Review Paper on Automatic Tap Infrared Sensor

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Abstract

The review paper presents an overview of non-microcontroller-based automatic tap systems. In recent years, automation has become a part of modern life, especially in improving hygiene and reducing wastage of natural resources such as water. One of the most common and effective examples of such automation is the Automatic Water Tap. It is a touchless system that automatically releases water when a user's hand is detected near the tap and stops the flow once the hand is removed. This system uses sensors (such as infrared or ultrasonic) to detect the presence of an object, and a microcontroller to control a solenoid valve that regulates the water flow. The main aim of developing this project is to promote contactless operation, which not only ensures better hygiene but also helps in saving water by avoiding unnecessary flow. Such systems are widely used in public places, hospitals, restaurants, and homes to maintain cleanliness and conserve water resources. The project also demonstrates the application of embedded systems and sensor-based automation in real-world problems. Through this project, we learn the integration of electronic sensors, microcontrollers, and actuators to build an efficient and user-friendly system. It is a practical implementation of automation principles that combines both hardware and software to achieve an intelligent and eco-friendly solution.

Keywords: IR Sensor, Single Channel Relay Module, 9v Battery, 6v Battery, 5v Mini Battery, Breadboard, Pipes, Water Tap Setup, Connecting Wires.
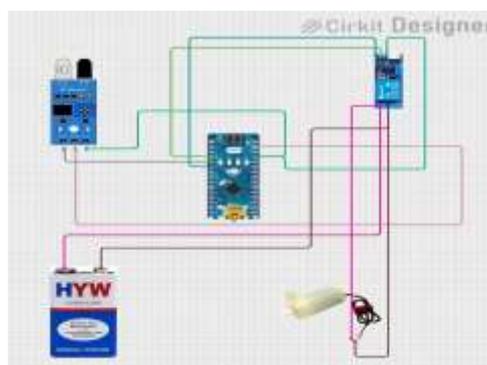
1. INTRODUCTION

Water is an essential natural resource, and its efficient management is critical given the increasing problem of scarcity in many regions. Traditional manual-control taps often lead to

significant water wastage due to user negligence or mechanical issues, such as being left partially on. Furthermore, in public and commercial settings, manual taps are a primary source of germ and bacteria transmission, posing a serious health and hygiene risk, a concern heightened by global health crises such as the COVID-19 pandemic.

The advent of automatic, touchless faucet technology provides a compelling solution to these challenges. First introduced by Norman Wareham, automatic faucets are equipped with a proximity sensor, typically an active infrared (IR) sensor, that detects the presence of a user's hands and activates a solenoid valve to start the water flow. The flow stops automatically a few seconds after the user removes their hands, which precisely limits water use to the time required for washing.

This paper provides a comprehensive review of the application and implementation of infrared sensor technology in automatic water taps. The review explores the fundamental working principles of active and passive infrared sensors within these systems and highlights their primary benefits, including improved hygiene by eliminating cross-contamination and substantial water and energy conservation. The existing literature on the design considerations, implementation using microcontrollers (such as Arduino Nano), and performance evaluation in various applications (homes, hospitals, airports, etc.) will be examined. This review aims to consolidate current knowledge, identify technological advancements, and outline future research directions for optimizing the efficiency and reliability of IR sensor-based automatic tap systems.

2. LITRATURE REVIEW

Automatic control system did not appear until the middle eighteenth century. The first automatic control system "the fly-ball governor", to control the speed of steam engines was invented by James Watt in 1770 (Nagrath and Gopal, 2010). Automatic taps were first developed in the 1850s but were not produced for commercial use until the late 1950s when they first appeared to general public at airport lavatories. Story has it that the first airport to adopt this technology is the Chicago O' here international airport. They arer now found in place other than the airports.

Dur to their assistive qualities, automatic taps are making their presence felt at living establishment and places where elderly and handicapped individuals called home. Automatic water saving great amount of water that would otherwise be wasted. Most of the existing project based on PIR sensors are for security purpose. This project however uses the PIR sensor along with other components to either turn on or off a water tap electronic circuits consists of interconnection of electronic components. Components are classified into passive and active devices.

Working Principal
1. The IR Sensor detects the presence of a hand.
2. The signal from the sensor is sent to the controller.
3. The Controller activates a relay circuit.
4. The relay energizes the solenoid valve allowing water flow.
5. When the Hand is removed the sensor output stops the valve doses.

Model Advantages
1. Water Conservation Automatically shuts off when not in use, reducing water wastage significantly.

2. Hygienic No need to touch the tap with dirty hands, reducing the spread of germs and bacteria.
3. Convenient and User-Friendly Easy for children, elderly, or people with disabilities to use.
4. Modern Aesthetic Sleek, stylish look enhances the design of modern bathrooms or kitchens.
5. Temperature Control (in some models) Some taps allow pre-set temperature settings for consistent comfort and safety.
6. Energy Efficient (Battery Operated or Low Power) Many run on batteries or low-voltage power, making them efficient and easy to maintain.

Model Disadvantages
1. Higher Initial Cost More expensive to purchase and install compared to traditional taps.
2. Maintenance and Repairs Sensors or electronics may malfunction and require professional servicing.
3. Battery Replacement Battery-operated models need periodic battery changes.
4. Water Flow Delay or Inaccuracy Sensors may have a slight delay or fail to detect hands properly, leading to frustration.
5. Limited Manual Control Some models don't allow manual operation, which can be inconvenient during a power or sensor failure.
6. Installation Complexity Requires electrical wiring or battery housing, which can complicate installation.

Future Scope
1. Integration with Smart Home Systems
Voice & App Control: Integration with platforms like Amazon Alexa, Google Home, or custom apps for remote control and monitoring. Usage Analytics: Track water usage over time to help users understand and reduce consumption. Custom Profiles: Personalized water flow and temperature settings for individual users.
2. AI & IoT Integration AI-Powered Optimization:
Automatically adjusts flow rate based on hand proximity, usage pattern, or activity (e.g., washing hands vs. brushing teeth). Leak Detection: Smart sensors could detect leaks or malfunction and alert users in real time. Predictive Maintenance: Using AI to anticipate when the faucet needs maintenance or battery replacement.
3. Water Conservation & Environmental Impact Ultra-efficient Flow Control:
Better control systems to optimize every drop, supporting sustainability goals. Greywater Reuse Systems: Integration with home-level systems that reuse slightly used water (like from handwashing) for flushing or irrigation.
4. Hygiene and Health Focus Antimicrobial Materials:
Faucets made from materials that inhibit bacterial growth. UV Sterilization: Built-in UV lights to sterilize the tap nozzle periodically. Public Health Integration: Ideal for hospitals, airports, and public restrooms where minimizing touch is essential.
5. Battery & Power Efficiency Energy Harvesting:
Faucets that charge themselves using water flow or ambient light. Longer Battery Life: Advanced low-power electronics for maintenance-free operation for years.

3. CONCLUSION

1. The automatic water tap system successfully detects the presence of hands using an IR sensor and automatically controls the water flow without physical contact.

2. This project helps in saving water and maintaining hygiene by reducing wastage and avoiding touch-based contamination.
3. The system is reliable, energy-efficient, and cost-effective, making it suitable for use in public places, homes, and hospitals.
4. The use of IR sensor technology ensures quick response and accurate detection for automatic operation.
5. Overall, the project demonstrates a practical and eco-friendly automation solution for modern sanitary systems.

4. REFERENCES

1. IR Sensor Datasheet
2. Arduino and Automation Tutorials
3. Research papers on automatic taps
4. Online electronics project references

An automatic water tap, also known as a sensor tap or touchless faucet, is a plumbing fixture that uses an infrared or motion sensor to automatically activate water flow when hands are detected beneath the spout. It typically consists of a sensor module, solenoid valve, control unit, and power source (battery or AC). These taps are designed for hygiene, water conservation, and convenience, commonly used in public restrooms, hospitals, and modern smart homes.