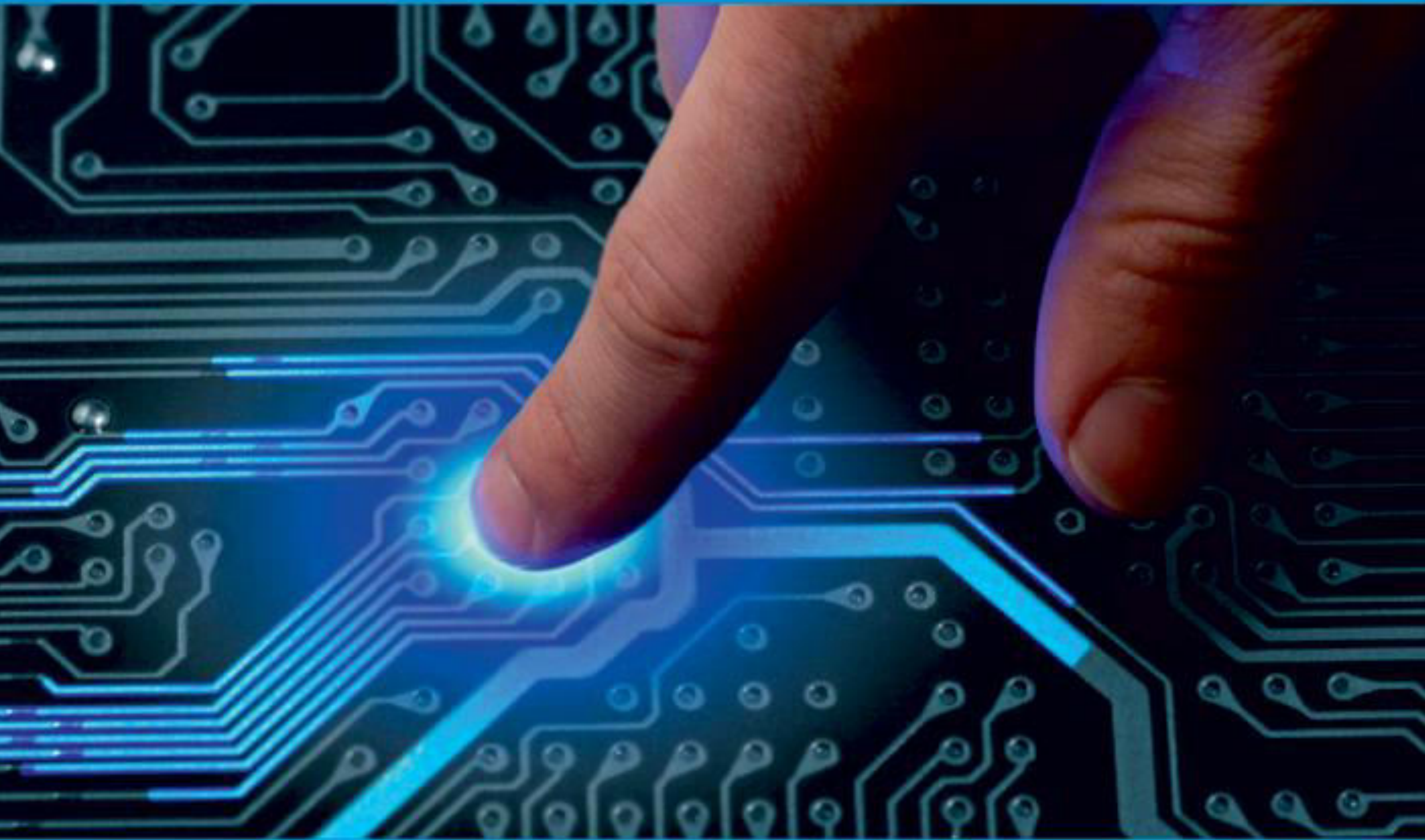
IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 12, Issue 3, March 2024

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.379

9940 572 462 6381 907 438 ijircce@gmail.com www.ijircce.com

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 | Monthly Peer Reviewed & Referred Journal |

|| Volume 12, Issue 3, March 2024 ||

| DOI: 10.15680/IJIRCCE.2024.1203153 |

Analysis and Design of Automatic Water Tank Filling System Using Arduino

Prof. V. N. Mahawadiwar, Divyansh Tembhare, Akash Moundekar, Utkarsh Raut

Department of ETC, Karmavir Dadasaheb Kannamwar College of Engineering, Nagpur, Maharashtra, India

ABSTRACT: This project centers on an Arduino-powered automated water level controller and indicator, leveraging ultrasonic sensors for precise water level measurement. These sensors operate on the principle of echo, where sound waves rebound upon encountering an obstruction. Utilizing this principle, the system accurately computes the travel time of outgoing and returning waves, facilitating precise distance assessment. The primary goal of the system is to combat the challenge of water scarcity, particularly acute in nations like India. In numerous Indian households, water is stored in elevated tanks, often resulting in overflow and significant water and electricity wastage. The system diligently monitors water levels and triggers a motor pump via a relay when levels drop below a specified threshold. This automated procedure curtails water and electricity wastage while enhancing efficiency by eliminating the need for manual intervention. Through the implementation of this project, our objective is to contribute to water conservation endeavors and advocate for sustainable practices, especially in regions grappling with water scarcity.

KEYWORDS: Arduino, Float Sensor, Water level, Overhead, underground etc.

I. INTRODUCTION

Water plays a pivotal role in the functioning of public establishments such as schools, colleges, hospitals, and various other facilities, serving essential purposes like drinking and sanitation. Often, to fulfill the water requirements of these spaces, overhead tanks adorn the rooftops, while underground reservoirs store rainwater or alternative sources. Water pumps are deployed to replenish these tanks from wells, boreholes, or underground reservoirs. However, the manual management of these pumps poses challenges, requiring someone to remember to activate or deactivate them as necessary.

Failure to switch off the pump upon tank saturation results in water wastage and unnecessary electricity consumption. Conversely, neglecting to switch it on when the tank nears depletion causes inconvenience and potentially exacerbates water scarcity concerns for users. Regrettably, some individuals exhibit carelessness in their water usage habits, exacerbating the issue of wastage.

Addressing these challenges necessitates the deployment of automatic water level monitoring and control systems. These systems leverage digital technology and electromechanical components, including magnetic sensors, power supplies, and motors, to ascertain water levels and regulate pump operations accordingly. Placed within the tank, the sensor activates the motor when the water level surpasses a specified threshold, ensuring optimal tank replenishment while mitigating overflow risks.

The adoption of such automated control mechanisms not only conserves water and reduces electricity consumption but also fosters environmental preservation and promotes sustainable water management practices. By harnessing technology to enhance water resource utilization, we pave the way for a more sustainable future, benefiting both current and future generations.

II. LITERATURE REVIEW

1. In 2013, Gunturi innovated an automatic plant irrigation system, leveraging a microcontroller for automation. This system aimed to minimize manual efforts, cut costs, and conserve water while boosting efficiency. Gunturi

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 | Monthly Peer Reviewed & Referred Journal |

|| Volume 12, Issue 3, March 2024 ||

| DOI: 10.15680/IJIRCCE.2024.1203153 |

programmed 8051 microcontrollers to control sprinkler activation via pulse signals. Additionally, temperature and humidity sensors, integrated into the microcontroller, detected environmental changes, triggering the sprinkler through interrupt signals, optimizing irrigation.

2. In June 2013, the International Journal of Computer Science, Engineering, and Applications (IJCSEA), Vol.3, No.3, showcased a groundbreaking paper titled "Revolution Agricultural Irrigation: A Breakthrough in Automatic Water Flow Measurement" by Ria Sood, Manjit Kaur, and Hemant Lenka. The research underscores the pivotal role of water level controllers in transforming agricultural irrigation practices, advocating for their adoption to tailor water usage to each crop's specific needs, thus curbing wastage. The study introduces an innovative technique utilizing a Hall Effect Sensor for precise water flow measurement in irrigation pipelines, employing a G1/2 Hall Effect water flow sensor with a turbine rotor to accurately gauge flow dynamics, offering a holistic approach to efficient agricultural water management.

3. The September 2014 issue of The International Journal of Scientific and Research Publications featured a paper titled "SMS Notifications Integration in Automatic Water Level Controller System" by Sanam Pudasaini, Anuj Pathak, Sukirti Dhakal, and Milan Paudel. This paper presents an advanced water level controller system with SMS notification capabilities, enhancing user control, especially during power outages. The system integrates automatic level control with SMS alerts, developed using Arduino and deployed on a Microcontroller, enabling automatic water level regulation and SMS alerts to users during load shedding. This innovative approach utilizes a single sensor for periodic measurements and motor control, preventing manual filling and overflow.

4. Several commercial entities offer solutions for single sump or bore motors, yet none tailor to specific needs. A personalized solution involves activating the bore motor only when the sump tank's water level dips below a set threshold, optimizing water management and reducing power consumption and overflow risks. This proposed system integrates water level sensing and control via a microcontroller, adaptable to both wired and wireless setups. It boasts cost-effectiveness and ease of configuration, centered around the P89V51RD2 microcontroller. Moreover, it includes a monitoring service accessible via web and cellular platforms.

III. BLOCK DIAGRAM

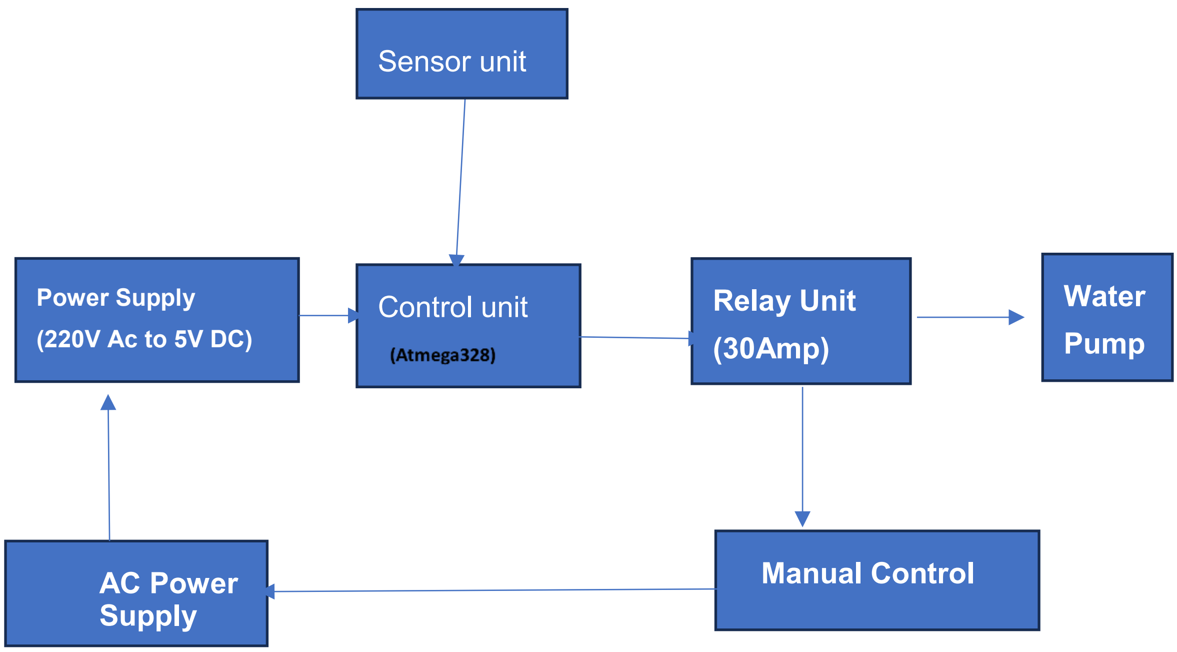


Fig 3.1 block diagram of automatic tank filling system

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 | Monthly Peer Reviewed & Referred Journal |

|| Volume 12, Issue 3, March 2024 ||

| DOI: 10.15680/IJIRCCE.2024.1203153 |

IV. HARDWARE DISCRIPTION

1. *Arduino Nano*

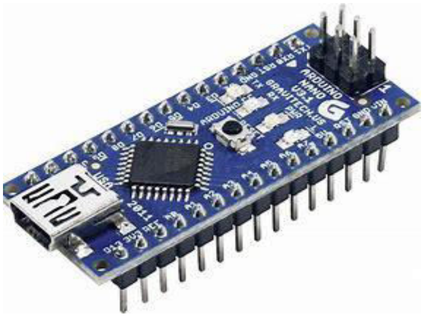


Fig. 4.1 Arduino Nano

The Arduino Nano, a standout within the Arduino microcontroller lineup, is renowned for its compact design housing the Atmega328 chip. Despite its size, it mirrors the functionalities of the larger Arduino Uno with integrated USB, it seamlessly connects to computers for programming and power. Boasting digital/analog pins, PWM outputs, and serial communication, it interfaces effortlessly with various sensors and actuators. Its versatility caters to a wide array of projects, from basic LEDs to intricate robotics, making it a top choice for wearables, drones, and compact electronics. Supported by a vibrant community, its open-source nature appeals to electronics enthusiasts of all levels.

2. *Float Sensor*

Fig. 4.2 Float Sensor

The float switch sensor is a crucial device used extensively in various industries and applications to monitor liquid levels in containers, tanks, or reservoirs. Working on the principle of buoyancy, it employs a buoyant float that rises or falls with the liquid level, activating a switch mechanism to open or close an electrical circuit. This action provides a signal indicating the liquid level. With its long-standing presence in multiple industries, the float switch operates on a single pole, either positive or negative, adjusting its position according to the liquid level. Its responsiveness to changes in liquid levels enables it to effectively control circuit connectivity. This adaptability makes it invaluable for liquid level monitoring tasks across different surfaces and environments, showcasing its versatility and reliability.

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 | Monthly Peer Reviewed & Referred Journal |

|| Volume 12, Issue 3, March 2024 ||

| DOI: 10.15680/IJIRCCE.2024.1203153 |

3. PCB

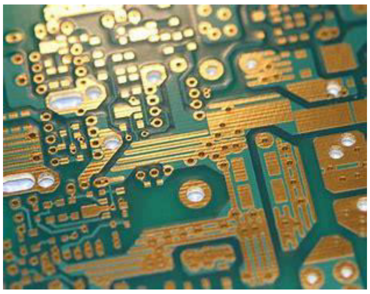


Fig. 4.3 PCB

The Printed Circuit Board (PCB) lies at the core of electronic systems, serving as a fundamental component in the field of electronics. Its primary role is to streamline the connection and organization of electronic components by replacing traditional wiring in circuits. As a sturdy and conductive structure, the PCB plays a crucial part in assembling and linking various electronic elements. Its introduction has revolutionized electronic circuit design by eliminating extensive wiring, resulting in mechanically stable structures. PCBs significantly reduce circuit complexity, simplifying hardware and enabling more compact and streamlined devices. Designed for versatility, PCBs come in multiple layers to suit various electronic configurations, accommodating both Surface-Mount Devices (SMD) and Through-Hole components. In essence, the PCB stands as a cornerstone in modern electronics, enhancing efficiency, compactness, and simplicity in electronic device design and construction.

V. WORKING

The automatic water tank filling system comprises several essential components, including a float switch sensor, Arduino Nano, 30-amp relay, and other necessary parts. Its operation is contingent upon monitoring the water levels in both overhead and underground tanks.

The float switch sensor is pivotal in this setup. It functions by moving vertically, generating signals "11" when in an upward position and "01" when downward. These signals are critical as they indicate the water levels in the tanks. The Arduino Nano acts as the central processing unit, receiving these signals through digital I/O pins.

Upon receiving the signals from the sensors, the Arduino Nano decodes the data and generates corresponding signals to trigger the relay. The relay serves as a switch, controlling the activation of the water pump based on the interpreted data.

The sensors are capable of generating four distinct conditions based on their sensing parameters. Among these conditions, the relay is activated only once, while it remains inactive for the remaining three scenarios.

For instance, if both tanks reach their maximum capacity and are full, the relay remains in the off position. This prevents unnecessary activation of the pump, thereby conserving energy and avoiding overflow.

Conversely, if the overhead tank is empty while the underground tank is full, the relay is activated, signaling the pump to start working. This ensures that the underground tank, which holds water reserves, can supply the system.

In the event that both the overhead and underground tanks are empty, the motor automatically turns off to prevent any futile operation and conserve power.

Subsequently, as the underground tank begins to fill, indicating a replenishment of water reserves, the motor

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 | Monthly Peer Reviewed & Referred Journal |

|| Volume 12, Issue 3, March 2024 ||

| DOI: 10.15680/IJIRCCE.2024.1203153 |

restarts its operation. It continues pumping water until the overhead tank reaches its full capacity, maintaining a continuous supply of water.

This systematic approach not only ensures efficient water management but also prevents wastage of energy and water resources. By automating the process of filling tanks based on real-time data from sensors, the system optimizes water usage and minimizes the risk of overflow or shortage.

VI. ADVANTAGES OF WATER LEVEL CONTROLLER

1. Amidst the push for energy conservation, a water level controller emerges as a sustainable solution, promoting mindful energy consumption and efficient power utilization.

2. Cost Savings: The implementation of a water level controller translates into monetary savings by curbing water and electricity wastage, contributing to a more economical and sustainable approach.

3. Automatic Operations: The water level controller operates automatically, ensuring that water levels are consistently maintained at appropriate levels. This automation enhances convenience and efficiency in water management.

4. Reduces Manual Labor: Water level controllers automate the process of managing water levels, reducing the need for manual intervention. This not only saves time but also minimizes the risk of human error.

5. Protects Equipment: Overfilling water tanks can lead to damage to pumps, valves, and other equipment. Water level controllers help prevent such damage by ensuring that water levels remain within safe limits.

VII. DISADVANTAGES OF WATER LEVEL CONTROLLER

1. Absence of Short Circuit Protection: One notable disadvantage is the potential risk of burning caused by the absence of short circuit protection in certain water level controllers. This vulnerability poses a concern for the overall safety and durability of the system.

2. Sensor Dysfunction from Water Flow: In cases where the sensor is rendered non-functional due to damage caused by the flow of water, proper installation becomes crucial to address this issue. Ensuring robust sensor protection is essential to maintain the system's reliability.

3. Wiring Vulnerabilities: The connection between the water level controller and the sensor involves wiring to the water tank. This introduces the possibility of wiring issues occurring at any time, posing a challenge in terms of system reliability and consistent performance.

4. Initial Cost: Water level controllers typically require an upfront investment for purchase and installation. Depending on the complexity of the system and additional features, the initial cost may be relatively high, especially for more advanced models.

VIII. RESULT

The development of an Arduino-based automatic water tank filling system involves a thorough analysis and complex design process. This culmination results in an extensive report that meticulously outlines various aspects of the project, including objectives, methodology, rationale behind component selection, circuit diagrams, programming code snippets, testing procedures, empirical results, and conclusions. This detailed documentation serves multiple purposes. Firstly, it elucidates the intricate functionality of the system, providing a comprehensive understanding of its

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 | Monthly Peer Reviewed & Referred Journal |

|| Volume 12, Issue 3, March 2024 ||

| DOI: 10.15680/IJIRCCE.2024.1203153 |

operations. Through detailed descriptions and diagrams, readers can grasp how the system functions and achieves its intended purpose.

Moreover, the report meticulously highlights the system's effectiveness. It presents empirical evidence and test results that demonstrate the system's ability to efficiently fill water tanks automatically. By showcasing its performance in real-world scenarios, the report reinforces the system's credibility and reliability. The documentation also acknowledges potential limitations. Through thorough analysis and testing, the report identifies areas where the system may fall short or encounter challenges. By acknowledging these limitations, the report encourages further refinement and improvement of the system.

Project image

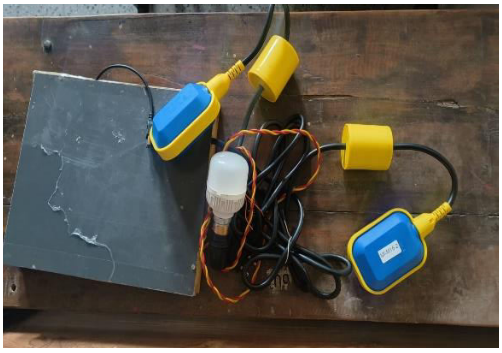


Fig. 8.1 Automatic Tank Filling System

Additionally, the report proposes innovative avenues for enhancement. Building on the project's success, it suggests ways to improve the system's performance, expand its capabilities, or address identified limitations. These proposals stimulate ongoing research and development efforts, ensuring continuous improvement of the system over time. Beyond its technical details, the report serves as a catalyst for discussions surrounding the system's feasibility, cost-effectiveness, and real-world applicability. By examining these factors, readers can assess the practicality of implementing the system in various contexts. This comprehensive evaluation fosters a nuanced understanding of the system's potential benefits and challenges.

X. CONCLUSIONS

This ambitious project has achieved its fundamental objectives, marking a significant milestone in its journey. Beyond immediate success, its essence lies in the intricate design and development of an automatic water level control system, combining software and hardware architecture seamlessly. Navigating the technological landscape adeptly, it harmonizes the complexities of both realms. Powered by advanced sensing technology, the system elegantly discerns water levels with precision. Functionally versatile, it proves invaluable across diverse landscapes, bridging rural and urban environments. Its prowess lies in optimizing water source utilization, ushering in an era of efficiency. However, its transformative potential extends further, acting as a guardian for water conservation on a grand scale. In the expansive realm of environmental sustainability, widespread adoption of this system could wield substantial influence, leaving a lasting legacy of responsible resource management for the present and future generations.

REFERENCES

[1]. Datasheet for AT89C52 microcontroller by Atmel Corporation. Last updated in May 2000. Available at www.microchip.com

[2]. Band, E. J., and Anyasi, F. I. (2014). Development of an automated water level controller employing a mercury float switch. Published in IOSR Journal of Electronics and Communication Engineering, Volume 9, Issue 2, Pages 16-21.

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 | Monthly Peer Reviewed & Referred Journal |

|| Volume 12, Issue 3, March 2024 ||

| DOI: 10.15680/IJIRCCE.2024.1203153 |

[3]. Getu, B. N., and Attia, H. A. (December 2016). Presentation on an advanced system for automatic water level sensing and control. Presented at the 2016 5th International Conference on Electronic Devices, Systems, and Applications (ICEDSA), pp. 1-4. IEEE.

[4]. S.M. Khaled Reza, Shah Ahsanuzzaman Md. Tariq, S.M. Mohsin Reza presented on automated water level sensing and control using microcontrollers in San Francisco. Also, Dr. Ram Krishan reviewed Wi-Fi 6 technology in the International Journal of Modern Electronics and Communication Engineering (UMECE), July 2019.

[5]. Presented at the 19th International Pump Users Symposium, Judy Hodgson and Trey Walters (2002) discussed the optimization of pumping systems to minimize first or life-cycle costs

[6]. In 2013, Venkata Naga Rohit Gunturi published an article titled "Automatic Plant Irrigation System Based on Microcontrollers" in the International Journal of Advancements in Research & Technology, Volume 2, Issue 4, ISSN 2278-7763.

[7]. In Mohali, India, Ria Sood, Manjit Kaur, and Hemant Lenka engineered an Automatic Water Flowmeter, showcasing craftsmanship and innovation

[8]. "Pioneering an Automatic Water Level Controller with SMS Notification by Sanam Pudasaini, Anuj Pathak, Sukirti Dhakal, and Milan Paudel at Kathmandu University, Nepal."

[9]. In their 2020 publication, "Incorporating Discretized Components for an Automatic Water Level Control System," Big-Alabo, A., and Isaac, C. contribute to the Journal of Applied Sciences and Environmental Management (Vol. 24, Issue 10, pp. 1781-1785).

[10]. In the realm of Automatic Water Level Control Systems, Eltaieb, A. A. M., and Min, Z. J. contribute their insights in the International Journal of Scientific Research.