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Automated Water Pump System

Prof. Praveen Rathod[1], Shreerang Karambelkar[2], Rutvik Khaire[3], Mangesh Dhavale[4], Pruthviraj Raut[5]

[1]*Assistant Professor, Mechanical Engineering, Vishwakarma Institute of Information Technology, PUNE*

[2]*UG - Mechanical Engineering, Vishwakarma Institute of Information Technology, PUNE*

[3]*UG - Mechanical Engineering, Vishwakarma Institute of Information Technology, PUNE*

[4]*UG - Mechanical Engineering, Vishwakarma Institute of Information Technology, PUNE*

[5]*UG - Mechanical Engineering, Vishwakarma Institute of Information Technology, PUNE*

Corresponding Author Orcid ID : 0000-0003-4491-6582

ABSTRACT

Automated water pump systems are becoming increasingly important as they can regulate water pumps based on current data and conditions, reducing energy use and water waste while ensuring efficient water distribution. Research shows that automated water pump systems have several advantages over traditional manual systems, including increased efficiency, lower energy consumption, better water management, and improved pump performance. However, there are also some drawbacks to using these systems, such as higher upfront costs due to advanced equipment and technology requirements, complex installation and design demands, and the need for a reliable power source. The choice of automated water pump system depends on the particular application and requirements, as each type has its own strengths and weaknesses. The article's methodology involves connecting the solid-state relays, ESP32, power supply, and water pump to enable automated operation. The Arduino IDE software is used to program the system, allowing the user to specify when the water pump should be triggered. The system is then controlled by the ESP32 microcontroller, which turns on the relay module to power the water pump until the user-specified threshold level is reached. This ensures that the plants receive the correct amount of water for optimal growth without the need for manual assistance. The article also discusses the hardware used, including the ESP32 microcontroller and relay module.

Keywords—Automation, water pump system, ESP32

1. Introduction

Automated water pump systems are intended to automatically regulate the operation of water pumps depending on specific circumstances, such as water pressure or level. As they aid in lowering energy use and water waste while also ensuring that water is distributed effectively, these systems are becoming more and more crucial. Agriculture, irrigation, and domestic water supply systems all frequently employ automated water pump systems.

This article aims to solve the issue of the need for more effective and efficient water pump control. The manual nature of traditional water pump systems can result in waste and inefficiencies. By regulating the operation of the water pumps based on current data and conditions, automated water pump systems can aid in resolving these problems.

The article will be divided into several sections, including an introduction that gives a general overview of the subject and identifies the problem, a literature review, a methodology and a conclusion. A reference section and possible appendices with additional supporting documentation will also be included in the article.

2. Literature Review

Because automated water pump systems are widely used in various fields, there is a substantial amount of research on them. The majority of research findings highlight the advantages of automated

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water pump systems over traditional manual systems, such as increased efficiency, lower energy consumption, better water management, and improved pump performance.

The use of an automated water pump system has some benefits and drawbacks which are noted below

2.1 Benefits

1. Enhanced effectiveness and decreased energy usage.
2. Better distribution and management of water.
3. Control and real-time monitoring of pump operation.
4. Lessening of human intervention and enhanced dependability.
5. Automatic fault finding and repair.
6. Long-term cost savings as a result of fewer maintenance needs.

2.2 Drawbacks

1. Higher upfront costs due to the need for advanced equipment and technology.
2. Demands for complex installation and design.
3. Reliance to a trustworthy power source.
4. Maintenance and repair require technical expertise and knowledge.

Automated water pump systems come in a variety of varieties, each with unique benefits and drawbacks. Typical types include:

1. Pressure-based systems: These programmers monitor and regulate water pressure to choose when to activate and deactivate the pump. Residential and small-scale irrigation applications are where they are most frequently used.
2. Systems based on levels: Pumps are turned on and off based on the water level in tanks or reservoirs, which is monitored by sensors in level-based systems. Large-scale irrigation and agricultural applications frequently involve their use.
3. Systems with variable speeds: These systems allow for more precise control of water pressure and flow because they use frequency inverters to alter the speed of the pump motor. They are frequently employed in commercial and industrial settings.
4. Systems for remote monitoring and control: These systems enable remote monitoring and control of pump operation using wireless communication and sensors. Large-scale irrigation and water supply systems frequently employ them.

The choice of automated water pump system depends on the particular application and requirements. Each type of automated water pump system has strengths and weaknesses of its own.

3. Methodology

3.1 GGBS and Cement

In order to enable the automated operation of the water pump, connections between the solid state relays, ESP32, power supply, and water pump were made. While the ESP32 microcontroller controls the system's automated operation, solid state relays are used to regulate the electrical power supply to the water pump.

Using the Arduino IDE software, which enables the creation of customized code to meet the unique needs of the user, the automated plant watering system is programmed. The user specifies the requirements for when the water pump should be triggered, and the code is written to check for those requirements.

When the prerequisites are satisfied, the Arduino microcontroller turns on the relay module, which then powers the water pump until it reaches the user-specified threshold level. This makes it possible to precisely control the water dispensed and guarantees that the plants receive the right amount of water for optimum growth.

Generally speaking, the automated plant watering system offers a simple and effective method of watering plants without the need for manual assistance. Users can save time and guarantee that their plants receive the right amount of water for healthy growth by automating the process.

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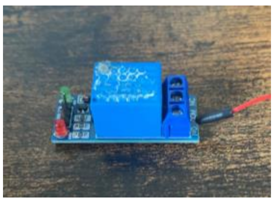
4. Hardware Used

4.1 As ESP32

Espressif Systems created the ESP32 microcontroller, which has a dual-core processor and WiFi/Bluetooth connectivity. Due to its low power consumption, sophisticated features, and simplicity of use, it is a well-liked option for Internet of Things (IoT) projects.
The ESP32 processor has two processing cores with a combined clock speed of up to 240 MHz, each of which is based on the Xtensa LX6 processor architecture. A wide range of peripherals are also included, such as analog-to-digital converters, outputs for pulse width modulation (PWM), and serial communication interfaces like I2C, SPI, and UART.
The ESP32 has WiFi and Bluetooth connectivity built right in, which is one of its key features. This makes the microcontroller perfect for Internet of Things applications because it enables it to connect to the internet and communicate with other devices. Over-the-air (OTA) updates can be performed easily and conveniently without requiring physical access to the device thanks to WiFi connectivity.

4.2 Relay Module

Relay modules are electronic parts that enable low voltage signals to control high voltage or current circuits. It is made up of a control circuit and a relay switch that are housed in a small module.
The electromagnetic switch known as the relay is triggered by an electrical signal. The switch closes when the control circuit sends a signal to the relay module, completing the high voltage or current circuit. The switch opens when the signal is turned off, cutting the circuit.
When low voltage signals need to regulate high voltage or current circuits, relay modules are frequently used in a wide range of applications. For instance, they can be used in industrial control systems to manage machinery and other equipment or in home automation systems to manage lights, motors, and other electrical devices.



4.3 Water Motor

A mechanical tool used to transport water from one place to another is a water motor, also referred to as a water pump. It functions by creating a pressure difference inside a casing as an impeller, a type of rotor, rotates, causing the water to flow.
There are numerous varieties of water motors available, each with a unique design and use. Jet pumps, centrifugal pumps, and positive displacement pumps are a few typical varieties of water motors.
The most prevalent kind of water motor is a centrifugal pump, which is used in a variety of applications like irrigation, water treatment, and HVAC systems. They function by generating centrifugal force with a spinning impeller, which forces water through the pump and out the discharge outlet.

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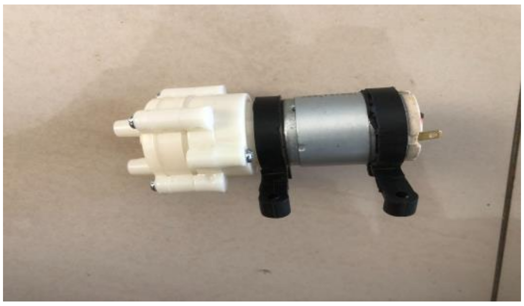

4.4 Jumper Wire

A jumper wire is a brief wire that joins two points in an electronic circuit. It is also referred to as a jumper cable or simply a jumper. During prototyping or troubleshooting, jumper wires are typically used to establish transient connections between circuit components.

Copper, aluminum, and gold-plated wire are just a few of the materials that can be used to create jumper wires. To avoid unintentional contact with other parts of the circuit, they are typically insulated with plastic or rubber.

Jumper wires can be purchased in pre-cut lengths or on spools for custom cutting and come in a variety of lengths and gauges. To make them simpler to use, they can also be purchased with connectors already attached, such as male/female header pins or alligator clips.

4.5 Power Supply

An electronic device known as a power supply delivers electricity to an electrical load. It transforms electrical energy into the voltage and current required to power electronic devices from a source, such as a wall outlet or battery.

The two main categories of power supplies are AC (alternating current) and DC (direct current) power supplies. While DC power supplies deliver a constant DC voltage output, AC power supplies transform the mains' AC voltage into the DC voltage needed by electronic devices.

Depending on the particular application, power supplies come in a variety of form factors and power ratings. They can be anything from tiny, low-power wall outlets for charging mobile phones to huge, high-power generators for industrial machinery.

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5. Source Code

```
/*
  Blink
*/

// ledPin refers to ESP32 GPIO 23
const int ledPin = 23;

// the setup function runs once when you press reset or power the board
void setup() {
  // initialize digital pin ledPin as an output.
  pinMode(ledPin, OUTPUT);
}

// the loop function runs over and over again forever
void loop() {
  digitalWrite(ledPin, HIGH);
  delay(1000);
  digitalWrite(ledPin, LOW);
  delay(1000);
}
```

This code is a simple example of how to blink an LED using an ESP32 microcontroller. The LED is connected to GPIO pin 23 of the ESP32.
The code is written in the Arduino programming language and consists of two functions: setup() and loop().
The setup() function is called once when the microcontroller is powered on or reset. In this function, the ledPin is initialized as an output pin using the pinMode() function.
The loop() function runs repeatedly after the setup() function has completed. In this function, the LED is turned on by setting the ledPin to HIGH using the digitalWrite() function. Then, a delay of 1000 milliseconds (1 second) is added using the delay() function. After that, the LED is turned off by setting the ledPin to LOW, followed by another delay of 1000 milliseconds.
This results in the LED blinking on and off every second, as specified by the delays. This is a basic example of how to use the digital output capabilities of an ESP32 to control external devices like LEDs.

6. Conclusion

Automated water pump systems have gained significant attention due to their ability to regulate the operation of water pumps based on specific circumstances such as water pressure or level. They help in reducing energy use and water waste while ensuring effective water distribution, making them increasingly important in agriculture, irrigation, and domestic water supply systems. There is a substantial amount of research on automated water pump systems, highlighting their benefits over traditional manual systems, including enhanced effectiveness, decreased energy usage, better water management, improved pump performance, automatic fault finding and repair, and long-term cost savings. However, they also have drawbacks such as higher upfront costs, complex installation and design demands, reliance on a trustworthy power source, and technical expertise and knowledge needed for maintenance and repair. Automated water pump systems come in various types, including pressure-based, level-based, variable speed-based, and remote monitoring and control-based systems. Each type has its own strengths and weaknesses, making the choice of automated water pump system dependent on the specific application and requirements.

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