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Jurnal Comasie

ISSN (Online) 2715-6265

IOT BASED SMART AGRICULTURE USING FUZZY LOGIC

Mohd. Bintan Kurnia Putra[1]
Nopriadi[2]

[1]Student of Informatics Engineering Study Program, University of Putera Batam
[2]Lecturer of Informatics Engineering Study Program, University of Putera Batam
email: pb170210120@upbatam.ac.id

ABSTRACT

This research is entitled IoT Based Smart Agriculture using Fuzzy Logic which discusses about automatic watering tools for plants. This tool is used for watering automatically with the help of temperature sensors and humidity sensors attached to plants. DC pump as a tool for spraying water when the temperature and humidity sensors detect when the plant is time to do watering. Then automatically the DC pump will work. The temperature sensor (DS18B20) takes an initial ambient temperature reading of 28℃. This value is read through the serial monitor in the Arduino IDE. The Capacitive Soil Sensor reads the soil moisture in the pot at 82% RH. The light sensor (BH1750) performs a light index reading around the sensor in the range of 29-30 Lux. This value is read through the serial monitor in the Arduino IDE. The value of the light index is very influential on the amount of light captured by the sensor, so the placement of the light sensor must be facing up or in the direction of the light and not positioned upside down. Because it can affect the reading of the light index input value so that the output value of the amount of water can be different. Esp -32 is a microcontroller used in this Agricutlture tool. Based on the tests and analyzes carried out, it was concluded that IoT Based Smart Agriculture using Fuzzy Logic can work well. And all sensors and also applications that are used as automatic operation can work properly.

Keywords: ESP-32, Fuzzy Logic, DS18B20, Capacitive Soil.

INTRODUCTION

The technologies that currently exist are rapidly developing with the development of social life, are widely used in various media technologies, and seem to be friendly to human work. From low tech to high tech, there are many new things to discover. One of them is IoT-based smart farming with fuzzy logic. This tool is intended to perform automatic watering on aquatic plants at specific times programmed or set. Due to the busy schedule of plant keeper at work and activity, they do not have time to water the plants, which makes them very deadly. With this tool equipped with ESP32 Microcontroller, This tool can be programmed by automatic watering. The tool is equipped with a light sensor, a temperature sensor, and a soil

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moisture sensor that can be tested using the Blynk application.

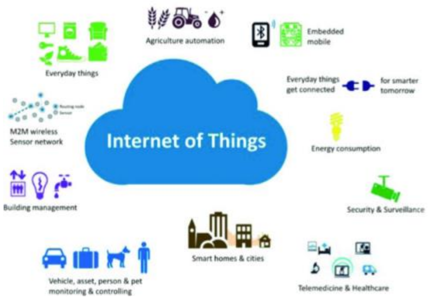
If the tool is programmed to your specifications when the tool requires water instead of water, you can perform automatic watering.

IoT - based smart agriculture with fuzzy logic is well-designed and programmed so that you can perform operations in a timely manner according to your wishes. A microcontroller is a device that can perform input, but it follows a coded user program.

STUDIES ON THEORY

2.1. *Internet of Things*

The Internet of Things (IoT) is not uncommon in the world of technology and will be popular in the future by connecting to the Internet and connecting devices such as microcontrollers and sensors that can be controlled by smartphones (Suhendar et al., 2021).



Picture 1 *Internet of Things*
(Source : Researcher Data, 2022)

2.2. Fuzzy Logic

Fuzzy logic is a type of artificial intelligence (AI) that has a truth value under certain conditions: true and false values. Fuzzy logic is a component of soft computing, and it was first developed in the 1960s. (Hutabri et al., 2019)

2.3. ESP-32

The ESP32 is a microcontroller introduced by the Espressif System, the successor or upgrade to the ESP8266 microcontroller. This microcontroller has a WiFi module on the chip to help you create application systems for the Internet of Things. (Imran & Rasul, 2020).

Picture 2 ESP-32
(Source : Researcher Data, 2022)

2.4. Temperature Sensor (DS18B20)

The DS18B20 is a temperature sensor with digital output and high accuracy of about 0.5 ° C in the temperature range of 10 ° C to + 85 ° C. (Ekayana, 2020).

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Gambar 3 DS18B20
(Source : Researcher Data, 2022)

2.5. Soil Moisture Sensor *(Capacitive Soil)*

Capacitive soil moisture is intended to measure soil moisture. This tool is made of anti-corrosion material. This sensor works by connecting to the ground to read the soil moisture rating. (Saydi, 2021).

Picture 4 Capacitive Soil
(Source : Researcher Data, 2022)

2.6. Light Sensor (BH1750)

The optical sensor BH1750 is a small modular system of BH1750 ICs with 5 pins for communication and is used as a leader of solar radiation in a lux (1x) unit. (Ecotipe & Wijaya, 2021).

Picture 5 BH1750
(Source : Researcher Data, 2022)

2.7 DC Pump

A DC motor is a motor that rotates 360 degrees and is often called a dynamo and is often used for wheel drives. If positive and negative areas are installed, the DC motor will rotate in the opposite direction of the previous rotation. (Purnomo, 2020).

Picture 6 DC Pump
(Source : Researcher Data, 2022)

2.8. Relay

Relay is an electrical terminal device that operates mechanically with the assistance of electricity.
A relay is made up of a series of conductors linked by a mechanical circuit. (Mega Rahmawati, 2021).

Picture 7 Relay
(Source : Researcher Data, 2022)

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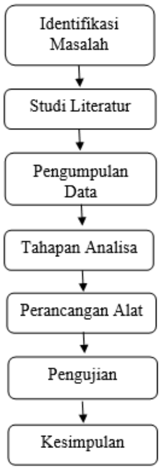
RESEARCH METHODS

The survey method includes the survey procedure from the start of production to the end of production.



Picture 8 Research Stages
(Source : Researcher Data, 2022)

1. Problem detection
   In the early stages of the author, the author seeks to identify problems that often arise due to timeliness constraints when watering plants. As a result, the plant does not grow or grow for a long time..
2. Literary research
   Researchers use multiple credible references or sources from journals and previous studies as research references.
3. Data collection
   At this stage, researchers have collected data on the Internet of Things, ESP32, temperature sensors, humidity sensors, optical sensors, and information related to DC pumps as a collection of materials to understand the behavior used to develop this tool. To collect.
4. Analysis phase
   Once the data is collected, you can perform phases of analysis to help you find the requirements that are being used. At this stage, you need to collect two types of data:
   a. Hardware data (hardware), including those prepared for the production of this tool. The following tool data is used: ESP32, temperature sensor, light sensor, humidity sensor, DC pump, data via relay.
   b. Data software for researchers to program this tool and Blynk using the Arduino IDE program.
5. Tool design
   Tool design consists of two parts: hardware design (hardware) and software design (software). The following tools are used:
   a. ESP32, temperature sensor, optical sensor, humidity sensor, DC pump, relay.
   b. Arduino IDE and Blynk are used as software.
6. Test
   In this phase, you run tool tests to see if the tools you create work as expected by your researchers..
7. Conclusion
   This is the final stage of the tool being manufactured, and this stage contains answers to problems that occur during the manufacture and operation of the tool during testing.

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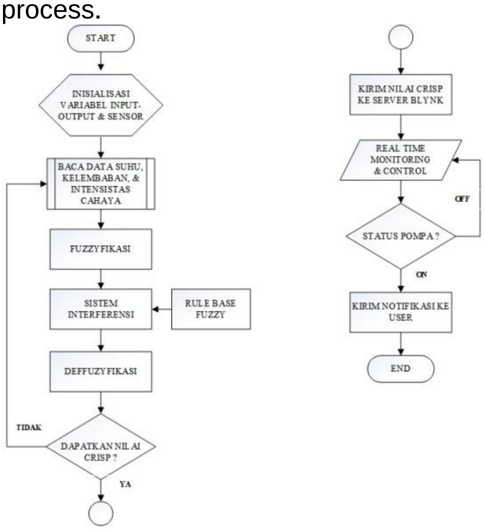
Below is a flow chart of the survey process.

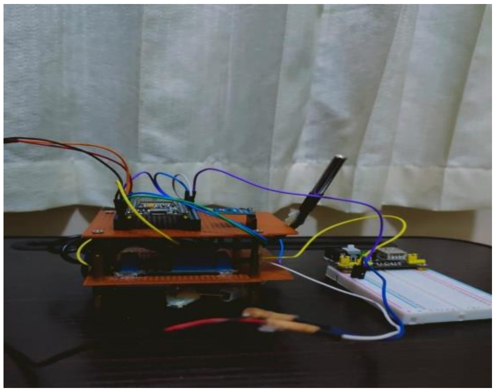


Gambar 8 Diagram Alir
(Source : Researcher Data, 2022)

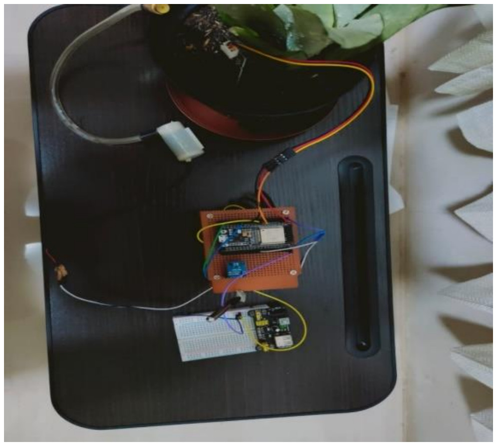
The way this system works is to initialize the input and output and sensor variables by capturing the value of each sensor as it reads.

RESULTS AND DISCUSSION

The ESP-32, which is utilized to support the work system of this tool, is derived from the results of the hardware design.
The input variables of external temperature, soil moisture, and light intensity, as well as the output, which is a firm value in the form of the amount of water required by plants to maintain ideal soil moisture, are all initialized initially in this monitoring and control system.



Picture 9 Front
(Source : Researcher Data, 2022)



Picture 10 Above
(Source : Researcher Data, 2022)

The outcomes of software design on this system make use of the Arduino IDE software to run programs in hardware design in a series of tools.This program codes the sensors that havebeen created so that each of these sensors can operate in accordance with what has been

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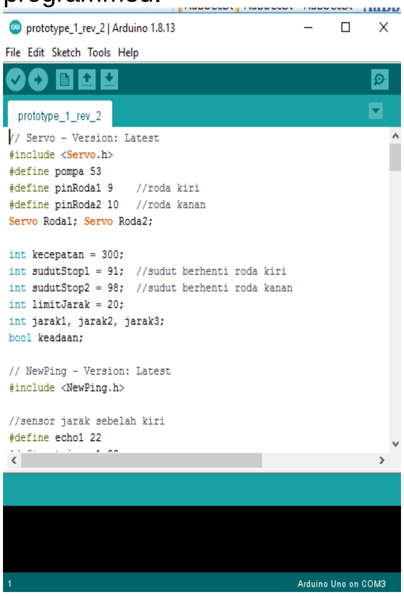
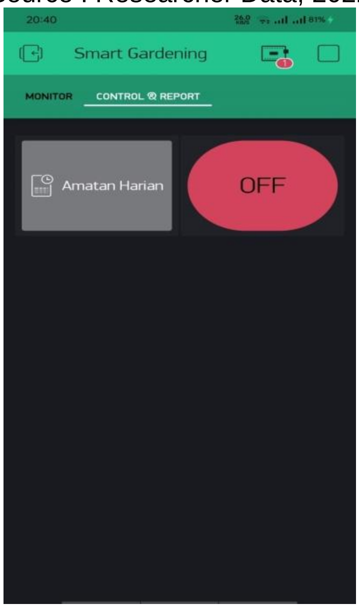
programmed.



Picture 11 Arduino IDE
(Source : Researcher Data, 2022)

The results of a software design that has been programmed using the Arduino IDE and already to use. And the next application is Blynk, which uses smartphones to send commands to hardware that has been programmed to ensure that each of these sensors operates as expected.

Picture 12 Blynk
(Source : Researcher Data, 2022)



Picture 13 Blynk
(Sumber : Researcher Data 2022)

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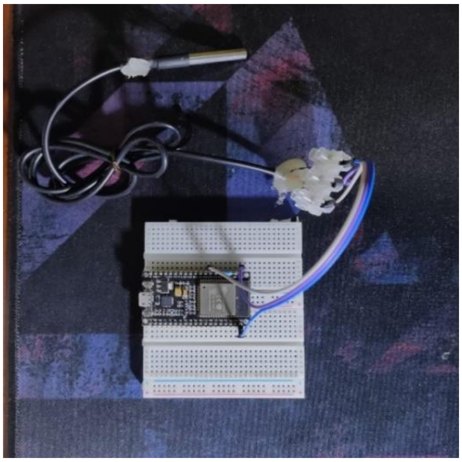
The following step after finishing all stages of system design, hardware, and software is to test the circuit to see if the tools that were built and programmed perform as intended by the researcher.

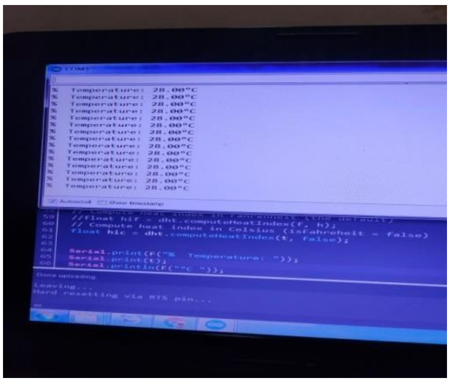
1. First Test – Reading the Value Sensor.

A. Initial Reading of Temperature Value.

The temperature sensor (DS18B20) reads 28°C as the initial ambient temperature. The serial monitor in the Arduino IDE is used to read this value.



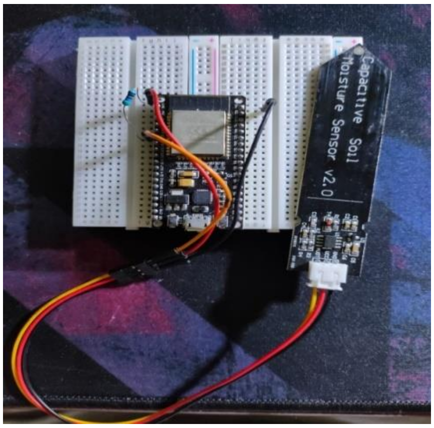
Picture 14 Temperature Sensor Test
(Source : Researcher Data, 2022)



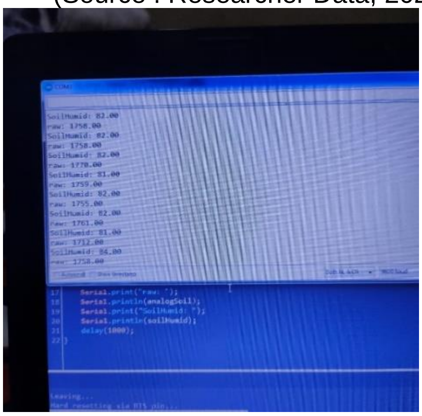
Picture 15 Initial reading of temperature value
(Source : Researcher Data, 2022)

B. Initial Reading of Soil Moisture Value

The Capacitive Soil Sensor measures the moisture content of the soil in the pot at 82 percent RH. The serial monitor in the Arduino IDE is used to read this value. On the serial monitor, the 'raw' value is the initial reading of the ADC value, which will be converted to a percentage (percent RH) using the mapping calculation formula.



Picture 16 Humidity Sensor Test
(Source : Researcher Data, 2022)



Picture 17 Initial reading of humidity value
(Source : Researcher Data, 2022)

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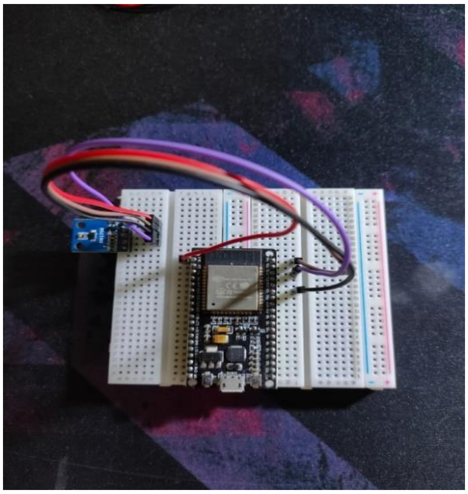
C. Initial Reading of Light Value

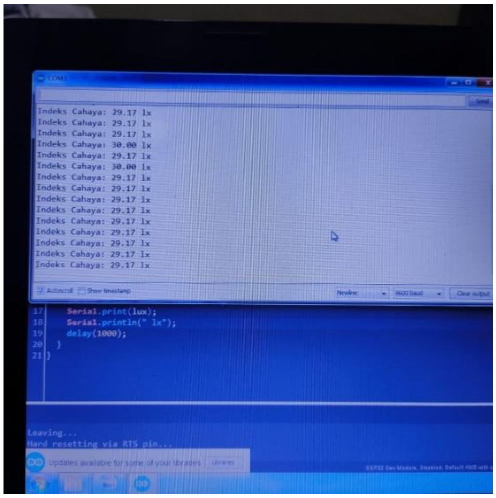
The light sensor (BH1750) measures the light index around the sensor in the 29-30 Lux range.The serial monitor in the Arduino IDE is used to read this value.

Because the value of the light index has a large influence on the amount of light captured by the sensor, the light sensor must be positioned facing up or towards the light and not upside down.

Because it can influence the reading of the light index input value, the output value of the amount of water can differ.



Picture 18 Light Sensor Test
(Source : Researcher Data, 2022)



Picture 19 Initial reading of light sensor value
(Source : Researcher Data, 2022)

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2. Test Scenario

Time	Input Variabel			Output Variabel	
	Temperature (℃)	Moisture (%RH)	Lighting (Lx)	Defuzzification /amount of water (mL)	Pump Status
20:20	26,875	74,000	26,667	75	Non-aktif
20:30	25,812	73,000	23,333	75	Non-aktif
20:40	25,750	73,000	26,667	75	Non-aktif
20:50	25,562	73,000	63,333	75	Non-aktif
21:00	25,625	72,000	20,000	75	Non-aktif
21:10	25,625	72,000	23,333	75	Non-aktif
21:20	25,625	0,000	20,000	150	Aktif

The system was tested under moist soil conditions, in a room with consistent lighting, and at a controlled room temperature utilizing air conditioning in this scenario (AC). The goal of this conditioning is to simulate nighttime settings in which the light and temperature in a room are relatively constant. Temperature and soil moisture, as seen in the table above at 20:50 and 21:20, have the greatest impact on output changes.

CONCLUSION

Following the development of tools and testing, the following conclusions can be drawn:

1. In this design, the ESP-32 is linked to electronic components such as temperature sensors, soil moisture sensors, light sensors, and pumps to send commands to the ESP-32, which is housed in a box.
2. The temperature and humidity detection process on agricultural equipment is carried out in moist soil conditions, in a room with constant lighting, and at a controlled room temperature using air conditioning (AC).This conditioning attempts to simulate nighttime conditions in which the light and temperature in a room tend to remain stable.
3. Use the Arduino IDE program to program agricultural tools to operate automatically using the Blynk application.

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	First Writer, MOHD. Bintan Kurnia Putra, is a Student from University of Putera Batam majoring Informatics Engineering.
	Second writer, Nopriadi, S.Kom,. M.Kom. is a Lecturer from University of Putera Batam.