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Automation Simulation of Plant Watering System using Moisture Sensor Based on Mobile Devices Urban Farming Method

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A B S T R A C T

This study makes a set of tools for monitoring soil moisture accompanied by mobile-based plant watering. The benefit of this soil moisture detector accompanied by watering plants is that it can facilitate human work in measuring soil moisture accompanied by watering. The soil moisture monitoring device accompanied by watering plants is composed of electronic components, which consist of Arduino Uno as a system controller of all circuits, a soil moisture sensor to measure soil moisture, how the soil moisture sensor works to measure soil moisture, by plugging a probe. on the ground. While blynk is used to transmit soil moisture signals via mobile phones. The results obtained from reading the sensor values are wet, damp and dry according to the predetermined range value. Wet soil conditions with a value range of 150 to 350, moist soil conditions with a range value of 351 to 475, dry soil conditions a value of 476 to 1023. From the results of testing the soil moisture monitoring system and watering plants can detect soil moisture and watering plants, then blynk works automatically to send signals to plant owners via cellphone. The existence of an automatic soil moisture meter and soil watering is expected to facilitate performance in the agricultural sector.

1. Introduction

The development of internet technology is one part of developments in the internet world, namely the Internet of Things (IoT). Internet of Things is a term that has recently started to be talked about and found all around us. In short, IoT is where objects around us can communicate with each other through an Internet network. So the Internet of Things (IoT) is a concept on an object that has the ability to transfer data over the internet.

So far, farmers have been watering plants manually, sometimes farmers don't have time to water the plants and they don't know how much water the plants need.

By utilizing the development of Internet of Things (IoT) technology, a soil moisture detector and automatic plant watering are made to make it easier for farmers to water their plants. By using this soil moisture detector and automatic plant watering, it is hoped that watering plants can be done at the right time.

The water content in the soil is an important thing that must be considered in agriculture, this is directly related to crop yields. Soil moisture is an agent that can carry and transfer nutrients and other compounds to the soil for plant fertility.

2. Method

The method used in conducting research is using experimental quantitative methods where this research includes several stages as follows:

2.1 Problem Identification

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At this stage, identification of existing problems is carried out, namely how to automate the watering device so that it runs as expected.

2.2 Literature Study

Where to look for theoretical references that are relevant to cases or problems found or taken from previous studies or from scientific journals and from several books.

2.3 Analysis of Device Requirements

in this case it is determined several devices that will be used for the experiment of this system consisting of the Arduino Uno Microcontroller, Relay, humidity sensor, water pump, plant pot, and several jumper cables that function to connect between devices.

2.4 Device Design

In this stage the devices are interconnected with each other so that they can be integrated with the microcontroller and read in the Arduino software to make commands so that the tool runs automatically as desired.

2.5 Device Trial

Testing the connected hardware and software to make settings for the relay and humidity sensor to find out how far the tool that will be developed is in accordance with the initial research design.

3. Result and Analysis

3.1 System planning

The design of this automatic watering system is divided into 3 parts;

a) YL69 Sensors,
b) Microcontroller on arduino.
c) Power supply and LCD display

a. Unified Modeling Language (UML) System Design

Some diagrams that will be discussed for soil moisture detection and watering applications include:

a) Use Case Diagrams
b) Class Diagram
c) Activity Diagrams

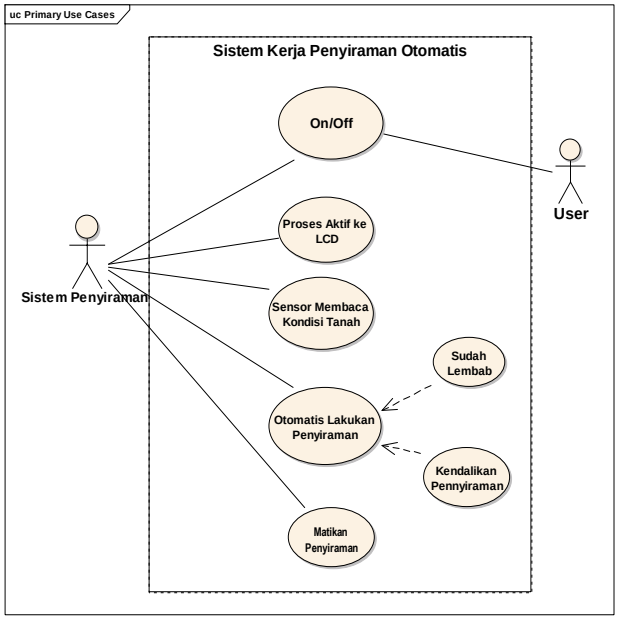

Fig 1 Use Case Diagram of the plant sprinkler system

a) Use Case diagram to show between actors, with their functional processes from the work process of plant sprinklers, starting from On/Off then continued to the LCD display system. Followed by the detection of soil moisture. The operation of the water pump is based on the received soil moisture sensor, all of which have been programmed into the microcontroller in this detector.

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b) Class Diagram

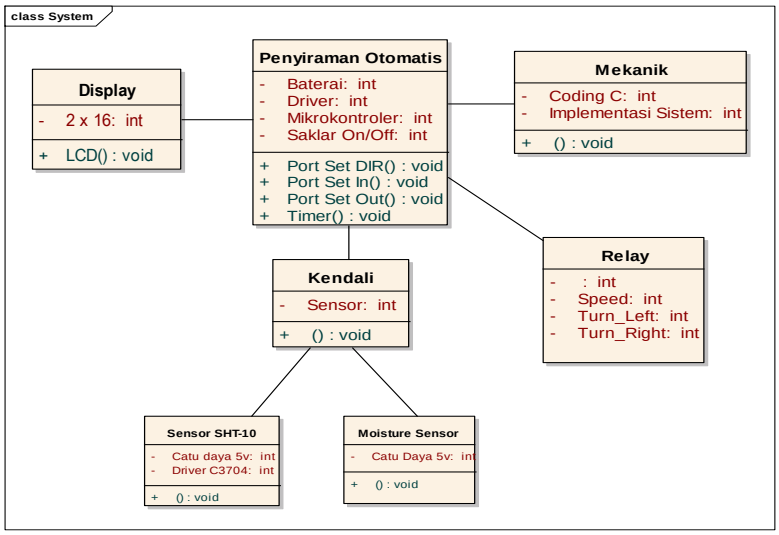

Fig 2 Plant Watering System Class Diagram

Class diagrams are designed to describe how to interact with the system created. The purpose of the Class Diagram is to show between soil moisture detection and watering, with the functional processes of soil moisture detection and watering work processes.

c) Diagram *Activity*

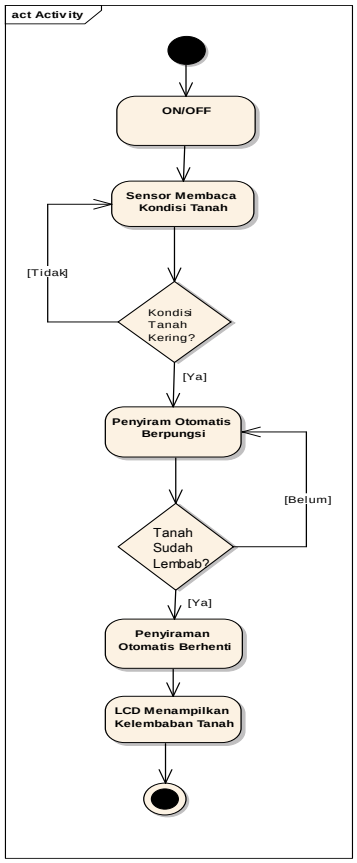

Fig 3 Activity Diagram

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When the system is running, the soil moisture sensor will detect soil conditions. If the soil conditions are dry, the relay driver will turn ON so that the water pump runs to water the plants. If the soil moisture sensor detects that the soil is already damp, the relay driver will turn OFF so the water pump will turn off. And Output Humidity Value. The ground will be displayed on the LCD.

b. Power Supply Circuit Design

This circuit serves to supply voltage throughout the existing circuit. This power supply circuit (Power Supply Adapter) consists of one output, which is 5 volts. The 5 volt output is used to supply voltage to the AVR Atmega 328P microcontroller circuit, humidity sensor. The battery is a source of voltage C, then it will be flattened by a 220 F capacitor. A 5 volt voltage regulator is used so that the resulting output remains 5 volts even though there is a change in the input voltage.

c. Soil Moisture Sensor

During the assembly process the A0 pin on the Arduino Uno will be connected to the A0 pin on the soil moisture sensor so that the Arduino Uno can receive soil moisture data from the sensor and can instruct the relay draiver to activate and deactivate the water pump according to soil conditions.

d. Relay Driver

When assembling pin 13 on the microcontroller it must be connected to the relay driver so that Arduino Uno can give instructions to the relay according to ground conditions.

e. Yl Sensor Circuit 69

Moisture Probe is a tool made of metal with a certain material. Moisture Probe made of metal is used as a sensor for measuring the water content in the soil. The moisture probe that is made consists of two copper metal rods. This moisture problem acts like a capacitor with earth as the dielectric. This moisture problem is also known as the capacitance probe. The moisture probe made is very simple, so the price is relatively cheap. The working principle of using this sensor for measuring soil moisture is as follows, a moisture probe is inserted into the soil to be measured humidity and connected to a signal generator. When the water content (humidity) of the soil changes, the probe will produce a change in the capacitance value, due to the change in the dielectric permittivity. Changes in the value of this capacitance (impedance) will change the frequency of the output waveform of the signal generator. Thus, the frequency of the output waveform of the signal generator will change according to soil moisture. This frequency change will then be processed to determine the percentage of moisture in the soil.

f. LCD

Liquid Crystal Display (LCD) 2x16 LCD has many uses in designing a system using a microcontroller. LCD (Liquid Crystal Display) can function to display a sensor value, display text, or display a menu on a microcontroller application. In the practice of this project, the LCD used is a 16 x 2 LCD, which means the display width is 2 rows and 16 columns with a 16 pin connector.

g. Plant Watering System Series

When the soil moisture sensor detects the soil, the results of the detection by the sensor will be input by the Arduino Uno, then the Arduino Uno instructs the diver relay to turn on the water pump and the LCD will read the humidity level.

h. System Specification

In the design of the Arduino Uno-based automatic plant sprinkler, it has the following specifications:

a) A microcontroller system in the form of Arduino Uno as a command processor from the soil moisture sensor and automatic watering control.
b) A soil moisture sensor as a command sender to activate the relay driver so that the water pump works.
c) An LCD as a display of the value of soil moisture.
d) The relay driver is used to activate and deactivate the Water pump
e) Water pump is used to water the plants

i. Research Tools and Materials

a) Hardware

The following is a list of hardware used in the study:

1) Arduino
2) Air Temperature and Humidity Sensor: DHT22
3) Soil Moisture Sensor
4) Water Level Sensor
5) 16x2 . Character LCD

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6) Water Pump
7) Nutrition Pump
8) Aerator
9) DC Motor Pump 12V
10) Elbow Iron
11) PVC Pipe
12) Water Hose

b) Software

The following is the software used in the research:

1) Arduino IDE C
2) PCB Wizard
3) Blinks
4) Android

c) Measuring instrument

The following are the measuring tools used in the study:

1) Multimeter
2) Measuring Meter

3.2 Tool Implementation

The implementation process is carried out after the hardware is made. This process is the most important part in the manufacture of this tool. The microcontroller program is designed to perform the algorithm process on the plant watering system automatically. Programming is done using C language using Arduino IDE software which is downloaded on the microcontroller and as a controller for the automatic plant watering system.

3.3 Testing Tool

From the test results, it can be seen the weaknesses and shortcomings that still exist in the tool, so that the results of hardware and software design can be further refined for real purposes and uses.

The test steps that will be carried out to test the tool are as follows:

a. Power Supply Test

The power supply functions to regulate the output voltage of 220 V electricity and provides power supply to various circuit system blocks as needed. The test is done by measuring the output on the IC regulator using a multimeter.

The data from the power supply test results can be seen in table 1 as follows:

Table 1
Power Supply Measurement Results

IC REGULATOR	INPUT (V)	OUTPUT (V)	KONDISI
7805	12,4	5,02	Baik
	11,1	5,02	Baik
	9,0	5,02	Baik

The test results show a difference in the magnitude of the input voltage. This difference is due to several factors, including the quality of each component used, the value is not pure. In addition, because the voltage used is sometimes less stable. In addition, from the data sheet it can be seen how much current and voltage are issued by the IC Regulator based on the series. The characteristics of the 7805 Regulator IC based on the data sheet are shown in table 2

Table 2
Characteristics of voltage regulator

TIPE	V *Out* (V)	
	Min	Max
7805	4.75	5.25

b. Soil Moisture Sensor Test

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Soil moisture sensor testing is carried out to find out how much voltage is generated by the soil moisture sensor in detecting moist/wet soil conditions as well as dry soil. The test is carried out by measuring the output voltage on the soil moisture sensor. The following is some data obtained when testing plant sprinklers using the Arduino Uno and the soil moisture sensor. This sensor test requires a voltage of 12 V DC by connecting the Ao pin with the allocation according to the program made on the Arduino Uno.

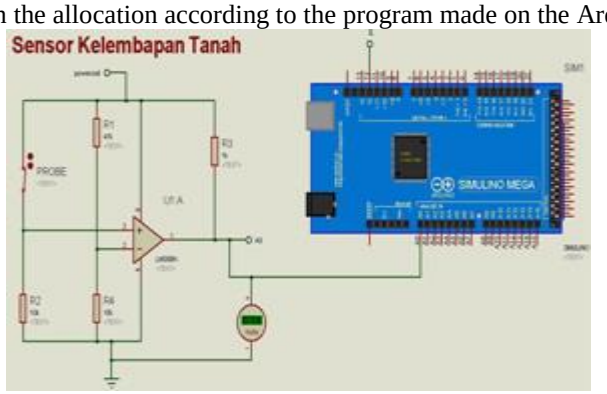

Fig. 4 Testing the soil moisture sensor

After checking the condition of the tool, the next step is to test the relay control circuit and work the water pump on the output unit. Place the two sensors in pot A, which was previously detected as having dry soil conditions, pay attention to the soil moisture value on both sensors and the motor status on the LCD display. The sensor detects the value of soil moisture in pot A of 124. The soil condition detected by the sensor has a value of < 300 so it is included in dry soil conditions, so the water pump status will turn on on" to start watering.

Fig. 5 process testing System process

In the picture above, you can see several circuits arranged in the process unit. The process unit is the most important part in this system. There is a minimum series of Arduino Microcontroller system, LCD Display module, button setting circuit and sensor module. In this unit, the sensor will set the humidity value limit by pressing the set 1 button to set the humidity value limit on sensor 1, and set 2 to set the humidity value limit.

- Soil moisture is read by the LCD 103, the soil is considered dry, the pump is watering the plants.
- The soil moisture is read as 111. The soil is considered dry. The pump is watering the plants.
- Humidity 432 soil is considered wet then the pump will turn off

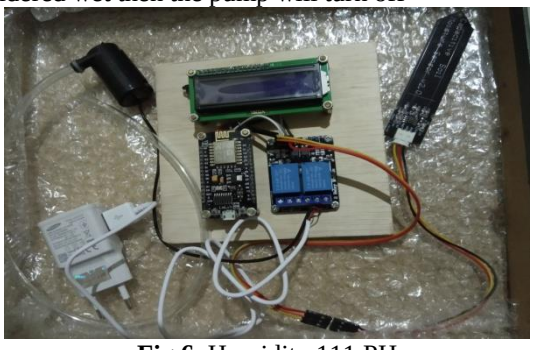

Fig.6 Humidity 111 PH

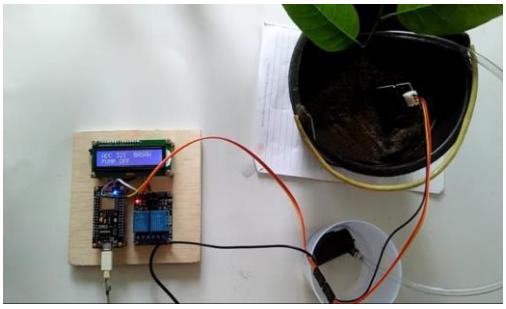

Fig 7. testing process System process

Table 3

Measurement results of plant sprinklers

N O	LCD	Kondisi tanah Basah/kering	Pompa ON/OFF
1	103	Kering	ON
2	111	Kering	ON
3	124	Kering	ON
4	226	Kering	ON
5	300	Kering	ON
6	302	Basah	OFF
5	363	Basah	OFF
6	432	Basah	OFF

Fig. 8 Configuration pin Widget

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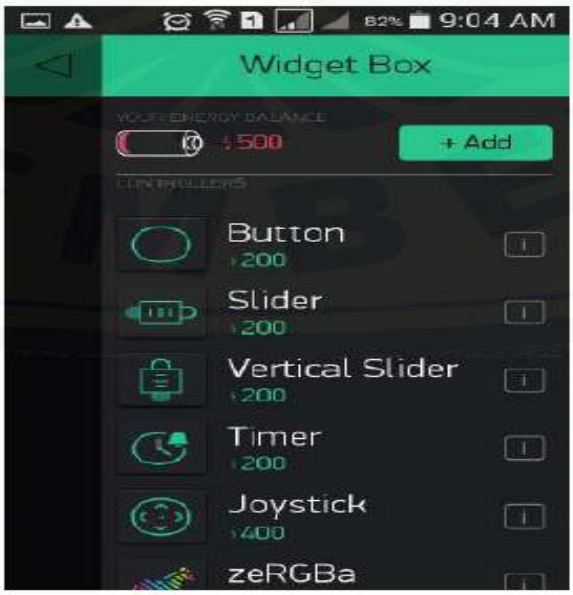

Fig 9. Widget Box

In the widget box menu there are many widgets that can be directly used by drag and drop on the blink project that has been created. In order to be able to connect to the device or tool that was created, an auth token from the blink application is required which has been emailed. The auth token obtained is entered on the arduino so that it can be connected

4. Conclusion

Based on the results of the manufacture and testing of plant watering equipment that has been made, the following conclusions can be drawn: 1. For the application, in addition to using a power supply (power supply) from PLN, a battery can be used so that when the power goes out, the system will remain on or work. 2. Regular maintenance is needed so that the tool can work optimally and also reduce the risk of damage that can occur at any time. 3. Unstable electrical voltage can cause the tool to work less than optimally. 4. After 10 (ten) experiments were carried out and carried out continuously, the tool made was still stable.

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