DESIGN AND IMPLEMENTATION OF AN AUTOM ATIC WATER SENSOR TAP

BY:

GEORGE SUCCESS OLUWAFEMI

ND/23/COM/FT/0044

A Project Submitted to the Department of Computer Science, Insti tute of Information and Communication Technology, Kwara State Polytechnic, Ilorin

In Partial Fulfillment of the Requirements for the Award of Nation al Diploma (ND) in Computer Science

July, 2025

CERTIFICATION

This is to certify that this project was carried out by **GEORGE, success oluwafemi** with matriculation number **ND/23/COM/FT/0044,** has been read and approved as meeting part of the requirements for the award of National Diploma (ND) in Computer Science.

....

Dr. (Mrs.) OLUSI, T. **Date**

(Project Supervisor)

....

Mr. Oyedepo, F. S. **Date**

(Head of Department)

....

External Examiner **Date**

DEDICATION

This project is dedicated to the creator of the earth and universe, the Almighty God. It is also dedicated to my parents for their moral and financial support.

ACKNOWLEDGEMENT

All praise is due to the Almighty God the Lord of the universe. I praise Him and thank Him for giving me the strength and knowledge to complete my ND progr amme and also for my continue existence on the earth.

I appreciate the utmost effort of my supervisor, Dr. (Mrs.) Olusi, T. whose patie nce support and encouragement have been the driving force behind the succe ss of this research work. She gave useful corrections, constructive criticisms, comments, recommendations, advice and always ensures that an excellent re search is done. My sincere gratitude goes to the Head of the Department and other members of staff of the Department of Computer Science, Kwara State Polytechnic, Ilorin, for their constant cooperation, constructive criticisms and e ncouragements throughout the programme.

Special gratitude to my parents who exhibited immeasurable financial, patienc e, support, prayers and understanding during the periods in which I was busy t irelessly in my studies. Special thanks go to all my lovely siblings.

My sincere appreciation goes to my friends and classmates.

TABLE OF CONTENTS

ABSTRACT

This project explores the design and implementation of an automatic water sensor tap aimed at addressing issues of water wastage and promoting efficient water management. The work aimed to switch ON and OFF a water tap automatically without the need of turning it manually. It employs a passive Infrared (PIR) Sensor which has a maximum sensitivity of about 3m. The sensor detects the presence of a user within its viewing range and responds by giving a high at its output. The automatic sensor water tap incorporates a microcontroller (PIC16F628A) which was programmed using the 'C' programming language and turns ON the tap automatically whenever the sensor senses a user, and turns OFF when the user moves back. This research has successfully provided the improvement on existing water condition by which human beings get the good quality of water.

CHAPTER ONE

GENERAL INTRODUCTION

1.1 BACKGROUND TO THE STUDY

Water is the available natural resources on earth, which has to be utilized effic iently. Also it has to be provided without wastage to face the problem of scarci ty with appropriate quantity and quality. Water bodies cover 70% of earth surfa ce out of this only 3% of water is portable and drinkable. Water conservation is a critical global concern, with increasing demand and dwindling resources exa cerbating the issue (Karthikeyan *et al.*, 2022).

Traditional taps often lead to significant water wastage due to user negligenc e or improper closure. The advent of sensor-based technology provides an inn ovative approach to mitigate these challenges. The problem to find a new wat er source, need to pay a high-water bill and the difficulty that been facing by di sabled people to used water tap becomes the reason why systems like this ar e needed to be built (Khulal & Ranganayakulu, 2024)

Mohammed and Mohammed (2020) explained that water scarcity affects billi ons globally, necessitating efficient management practices. Traditional water dispensing systems are prone to wastage, particularly in public facilities wher e taps are often left running. Automatic water taps, equipped with sensors, off er a practical solution by activating water flow only when a user is detected, th us minimizing waste. However, challenges such as inconsistent detection acc uracy and power dependency have limited their widespread adoption.

The concept of an automatic water tap was first introduced by the Australian i

nventor Norman Wareham. Norman Wareham initiated electronic controls of water flow for domestic, commercial, medical and industrial sector. The auto matic faucet is equipped with a proximity sensor. The working mechanism hel ps to opens its valve to flow water in response to the presence of a user's han ds in close proximity. The water tap closes its solenoid valve, after a few seco nds when it no longer detects the presence of a user's hands. The developed system is able to control the water tap to protect the wastage of water (Pahal son & Dayer, 2019). This device developed is very-cost if compared to this pro posed system.

Automatic sensor taps offer the benefit of improved hygiene, by eliminating th e need to physically turn the knob of the tap ON or OFF. This eliminates the ch ance of re-contaminating one's hand by touching the same handle that was pr eviously touched by not only your unwashed hands, but by that of those befor e you. This tap greatly reduces the chances of water wastage which may aris e if one forgets to turn off the tap after use or turned it only partially off out of haste. By implication, when installed in home, sensor taps alleviate the need f or parents to ensure that their children have turned off taps. Economically, sen sor taps use less water, resulting in direct savings on water bills (Sinaga *et al*, 2023).

Additionally, the integration of advanced microcontroller technology and infrar ed sensors presents an opportunity to enhance the efficiency of automatic ta ps. These innovations aim to address the shortcomings of existing systems w hile ensuring affordability and environmental sustainability (Wanga *et al.*, 202 0).

This project emphasizes bridging the gap between technological advancements and practical implementation to promote global water conservation. Automatic water tap or faucet is a tap equipped with an IR sensor and mechanism that opens its valve to allow water to flow in response to the presence of an object nearby to the sensor. The advantage of this system is, it will work very accurate because the system will let the water flow out only when the sensor sense the present of human and it automatically stop the water flow when the sensor do not detect any motion of human. It will minimize the water waste because water only flow out when someone used the water tap.

This study seeks to address the existing system barriers by developing a cost-effective, user-friendly, and reliable system.

1.2 STATEMENT OF THE PROBLEM

Usually, most of the water taps available today used the old system where it uses manual control to turn ON or OFF the system. The water tap is easy to be spoiled due to frequent turning as some people do not know how to carefully handle it. The manual operation of traditional taps often results in excessive water wastage due to human error or negligence. This inefficiency not only exacerbates water scarcity but also increases utility costs and environmental impact. Another disadvantage of the older system is that, when users wash their hands, their hands are not always clean because they still have a direct contact with the messy tap which is exposed to germs. Existing automatic taps are frequently cost-prohibitive and require significant maintenance, limiting their accessibility and usability. There is a need for a more affordable, efficient, and reliable solution to tackle these issues.

1.3AIM AND OBJECTIVES OF THE STUDY

The aim of this project is to design and implement a cost-effective and efficie nt automatic water sensor tap to promote water conservation and reduce was tage. The objectives are to:

i. Design a sensor-based tap system capable of detecting user presence;
ii. Implement and test the designed system for effectiveness and efficienc y; and
iii. Evaluate the economic and environmental benefits of the proposed syst em.

1.4 SIGNIFICANCE OF THE STUDY

This project contributes to global water conservation efforts by addressing ine fficiencies in traditional water dispensing systems. The proposed solution offe rs practical applications in residential, commercial, and industrial settings. By r educing water wastage and operational costs, it supports sustainable resourc e management and environmental protection. Also, the system will reduce th e need to pay a high-water bill and the difficulty that has been facing by disabl ed people to used water tap becomes the reason why this system is built

1.5 SCOPE OF THE STUDY

The study focuses on the design, development, and testing of an automatic w ater sensor tap. It examines the system's functionality, efficiency, and cost-eff ectiveness. The implementation scope is limited to small-scale applications, s uch as households and public restrooms, with potential scalability for broader

applications.

1.6 ORGANIZATION OF THE REPORT

The project write-up is organized into five distinct chapters. Chapter one cover s general introduction, which contains introduction to the project topic, statem ent of the problem, aim and objectives of the study, significance of the study, s cope of the study and organization of the report. Chapter two covers the litera ture review, which contains review of related past works, overview of artificial i ntelligence, description infrared sensor, automatic water sensor tap and other related concepts. Chapter three explains the project methodology which inclu des analysis of existing system, problems of the existing system, the descripti on of the proposed system and advantages of proposed system. Chapter four explains the design, implementation and documentation of the system which contain system designed output design, input design, procedure design, imple mentation of the system hardware and software support and documentation of the new system installation procedure, operating the system and system m aintenance. Lastly, chapter five explains the summary of the research, recom mendations, and conclusion.

CHAPTER TWO

LITERATURE REVIEW

2.1 REVIEW OF RELATED LITERATURE

Muhammad and Mohammad (2020) developed an automatic water tap syste m. The aim of the paper is to develop an automatic water tap system that can reduce the water wasting in our daily life and save water bill so it can reduce li fe cost. It's also can help disabled people to used water tap in easy way. This system can be used at residence, school, mall and mosque. In the system, Ar duino Uno was used as microcontroller and LDR sensor also been used to det ected a user. When the sensor detects the user, the system will let the water f low out. The microcontroller receives the signal from sensor and will send the signal to L239B (motor driver) to control the motor rotation. It will control the motor to rotate clock wise or anti-clock wise for open and close the water tap. The LED also been used in this system. The water flows out accurately becau se it only flows when the sensor senses the user hand and it automatically sto p the water flow when there is nobody uses the water tap. The result shows t hat the system is able to save water and automatically detect a hand when pl aced under the tap.

Khulal and Ranganayakulu (2024) implemented an automatic water tap. The p aper presented the development of an automatic water tap based on an indus trial grade adjustable infrared sensor. A typical Automatic water tap can switc h the device on and off continuously and mitigate the usage of water from wa stage. The industrial grade adjustable sensor is used which can sense transpa

rent or opaque with maximum sensitivity of about 80 cm. Active infrared sens or emits and receives infrared radiation, which detects the presence of objects nearby and bounces back to the receiver of the device. The high or low signal generated by the IC is used to control the water flow by switching the solenoid valve and vice versa. The overall design and unique feature an automatic wat er tap makes the product user-friendly. It is comfort and easy to plug in a regul ar water pipe socket for standard hand-washing. The extensively tested of de vice results to achieve the high levels of reliability. By considering the hygienic to avoid cross contamination, automatic water taps make significant on savin g water.

Pahalson and Daya (2019) worked on the design and implementation of an au tomatic sensor water tap for hand washing. The research is a design and impl ementation of an automatic sensor water tap for hand washing. The work aim ed to switch ON and OFF a water tap automatically without the need of turnin g it manually. It employs a passive Infrared (PIR) Sensor which has a maximu m sensitivity of about 3m. The sensor detects the presence of a user within it s viewing range and responds by giving a high at its output. The automatic se nsor water tap incorporates a microcontroller (PIC16F628A) which was progra mmed using the 'C' programming language and turns ON the tap automaticall y whenever the sensor senses the user's hand, and turns OFF when the hand i s withdrawn.

Sinaga *et al.*, (2023) proposed an automatic water faucet system using the IO T based HC-SR04 sensor. In the system, the concept of the Internet of Things

(IoT) emerges as a potential solution by connecting physical objects via the int ernet. This research designs and builds an IoT-based automatic water faucet s ystem using the HC-SR04 sensor to measure the water level in a container. H ardware components such as Node mcu Esp8266, Infrared Sensor, 2 channel 5v Relay, and others are used to control the system automatically. The softwa re used includes the Arduino IDE. This system aims to intelligently monitor an d control water flow, prevent water wastage, and incorporate the advantages of IoT technology to create an automatic water faucet system that is responsi ve to water levels and the presence of objects in front of it.

Karthikeyan *et al.*, (2022) designed an automatic water tap. The aim of the pro ject is to build and to test a smart tap system. The Smart tap system is more advanced than the conventional method and it is designed to improve life by h aving a more convenient drinking water filling in containers. The project was c reated and implemented as a prototype of automatic water tap. The aim of thi s project is to build and test a smart tap system using IR sensor. The smart ta p system is used to turn over water from source point to usage point in an effi cient way and avoids human error. This involves Arduino Nano, IR Sensor, Sole noid Valve and 7805 IC. Automated water supply can be done through embed ded system in cost effective way. The smart tap system is actually a smart sy stem as the people who wish to drink water without turning on the water tap. This project works on automated on/off tap when sensed by a sensor. This re search has successfully provided the improvement on existing water condition by which human beings get the good quality of water.

Wanga (2020) proposed a war against coronavirus (COVID – 19) in Tanzania:

designing a low-cost automatic water tap. In the paper, an attempt has been made

to design a low-cost automatic water tap as a measure to fight the spread of Coronavirus (Covid-19). The designed system uses simple, easy to get and low-cost instruments. The system does not require a user to touch the water tap. It uses microcontroller to implement intelligence. The solar panel is used as a source of power. The system design uses green solution based automatic water tap. The system will be used in gatherings to avoid Coronavirus spreading. Such gathering places include hospitals, markets, bus stops, public transports, churches, mosques, and restaurants.

2.2 REVIEW OF RELATED CONCEPTS

2.2.1 Infrared Sensor Technology

Infrared (IR) sensor technology involves the use of infrared light to detect objects, measure distances, or sense heat. Infrared sensors operate by emitting infrared radiation and detecting the changes in the reflected or transmitted signals. This technology finds widespread use in proximity sensing, motion detection, temperature measurement, and environmental monitoring. The versatility of infrared light, which is invisible to the human eye, makes these sensors ideal for non-intrusive and non-contact applications, ensuring minimal interference with the observed object or environment (Prima *et al.*, 2017).

One common application of infrared sensors is in remote control devices. They transmit infrared signals to control various appliances such as televisions and air conditioners. These sensors are also critical in industrial automation, where they detect object presence, position, or motion in manufacturing lines. Similarly, IR sensors are employed in security systems for intrusion detection, as they can effectively sense motion and heat from humans or animals.

Infrared sensors come in two main types: active and passive. Active infrared sensors emit infrared light and measure the reflections to determine distance or motion. In contrast, passive infrared (PIR) sensors detect infrared radiation emitted naturally by objects, such as human body heat. This makes PIR sensors a popular choice for energy-efficient lighting systems and security cameras, as they can trigger actions like turning on lights when movement is detected.

As technology advances, IR sensors are becoming more sensitive, compact, a

nd affordable. They are integral in applications like health monitoring, where t hey measure heart rate and oxygen levels through infrared light absorption. W ith the rise of smart devices and IoT systems, infrared sensor technology is po ised to play an even more significant role in creating intelligent, connected sol utions for everyday challenges (Zhang & Liu, 2020).

2.2.2 Overview of Microcontroller Applications

Microcontrollers are compact computing devices that integrate a processor, m emory, and input/output peripherals onto a single chip. They are the brains be hind many electronic devices, enabling automation, control, and communicati on in a vast array of applications. Microcontrollers are specifically designed for embedded systems, where they execute dedicated tasks efficiently, making t hem an essential component of modern technology (Amin, 2020).

One of the most common applications of microcontrollers is in consumer elect ronics. They are found in appliances like washing machines, refrigerators, and microwaves, where they control operations and user interfaces. In automotive systems, microcontrollers are crucial for functions such as engine control, anti -lock braking systems, and infotainment. Similarly, in healthcare devices like gl ucose monitors and pacemakers, microcontrollers ensure precise control and reliability.

In industrial environments, microcontrollers enable process automation and m onitoring. They are at the heart of robotic systems, controlling movements, se nsors, and actuators. They also manage energy-efficient lighting systems and HVAC (heating, ventilation, and air conditioning) units in buildings. The rise of I oT has further expanded their utility, allowing devices to communicate and sh

are data for intelligent decision-making.

Advancements in microcontroller technology are leading to greater computati onal power, lower energy consumption, and enhanced connectivity. Modern m icrocontrollers often feature wireless communication capabilities, such as Blu etooth and Wi-Fi, enabling seamless integration into smart ecosystems. As in dustries continue to innovate, microcontrollers will remain a pivotal technology for enabling smarter, more efficient systems (Ihsan *et al.*, 2021).

2.2.3 Overview of Artificial Intelligence

Artificial Intelligence (AI) refers to the development of computer systems that can perform tasks typically requiring human intelligence. These tasks include l earning from experience, reasoning, problem-solving, understanding natural la nguage, and visual perception. AI leverages algorithms, data processing, and computational power to mimic cognitive functions, enabling machines to mak e decisions or predictions.

AI can be broadly categorized into narrow AI and general AI. Narrow AI, which focuses on specific tasks, is prevalent in applications like virtual assistants, re commendation systems, and autonomous vehicles. General AI, on the other h and, aims to replicate human-level intelligence across a wide range of tasks, t hough it remains a theoretical concept in current research. Machine learning, a subset of AI, is a pivotal technique where systems learn from data to improv e their performance over time (Kumar, 2022).

Industries across the board are adopting AI to enhance efficiency and innovati

on. In healthcare, AI algorithms assist in diagnosing diseases, predicting patie nt outcomes, and personalizing treatment plans. In finance, AI-powered syste ms analyze market trends, detect fraudulent transactions, and optimize invest ment strategies. Additionally, AI is revolutionizing education, agriculture, and e ntertainment by automating processes and enabling new experiences.

Despite its immense potential, AI also presents ethical and technical challeng es. Issues such as bias in algorithms, privacy concerns, and job displacement must be addressed as the technology evolves. Responsible development and regulation are critical to ensuring that AI serves humanity effectively while min imizing risks and inequities (Mashilkar *et al.*, 2018).

2.2.4 Artificial Intelligence in Water Sensor Tap

Artificial Intelligence in Water Sensor Tap

Integrating Artificial Intelligence (AI) into water sensor taps transforms these devices into intelligent systems that optimize water usage and enhance user convenience. AI enables the tap to analyze patterns of water consumption an d adapt its operation to minimize wastage. For instance, it can adjust the wate r flow rate based on the detected level of dirt on hands or the type of activity b eing performed.

AI-powered water sensor taps use advanced machine learning models to proc ess data from various sensors, such as proximity, pressure, and flow sensors. This allows the system to detect not only hand movements but also contextu al cues like water temperature preferences. By learning user habits, the tap ca

n provide personalized settings, improving the overall user experience while c onserving resources (Tibe *et al.,* 2021).

These systems can also be connected to IoT networks for remote monitoring and control. Facility managers can access real-time data on water usage thro ugh dashboards and receive alerts in case of anomalies, such as leaks or unu sually high consumption. AI algorithms can analyze this data to predict mainte nance needs, ensuring the taps operate efficiently and reducing downtime.

The combination of AI and water sensor taps is a significant step toward sust ainable technology. By reducing water waste and providing data-driven insight s, these systems align with global efforts to address water scarcity and promo te environmental conservation. As the technology evolves, it has the potential to be widely adopted in homes, businesses, and public spaces (Tibe *et al.,* 202 1).

2.2.5 Automatic Water Sensor Tap

Automatic water sensor taps are a modern solution for minimizing water wast e and enhancing hygiene. These taps operate using sensors that detect the pr esence of hands or objects, automatically activating water flow without the ne ed for physical contact. This touchless functionality not only conserves water but also reduces the spread of germs and bacteria, making them ideal for publ ic restrooms and healthcare facilities.

The core technology behind automatic water sensor taps includes infrared se nsors or ultrasonic sensors, which detect proximity or motion. When an object is detected, the sensor sends a signal to a control unit that activates the solen