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Smartphone-Controlled Water Pump Management System for Various Irrigation Sectors Using Ardunio UNO

Rafat Ara[1], Harun-Or-Roshid[2], Md. Abdur Rahim[3]

[1,3]Assistant Professor, Department of CSE, German University Bangladesh, Gazipur, Bangladesh
[2]Student, Department of CSE, German University Bangladesh, Gazipur, Bangladesh

ABSTRACT

The water pump technology described in this paper is Bluetooth-controlled and may be used to remotely manage water using a mobile application. The system consists of a microcontroller with Bluetooth functionality coupled to a water pump. Through the interface of the mobile application, users may control the pump, modify flow rates, and keep an eye on its current status. The technology uses a secure Bluetooth connection and is energy-efficient. It can be applied in a variety of contexts, such as water management in gardening, fisheries, agriculture, and diverse sectors of irrigation. This research demonstrates the viability and efficiency of using Bluetooth technology to remotely control water pumps, which contributes to preserving resources. The implementation of this initiative may also contribute to the reduction in the waste of electricity and water.

KEYWORDS: *Water Pump, Smartphone, Arduino, Bluetooth, Power Supply*

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I. INTRODUCTION

One of the most vital natural resources for humans is water. Water is essential to nearly every daily activity that humans engage in, including cleaning, bathing, irrigation, and meeting industry demands. But while the world's population continues to rise, the quantity of clean water is declining. It is clear that improvements in the clean water supply are necessary to meet the population's ongoing needs for clean water. Technology plays a role in the evolution of culture. Technology is typically created to make certain tasks easier for people to complete. Thus, technological advancement typically sets off cultural change. Automation technology is one of the technologies of today. People occasionally wish for their work to be done automatically so they can save energy for other tasks. Advanced automation tools, like the Arduino UNO, which allows logical control of electrical circuits, have been developed to set certain tasks automatically. The circuit is intended to be logically controlled by Arduino.[1] The primary part of an integrated circuit chip that can be programmed with embedded C++ is in Arduino. This microcontroller is an AVR, made by the company Atmel. The gadget can process the program, read the input, and generate a variety of outputs depending on what we need. A microcontroller is comparable to the human brain as a result. When looking at the watering purposes of the previous works, it is found that the automated irrigation systems, temperature control, distance measurement, automated bottle filling systems, soil humidity monitoring, and plant watering systems have all been implemented using Arduino UNO-based sensors.

This proposal proposes an automated water tank filling system using an Arduino UNO microcontroller. The water pump, which pumps groundwater into the tank, has two models: a manual operation and a floating ball tap-equipped system. The manual operation is inefficient and can cause water spills, excessive electricity use, and damage to walls. The proposed system uses an Arduino UNO and an ultrasonic sensor to regulate water filling

levels. The sensor will automatically turn off the machine when the tank is filled and on at a predetermined level once the tank is filled.

II. Proposed System

Our proposed system is an efficient way to extract water from underground sources, wells, lakes, rivers, or reservoirs for various purposes of irrigation. It will save time and energy compared to manual extraction methods. Other benefits include controlled by Mobile App, energy efficiency, real-time monitoring, a user-friendly interface, reduced wiring complexity, portability and flexibility, cost-effectiveness, ease of installation and improved safety. The design of a smart water pump system controlled by a smartphone is given below:

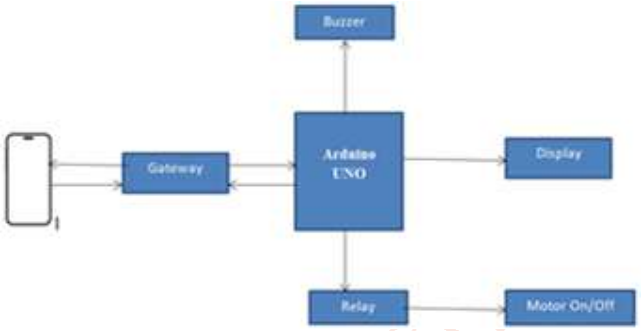


Fig 1 Design of smart water pump system controlled by smartphone

A. Software/Hardware Requirements

- Water pump
- Male to male cables
- Male to female cables
- Arduino UNO
- Relay
- 9v Battery

B. Modules Description

To set up a Bluetooth-controlled water pump, specific electronic components are required, including Bluetooth modules, a microcontroller, and associated peripherals. These are the key modules typically used in such a system.

1. Microcontroller:

- **Description:** The microcontroller is responsible for managing the water pump system by processing Bluetooth commands, controlling the motor, and adjusting settings based on user inputs.
- **Functionality:** A microcontroller is used to interpret Bluetooth commands, execute pump control logic, and provide feedback to the mobile app. Common microcontrollers used for this purpose are Arduino boards, PIC microcontrollers, or custom-designed microcontrollers based on the specific system requirements.[2]

2. Bluetooth Module:

- **Description**: The water pump system can communicate wirelessly with a mobile device through a Bluetooth module. Bluetooth Classic and Bluetooth Low Energy (BLE) are the two types of Bluetooth modules available. Bluetooth Classic has HC-05, HC-06, and HM-10 as its common manufacturers, while BLE has HM-11 or HM-19.
- **Functionality:** The microcontroller in the water pump system can receive commands and transmit feedback to and from a mobile device through the Bluetooth module.

3. Power Supply:

- **Description:** This module provides electrical power for the entire system, which can be either a battery or an external power source depending on the application.
- **Functionality:** It is responsible for providing a stable and suitable voltage to various components, including the Bluetooth module and microcontroller.

4. Motor Driver:

- **Description:** When a water pump includes a motor, such as in irrigation or circulation pumps, a motor driver circuit is required. This circuit converts signals from the microcontroller into power levels that operate the motor.
- **Functionality:** The pump motor's speed and direction are controlled by the motor driver, which receives signals from the microcontroller.

5. User Interface (Mobile App):

- **Description:** The mobile app acts as a user interface for controlling the water pump system, communicating with the Bluetooth module for commands and feedback.
- **Functionality:** With the mobile app, users can control and monitor their water pump through Bluetooth. They can easily turn the pump on or off, adjust settings, and keep track of the system.

C. Necessary Tools

1. Arduino UNO: Based on the ATmega328P microcontroller, the Arduino UNO is a popular open-source microcontroller board.[3] It is a component of the Arduino hardware platform and is renowned for being user-friendly, adaptable, and simple. The ATmega328P microcontroller is an 8-bit AVR microarchitecture chip that has EEPROM, SRAM, and flash memory for data retention and program storage.

Fig 2 Arduino UNO

2. Water Motor:

Water motors, also known as water pumps, are mechanical tools that move water from one place to another. They work by creating a pressure difference inside a casing as the impeller, a type of rotor, rotates. Various types of water motors exist, such as jet pumps, centrifugal pumps, and positive displacement pumps. The most common type of water motor is the centrifugal pump, which generates centrifugal force with a spinning impeller. Centrifugal pumps are used in numerous applications, such as irrigation, water treatment, and HVAC systems, to move water through the pump and out of the discharge outlet.

Fig 3 Water motor

3. Power Supply:

A power supply provides electricity to an electronic device by transforming electrical energy from a source. AC and DC power supplies are the two main categories, with DC providing a constant voltage output and AC transforming the mains' AC voltage into DC. Power supplies come in various forms and ratings, from small wall outlets for mobile phones to large generators for industrial machinery.

Fig 4 Power Supply

4. Bluetooth Sensor:

The HC-05 is a Bluetooth device that communicates with microcontrollers using serial communication. Its default settings can be changed with certain AT commands. The module has a 3.3 V level for RX/TX, so there's no need to shift the TX voltage level. However, the transmit voltage level from the microcontroller to the RX of the HC-05 module needs to be shifted. For more information on how to use the HC-05 Bluetooth module, refer to the topic in the sensors and modules section.[4]

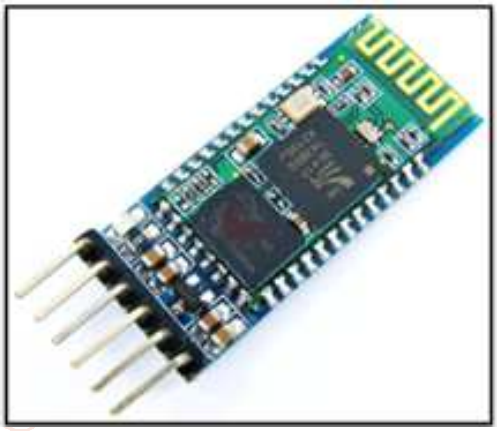
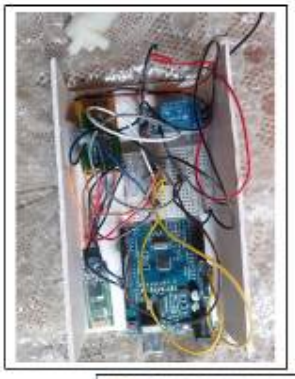


Fig 5 Bluetooth Sensor

III. Physical View of the System



IV. Advantages of Smartphone-Controlled Water Pump Management System

- Efficiency is increased and energy usage is decreased with enhanced water distribution management.
- Pump operation can be monitored and controlled in real-time, reducing the need for human intervention and improving reliability.
- Automatic fault detection and repair capabilities are also provided, resulting in long-term cost savings due to reduced maintenance needs.[5]
- It was put in place to minimize the need for labor.

V. Disadvantages of Smartphone-Controlled Water Pump Management System

Reliance on electronic components may pose challenges in areas with limited access to skilled technicians for maintenance and repairs.

VI. Conclusion

In today's world, technology has advanced to the point where we prefer automatic processes that don't require human effort. This project helps to reduce the amount of manual work required by a person to turn the pump on or off. The project is particularly helpful in situations where it's difficult to operate the water pump properly. The system uses an Arduino to control the pump and can be applied to areas such as irrigation, water treatment, and industrial process control.

In the future, GSM technology will be used to control the water pump from anywhere in the world.

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AUTHORS PROFILE

Rafat Ara teaches as an Assistant Professor in the German University Bangladesh's Department of Computer Science and Engineering in Gazipur, Bangladesh. She graduated with a B.Sc. in computer science and engineering from Jatiya Kabi Kazi Nazrul Islam University (JKKNIU) in Bangladesh and an M.Sc. in computer science from Jahangirnagar University (JU) in Bangladesh. Her research interests include cloud computing, artificial intelligence, computer networks, Internet of Things, software engineering, cryptography, and network security. She has published research papers in a number of national and international journals.

Harun-Or-Roshid is a student in the department. of Computer Science and Engineering at German University Bangladesh in Gazipur, Bangladesh. He has research interests in robotics, artificial intelligence, Internet of Things, and cloud computing.

Md. Abdur Rahim teaches as an Assistant Professor at German University Bangladesh in Gazipur, Bangladesh, in the Department of Computer Science and Engineering. He received his M.Sc. in computer science from Jahangirnagar University (JU), Bangladesh, and his B.Sc. in computer science and engineering from Jatiya Kabi Kazi Nazrul Islam University (JKKNIU), Trishal, Mymensingh, Bangladesh. He has authored numerous research articles for both domestic and foreign publications. Software engineering, cloud computing, Internet of Things, blockchain technology, internet and web programming, and wireless communications are some of his areas of interest in research.