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Design of an Automatic Device for Watering Jasmine Flower Plants Using a Soil Based Moisture Sensor Arduino Microcontroller

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ABSTRACT

The In everyday life, watering plants is a very important factor in maintaining and caring for jasmine plants. Water itself is a basic resource that supports the life needs of jasmine plants. If there is no water, the growth of jasmine flowers will be hampered, and the plant can even die. In general, watering plants is done conventionally, this is considered impossible to do in a short time, not to mention when the plant owner is far from where the plants are. In this case, an automatic device for watering jasmine plants was created using a pump controlled by the Arduino Uno, as well as using a soil moisture sensor to provide analog data to the Arduino Uno to regulate the on and off of the water pump based on the humidity that has been set and the use of the LCD module. I2C to display soil moisture, to make it easier for jasmine plant lovers to care for their plants in terms of watering. This research method was adopted from the prototype development method. The results of this research are that the pump can water plants when the humidity is < 30%, and the pump stops watering when the humidity is > 50%.

I. Introduction

The Knowledge and technology are currently developing very rapidly. With advances in science and technology, new innovations have emerged that lead to a better direction. This can be seen from the electronic equipment that we use every day.

In the current era of globalization, we cannot be separated from the development of science and technology. Therefore, we must be able to master technology and be able to follow technological developments. Currently, convenience and efficiency of time and energy are the main considerations for humans in carrying out activities. From time to time, we are faced with rapid technological developments. So, it makes human work faster, easier and lighter. Like watering plants, which is still often done conventionally, this activity is considered impossible to do in a short time, not to mention when the plant owner is far from home or where the plants are. Even plant owners can forget to water their plants. Therefore, an automatic plant watering system is needed, especially for ornamental plants, such as jasmine flowers.

Jasmine plants (Jasminum spp.) are one of the ornamental plants that are popular with Indonesian people. The shape and color of the white flowers and the fragrant aroma are the characteristics of jasmine. Apart from being used as an ornamental garden plant or potted plant, it is also used as a raw material for perfume and cosmetics, tea fragrance, and traditional medicine. Apart from that, it is also used as a flower arrangement.

Jasmine plants will grow well if their water needs are met. Therefore, when caring for jasmine plants, it is very necessary to water them. Watering is not only used as a material for metabolic processes to take place. However, it also aims to maintain environmental humidity.

Arduino is an open-source single-board micro controller, derived from the Wiring platform, designed to facilitate the use of electronics in a variety of fields. Atmel's high-performance PicoPower 8-bit AVR RISC microcontroller-based combines 32KB ISP flash memory with read-while-write capability, 1024B EEPROM, 2KB SRAM, 23 general-purpose I/O lanes, 32 general-purpose registers, three timers flexible/counter with comparison mode, internal and external interrupts, programmable serial USART, byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channel in TQFP and QFN/ MLF package), programmable timer with internal oscillator, and five software-selectable power saving modes. The device operates between 1.8-5.5 volts [1].

Soil moisture sensor measures the soil water content. Soil moisture probe consists of a plurality of soil moisture sensors. Soil moisture sensor technology, commonly used are:(1) Frequency domain sensor, such as a capacitive sensor. (2) Neutron moisture meter, characteristic of the use of water in the neutron moderator. (3)Soil resistivity. In this particular project, we will use the soil moisture sensors which can be inserted into soil to measure the soil moisture content

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A pump is a device that moves fluid (liquid or gas) through mechanical action. Pumps can be classified into three main groups according to the method they use to move fluids: direct lift, displacement, and gravity. Pumps operate by some mechanism (usually reciprocating), and expend energy to do mechanical work by moving fluid. Pumps operate via multiple energies including manual operation electricity, engine, or wind power, come in a variety of sizes, from microscopic for use in medical applications to large industrial pumps.

Several IoT-based studies as a reference for this research are first use of IoT in the field of transformation [3]. Secondly, designing the internet of things in infrastructure control [4]. Third, design and build a prototype of a temperature monitoring system and hand sanitizer sprayer based on the Internet of Things[5]. Fourth, Internet of Things for temperature classification [6]. Fifth, Internet of Things for position and temperature detection[7]. Sixth, The prototype of IOT based weight scale and calorie [8]. Seventh, Internet of Things for smart park [9].

II. Method

The research method uses a system functional block diagram as shown in Figure 1. Consists of Soil Moisture Sensor, Microcontroller Board, LCD Display, Relay, and Water Pump. Soil moisture sensors measure volumetric moisture content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for moisture content [10]. The Soil Moisture sensor will send analog data to the Arduino board. The sensor reads an input voltage ranging from 0-5V which will be calculated as 0-1023.

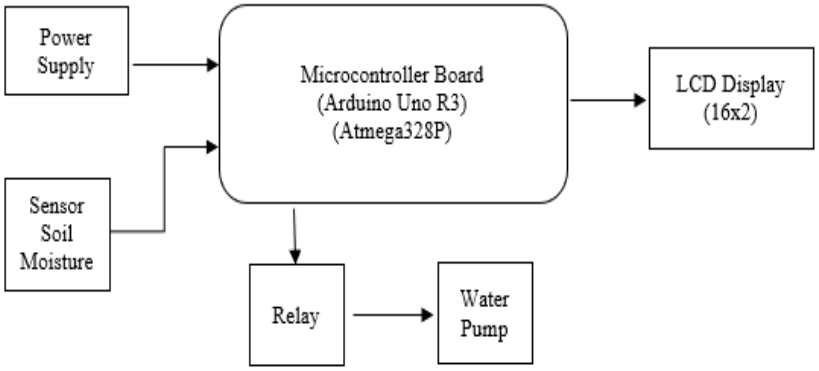

Fig. 1. Functional Block Diagram

The drier the sensor conditions, the greater the output value, and the more humid the sensor conditions, the smaller the output value. Then the data will then be processed by the Microcontroller Board into a percentage value and display the data on the LCD Display. Then, from the humidity data, the Microcontroller Board will give a LOW or HGH signal to the Relay to turn the Water Pump on and off.

1. Software Development

The software for this system is developed in Arduino IDE and the flow diagram depicts automatic watering as shown in Fig.2. The Microcontroller Board will read the humidity based on the voltage sent by the Soil Moisture Sensor which has a value of 0 - 5V and is calculated into a value of 0 - 1023, this value will be converted into percentage data, then the data will be printed on the LCD Display. Next, the Microcontroller board will match the percentage data received with the sketch stored in the Arduino sketch, if the data is <= 30% then the relay will be On and the water pump will turn on, if not then the relay will be Off and the water pump will die. After the water pump turns on and humidity increases, then when the data is >= 50% the relay will be Off and the water pump will turn off.

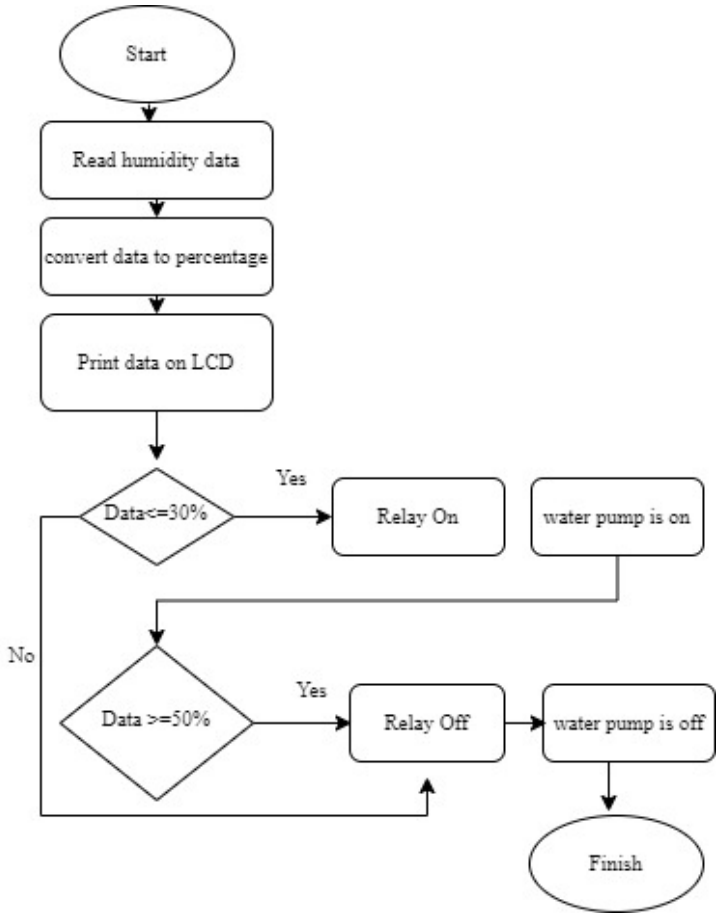

Fig 2. Program Flow Diagram

III. Results and Discussion

The results obtained using the proposed system are discussed in this section.

3.1 Soil Moisture <30%

9% humidity refers to the water content contained in the soil or air. If it is in soil, this means that only 9% of the soil capacity is filled with water, while the other 91% consists of solid particles and air.

Soil moisture of only 9% is generally considered very low and can be dangerous for plants. Most plants require higher soil moisture for optimal growth. Lack of water can cause plant stress, decreased photosynthesis rates, and even death if it lasts too long. Soil moisture is measured using tools such as tensiometers, capacitive sensors, or gravimetry. It is important to measure soil moisture regularly to ensure plants are getting enough water.

Fig 3. Humidity 9% and Water Pump On

The "Water Pump On" means that the water pump is operating or on. A water pump is a mechanical device used to move water from one place to another, often from a water source such as a well or river to an irrigation or water storage system. In irrigation systems, water pumps are used to provide the water necessary to maintain soil moisture at the desired level. When soil moisture is low, such as 9%, the water pump will be activated to channel water to the field or garden.

Modern irrigation systems are often equipped with humidity sensors that can control the water pump automatically. When the sensor detects soil moisture falling below a certain level (for example 9%), the system will automatically turn on the water pump to irrigate the plants until the soil moisture reaches a higher and safe level.

Fig. 4 Live Water Pump

3.2 Soil moisture>50%

In the context of irrigation and agricultural management, the terms "55% Soil Moisture" and "Water Pump Off" have important meanings related to soil conditions and irrigation systems. Soil moisture of 55% refers to the water content in the soil. This means that 55% of the soil's pore capacity is filled with water, while the other 45% is filled with air or soil particles. Soil moisture of 55% is often considered ideal for many types of plants, especially if they require soil conditions that are moist but not saturated. Most plants will grow well in this soil moisture because they can absorb water optimally without experiencing stress due to lack of water or excess water.

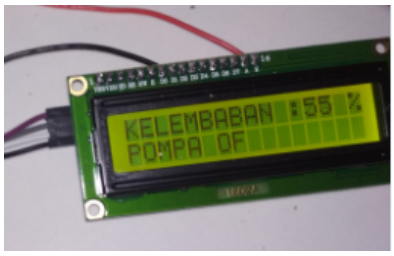

Fig 5. Soil Moisture 55% and Water Pump Off

Soil moisture is measured using tools such as soil moisture sensors, tensiometers, or gravimetric methods. This data is important for determining irrigation needs. "Water Pump Off" means that the water pump is not operating or is turned off. Water pumps are usually used to channel water from a source to an irrigation system. In an automatic irrigation system, the water pump can be turned off when the humidity sensor detects that the soil moisture has reached a sufficient level (such as 55%). Turning off the water pump when soil moisture is high enough helps conserve water and prevents over-irrigation which can cause problems such as leaching of nutrients or water stagnation. Using soil moisture data, the irrigation system can be set to turn the water pump on and off as needed, ensuring efficient water use.

The water pump is turned off to prevent over-irrigation which can damage plants and reduce water efficiency. Soil Moisture Monitoring Uses soil moisture sensors to monitor soil conditions in real-time. An automatic irrigation system that can turn on and off the water pump based on data from sensors.

Irrigation Schedule by Establishing an irrigation schedule that is tailored to specific plant needs and environmental conditions to optimize water use. Thus, understanding and applying the concepts of "55% Soil Moisture" and "Pump Water Off" is very important to maintain water balance in the soil, ensure optimal plant growth, and prevent waste of water resources.

Fig 6. Dead water pump

In the Figure 6 Water Pump is Off" in the context of irrigation management or water distribution systems. The drawing will provide a clear visual representation of how the irrigation system works, especially in situations where the water pump is not active, as well as the procedures carried out to ensure the pump remains in good condition.

IV. Conclusion

An automatic jasmine watering device designed using an Arduino microcontroller-based soil moisture sensor is able to provide watering that is timely and as needed. This ensures the plants get the optimal amount of water without wastage or shortages. Save Resources with This system reduces excess water consumption and unnecessary energy use because the water pump is only activated when soil moisture falls below a specified level. Using the Arduino Microcontroller as a control center, Arduino reads data from the humidity sensor and controls the water pump based on this data. Soil Moisture Sensor measures water content in the soil in real-time and sends data to a microcontroller for analysis. Water Pump Operated automatically by Arduino to supply water to plants when soil moisture is below a specified level. Fast Response This system provides a fast response to changes in soil moisture, ensuring plants are always in optimal conditions for growth.

Precise Settings Adjustable soil moisture levels allow adjustments to suit the specific needs of jasmine plants. Reduced Workload as This tool reduces the manual workload for watering plants, especially for garden owners who are busy or have lots of plants. Increased Plant Growth With consistent and proper watering, jasmine plants can grow healthier and flower more abundantly. The use of a microcontroller with Arduino allows flexibility and scalability, where the system can be further developed with additional features such as an internet connection (IoT) for remote

monitoring. Sensor integration with integrated soil moisture ensures accurate, real-time data, which is critical for reliable automated operation. The design project for an automatic device for watering jasmine plants with a soil moisture sensor based on an Arduino microcontroller proves that simple but effective technology can be applied to increase efficiency and effectiveness in plant care. This system not only provides a practical solution for automatic watering but also opens up opportunities for further development in agricultural and garden automation. The tool can sprinkle water on jasmine plants if the soil moisture is below 30%. The tool cannot water jasmine plants if the soil moisture is above 50%. Overall, the tool functions well and works as expected. LCD works well with the display of soil moisture processed by the soil moisture sensor. Thus, this tool has great potential for widespread adoption on a household to commercial scale, providing significant benefits in resource management and increasing crop yields.

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