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Smart System In Rice Field Implementation With Fuzzy Logic

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ABSTRACT

Rice fields have a strategic function, because they provide primary food for the Indonesian population. and the conversion of paddy fields tends to increase which forms the emergence of new feuds because agricultural sector land will be replaced with housing or factory sectors. This is so necessary to make the latest rice fields because the planting and harvesting process is not mandatory in large rice fields. As for using the components used such as wemos D1 R1 microcontroller, soil moisture sensor, DHT sensor, RTC sensor, relay, fan and pump. and also produced the results of his research which were obtained in the test results that were declared successful, in the form of implementing fuzzy logic with a rule base on a microcontroller with Soil moisture and DHT sensor inputs. and as a fan and pump output with fuzzy sets included in the form of fast, medium, long and fertilization scheduling using RTC sensors. With the addition of technology, modern farmers need to receive more effectiveness in monitoring systems and plant care.

KEYWORDS
Persawahan
Microcontroller
Fuzzy Logic
Modern Farmer

1. Introduction

Rice fields have a strategic function, because they provide primary food for the Indonesian population. Data on the standard area of paddy fields for all of Indonesia proves that approximately 41% are found in Java, and around 59% are outside Java (BPS, 2018) using the existing rice field area will be very unfortunate if the use of rice fields is not optimized by farmers. Paddy paddy land is used to grow several crops that can be consumed, either continuously (throughout the year) or in turns. The term paddy field does not mean a taxonomic word, but generally as well as forest land, plantation land, agricultural land and so on [1]. The standard area of paddy fields for all of Indonesia is 8.1 million ha, about 43% is found in Java, and about 57% is outside Java.

In Java the impact of conversion of raw rice fields tends to decrease in area, as well as in areas outside Java the impact of conversion of rice fields that occur naturally and are difficult to avoid, the development of indoor rice fields must be more intensified. The slowdown in extensification coupled with the insistence on the conversion of paddy fields for the development of the lain sector resulted in a decrease in the standard area of paddy fields.

With the reduction of raw rice fields, it will disrupt the national food sector. Most paddy fields outside Java have productivity and production that is difficult to outperform rice fields in Java. The number of workers in the agricultural sector is very limited, the low mastery of agricultural technology by farmers and the limited workforce in the agricultural sector are obstacles in efforts to increase food production in Indonesia. Efforts to increase food production through the opening of new paddy fields will not be fully successful in the short term.

From the above problems, it is necessary to make efforts to create new rice fields for effective food production, by utilizing existing empty areas both indoors and outdoors. So that the national food sector is not only centered on the raw rice field area which is increasingly exhausted, replaced by the construction sector of residential areas and factories and government infrastructure. Therefore, it is necessary to implement a smart system of fuzzy logic-based rice fields. With the smart system of smart rice fields based on fuzzy logic, it is expected to further optimize the performance of farmers, because it can control the state of rice fields automatically. The purpose of this research is to implement an intelligent system of automatic control on smart rice fields based on fuzzy logic.

2. Method

The following is a methodology for designing software systems using the waterfall model.

Figure 1. Procedure Flow 1

In figure 1 is the flow of procedures in the implementation of the fuzzy logic-based smart rice field Smart System, starting from the plan, analysis, design and implementation design.

a. Plan

is the first step in conducting research by collecting data in monitoring rice fields. It will be created by designing smart rice fields using web-based wemos D1 R1 by implementing fuzzy logic.

b. Analysis

as steps in collecting data, preparing the design of smart rice fields with wemos D1 R1 and recording the hardware and software used as system manufacturing.

c. Design

The design is the development stage after the system analysis is carried out. Design smart rice fields using wemos D1 R1 using flowcharts for workflow. In this design will use software and fuzzy logic as a method to give commands to the system.

d. Implementation

The results of the study will be tested in real time to assess how well the smart rice field design product with the web-based D1 R1, which has been made and correct if there are errors that will occur.

Table 1. Component Description 1

NO	Nama Komponen	Pin	Pin2	Pin3	Pin4	Pin5	Pin6
1	soil mosture	VCC	GND	G0	A0		
	Wemos D1R1	5V	GND	GPIO0	A0		
2	DHT 22	VCC	GND	D0			
	Wemos D1R1	VCC	GND	GPIO0			
3	RTC	VCC	GND	SDA	SCL		
	Wemos D1R1	VCC	GND	SDA	SCL		
4	Relay 4 Chanel	VCC	GND	IN 1	IN 2	IN 3	
	Wemos D1R1	VCC	GND	12		14	
5	Adaptor 12V 2	12V	GND				
	Pompa DC 12V 1		GND	12V			
	Relay 4 Chanel IN 1	C		NO			
6	Adaptor 12V 2	12V	GND				
	Pompa DC 12V 2		GND	12V			
	Relay 4 Chanel IN2	C		NO			
7	Adaptor 12V 1	12V	GND				
	Kipas In		GND	12V			
	Relay 4 Chanel IN 3	C		NO			
8	Adaptor 12V2	12V	GND				
	Kipas Out		GND	12V			
	Relay 4 Chanel IN 4	C		NO			
9	Adaptor 12V	12V	GND				
	Wemos D1R1	VCC	GND				

The component box contains a 4 channel wemos D1 R1 relay, RTC module, 12V DC adapter connector and 12V DC pump.

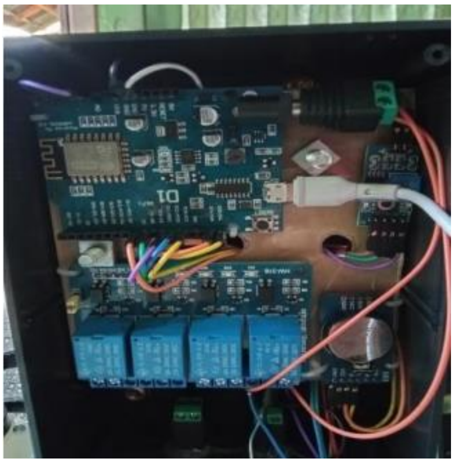

Figure 2. Rancan Build Series 1

The use of soil mosture sensors to determine humidity levels, and DHT 22 to determine air humidity and temperature.

a. Fuzzy Tsukamoto implementation

This is the next step after setting fuzzy variables, fuzzy sets, membership functions and fuzzy rule bases, then the next step is to determine the values of a and z in the fuzzy inference system to the values in the Defuzzification step.

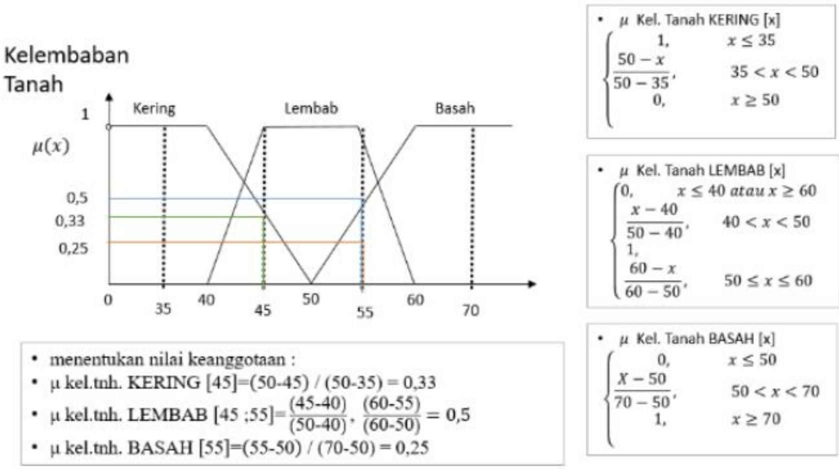

Figure 3. Humidity Variable Inference 1

In the picture above is an inference of soil moisture variables, in each set of soil moisture based on the formula. then here is a step to determine the values of a and z. using the MIN function, taking each rule base as a reference for its formulation.

[R1] IF Kelembaban Tanah KERING AND Suhu PANAS THEN Pompa & Kipas (ON) LAMA

α– predikat 1 = μ kel tnh kering ∩ μ suhu panas
= min (μ kel tnh kering [45], μ suhu panas [30])
= min (0,33 ; 0,28)
α 1 = 0,28.

Lihat himpunan pompa & kipas LAMA,

(z-30) / (60-30) = 0,28 → 38,4
(z-30) / 30 = 0,28
z-30 = 0,28 * 30
z = 8,4 + 30
z1 = 38,4.

Figure 4. Inference Rule Base 1

in figure 4 is the step to determine the values of aq and z1 by adding the MIN function to determine the value of z using the formula set of pumps and fans. The determination of this value applies to other rule bases as well.

In figure 5 determine the final step, which is to determine the Defuzzification value of each value a and z.

Defuzzifikasi

$$Z = \frac{\alpha 1 * z1 + \alpha 2 * z2 + \alpha 3 * z3}{\alpha 1 + \alpha 2 + \alpha 3}$$

$$= \frac{0{,}28 * 38{,}4 + 0{,}33 * 21{,}75 + 0{,}25 * 0}{0{,}28 + 0{,}33 + 0{,}25}$$

$$= \frac{10{,}75 + 7{,}17 + 0}{0{,}86}$$

$$Z = 20{,}83.$$

Jadi lama waktu pompa & kipas hidup rata-rata selama 20,83 detik

Figure 5. Fuzzy Defuzzification Results 1

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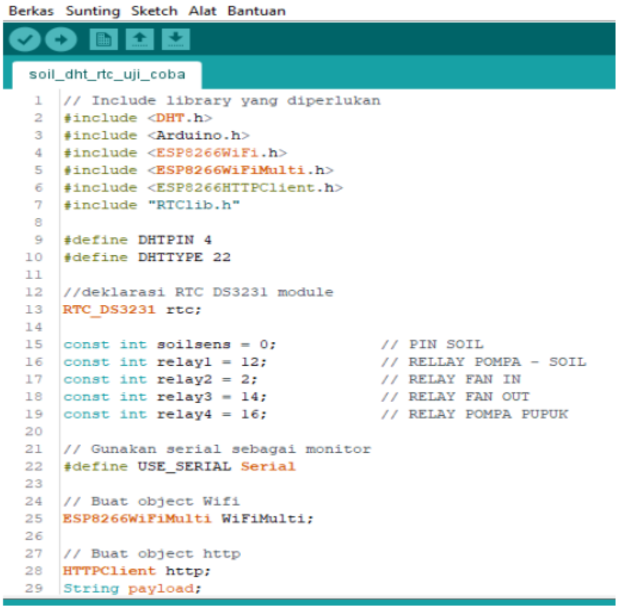
b. Software Implementation

A software is needed to manage the program code used on the system is the Arduino IDE application. An explanation of the code creation steps can be seen in figure 6.




```
// Include library yang diperlukan
#include <DHT.h>
#include <Arduino.h>
#include <ESP8266WiFi.h>
#include <ESP8266WiFiMulti.h>
#include <ESP8266HTTPClient.h>
#include "RTClib.h"

#define DHTPIN 4
#define DHTTYPE 22

//deklarasi RTC DS3231 module
RTC_DS3231 rtc;

const int soilsens = 0;            // PIN SOIL
const int relay1 = 12;             // RELLAY POMPA - SOIL
const int relay2 = 2;              // RELAY FAN IN
const int relay3 = 14;             // RELAY FAN OUT
const int relay4 = 16;             // RELAY POMPA PUPUK

// Gunakan serial sebagai monitor
#define USE_SERIAL Serial

// Buat object Wifi
ESP8266WiFiMulti WiFiMulti;

// Buat object http
HTTPClient http;
String payload;
```

Figure 6. Wemos D1R1 coding display 1

3. Results and Discussion

Test Results In this test it is a matter to determine the results of the system created.

Table 2. Intelligent System Test Results 1

No	Jenis Pengujian	Kriteria Pengujian	Hasil Pengujian	Keterangan
1.	Rule Base [R1]	Apabila nilai kelembaban tanah kering dan suhu panas, maka pompa dan kipas hidup dalam waktu lama diantara 30-60 detik	Pompa dan kipas hidup dalam waktu lama	Berhasil
2.	Rule Base [R2]	Apabila nilai kelembaban tanah lembab dan suhu normal, maka pompa dan kipas hidup dalam waktu cepat diantara 0-30 detik	Pompa dan kipas hidup dalam waktu cepat	Berhasil
3.	Rule Base [R3]	Apabila nilai kelembaban tanah basah dan suhu dingin, maka pompa dan kipas mati	Pompa dan kipas mati	Berhasil
4.	Penjadwalan pemupukan	Pertama seting waktu penjadwalan, dan apabila pada waktunya sudah tiba, maka pompa hidup dalam 10 detik	Pompa hidup sesuai waktu yang ditentukan	Berhasil Delay waktu selisih 30 detik

Table 3. System Website Test Results 1

No	Jenis Pengujian	Kriteria Pengujian	Hasil Pengujian	Keterangan
1.	Login	Apabila data user dari database dan data yang didinputkan sesuai maka login berhasil	Data yang diinputkan berhasil	Berhasil
2.	Logout	Apabila data user yang berada di database terverifikasi benar maka bisa logout	Database sudah terverifikasi	Berhasil
3.	Monitoring	Apabila pembacaan nilai sensor dari database dapat ditampilkan di website maka monitoring berhasil	Nilai dari database dapat ditampilkan di website	Berhasil
4.	Realtime Database	Apabila pengambilan data nilai sensor dari database ke website ditampilkan secara realtime	Nilai sensor dari database yang ditampilkan ke website secara realtime perlu adanya referesh secara manual	Berhasil dengan refresh secara manual

4. Conclusion

From the research above, the following conclusions can be drawn:

a. The implementation of fuzzy logic in the smart design of rice fields is useful as an automatic controller that is able to carry out automatic watering fertilization based on the rules made. System implementation is applied to Arduino IDE software that is able to make commands on every sensor and microcontroller.

b. From the test results, the system is successful and able to work according to soil moisture and temperature conditions based on the rules made.

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