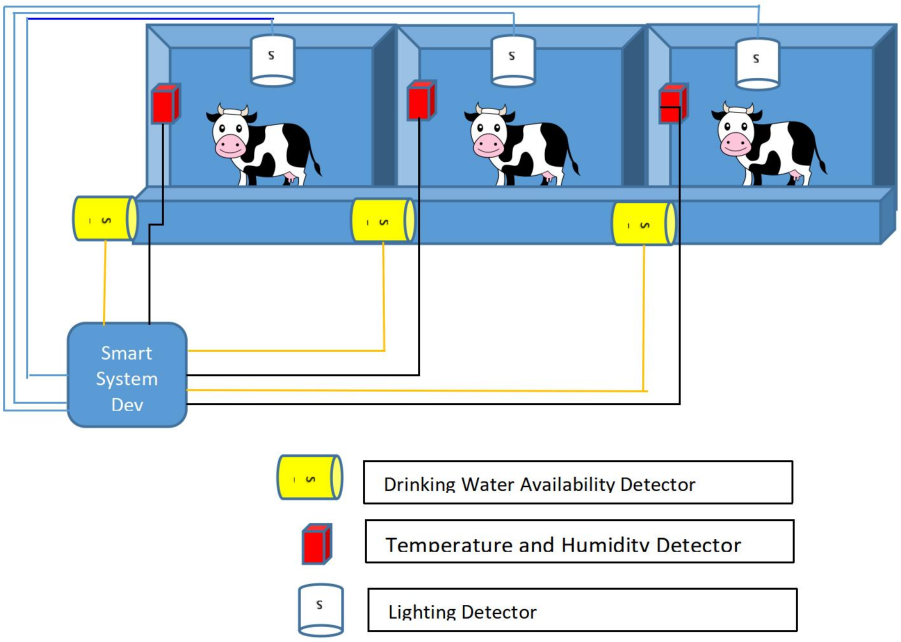

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Figure 4. E-AgriFArm system monitoring workflow

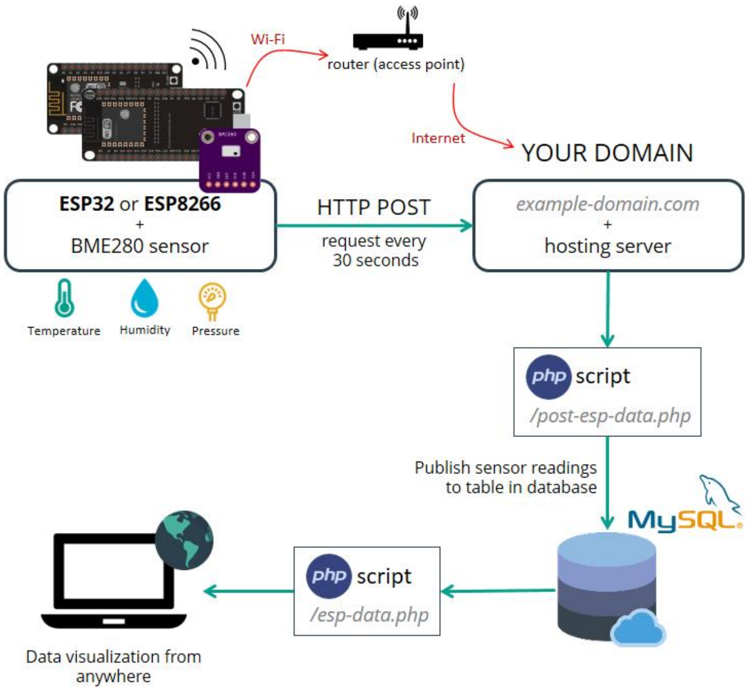

Figure 6. *E-AgriFarm Application Infrastructure*

By the E-AgriFarm system monitoring workflow in Figure 7. the application layout to be designed later is as follows:

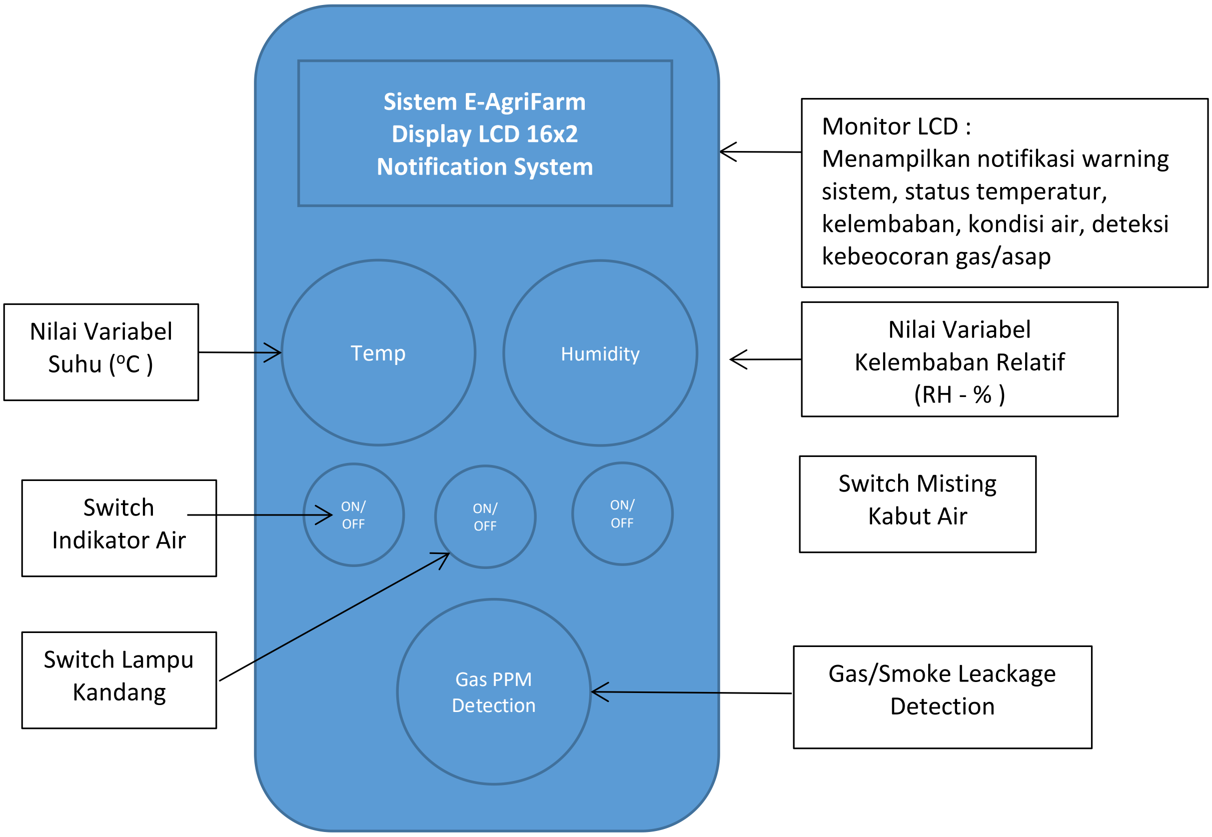

Figure 7. layout design of the E-AgriFarm blynk application

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According to the UGM Faculty of Veterinary Medicine (2018), the cage is a home for animals and a means to carry out various production activities and other livestock activities. The cage has an important function to protect animals from various weather such as heat, cold and rain. For this reason, a temperature and humidity monitoring device is needed in the cage area.

Especially for animals such as cows, there are several references for ideal cages, including:

a) The length and floor width are 2.10 x 1.45m and 2.10 x 1.5m
b) The length of the ration and drinking water is as wide as the cow
c) The depth of the cattle ration is +/- 40 cm
d) The depth of the water for drinking cows is +/- 40 cm
e) There is a ditch +/- 20 cm deep and 20-30 cm wide
f) There is a road between row cages with a width of 1 meter
g) The cage is made in such a way that sunlight can enter the cage area
h) Moisture needed by cows is 60-70%
i) The roof of the stable is made of lightweight material
j) The walls of the cow shed are made sturdy protected
k) The place for feed is wide so that it makes it easier for
l) The place to drink is made so that water is always available every

Furthermore, according to Pandu Anugerah in a publication entitled "The concept of a healthy building in a cow shed in the case study of UPTTPT and HMT Kota Batu", the standard temperature for cow sheds in Indonesia that must be achieved is between 10oC - 27oC and the strategy of cooling the cage uses water sprinklers, fans and vegetation to help. lowering the temperature in the dairy cow pen. As a testing phase for the work of sensors and relays before being connected to the application, connectivity testing is carried out and the results can be seen in Table 1.

Table 1. Device Connectivity Testing

Device	Function	Status	Interface Data/Signal Pin
Sensor DHT11	Temperature Detection	*Success*	Analog A4
Sensor DHT11	Humidity Detection	*Success*	Analog A4
Sensor MQ2	Gas Leakage Detection	*Success*	Digital D10
Sensor LM35	Temperature Detection	*Success*	Analog A0
Sensor Ultrasonic	Water Level	*Success*	Digital D12, D13

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HC-04	Detection		
LCD 16x2	Parameter Display	*Success*	Digital D2, D3, D4, D5, D6, D7
Relay 1N	Room Lighting	*Success*	Analog A1
Relay 2N	Water Indicator	*Success*	Analog A2
Relay 3N	Misting System	*Success*	Analog A3
Relay 4N	Emergency Alarm	*Success*	Analog A4

Table 1 shows that all sensor and relay devices are connected successfully and will be ready to be integrated into the Blynk application to monitor the measurement results of the sensors and indicators needed.

By using the MySql database system which is triggered by readable indicators and sensors, measurements of temperature and temperature variables are generated as in Table 2.

Table 2. Temperature and Humidity Measurement

idrec	timestamp	(RH - %)	(ºC)
402	04/08/2020 16:28	64.0	31.0
403	04/08/2020 16:29	65.0	31.0
404	04/08/2020 16:30	65.0	31.0
405	04/08/2020 16:31	65.0	31.0
406	04/08/2020 16:31	65.0	31.0
407	04/08/2020 16:32	65.0	31.0
408	04/08/2020 16:32	65.0	31.0
409	04/08/2020 16:33	65.0	32.0
410	04/08/2020 16:34	65.0	31.0
411	04/08/2020 16:34	65.0	31.4
412	04/08/2020 16:35	66.0	31.2
413	04/08/2020 16:35	66.0	31.2
414	04/08/2020 16:36	66.0	31.3
415	04/08/2020 16:36	66.0	31.3
416	04/08/2020 16:37	66.0	31.2
417	04/08/2020 16:37	66.0	31.2
418	04/08/2020 16:38	66.0	31.3
419	04/08/2020 16:38	65.0	31.0
420	04/08/2020 16:39	65.0	30.8
421	04/08/2020 16:39	65.0	30.6
422	04/08/2020 16:40	65.0	30.2
423	04/08/2020 16:41	66.0	29.8
424	04/08/2020 16:41	67.0	29.9
425	04/08/2020 16:42	67.0	29.7
426	04/08/2020 16:42	66.0	29.7
427	04/08/2020 16:44	67.0	29.5

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428	04/08/2020 16:44	67.0	29.2
429	04/08/2020 16:45	68.0	29.3
430	04/08/2020 16:45	68.0	29.1
	Average	**65**	**30,7**

In accordance with healthy cage guidelines, where a healthy enclosure environment requires an RH (%) value between 60% - 70%, the E-AgriFarm smart system detects an RH value of 65% on average. Meanwhile, the standard conditions for a healthy cow shed temperature are 10ºC - 27ºC, and the E-AgriFarm smart system detects an average temperature of 30.7ºC. Thus the E-AgriFarm smart system will be ordered to be able to reduce the temperature to 27ºC by utilizing water circulation and water misting techniques in the cage area. Water Level Warning System Testing is carried out to determine the condition of the availability of drinking water for livestock and also the circulation of water which will be needed to help reduce the temperature of the stables according to livestock health standards.

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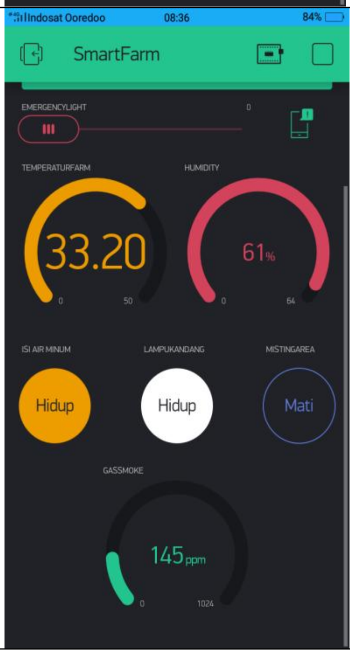
If the drinking water container is lacking in minimum water availability, the system will add water from the existing irrigation system. Gas/Smoke Leackage Warning System test is conducted to determine air quality, especially for gas and smoke pollution that may occur in livestock production areas. In accordance with the MQ2 sensor used, the indicator will work as well as PPM reaches a value of 300 which indicates the air quality is not healthy for livestock and other living things. Testing of sensor and relay integration through the Blynk application which is provided in the form of an android smartphone application is carried out to see that the smart system model designed has good performance and functionality.

Table 3. Blynk Integration

<table>
<tr><th>Blynk Application Display</th><th>Notes</th></tr>
<tr><td>
</td><td>This Monitoring System indicates that all the measurement working well, specially some device were triggered Off.

Variabel Information :
Temperature : 32^0C
Relative Humidity : 60%
Room Lighting : On
Water Pump : On
Misting System : Off

Gas/Smoke : 174ppm</td></tr>
<tr><td>
</td><td>This Monitoring System indicates that all the measurement working well, specially some device were triggered Off.

Variabel Information :
Temperature : $33{,}2^0$C
Relative Humidity : 60%
Room Lighting : On
Water Pump : On
Misting System : Off

Gas/Smoke : 145ppm</td></tr>
</table>

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Table 3 above shows that the E-AgriFarm smart system is running very well and several variables show the value of each sensor and indicator that changes according to the environmental conditions of the observation.

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SUMMARY
The Mobile IoT-based E-AgriFarm Smart System Model can detect various indicators and measurements of temperature, humidity, water availability, and air pollution detection to increase livestock production output. This model can provide monitoring systems for agricultural production on a larger scale.

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