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Automatic Water Dispenser: An IOT-enabled Water Dispenser with touch-free Dispensing and App Control

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***Abstract* - This literature survey explores existing research relevant to the development of an "Automatic Water Dispenser" project. This project aims to revolutionize water dispensing through a touch-free and app-controlled approach. It leverages sensor technology for hands-free activation, eliminating the need for physical buttons and screens. Users simply place a container under the dispenser to initiate water flow. Additionally, a companion app allows for precise control over the dispensed volume. This literature survey aims to establish a foundation for the development of an automatic water dispenser that promotes hygiene, user convenience, and responsible water usage.**

Keywords: IOT, sensor technology, dispensed volume, Automatic Water Dispenser, Water Dispenser, Dispensing, App Control.

I. INTRODUCTION

The growing integration of Internet of Things (IoT) technologies into everyday appliances is transforming how we interact with them. Water dispensers are no exception, with the emergence of smart water dispensers offering innovative features that enhance user experience and promote healthy habits.

One of the key benefits of IoT water dispensers lies in their ability to improve hygiene. Traditional water dispensers with touch-based controls can harbor germs and bacteria, potentially leading to cross-contamination [5]. IoT water dispensers equipped with touchless activation methods, such as gesture recognition or proximity sensors, address this concern by eliminating the need for physical contact [1]. This not only promotes hygiene in individual households but also holds significance in public spaces like offices, schools, and healthcare facilities.

Beyond hygiene benefits, IoT water dispensers empower users with greater control over their hydration habits. Integrating these devices with smartphone applications allows for features like monitoring water consumption, setting dispensing schedules, and receiving reminders to stay hydrated [2]. This fosters mindful water consumption and can be particularly beneficial for individuals with specific health goals or those prone to forgetting to drink sufficient water throughout the day [4].

The proposed project aims to contribute to this evolving landscape by developing a sensor-based water dispenser prototype. This prototype will leverage hand gesture recognition technology to enable touch-free operation, promoting hygiene and minimizing the risk of germ transmission. Additionally, the project will integrate an Arduino microcontroller to facilitate seamless communication and control of the dispenser through IoT connectivity.

The focus on gesture recognition aligns with the growing interest in exploring alternative interaction methods that reduce dependence on physical touch. Research suggests that users readily adapt to gesture-based interfaces, finding them intuitive and convenient [3]. Integrating Bluetooth support further enhances user experience by allowing for app-based control of the water dispenser. A user-friendly mobile application interface will be designed to provide users with a simple and intuitive means of adjusting dispensing volume, setting preferences, and monitoring water consumption.

By investigating the feasibility of reducing physical contact through advanced technology like gesture recognition, this project seeks to contribute to the development of more hygienic and user-friendly water dispensing solutions. The project's functionalities, including gesture control and Bluetooth support, are aimed at showcasing the potential of sensor-driven water dispensers to improve convenience and user experience while promoting healthy hydration habits.

The following section will delve deeper into the existing research on sensor-based touchless interaction, Bluetooth-powered app control, and user interface design for IoT devices. This literature review will serve as a foundation for the development of the proposed water dispenser prototype.

II. HARDWARE COMPONENTS

This section details the core hardware and software components required for the prototype water dispenser and their functionalities within the system.

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1) Arduino UNO / Microcontroller:

The Arduino UNO is a microcontroller board based on the ATmega328P chip [6]. It serves as the central processing unit of the system, responsible for:

- Connecting and receiving signals from various components like sensors, motors, and the Bluetooth module.
- Interpreting sensor data, controlling water flow duration based on user gestures, and transmitting data to the Bluetooth module if applicable.
- Running the embedded code programmed to define the overall functionality of the dispenser.

Figure 1: Arduino Microcontroller

2) Wires:

Jumper wires provide essential electrical connections between the different components on the breadboard or perfboard used in the prototype [7]. They allow for:

- Delivering power from the Arduino board or external power source to other components.
- Carrying control signals from the Arduino to activate components like the pump motor and transmitting sensor data back to the Arduino.

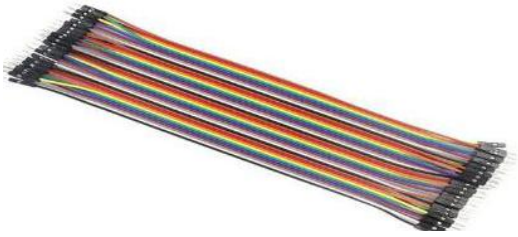

Figure 2: Wires

3) Ultrasonic Sensors:

Ultrasonic sensors will be used for gesture detection in this project. These sensors emit high-frequency sound waves and measure the time it takes for the reflected wave to return. This information is used to calculate the distance between the sensor and the nearest object [8]. In our project, the Arduino will interpret the changes in distance detected by the sensor as user gestures (e.g., hand movement in front of the sensor) to initiate water flow.

Figure 3: Ultrasonic Sensor

4) Air Pump Motor:

A small air pump motor will be used to create the pressure necessary to dispense water from the tank. The Arduino will control the motor's activation and duration based on the interpreted user gesture or app commands (if applicable).

Selection of a specific air pump motor will depend on factors like tank size and desired water flow rate. Several online retailers like SparkFun or Adafruit offer a variety of air pump motors suitable for hobbyist projects.

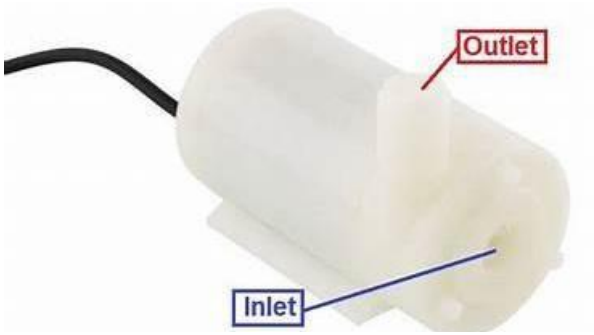

Figure 4: Air Pump Motor

5) Water Tank:

A temporary water tank will be used for the prototype to hold and dispense water. The size and material will be chosen based on project requirements and safety considerations.

6) Tubes:

Food-grade tubing will be used to connect the water tank to the pump motor and the dispensing outlet, ensuring safe and hygienic water flow.

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7) Bluetooth Module:

The Bluetooth module will enable wireless communication between the water dispenser and a user's smartphone. This allows for:

- App Control: Integrating the dispenser with a mobile application for features like setting water dispensing volume, monitoring water consumption, and potentially scheduling water dispensing routines.
- Data Transmission: Potentially transmitting sensor data or status updates to the smartphone app.

Figure 5: HC-05 Bluetooth Module

Several Bluetooth modules are compatible with Arduino, such as the HC-05 or HC-06 modules. The specific module selection will depend on functionalities and communication protocols used in the project.

8) Arduino Libraries and IDE:

The Arduino IDE (Integrated Development Environment) provides a set of pre-written libraries that simplify working with various components. This project will likely utilize libraries for:

- Sensor Interfacing: Libraries like "Ultrasonic" or specific sensor model libraries to interact with the ultrasonic sensor and interpret its data.
- Bluetooth Communication: Libraries like "SoftwareSerial" or specific Bluetooth module libraries to establish communication and data exchange with the Bluetooth module.

9) Compatible Operating System:

The Arduino IDE software is available for various operating systems, including Windows, macOS, and Linux [9]. This allows for code development and program upload to the Arduino board from the chosen platform.

III. METHODOLOGY

1) Detection using Ultrasonic Sensor:

Ultrasonic sensors employ high-frequency sound waves to detect the presence and distance of objects. They work by:

i. The sensor generates inaudible sound waves at a very high frequency.
ii. These sound waves travel outwards and bounce off any object in their path. The sensor then measures the time it takes for the reflected wave (echo) to return.
iii. Based on the speed of sound and the measured echo time, the sensor calculates the distance between itself and the nearest object.
iv. In this project, the Arduino will utilize the ultrasonic sensor's distance readings to detect user gestures. For example:
    - When an object (glass or container) moves in front of the sensor, the distance reading will decrease significantly.
    - The Arduino can be programmed to interpret this change in distance as a trigger to activate the water pump.
v. It is important to note that, the rest of the app functions are restricted unless an object is detected by the ultrasonic sensor continuously. In absence of such an object, no water will be released.

Figure 6: Physical Dispenser Model

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2) Selection of water quantity via application:

The Bluetooth module enables communication between the water dispenser and a smartphone application. This allows users to control the water dispensing process remotely through the app.

Figure 7: APP Controlling UI

i. A mobile application will be designed for the specific water dispenser.
ii. The smartphone establishes a wireless connection with the Bluetooth module on the dispenser.
iii. The app will provide an interface for users to select the desired water dispensing volume. This can be achieved through buttons.
iv. Once a selection is made, the app transmits the chosen water quantity data to the Arduino via Bluetooth.
v. The Arduino receives the data and controls the water pump activation time accordingly, ensuring the desired amount of water is dispensed.

3) Water retrieval due to submergible motor:

i. The submergible motor is controlled according to the activation time and duration set by the Arduino controller and thus pumps a specific amount of water before stopping.
ii. The water flows through the tubes, and is released at the designated opening, the other end of the tube comes outward from the opening provided in the model.
iii. The container or any other object will be on the receiving end of the water tube and the selected amount of water will flows out onto the object.

Figure 8: Measures Water To Dispense

Figure 9: Water Dispensing

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IV. CONCLUSION

The implementation of touchless operation and app control features significantly enhances the project's value proposition. Eliminating the need for physical contact with the dispenser promotes hygiene by minimizing the risk of cross-contamination, especially beneficial in public spaces or healthcare settings. Additionally, app control empowers users with greater flexibility and convenience. Users can monitor water consumption, adjust dispensing volumes precisely and potentially set automated dispensing schedules through the app, promoting mindful hydration habits.

While the current prototype focuses on water dispensing, the core functionalities can be adapted for dispensing various liquids with adjustments. Implementing appropriate tubing materials and pump capacity could enable dispensing medicines, essential oils, or other compatible liquids with precise control. Integrating the app with user profiles and dosage settings could further enhance this functionality for measured and personalized dispensing of various liquids.

This project exemplifies the potential of IoT technology in promoting smart automation. The integration of sensors, microcontrollers, and app control lays the groundwork for further exploration of connected features. Future iterations could incorporate functionalities like real-time monitoring of liquid levels, automatic reordering of supplies, or integration with smart home platforms for voice-controlled dispensing.

The successful implementation of this project demonstrates the feasibility of developing a user-friendly and versatile dispenser system with applications beyond water management. By leveraging touchless operation, app control, and the potential for multi-liquid dispensing, this project contributes to the growing landscape of smart IoT devices that promote hygiene, convenience, and precise control in our daily lives.

V. FUTURE SCOPE

1. Smart Home Integration with voice assistants and automation.
2. Advanced Hygiene Features like UV-C sterilization and enhanced touchless sensors.
3. Real-Time Monitoring for water quality and usage analytics.
4. Sustainability through smart dispensing algorithms and automated reordering.
5. AI and Machine Learning for predictive hydration and behavior adaptation.
6. Multi-Liquid Dispensing with customizable parameters for different liquids.
7. Public Space Deployment in hospitals, schools, and public areas.
8. Cost Reduction for wider accessibility and adoption.

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