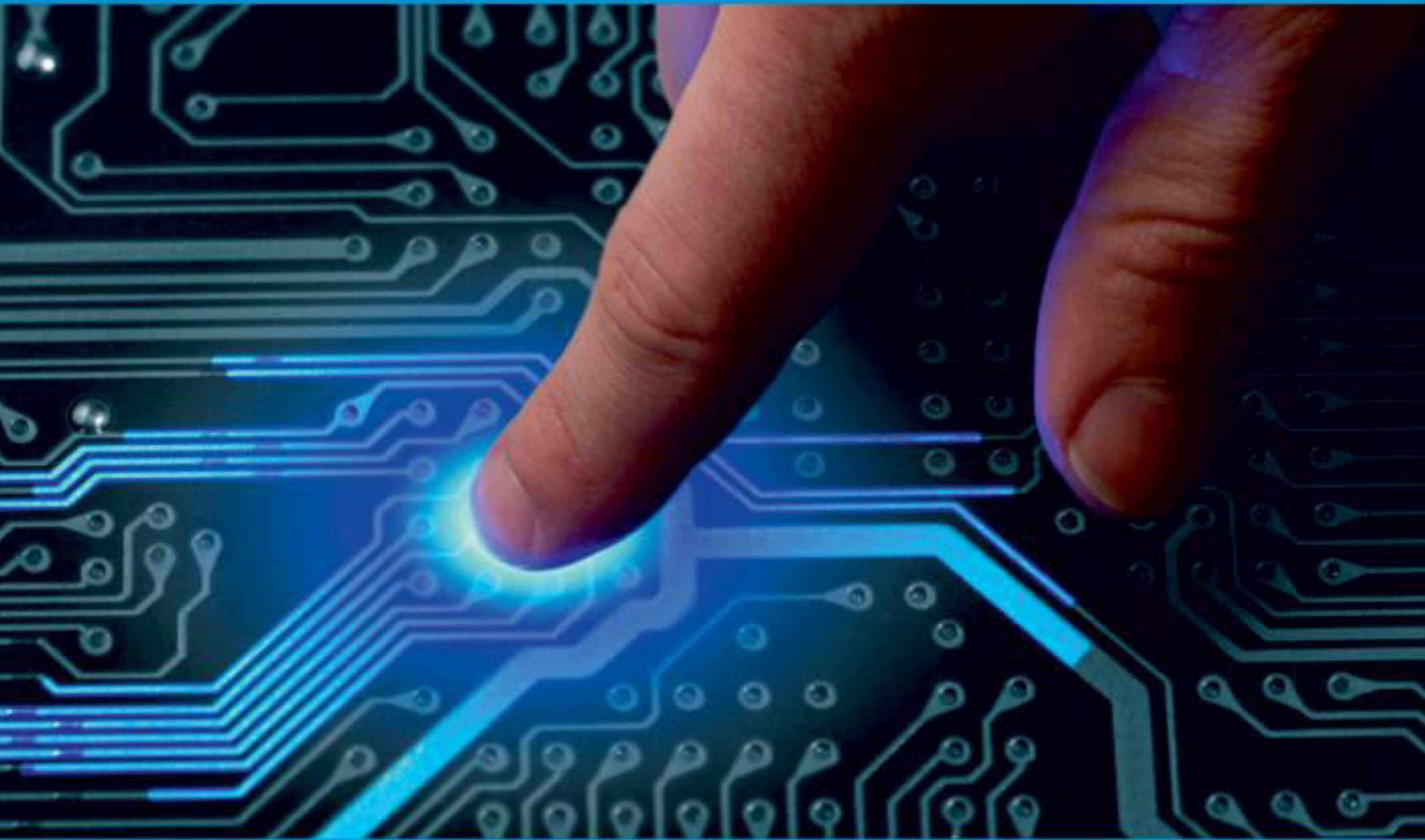
IJIRCCE

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



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 11, Issue 10, October 2023

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.379

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

|| Volume 11, Issue 10, October 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1110022 |

System for Remote Management of Residential Water Tanks

Ketaki M. Deshmukh, Prof. Pramila M. Chawan

B. Tech Student, Dept. of Computer Engineering, and IT, VJTI College, Mumbai, Maharashtra, India

Associate Professor, Dept. of Computer Engineering, and IT, VJTI College, Mumbai, Maharashtra, India

ABSTRACT: This paper presents a system for managing water tank levels using Internet of Things (IoT) technology. This system is implemented to utilize the ESP8266 Wi-Fi module, which enables the real-time transmission of data from ultrasonic water level sensors placed inside water tanks to a Blynk application. The main objective is to provide the user with accurate information about the current water levels in the tanks and ensure timely notifications in the event of tank overflow. Moreover, the project enables users to remotely control the pumps that supply water to the tanks, thus simplifying the tedious process of manual tank monitoring.

KEYWORDS: Water Tank Monitoring, HCSR04 sensor, ESP8266 Wi-Fi Module, Blynk, Notification System

I. INTRODUCTION

Water is the arguably the most important natural resource that we need, not just to sustain ourselves but also because it plays a fundamental role in agriculture, industry, energy production, etc. However, the availability of fresh water is limited, and the growing global demand, combined with the impacts of climate change, has led to water scarcity in many regions. Living in a city prone to water cuts in the summer months and in the face of global warming, effective and efficient management of water is not only a necessity but an ethical imperative.

Traditional methods water tank management often rely on manual checks, which necessitates you to stay on the site of the pump and makes the task of monitoring water tanks rigid and tedious. Moreover, in most buildings the water tanks are stored on the roof while the pumps that control the water supply are located on the ground level, creating a disconnect between the two that leads to a lot of water wastage. Focusing on water tank management systems in a residential setting and in response to these challenges, this project introduces an innovative solution that leverages Internet of Things (IoT) technology to simplify water level management in tanks.

The core objective of this project is to design and implement a robust IoT-based water tank level management system, utilizing ESP8266 board that is capable of interfacing with multiple ultrasonic water sensors. These ultrasonic sensors, strategically placed within individual water tanks, can provide users with real-time data on water levels. This data is seamlessly transmitted over Wi-Fi to a user-friendly Blynk application, that is both a web dashboard as well as a mobile application, offering an intuitive interface for monitoring and management. Moreover, the system incorporates a notification mechanism that promptly alerts users slightly before a tank reaches its full capacity, mitigating the risk of overflow and water wastage.

II. LITERATURE REVIEW

A summary of the existing works is provided in this section. A new water tank management system with additional functionalities will be designed based on these works.

[1] The paper proposes a system that utilizes a pair of Arduino boards that communicate with each other for smart water management. This system introduces an automated way to sense water levels using sensors. The calculated values are transmitted to another board using SPI communication.

[2] This paper proposes a system that uses the HCSR04 ultrasonic sensor to accurately measure the water level. These values can then be transmitted as an SMS or be displayed on the LCD used adjacently.

[3] This paper discusses a potential system that will use an ultrasonic sensor to read the water level and once it crosses a particular threshold, a buzzer will alert the user to the level of water in the tank, thus incorporating a notification system.

[4] This paper proposes the use of Wi-Fi to send the water level notifications to an Android app. This system introduces the concept of remote water tank monitoring. It also utilizes a relay that can control the water pump from the android app itself.

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

|| Volume 11, Issue 10, October 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1110022 |

[5] This paper describes a system that utilizes the Blynk platform as an Android app to monitor the water levels from the phone. Blynk is an IoT platform that acts as a graphical human machine interface to interact with and control the water management system.

[6] This paper introduces a new metric of percent of water in the tanks and demonstrates a simple formula to calculate it. The ultrasonic sensor simply provides the distance of water level from the sensor to the water level. This percent metric is far more intuitive.

III. Problem and Existing System

A. *Problem Statement:*

To develop a robust IOT system that will enable the remote and reliable management of a water tank system consisting of multiple water tanks to prevent water wastage and promote water conservation efforts.

B. *Problem Elaboration*

In most residential buildings, the water supply comes from either the overhead water storage tanks or from underground water cisterns. Water reaches these tanks via the government supply. For the overhead tanks, powerful water pumps are necessary to push the water to these tanks. Now either the pumps must be switched on during the period of water supply or the water needs to be collected in underground tanks and later transferred to overhead tanks.
In this paper, we will focus on such a hybrid system where the government water supply is automatically collected in a large volume underground cistern and is later shifted to two separate overhead tanks using a water pump. The focus of this project is to monitor and remotely facilitate the transfer of water from the underground cistern to the above ground tanks. Monitoring the water tank levels in all the 3 tanks will provide an accurate assessment of the water levels and allow management of the system without having to manually check the tanks for overflow.

C. *Existing Physical System:*

So far, the water tanks for use in residential areas are filled manually. In the system we are focusing on, water supplied by the provider is stored in an underground tank automatically. Once this tank is full, a mechanical sensor simply closes the valve as it is an underground system. The reason behind developing this system is that supplying water to the residential areas requires the water to be pumped up to the roof of the building. In this system, there are 2 such water tanks at the first and second level that are provided water from the same underground tank. Water can be transported from one pump to both the tanks by simply changing the valve outlet.

IV. APPROACH

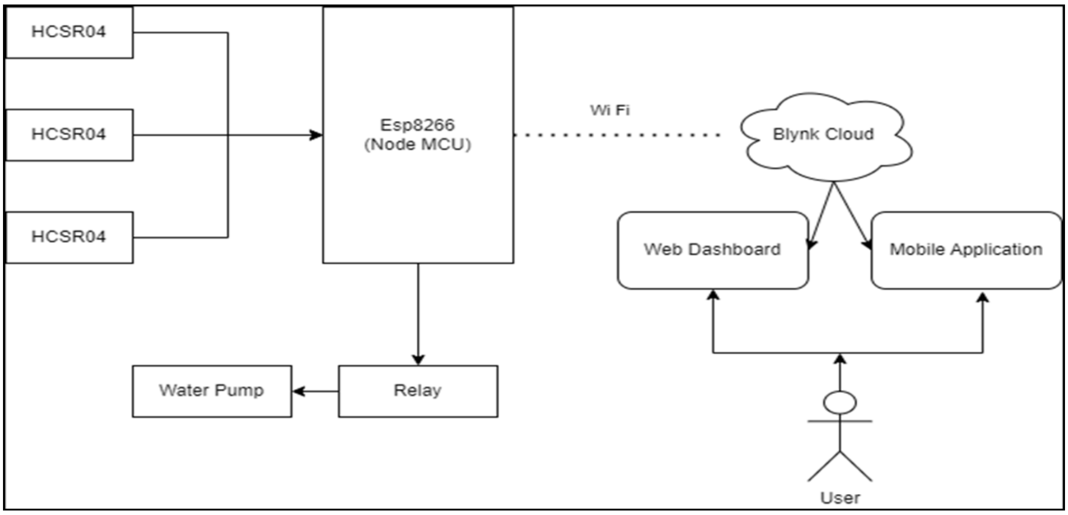


Fig 1: Block Diagram

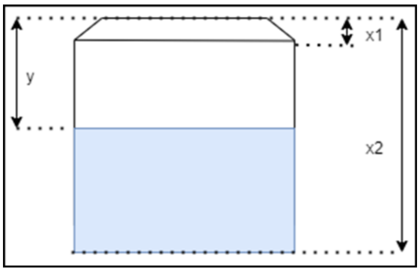
| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 || A Monthly Peer Reviewed & Referred Journal |

|| Volume 11, Issue 10, October 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1110022 |

A. Sensor – HCSR04

The HCSR04 is a sensor that uses ultrasonic waves to gauge the distance between an obstacle and the sensor. Each sensor has 4 pins – VCC, Ground, Echo and Trigger. Fitted at the upper rim of the tanks, these sensors utilize ultrasonic waves to measure the water level by calculating the time taken for the wave to bounce off the water surface and return. This gives us the distance of the water level from the top of the tank. As this measured quantity increases, the actual level of water in the tank decreases. Moreover, there is always some gap between the water level and the rim of the tank. As this metric is counterintuitive and to make up for the measurement shortcomings, we use the knowledge of the structure of the tank to calculate the percentage of tank filled with water.



$$\text{Percentage of tank filled} = \frac{x2-y}{x2-x1} \times 100$$

x1 is the reading of the sensor when the tank is full

x2 is the reading of the sensor when the tank is empty

y is the current reading of the tank in cm

Fig 2: Representation of tank

B. Actuator – Relay

A relay is a switch that can be controlled by a microprocessor. Once connected in an ac circuit, it can turn the circuit on or off depending on the instructions provided by the microcontroller. In this system, the relay is connected to the water pump. This means that depending on the water levels and after receiving commands from the app, it will control the water pump.

C. Microcontroller – NodeMCU

Each of the sensors is connected to the Esp8266(NodeMCU) board. Each sensor needs an input of 5V to work. Since Vin is the only pin that can provide the necessary voltage when it is being charged via the USB port, it is connected in parallel with all the sensors. There are multiple ground pins that can connect with the ground of the sensor. Finally, Esp8266 has 8 pins labelled D0 to D7 that can be used for the pair of echo and trigger of the sensors, leaving space for 4 potential sensors to be connected simultaneously. In this case, we use 6 pins to connect to sensors and the rest to connect to the relay used for controlling the water pump.

D. Online Interface - *Blynk*

Finally, the most important part of the monitoring system is the Blynk application. It can be used as both an android application as well as a web dashboard. The platform is employed as a user-friendly interface for data visualization, pump management and alarm notifications. Users can conveniently monitor the water level in their tanks in real-time through the Blynk mobile application, which provides graphical representations of tank levels. Moreover, the system incorporates a notification mechanism that triggers notifications via the Blynk app when a tank reaches its full capacity, thereby preventing potential overflow and water wastage. The mechanism to switch the pump on and off is implemented in the same application, completing the water management ecosystem. Finally, the web dashboard provides a bird's eye view of the water consumption patterns over a certain period and can help users make informed choices about water usage.

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

|| Volume 11, Issue 10, October 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1110022 |

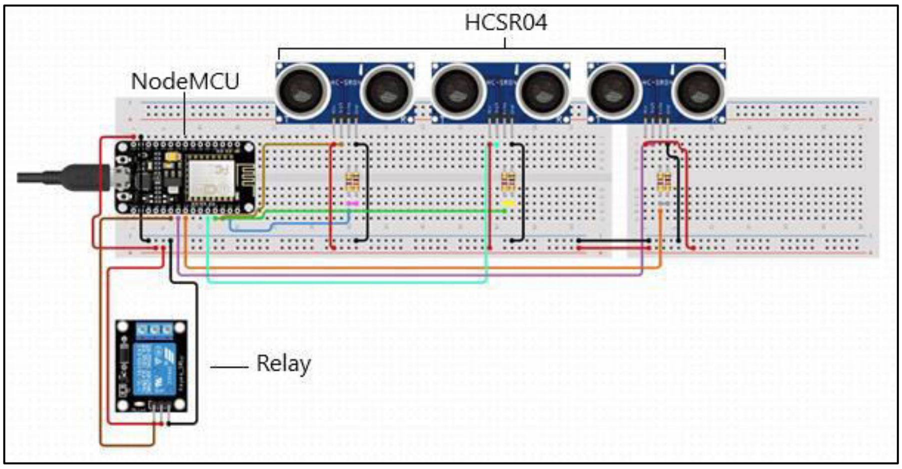


Fig 3: Circuit Diagram

V. IMPLEMENTATION AND RESULTS

A. Sensor Setup

Each HCSR04 sensor is enclosed within a protective plastic box to prevent corrosion of the metal parts of the sensor exposed to the humid air inside the water tank. Circular cutouts are made for the transmitting and receiving cylinders to ensure uninterrupted readings. The box is then suspended within the water tank using an aluminium strip that is placed across the rim of the tank.

Fig 4:Plastic protective covering for HCSR04

Fig 5:Suspension of sensor in tank

B. Esp8266 Setup

The wires from all 3 sensors are brought to the same Node MCU. The Vin is connected in parallel to the VCC pins of all the sensors as well as the relay and the same is done for the ground pins. Each individual connection is made for the echo and trigger pins of the sensor as well as for the relay.

C. Blynk Setup

The Esp8266 interfaces with the Blynk Application via Wi Fi that is stored in the controller during setup. The Esp8266 transfers data to the Blynk Cloud via Virtual Pins that have to be set up initially. The data is transmitted at an optimal interval of 30 seconds to ensure real time data while making sure that the network does not get overwhelmed. Using the inbuilt features of the Blynk system, we set up the interface for the Android App as well as the Web Dashboard, through which, we can control the pump. We have also set up a notification system that can be customized to provide alerts about the state of the water levels in the tank. Once a particular threshold is crossed, a notification pops up in the app. Finally, using the data from the cloud, we can visualize the data to intuitively understand the water consumption habits and further utilize this knowledge to promote water conservation and mindful use of resources.

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

|| Volume 11, Issue 10, October 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1110022 |

D. Outputs

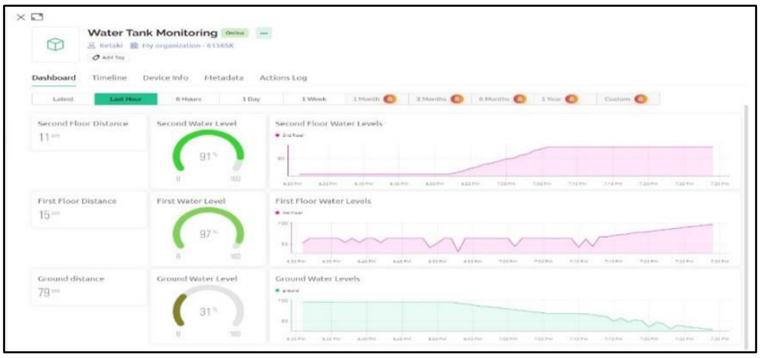


Fig 6:Web Dashboard

This is the web dashboard of Blynk. It displays the same distance readings as well as the percent of water. Moreover, it shows water readings of the last hour. As the water from the underground tank was transferred to the first and second tanks, the water level of the underground dropped while the other 2 increased.

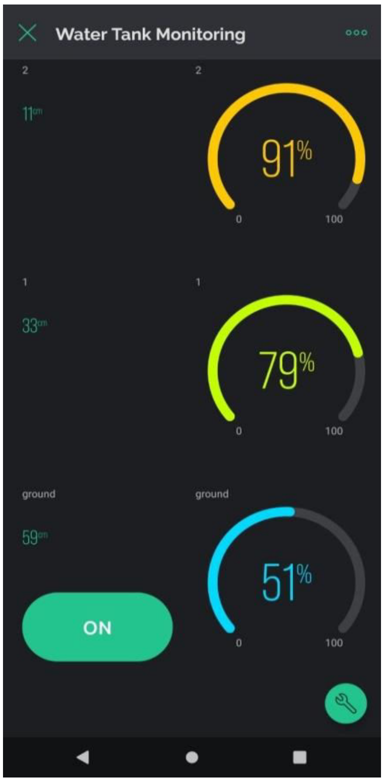


Fig 7:Home screen of mobile app

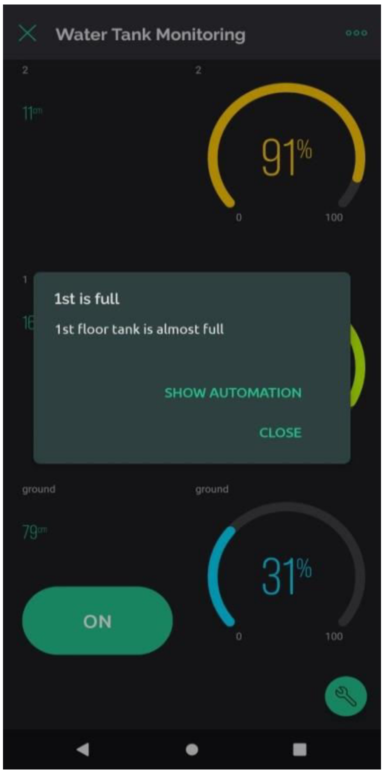


Fig 8: Notification in mobile app

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

|| Volume 11, Issue 10, October 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1110022 |

This is a screenshot of the Blynk App. Since there are 3 tanks, the direct distance reading from each tank is displayed in the left column. The right column displays a gauge that visualizes the percent of water present in the tank. The distance and percent readings for each tank are calculated independently as the capacity of each tank is different. The button controls the water pump. In this screenshot, water is being transferred from underground to the first floor. As the tank gets full, a notification is displayed as shown in the second snap.

Fig 9: Water consumption statistics

This displays the water usage and consumption over the past week. The water is regularly filled in the underground tank at 4 am. During the day, it is transferred to the other 2 from where it is utilised throughout the day.

VI. CONCLUSION

Thus, we have proposed and implemented a robust and effective way to remotely monitor and manage the water tank system for a residential building. This innovative system combines sensors and actuators to provide a remotely operable system. Providing real time data on the water levels in a tank can provide peace of mind to the users while also preventing water overflow with the notification system. This system can provide an insight into the water usage patterns of residents, thus promoting water conservation.

REFERENCES

1. Jemy Joseph, Manju K M, Sajith M R, Sujith Nair, Vishnu P Viay, Sithara Krishnan, "Water Management System Using IoT", International Research Journal of Engineering and Technology (IRJET) Volume: 05 Issue: 04 | Apr-2018
2. M Rama Krishna, SK Sajeeda, B Dhanya, M Meghana, "Smart water management using IOT", International Journal of Advance Research and Innovation Volume 8 Issue 2 (2020) 172 -174
3. Priya J, Sailusha Chekuri, "WATER LEVEL MONITORING SYSTEM USING IOT", International Research Journal of Engineering and Technology (IRJET) Volume: 04 Issue: 12 | Dec-2017
4. Nishmitha, Poorna Shetty, Dr. Manjunath Kotari, Shraddha Shetty, Sudarshan G, "Water Tank Monitoring System", International Journal of Engineering Research & Technology (IJERT) Volume 7, Issue 08 Special Issue - 2019
5. Ch. Shanthi, R. Pravalika, R. Krishnaveni, R. Mahesh, P. Sripal, "IOT BASED SMART WATER TANK", International Journal of Engineering Technology Research & Management Vol-06 Issue 01, January -2022
6. Samuel C. Olisa, Christopher N. Asiegbu, Juliet E. Olisa, Bonaventure O. Ekengwu, Abdulhakim A. Shittu, Martin C. Eze, "Smart two-tank water quality and level detection system via IoT", 2021 Heliyon, DOI: https://doi.org/10.1016/j.heliyon.2021.e07651

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

|| Volume 11, Issue 10, October 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1110022 |

BIOGRAPHY

Ketaki Deshmukh: B. Tech Student, Dept. of Computer Engineering and IT, VJTI, Mumbai, Maharashtra, India.

Prof. Pramila M. Chawan is working as an Associate Professor in the Computer Engineering Department of VJTI, Mumbai. She has done her B.E. (Computer Engineering) and M.E. (Computer Engineering) from VJTI College of Engineering, Mumbai University. She has 28 years of teaching experience and has guided 80+ M. Tech. projects and 100+ B. Tech. projects. She has published 134 papers in International Journals and 20 papers in National/International Conferences/ Symposiums. She has worked as an Organizing Committee member for 21 International Conferences and 5 AICTE/MHRD-sponsored Workshops/STTPs/FDPs. She has participated in 14 National/International Conferences. She has worked as NBA Coordinator of the Computer Engineering Department of VJTI for 5 years. She had written a proposal under TEQIP-I in June 2004 for 'Creating Central Computing Facility at VJTI'. Rs. Eight Crores were sanctioned by the World Bank under TEQIP-I on this proposal. The Central Computing Facility was set up at VJTI through this fund which has played a key role in improving the teaching-learning process at VJTI.

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

9940 572 462 6381 907 438 ijircce@gmail.com

Scan to save the contact details

www.ijircce.com