Water Tank Automation

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Abstract—This paper proposes a novel irrigation system that utilizes a Bluetooth-controlled automated water pump. The system comprises 6 key components: Arduino Uno Board, Ultra Sonic Sensor, 5 Volt Water pump, 9 Volt Battery to power the Arduino Uno, Relay Module, Bluetooth Module, Latex tube for Water pump. The system operates autonomously based on sensor data and user-defined watering schedules transmitted via Bluetooth. This paper delves into the system design, hardware components, software algorithms, and user interface. Experimental results from field trials demonstrate the effectiveness of the proposed system in reducing water consumption. This solution presents a promising approach for sustainable and efficient water management.

Index Terms—Arduino Uno Board, Ultra Sonic Sensor, 5 Volt Water pump, 9 Volt Battery, Relay Module, Bluetooth Module, Latex tube

I. INTRODUCTION

All of the above listed components were connected by jumper wires to create a Water tank automation system. The main components are explained as followed:

A. Arduino Uno Board

The Arduino Uno, often referred to as the workhorse of the Arduino family, is a Microcontroller board that opens doors to the wondrous world of electronics for hobbyists, students, and professionals alike. It's a simple yet powerful platform that allows you to control LEDs, motors, sensors, and more, bringing your creative ideas to life.

1) Ease of use: Arduino provides a beginner-friendly programming environment, ideal for individuals with no prior coding experience. Its visual programming style and simple syntax make it intuitive and accessible. Versatility: The Uno boasts numerous input and output pins, allowing you to connect various sensors, actuators, and communication modules. This lets you build diverse projects ranging from simple LED blinkers to complex robots and weather stations.

2) Affordability: Uno is one of the most affordable Arduino boards, making it an excellent choice for beginners and budget-conscious enthusiasts. Its low cost removes financial barriers to entry, democratizing electronics exploration. Large community: A vast and supportive community of Arduino users exists online and in local chapters. This provides access to tutorials, troubleshooting tips, and inspiration for your projects. Now, let's delve deeper into the technical specifications of the Arduino Uno:

3) Microcontroller: At its heart lies the ATmega328P microcontroller, responsible for processing program instructions and controlling devices. Memory: It offers 32 KB of flash memory for storing your code and 2.5 KB of SRAM for temporary data storage.

4) Input/Output pins: 6 analog input pins can read analog voltages from sensors, and 14 digital I/O pins can switch digital signals on and off, controlling LEDs, motors, etc. Some digital pins can also be used for PWM (pulse-width modulation) for dimming LEDs and controlling motor speeds.

5) Power supply: You can power the Uno via a USB cable connected to your computer or with an external power adapter (5-6 Volt).

6) Getting started with Arduino:

- Download the Arduino IDE (Integrated Development Environment) from the official website.
- Connect your Uno to your computer with a USB cable.
- Choose your project and write the code in the Arduino IDE.
- Upload the code to the Uno, and watch your creation come to life!

B. Ultra Sonic Sensor

Ultrasonic sensors, drawing inspiration from the echolocation abilities of bats, are electronic devices that measure distance or presence based on high-frequency sound waves. They operate through the following principles:

- Transmission: The sensor emits a burst of ultrasonic sound waves, typically above the audible range of human hearing (20 kHz).
- Reflection: Upon encountering an object within the sensor's detection range, the ultrasonic waves reflect back towards the sensor.
- Time Measurement: The sensor accurately measures the time elapsed between the transmission and reception of the reflected sound waves.
- Distance Calculation: Knowing the speed of sound in the medium (usually air) and the measured time delay, the sensor can calculate the distance to the reflecting object using the following formula: Distance = (Speed of Sound * Time Delay) / 2

C. 5 Volt Water pump

5V Water Pump: Tiny Titan of Liquid Flow A 5V water pump is a compact powerhouse, designed to operate using the

ubiquitous 5V voltage found in USB ports, power banks, and even some batteries. Here's a quick breakdown:

1) Key Features:

- Voltage: Low 5V operation makes it portable and versatile, easily powered by readily available sources.
- Flow rate: Varies depending on the model, but typically ranges from 50 to 200 liters per hour, sufficient for small fountains, misters, and hydroponic systems.
- Size: Compact and lightweight, ideal for integrating into miniature projects or portable applications.
- Cost: Generally affordable, making them accessible for hobbyists and experimenters.

2) Applications:

- Circulating water: Perfect for keeping liquids in aquariums, fountains, or miniature hydroponic setups fresh and oxygenated.
- DIY projects: Ideal for adding liquid movement to artistic creations, science experiments, or interactive displays.
- Portable solutions: Power water features on-the-go, from camping trips to picnics, with readily available USB sources.

D. Relay and Bluetooth Module

1) Relay Module: The relay, serves as a miniature electrical switch. Unlike traditional switches, however, it is actuated by a low-power signal rather than direct physical contact. This allows for sensitive control circuitry to manipulate high-wattage devices, a crucial distinction in ensuring safety and efficient operation. The relay's internal electromagnet acts as the conductor, responding to the control signal by drawing internal contacts together and completing a circuit. When the signal ceases, a spring mechanism forces the contacts apart, effectively breaking the circuit. This elegant dance of magnetic attraction and spring-loaded separation empowers the relay to act as a silent yet potent intermediary, controlling the flow of power to lights, motors, and various other high-power apparatus.

2) Bluetooth Module: The Bluetooth module, operating on the invisible stage of radio waves, plays the part of a communication hub. It facilitates wireless data exchange between devices via the ubiquitous Bluetooth protocol. These diminutive modules, often packaged as readily integrable components, translate commands and data into a language understood by both the control circuitry and the devices they govern. This wireless dialogue enables remote control and monitoring, opening a world of possibilities in automation and the burgeoning landscape of the Internet of Things. HC-05 module is used.

3) Working Together: Together, the relay and the Bluetooth module form a formidable partnership, orchestrating the interplay between the subtle whispers of control and the robust roar of high-power execution. Their combined prowess unlocks a spectrum of applications, from simple remote lighting control to intricate home automation systems where devices seamlessly converse and collaborate. Whether manipulating household appliances, monitoring environmental sensors, or integrating devices into larger networks, these technological titans work tirelessly behind the scenes, ensuring the symphony of modern technology plays on.

II. METHODOLOGY

This section contains the hardware connections of all the components used to control the water tank levels by an automated water pump.

A. Connections

- Arduino is connected to Relay by its Digital pin 2 to the IN pin of the relay. While the VCC and Ground are given to relay from Arduino
- Ultrasonic sensor sitting at the top of the tank is connected to Arduino as follows: Trigger pin to Digital pin 9 of Arduino, Echo pin to Digital pin 10. VCC and ground are given from Arduino.
- Bluetooth Module is connected as follows: TxD pin to Digital pin 4 and RxD pin to Digital pin 5. VCC and ground are given from Arduino.
- Also to power the Arduino it is connected to 9 Volt battery.
- The 5 Volt Water pump's positive end is connected to the relay and the negative end is connected to the ground. Whereas, the relay has one additional 5 Volt power by the breadboard.

B. Working

The Arduino Uno controls every component directly or indirectly. Following steps show the working of Water tank automation:

- Ultrasonic sensor is always monitoring the water level of the tank. If the water level goes down to a lower threshold the water pump turns ON and fills the tank up to an upper threshold where it stops when it exceeds the limit.
- Bluetooth Module is used to connect any android application to the relay module using Bluetooth. It turns the module on/off from the mobile phone so that it works as a remote.
- Relay is used to give 5 Volt to every component.

III. RESULTS

All of these components when connected together make a working Automated Water Tank.

Bluetooth module connected the phone to the relay. Relay was turned ON when the button on the phone was turned ON and vice versa so was the whole automation system including the Ultrasonic sensor which constantly monitors the water level. The water level was only 1 cm which was less than the 2 cm Lower threshold so the 5 Volt Water pump turned ON and started to fill the tank. The total length of the tank was 12 cm and the upper threshold was 11 cm. When the water level reached 11 cm the water pump automatically turned OFF.

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