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DESIGN AND BUILD SMART AGRICULTURE USING COGNITIVE INTERNET OF THINGS (C IOT)

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Abstract. In Indonesia, agriculture is required to be able to develop growth in the region and be able to produce agricultural products that have high competitiveness while also empowering the community. IoT, or commonly known as the Internet of Things (Internet of Things), allows us to connect to various things. For example, we can use a smart farm. This research leads to the implementation of a plant sprayer that uses the Cognitive internet of things that can be integrated into farmers and factories whose raw material uses corn. This irrigation system uses a NodeMCU microcontroller, automatic discharge using a DC water pump, a soil moisture sensor using a capacitive soil moisture v.2 sensor. The system used uses fuzzy logic algorithms as data processing. The sensor data shows the 70% soil moisture value displayed on the smartphone so that the system will water or not automatically until the soil moisture value is as needed. Soil moisture in this system is in 3 criteria, namely dry, normal, and wet. Watering produced by this system with an average time duration of 8 seconds. This farming system is designed to increase productivity and predict problems in agriculture. This analysis illustrates that the Cognitive internet of things has great potential in agricultural technology because it can increase and facilitate corn production for farmers.

Keywords: cognitive internet of things; algoritma fuzzy logic; soil moisture sensor.

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INTRODUCTION

Technological developments in the current era of globalization have an impact on all aspects of life. For example, the impact that arises on work in agriculture (Wandi & Husni, 2019). An important aspect of plant growth in agriculture is the watering process, because plants need nutrients contained in the soil. In order for watering to remain in the best condition, monitoring must be carried out so that the plants being treated do not show too much or lack of water, which can cause plants to die (Afif, Kastono, & Yudono, 2014). Watering plants is influenced by various factors, namely air temperature and soil humidity. Especially in corn farming. Because soil moisture is an element that is very influential on plant growth (Yan, Marschner, Cao, Zuo, & Qin, 2015); (Leghari et al., 2016).

In a dry climate, corn plants can grow better. Corn sensitivity to foggy weather, rainfall and rainfall intensity. This plant most requires (at least) 70% sunlight radiation), 50-70% relative humidity, and an air temperature of 25-320 ° C. The increase in population causes an increase in the demand for corn. The Central Statistics Agency (BPS) and the Directorate General of Horticulture (DJH) stated that from 2017 to 2020 Indonesia's onion production has always increased from 1 470 155 tons, 1 503 438 tons, 1 580 247 tons, to 1 815 445 tons.

Based on these problems, a smart farming is needed which is an innovation from modern IOT-based agriculture and also android (Dewi, Ulinuha, Mustofa, Kurniawan, & Rakhmadi, 2021). Irrigation care or watering using a smart farm, a system is needed that can provide automatic decision making in the form of decision data when watering is needed. , when watering is not needed, and how much water is needed for irrigation. Plant watering systems using mobile applications with Internet of Things (IOT) communication methods can help farmers monitor and water plants (Wasista, Saraswati, & Susanto, 2019). So if there is an automatic watering system it will really help watering evenly as needed (Fauziah, Susila, & Sulistyono, 2016).

This system can be authorized via an IoT-based communication link, so that data monitoring and irrigation scheduling can be done via an Android smartphone (Kumar, Surendra, Mohan, Valliappan, & Kirthika, 2017). A system that uses Internet of Things technology uses wireless sensors to process data obtained by sensors and turns it into information (Tzounis, Katsoulas, Bartzanas, & Kittas, 2017). As well as a decision support system for plant care or watering using input from soil moisture on a microcontroller machine by using fuzzy logic method (Muslihudin, Renvillia, Taufiq, Andoyo, & Susanto, 2018). The IoT concept is divided into 3 layers, namely the network layer (data transmission), the perception layer (sensing), and the application layer (data storage). Modern agriculture is becoming more industrialized (Kremen, Iles, & Bacon, 2012).

These combinations called Cognitive Internet of Things (C IoT) are a combination of cognitive computing technology and data collected from connected devices (Sassi, Jedidi, & Fourati, 2019). This has led to the development of ubiquitous computing, which has led to heterogeneous infrastructure challenges (Sassi et al., 2019). Through an objective context, the Internet of Things solves the challenges represented in context awareness by producing intelligent systems that meet user needs as shown in Figure 1.

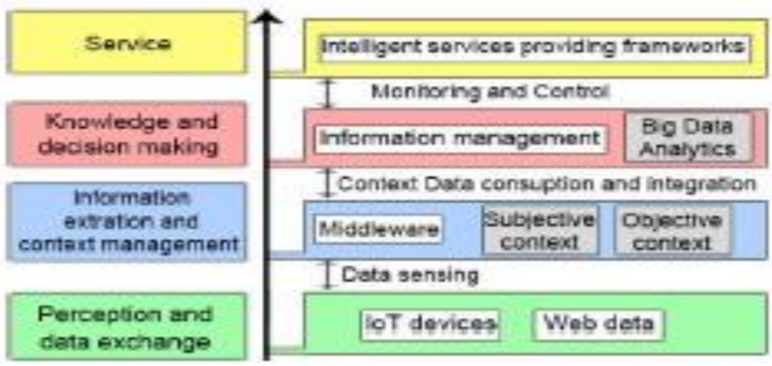


Figure 1. C IoT Architecture (Sassi et al., 2019)

Based on this explanation, it is necessary to develop a smart agriculture model that is integrated with factories made from corn using the Cognitive Internet of Things (IoT) network formed in cloud computing using data mining (Fuzzy logic). This makes it easier for corn farmers to monitor the condition of corn plants and carry out watering automatically so that they can improve agriculture and are integrated with factories made from corn (Grigorova, 2019).

METHODS

The method used is a type of applied research (applied research). The implementation of the work is carried out by designing software and hardware designs as well as implementing cognitive internet of things (C IOT) based tools. Applied research is usually used by companies, agents or individuals who aim to find solutions to a current problem that is being faced by society or industrial/business organizations (Costa, Soares, & de Sousa, 2020). The stages of this research are as follows:

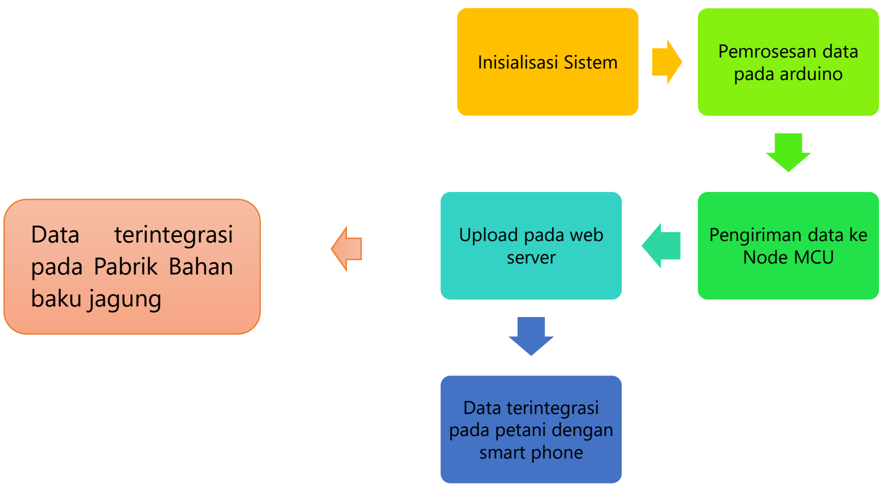
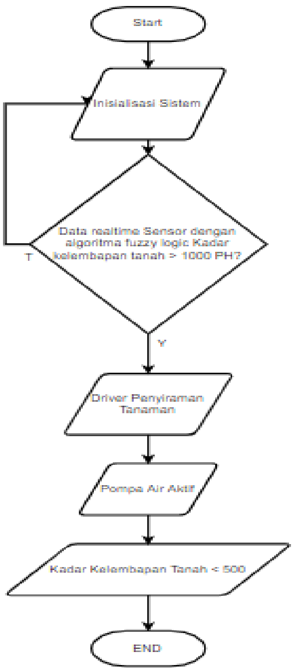


Figure 2. General Stages of Research

This system starts by initializing the system and then checking the soil moisture with sensor data which is processed using Arduino, then Arduino data is sent to the MCU Node and then uploaded to the web server, so the sensor data will be displayed on the farmer's smartphone via the internet. data from agriculture is also integrated in factories made from corn.

Flowchart Sistem

The flowchart of this system describes the process of running the application as shown in Figure 3.

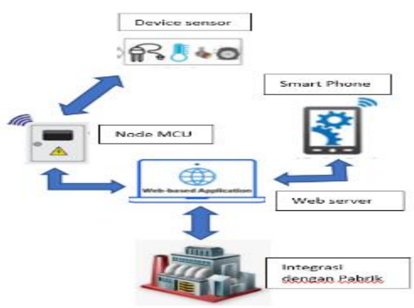


Gambar 3. Flowchart Sistem Smart Agriculture Mennggunakan Internet Of Things (IOT).

The system starts from the next initialization if the PH is greater than 1000 the data will be displayed on the smart phone which is processed using a fuzzy logic algorithm then the plant watering driver is activated so that the Water Pump automatically activates and performs watering after the soil moisture content is less than 500 then watering stops.

Diagram Blok

Based on the block diagram on the system design are as follows:



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Algoritma Fuzzy Logic

Fuzzy Logic Algorithm is a process to get a clear input value. Each appropriate fuzzy set can determine the degree of membership. After the membership value is obtained, the minimum operation or maximum operation is then used to perform the process of calculating the truth value of each existing premise. If the premise of a rule has a non-zero degree of truth, it can be said that the rule is said to be triggered (Arhami, 2005). Suppose min is operated as follows:

$V_1 = \text{mln}\ (\mu 1(\mu), \mu 3(\mu)) \Rightarrow$ terpicu (*fired*) ; $V_2 = \text{mln}\ (\mu 1(a), \mu 4(a)) \Rightarrow$ terpicu (*fired*)
$V_1 = \text{mln}\ (\mu 2(a), \mu 3(a)) \Rightarrow$ terpicu (*fired*) ; $V_1 = \text{mln}\ (\mu 2(a), \mu 4(a)) \Rightarrow$ terpicu (*fired*)

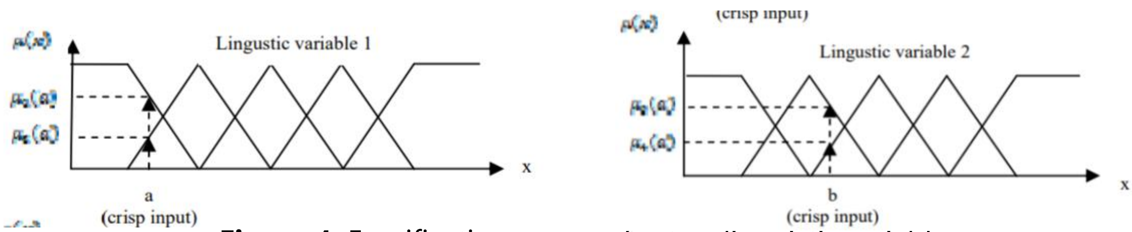


Figure 4. Fuzzification process for two linguistic variables

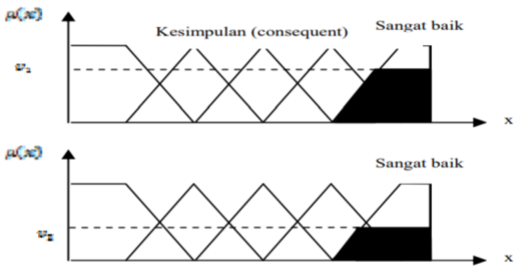


Figure 5. The process of forming a "Very Good" fuzzy set

RESULTS AND DISCUSSION

Implementasi Hardware

The Smart Farm system consists of an internet-based soil moisture control and monitoring subsystem. Internet of Things (IoT) and Android.

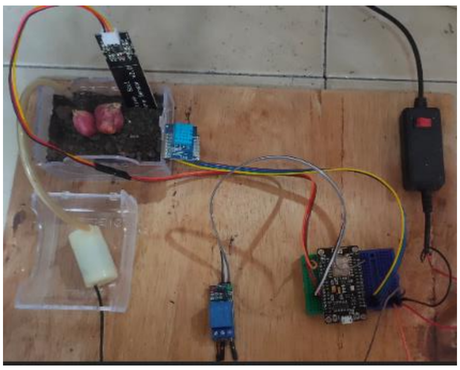


Figure 6. Implementation of sensor installation with node MCU ESP8266

Implementation On Smart Phone

This smart farm system uses the blynk application. This application displays a sensor graphic, an LCD in the description of the soil and pump, the value of soil moisture, and the on or off status of the pump.

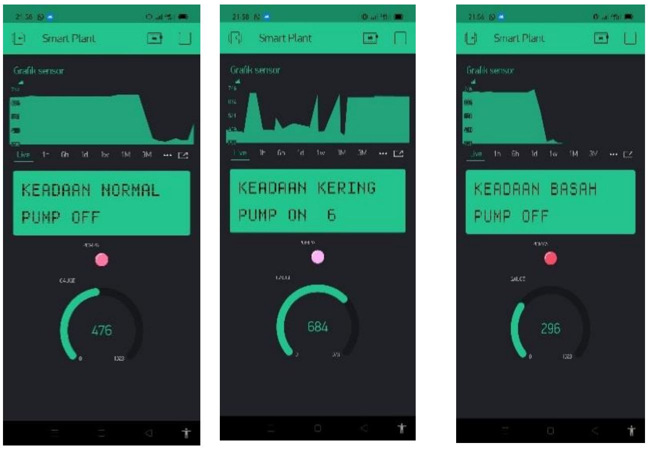


Figure 7. Smart Farm Application Display in Dry, Normal, and Wet Conditions

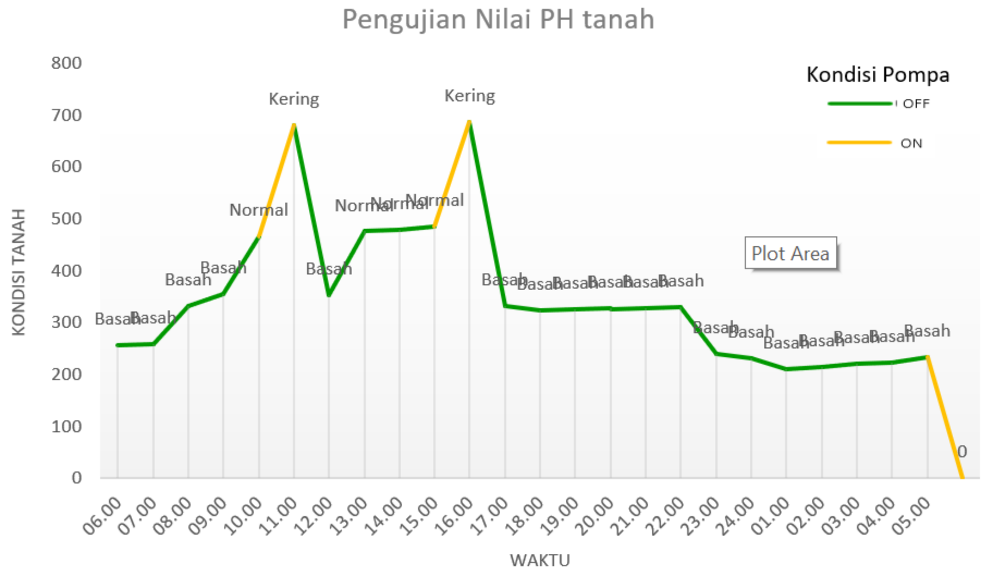
Testing on Smart Farm System

The smart farm system connected to the MCU node is tested with several sensor modules. The purpose of testing this sensor is not to measure the accuracy of sensor readings so that humidity readings are obtained that are suitable for corn plants.

Table 1. Testing Soil Moisture Value

No	Waktu	Nilai PH tanah	Keterangan Kondisi Tanah	Kondisi Pompa
1	06.00	256	Basah	Off
2	07.00	258	Basah	Off
3	08.00	332	Basah	Off
4	09.00	356	Basah	Off
5	10.00	467	Normal	Off
6	11.00	680	Kering	On
7	12.00	354	Basah	Off
8	13.00	476	Normal	Off
9	14.00	480	Normal	Off
10	15.00	485	Normal	Off
11	16.00	687	Kering	On
12	17.00	332	Basah	Off
13	18.00	324	Basah	Off
14	19.00	325	Basah	Off
15	20.00	327	Basah	Off
16	21.00	328	Basah	Off
17	22.00	331	Basah	Off

No	Waktu	Nilai PH tanah	Keterangan Kondisi Tanah	Kondisi Pompa
18	23.00	240	Basah	Off
19	24.00	231	Basah	Off
20	01.00	210	Basah	Off
21	02.00	215	Basah	Off
22	03.00	220	Basah	Off
23	04.00	223	Basah	Off
24	05.00	234	Basah	Off



Graph 1. Soil Moisture Value Test

The results of the measurement of the moisture oil sensor are used as the results of actual temperature measurements. The reading of the PH sensor module in order to monitor plant PH levels has a very important effect on plant growth. From the test results in the morning there was a decrease in the PH value of soil moisture and its value increased by 70% during the day. The output produced in this study is the condition of soil moisture in 3 criteria, namely dry, normal and wet. The results of this study showed a soil moisture value of 70%. Watering in this study had an average duration of 8 seconds.

CONCLUSIONS

This study proposes an automatic watering control system using soil conditions (humidity) using fuzzy logic. The output produced in this study is the condition of soil moisture in 3 criteria, namely dry, normal and wet. The results of this study indicate that the soil moisture value is 70%. Watering in this study has an average duration of 8 seconds.

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