Smart Rainwater Harvesting System

Prof. Priyanca Gonsalves[1], Mr. Vivek Modi[2], Mr. Amaan Jambura[3], Komal Ayare[4]

[1]*Professor, Dept. of Information Technology, SVKM's Dwarkadas J. Sanghvi College of Engineering, Maharastra, India*

[234]*Students, BTech, Information Technology, SVKM's Dwarkadas J. Sanghvi College of Engineering, Maharastra, India*

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Abstract - *Water is an essential resource for life to exist and thrive. As more people move from rural to urban areas, cities are rapidly expanding in population. We provide a technique based on IoT to satisfy the demands for monitoring water quality and providing water (Internet of Things). In this study, we demonstrate a method for collecting rainwater in rural areas as well as an Internet of Things model which is used for monitoring water quality and level. The collected data via sensors are made available for real-time viewing on a website. The proposed system contains an Arduino as the main controller along with a number of sensors used are water level sensor, pH sensor, and water flow .A microcontroller processes the data it receives from the sensors and then uses a wireless connection module to send it to the cloud.*

***Key Words*: Potential of Hydrogen (pH) sensor, Water flow sensor, cloud computing, Internet of Things, water level sensor, Arduino UNO, ESP8266, water management, water quality monitoring.**

1. INTRODUCTION

Urbanization, development, and population growth all contribute to the degradation and contamination of drinkable water. Therefore, more effective methods for monitoring water purity are required. Physical testing was required to determine the water's cleanliness. Such methods require more effort and cannot be regarded as effective. By concentrating on the aforementioned problems, this model would create a cost cutting system which will provide a real-time monitoring of water quality in an Internet of Things environment.

1.1 Internet of Things (IoT)

IOT facilitates the interconnection of various devices such as cell phones, Televisions, PC's, sensors, and actuators to the Internet. This connectivity enables novel modes of communication between people and objects, as well as between objects themselves. In the last few years, IoT construction has advanced considerably. A growing number of gadgets are being linked to the internet every day. Machine-to-machine transmission costs on mobile networks are typically lower than those on stationary networks. Now, individuals are able to connect to the internet anytime and wherever they like. The Internet of Things is being used by a wide variety of businesses, including those in the fields of robotics, transit, energy, smart farming, healthcare, financial services, smart-cities, Industrial automation ,agribusiness, and nanotechnology.

1.2 Problem Statement

Extreme shortage of water in the summertime is one of the biggest issues in hilly locations. In the summer, there is sometimes a severe water scarcity in higher-elevation areas where there has been a recent significant growth in population. Most of the time, natural subterranean water systems provide water supplies. The absorption of water into the ground during the rainy season has decreased dramatically over time due to rising urbanization, which has led to a rise in concrete surfaces. As a result, the population is dependent on the natural resources, which frequently run out. In these locations, when water is pumped from lower areas near a river, lake, etc., large water tanks are frequently erected. The rocky terrain and limits on blasting, etc. make water collection in these locations a challenging undertaking. Through this hackathon, students may provide a solution to the water problem.

1.3 Block Diagram

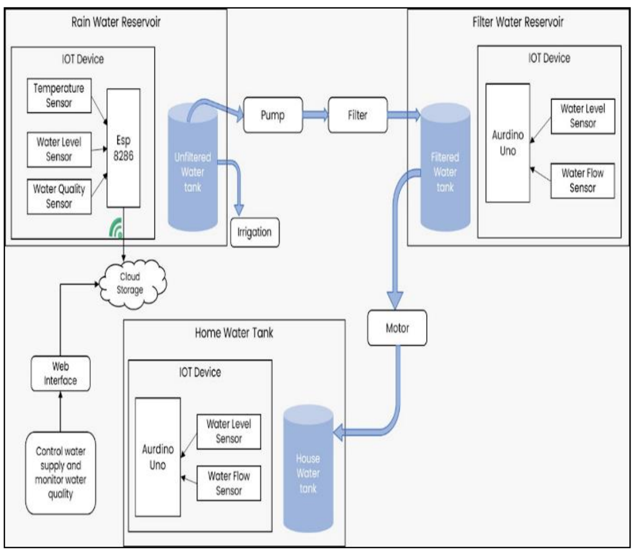

Fig -1: Our Approach to the Problem

2. LITERATURE REVIEW

The Internet of Things (IoT) has created new opportunities for raising the productivity and efficiency of systems for collecting rainwater.

In the existing system the primary focus of this study was to improve the quality of collected rainwater by monitoring its quality through IoT-based sensors. The system was designed to monitor the pH, turbidity, and total dissolved solids (TDS) levels of the collected rainwater. The outcomes demonstrated that the method successfully kept and tracked the quality of the rainwater gathered.

It is crucial to remember that the research did not cover the temperature and flow rate of the rainfall that was gathered. This is a research drawback because these variables may significantly affect the usability and purity of the gathered rainwater.

The method used in this research included a water level sensor to ascertain the water level inside a tank, thereby enabling automated regulation of the water motor to activate or deactivate as required. The water level sensor's data was shown on an Android application, enabling the user to monitor it.

The methodology used in this research study centered on the automation of water management to minimize waste and enhance operational efficiency. The system was designed with the capability to autonomously activate and deactivate the water motor in response to the water level inside the tank. The aforementioned strategy is a direct and efficient method for mitigating water loss since it guarantees that the water motor functions only when required.

Nevertheless, the investigation failed to include the crucial element of water quality monitoring, a significant facet of water resource management. In the absence of effective quality monitoring, there is a possibility that water of inadequate quality may be distributed to consumers. Hence, the integration of water quality monitoring inside the system is crucial to ascertain the safety of the provided water for various applications.

The present study addresses the shortcomings of previous rainwater-collecting models and proposes a novel approach that leverages cloud-based storage for sensor data. Implementing this measure will ensure the protection of data and mitigate the risk of data loss. The model we have developed also integrates temperature sensors to assess the suitability of irrigation, and water level sensors to provide up-to-date data on the water quantity inside the reservoir.

3. PROPOSED FRAMEWORK

3.1 Features of the Proposed System

A rainwater harvesting system equipped with an intelligent monitoring device may include the accompanying characteristics:

- Rainwater harvesting structure: A structure to capture and store rainwater, such as a roof or a catchment area, is the first component of a rainwater harvesting system.
- Smart monitoring device: A monitoring device with sensors to measure the level of rainwater collected, quality, and flow rate is a crucial component of a smart rainwater harvesting system. The monitoring device can be connected to a smartphone application, allowing the user to track the system's performance and adjust the system settings remotely.
- Filtration system: A filtration system is necessary to remove impurities, debris, and sediment from the collected rainwater before it is stored.
- Storage tank: A storage tank to hold the filtered rainwater is an essential part of a smart rainwater harvesting system. The size of the tank depends on the amount of rainwater to be collected, the user's water requirements, and the availability of space.
- Pumping system: A pumping system is required to deliver the harvested rainwater to the intended usage points, such as faucets, toilets, or irrigation systems.
- Automated control system: An automated control system can be integrated into the smart rainwater harvesting system to manage the water flow and optimize the system's performance based on real-time weather data and water usage patterns.
- Alarms and alerts: Alarms and alerts can be incorporated into the system to notify the user of potential issues, such as low water levels, system malfunctions or maintenance requirements.

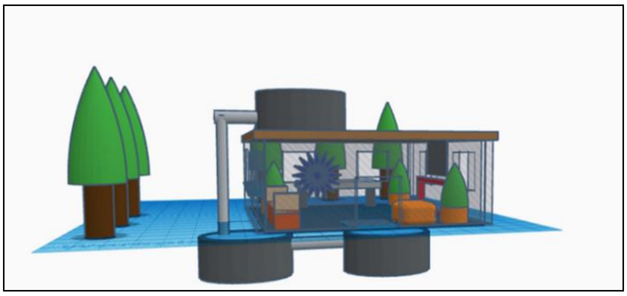

Fig -2: 3D Blueprint of Proposed Solution

We thought of a solution that to provide 2 water tanks in a radius of 100 - 200m covering around 3-4 houses where in the 1st water tank will store unfiltered water collected from rain.

2nd water tank will store the filtered water and 3rd water tank will be installed in each house in the range of 100-200 meters that will be used for household purposes.

Water will be collected by Rain and will be keeping our smart monitoring device in the tanks to monitor various properties of the water.

By creating this system, we can check the quality of the water by using sensors that are immersed in a water tank to collect data on the different characteristics of the water.

This device can measure a number of factors from water, including temperature, pH, water level, and water flow.

3.2 Benefits of the Proposed System

A smart rainwater harvesting system equipped with a monitoring device offers several advantages:

- Water conservation may be achieved by the implementation of a smart rainwater harvesting system equipped with a monitoring device. This system allows for the collection and storage of rainwater, which can then be used for various purposes such as laundry, toilet flushing, and irrigation. By effectively managing and using rainwater resources, this system contributes to the overall goal of water conservation.

- One potential benefit of using gathered rainwater as opposed to municipal water is the potential for substantial cost savings, particularly in regions where water prices are high.

- One of the advantages of rainwater collecting is its positive impact on the environment. By implementing this practice, the reliance on municipal water is reduced, leading to a decrease in the carbon footprint connected with water treatment and transportation.

- Enhanced water quality is achieved by the use of a monitoring device inside a smart rainwater harvesting system, which effectively tracks and verifies the cleanliness and safety of the collected water for various applications.

- Real-time monitoring and control are facilitated by the inclusion of a monitoring device inside a smart rainwater harvesting system. This device enables the user to continuously monitor water levels, use patterns, and overall system performance. Consequently, the user is empowered to make necessary adjustments to system settings in order to optimize its performance.

- One advantage of a smart rainwater harvesting system is the potential for reduced maintenance expenses. This is due to the presence of a monitoring device that may notify the user of any maintenance needs. By promptly addressing these requirements, the system is less likely to experience expensive repairs or periods of system downtime.

- One of the key benefits of implementing a smart rainwater harvesting system equipped with a monitoring device is the enhanced dependability of water supply. This becomes particularly significant during times of drought or when there are constraints on municipal water resources.

In general, the implementation of an intelligent rainwater harvesting system equipped with a monitoring device offers a viable approach that is both economically efficient and ecologically sound for the purpose of acquiring, retaining, and using rainwater resources.

4. HARDWARE USED

4.1 Arduino

The Arduino platform is an open hardware development platform that enables individuals such as makers, hobbyists, and innovators to design and fabricate items capable of interacting with the physical world.

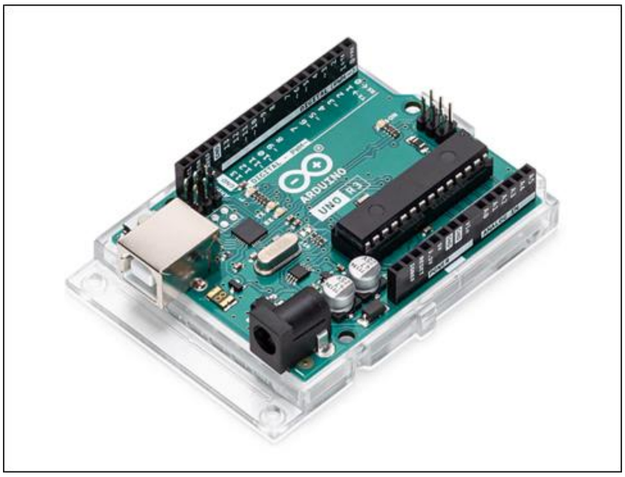

Fig -3: Arduino

4.2 Ultrasonic Sensor

Ultrasonic pulses are used for the purpose of distance measurement. The sensor head emits an ultrasonic signal and afterwards detects the wave that is reflected by the target. Ultrasonic devices has the capability to determine the distance of a target by precisely measuring the temporal interval between the emission and subsequent receipt of ultrasonic waves. The website provides quantitative data on the volume of both clean and dirty water, measured in liters, as well as the depth of each respective tank.

Fig -4: Ultrasonic Sensor

4.3 Pixhawk Buzzer

To announce status tones, this buzzer is utilized with the Pixhawk and PX4 autopilot.

Fig -5: Pixhawk Buzzer

4.4 ESP8266 NodeMCU

It is an open source Internet of Things (IoT) platform. The device operates via the use of the ESP8266 Wi-Fi System-on-a-Chip (SoC) and accompanying integrated circuits, which are seamlessly included into the ESP-12 module.

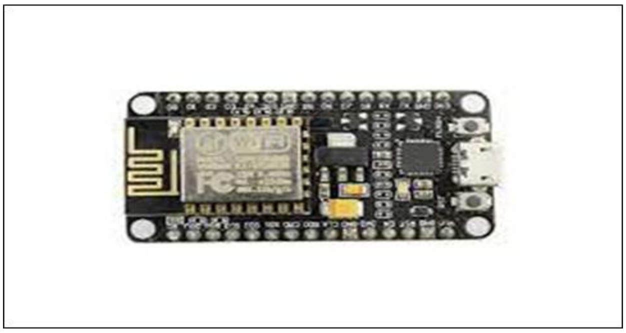

Fig -6: ESP8266 NodeMCU

4.5 pH Sensor

The voltage generated by the solution under investigation, which pertains to its acidity, is quantified by means of a comparative measurement against a reference solution. The discrepancy between the two voltage values is then used to determine the disparity in pH levels. The pH monitor inside our project assumes responsibility for categorizing rainwater based on its pH levels.

Fig -7: pH Sensor

4.6 Direct Current Motor

A direct current (DC) motor is an electrical apparatus that converts electrical energy into mechanical energy. The conversion of electrical energy from direct current (DC), which serves as the input source in a DC motor, into mechanical rotation is achieved.

Fig -8: DC Motor

4.7 Breadboard

The construction of a semi-permanent prototype for an electrical circuit often involves using a breadboard, solderless breadboard, or protoboard. Breadboards provide reusability since they do not need soldering or incur track damage, unlike perfboards or stripboards.

Fig -9: Breadboard

5. CIRCUIT DIAGRAMS

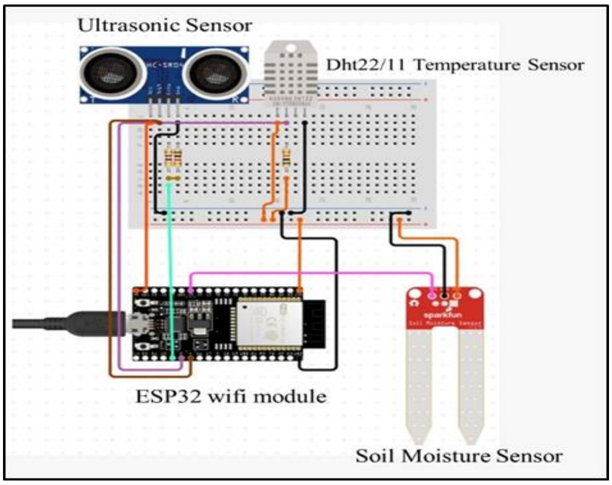

Fig -10: Circuit Diagram for Unfiltered Tank

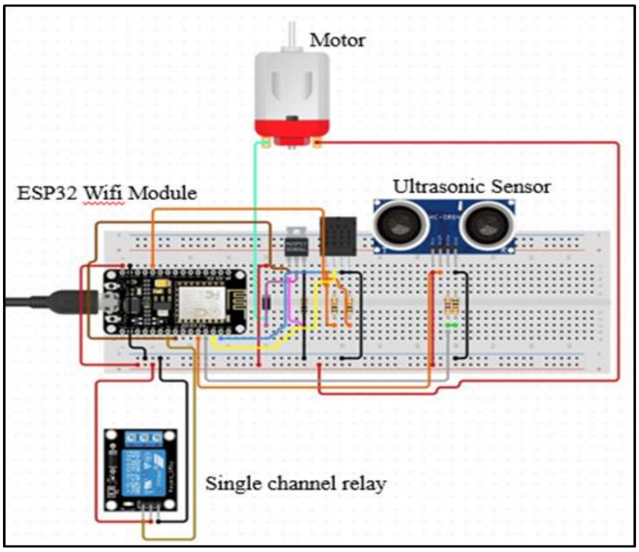

Fig -11: Circuit Diagram for Filtered Tank

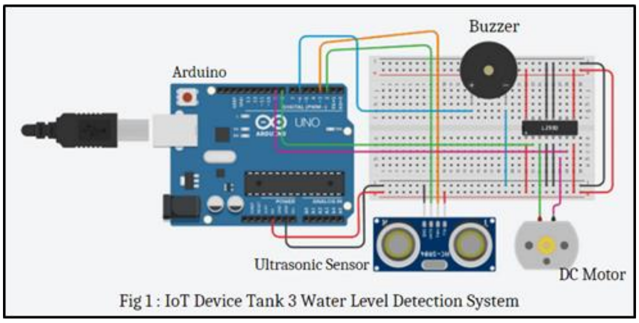

Fig -12: Circuit Diagram for Home water Tank

6. CONCLUSIONS

In summation, rainwater harvesting systems provide a useful and long-lasting approach to water management. These systems can lessen reliance on the public water supply, preserve water resources, and lessen the burden on water purification facilities by collecting and storing rainwater.

Rainwater harvesting systems can be set up in a variety of locations, from private residences to office and industrial structures, and they can be customized to suit demands and specifications. These systems can offer a dependable supply of water for several non-potable purposes, such as watering plants, flushing bathrooms, and washing vehicles, with the proper design, implementation, and upkeep.

Overall, rainwater harvesting systems provide a viable and ecologically favorable method of managing water, and they can have a big impact on both people and communities.

7. RESULT AND OBSERVATION

As part of our research project, we were able to effectively install an intelligent rainwater collecting system that made use of internet of things technology. The system had three tanks: one to store unfiltered water, one to store filtered water, and one to store water for use in the house.

A temperature sensor and a soil moisture sensor were among the sensors that we put alongside water level sensors in each tank so that we could monitor the water level in each tank. These sensors were linked up to an ESP8266 microcontroller in order to facilitate the gathering and transmission of data in real time.

After the rainwater was collected in the water tank that did not have a filter, it was pumped into the water tank that did have a filter. After that, the water was transferred to the storage tank in the basement of the house so that it could be used inside. This insured that there would always be a dependable supply of rainwater that has been cleaned and filtered to fulfil the requirements of the consumers.

The sensors that were embedded in the soil allowed for continuous monitoring of the moisture content of the soil. The device took measurements of the soil's moisture content and then automatically watered the area when it became dry, so guaranteeing that the amount of moisture was just right for the development of the plants.

The information collected by the sensors, including water levels, temperatures, and the amount of moisture in the soil, was safely uploaded to the cloud and kept there. Because of this, users were able to monitor the system in real time using an interface that was simple to use.

In the event that the water level reached a specific threshold, signaling the possibility of an overflow, a buzzer would sound and an alert would be sent to the user. This would ensure that the user would respond in a timely manner, so preventing any waste or damage.

In general, our intelligent rainwater collecting system was able to show good water management, which promoted the environmentally responsible and economically sound use of water in residential settings. The convergence of Internet of Things (IoT) technology, sensor integration, and cloud monitoring has empowered users with significant insights and enhanced control over their water resources. This development has played a pivotal role in advancing water conservation endeavors.

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BIOGRAPHIES

Prof. Priyanca Gonsalves
Professor , Department of Information Technology at SVKM’s Dwarkadas J. Sanghvi College of Engineering, Mumbai, India

Mr. Vivek Modi
BTech (Information Technology), SVKM’s Dwarkadas J. Sanghvi College of Engineering ,Mumbai, India

Mr. Amaan Jambura
BTech (Information Technology), SVKM’s Dwarkadas J. Sanghvi College of Engineering ,Mumbai, India

Ms. Komal Ayare
BTech (Information Technology), SVKM’s Dwarkadas J. Sanghvi College of Engineering ,Mumbai, India