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Smart Water Supply and Management System

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Abstract: ***A smart water management system basically refers to a system created to collect information on the distribution, pressure, and flow of water in a city or town. Our principal objective is to improve the current system for managing and meeting the water needs of urban areas. Our goals include meeting urban areas' water needs while [1] ensuring sustainability and security, developing a rainwater harvesting system nearby the water treatment facility for additional use, developing a mechanism to identify the source of leaks and water shortages in the supply system, and coming up with ways to reuse waste water from the washing machineand kitchen faucets.***

Keywords**:** ***Leakage Detection, Pipeline management, TDS value checking, Water level indication.***

I. INTRODUCTION

A vital component of our globe, water is required for electricity production, agriculture, manufacturing, and maintaining human health. [2] In the entire world, about a billion people lack access to clean drinking water. Water transmission pipes regularly lose 20% to 30% of the water that flows through them, with losses exceeding 50% in older systems, especially those that have had subpar maintenance. Leaks, metering issues, public use, and theft are just a few of the things that can lead to water loss in transmission pipelines. Smart water management systems are crucial in smart cities since water is a resource that is necessary for human life. Smart water management technology can increase a water delivery system's efficiency and stability while lowering costs and boosting longevity.

II. METHODS

A. Water Level Indication

This Water Level Indication device is used to measure the amount of water and determine the water level that is present in the water tank.

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The water level indicator is an indicator that lets you know how much water is in your tank, according to its definition.

HOW DOES THE WATER LEVEL INDICATOR WORK?

- We split the water level of the tank into low, medium, and high levels in order to determine the water level that was there.

By doing this, our indication will enable us to quickly determine the water level in the tank and, in accordancewith that level, to refill the tank with water.

- As an alternative to overflowing, we can conserve water.
- To create this water level indicator, we needed a few LEDs, a battery, and some wire connections. We then placed cables within the tank at various levels withvarying lengths, which will display the water level by sending a signal back to LEDs.

Fig. 1: Level-wise indication using LEDs

THE ADVANTAGES OF THIS INDICATOR INCLUDE:

- Less electricity will be consumed since the indicator helps to prevent the engine from running unnecessarily after the tank is filled.
- Overflow of water is stopped/avoided.
- The cost of implementation is less, so we can save money.
- The design planning of the indicator is simple.
- This system can be implemented easily.

B. Checking Purity of Water

We have selected a TDS metre to verify the purity of the water. Total Dissolved Solids (TDS) in drinking water is the measurement of all inorganic and organic components that are dissolved in water. You can figure out how many dissolved ions are present in a solution with a TDS metre. Due to the fact that dissolved ionised solids, such as salts and minerals, enhance a solution's conductivity, [6] a TDS metre detects the solution's conductivity and infers the TDS from that value.

[7] Less electricity will be consumed since the indicator helps to prevent the engine from running unnecessarily after the tank is filled. The water becomes dangerous when it is contaminated and cannot be utilised for drinking, washing, or bathing. You can determine if the water you are consuming is pure or dirty by checking the TDS levels in the water. The water becomes dangerous when it is contaminated and cannot be utilised for drinking, washing, or bathing. [9] You can determine if the water you are consuming is pure or dirty by checking the TDS levels in the water.

Working:

In our project, water is drawn from a river and stored collectively for a street or other location where the TDS levels are manually measured with a TDS meter. Estimated total dissolved solids (TDS) in milligrams per litre (mg/L) are created from the collected data. The TDS level will be transferred to the next stage if it is less than 500(mg/l).

Fig. 2: TDS value checked using TDS meter

C. Reach of Water to the Destination

Here, a mechanism is being used to gauge how much water is moving through the pipe. [3] This enables us to determine if someone is drawing more water than necessary by utilizing an external motor. The person can also use this method to determine which part of the pipe is the source of any water shortages in the pipelines.

WORKING:

We have installed a Hall effect water flow sensor (Model No.: YFS401) for this purpose, and we used it in our project because it can connect to 1-inch pipe. If PVC pipes are used within the home, a sensor with a 11/2 inch connection can be used. Water enters the sensor at one end and exits at the other end thanks to the pipe connections created at both ends of the sensor. These installed sensors determine whether there is a high or low pulse of water going through the pipe. A breadboard, a pair of jumper wires, and the system are used to transmit the gathered data. The high/low pulse is first converted to time, then to frequency, by the way the Arduino code is written. From the obtained frequency value the volume of the water is calculated.

Advantages:

- Illegal Extraction of water can be identified.
- In case of shortage of water flow inside the pipes can also be found out.

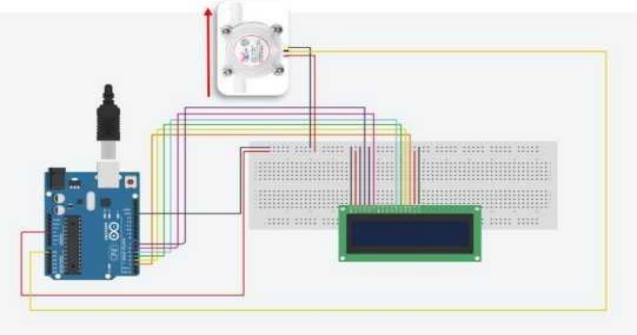

Fig. 3: Design of Reach of Water to the Destination

Github Link for Code:
https://github.com/Abijspy/Smart-Water-Supply-and-Management-System/blob/main/Reach%20of%20water%20to%20the%20destination.txt

D. Leakage Detection

1) What is water leakage detection?

The **[4]** water leakage detection system is to find the water leakage in the pipes.

2) Material Required:

The leakage of water in pipes can be found by using Led Display, Arduino UNO and two water flow sensors **(Model No: YFS401).**

3) How does water leakage detection work?

By determining the flow frequency of each sensor, we must determine the water's constant flow. **[8]** We estimate the time required for the water to travel between the two flow sensors using the flow frequency and compare it to the actual time.

4) We get four results,

1. If the calculated time exceeds the estimated time, more water flows through the pipe.
2. If the calculated time is equal to the estimated time, water flow is normal.
3. If the calculated time is lesser than the estimated time, the water overflows from the pipe.
4. If calculated time is zero then there is no water flow through the pipe.

❖**THE GRAPH'S GENERATION FROM CALCULATED TIME AND FREQUENCY DATA MAKES IT SIMPLE TO DETERMINE WHETHER A PIPE IS LEAKING WATER.**

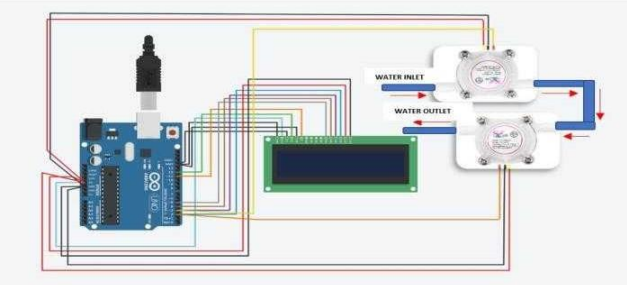

Fig. 4: Systematic Diagram of Water Leakage Detection

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Github Link for Code:
https://github.com/Abijspy/Smart-Water-Supply-and-Management-System/blob/main/Water%20Leakage%20detection.txt

E. Rainwater Harvesting

The immediate gathering of rainfall that is dripping from surfaces where it has fallen directly is commonly understood to be the intent of the term "rainwater harvesting." It is a very effective method of water conservation. The idea of rainwater harvesting is to stop wasting rainwater and stop it from evaporating into the atmosphere. In this method of rooftop harvesting, the building's or home's roof serves as the catchment, and rainwater is collected by fitting the roof with pipes that lead to a tank. To prevent water from falling off, these pipes will direct water that is falling on the roof into the tank. After the text edit has been completed, the paper is ready for the template. Duplicate the template file by using the Save As command, and use the naming convention prescribed by your conference for the name of your paper. In this newly created file, highlight all of the contents and import your prepared text file. You are now ready to style your paper. This method of collecting rainwater is incredibly cost-effective and effective, and it also reduces water waste. The necessity of taking action to make sure that rain falling in a specific area is captured as much as feasible through rainwater harvesting.

Fig. 5: Rainwater harvesting system

F. Recycling of Water

This is the main procedure of this concept, where spent water from the kitchen, bathroom, washing machine, and other uses can be recycled. This recycles tank has eight chambers in its design.

Starting from the Kitchen water ➜ Solid waste removing ➜ Oil / Grease separation ➜ Sedimentation process ➜ Oxygen supply ➜ Non-Oil / Grease water ➜ Plants ➜ then Recycled water.

In the final stage of this procedure, the water is cleansed, and we can add some fish to the recycled water. So, it won't produce any bacteria, mosquitoes, or other insects.

As a result, it aids in water purification and improves the quality of recycled water. You can use this recycled water for irrigation, gardening, and other uses.

WORKING OF THIS PROCESS:

Basically, this Recycle Tank has 8 chambers to recycle the water.

- Coming to the first chamber, we have our kitchen water, which is directly discarded solid waste from the kitchen.
- After that, the solid wastes in the second chamber are eliminated, and only the water containing all kinds of grease and oil is transferred to the third chamber.

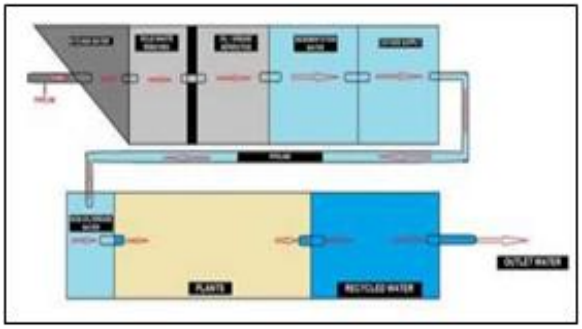

Fig. 6: Recycle Tank Architecture

- Because oil and grease always float on the water and the water remains below, the water enters this third chamber slowly. Thus, it makes sure that only water is sent to the following chamber.
- Coming to the fourth chamber, this is where we perform the sedimentation process for the water because it has been immediately coming from the kitchen along with some detergent. Where only the water at the top is permitted to enter the next compartment and all the soap components have settledto the bottom.
- We provide some oxygen to the water in the fifthchamber so that it won't produce any dangerous gases there where the dissolved oxygen content is higher.
- This effectively removes all carbon from the water because the organic bacteria flourish and consume it all. As a result, we have given the chambers a net-like structure.
- After leaving these chambers, the water is allowed to pass through a sand filter, where it is purified of grease and oil. Sand and plants are present here; the plants we employ for this are vetiver plants.
- It has been discovered that vetiver plants can be used to purify water.
- Vetiver plant has the ability to filter water, which aidsin the treatment of wastewater.
- In India, vetiver is a plant that is extensively distributed and capable of removing phosphate, nitrogen, and several heavy metals from water.
- The vetiver's roots enter the water and remove the phosphates there. This is how the sand filter is made since this is where the phosphate comes from in the detergent.
- Since Vetiver is a big tufted bunchgrass that can grow up to 1.5 meters in height, we were unable to set it upin this model and instead used regular grass and plants to filter the water.

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- Finally, this is where we have the recycled water that can be used for gardening. Adding fish to the water is one of our indications since it helps us get rid of mosquito larvae and other pests from the water.
- There is an overflow pipe here. The overflow line runs into a recharge well outside if the chamber fills up with water, allowing the extra water to be injected back into the soil.

III. RESULTS AND DISCUSSION

A. Water Level Indication

We used a demo to test this indicator, and we found that it functions properly. **[5]** The low LED will glow if there is waterin the tank to the extent of 25% of its capacity.
The high LED will glow if the water level in the tank is between 75% and 100%, and the medium level LED will show an intermediate water level. When the tank is filled or emptied, the indicator accurately illuminates the LEDs to display the water level. It is quite simple to put into practise on the field.

Fig. 7: LED showing water level

B. Checking the Purity of Water

The river water that we tested for purity has a TDS value of 394, which is considered safe for drinking.

Fig. 8: TDS meter showing value 394

Table 1: TDS Range

Level of TDS (mg/L)	No. of TW	%	TDS Rating
<300	5	25	Excellent
300-600	8	40	Good
601-900	5	25	Fair
900-1200	-	-	Poor
>1200	2	10	Unacceptable

C. Reach of Water to the Destination

The water flow sensor has detected and transmitted data to the Arduino, which then sends the instruction to print the water volume after computations and show it on the LCD.

Fig. 9: LCD displaying Volume of Water

D. Leakage Detection

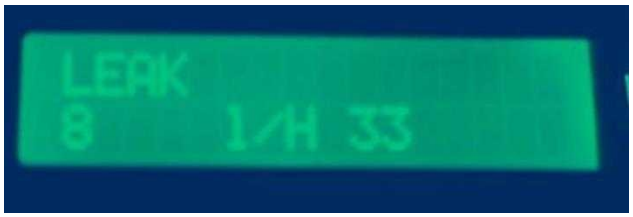
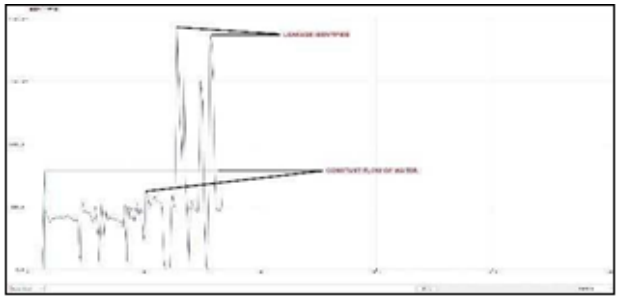


Fig. 10: Display that water leaks from the pipe



Graph 1: Water Leakage Detection

According to the aforementioned graph, **[10]** if the reading is high, water is leaking from pipes, and if it is low, there is no leak.

E. Rainwater Harvesting System

Fig.11: Rain water harvesting

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Harvesting rainwater offers a variety of uses and advantages. However, water harvesting systems are used to operate and store a significant amount of water for later uses.

F. Recycle Tank

Fig. 12(a), 12(b): Recycle tank

This recycling tank has eight chambers with different processes running through them. This tank's output is clean water, which we receive. This can also be used for things like car cleaning, irrigation, gardening, etc.

Fig. 13: Main Model

IV. CONCLUSION

We have developed a method to regulate the elements of the supply system, including water pressure, water quality, and water pollution. This technique has been demonstrated to be effective in controlling and meeting metropolitan areas' water needs. Each house has a rainwater harvesting system in place for water backup. Leakage detection and water reach to destination procedures are used to identify major water-related concerns including water leakage and scarcity. The leak revealing graph and LCD display provide immediate notification of any leakage or water shortage. Utilizing water level indication to know how much water is in the tank, situations like water overflow are prevented. Later, a huge number of distribution tanks and consumers might be used using the same idea. A TDS metre is used tocheck the cleanliness of water as part of safe water usage. Reusing the waste water from the washing machine outlet and kitchen sink is a crucial component of this system'swater recycling mechanism. After recycling, the water obtained is suitable for washing cars and gardening. Our smart water supply and management system is suggested here as a benefit for the developing and evolving planet as we go toward enhancing and sustaining our surrounds with the aid of smart technologies and many more. This system can be used in smart cities, towns, villages, and other locations where intelligent and sophisticated water management and distribution is required.

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AUTHORS PROFILE

Gopinath K, (B.Tech) Electronics and Communication Engineering from VIT Bhopal University Kothri kalan (M.P.), India – 466114. Worked on drafting of architectural artwork in the Main model and Recycle tank. • Providing Sufficient the framework concept and the construction methods of the primary model and recycling tank. • Giving various ideas and different methodologies to implement the working modules. • Organizing the materials needed for the entire project and establishing a budget. • Reach of water to the destination system and leakage detection systems connections were made to the Arduino UNO board, and LCD display connections were properly connected from the breadboard. • Accomplishment of pipeline connections to each house was made.

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A study was done on water flow sensor then it's working. Finally, selected which sensor to buy for this specific model. • In addition to it, some extra features were been added to the main model to make it more decorative. Like (Lighting for street lights, house lighting, the Reach of water to the destination system, and leakage detection systems room lighting • Each house was built and its electrical connections were properly connected through wires and a battery. •Implementing the Recycle tank model with various chamber designs under lighting conditions and making it an operational one.

Manin Thomas T A, (B.Tech) Electronics and Communication Engineering from VIT Bhopal University Kothri kalan (M.P.), India – 466114. Worked on planning and initialization of the project. • Researching about the water related issues that our community face. • Also, I was involved in the design and implementation of reach of water to the destination that checks and updates the volume of water flow in the pipes. • Cross-checking existing works. • Took responsibility of compiling what we have done to present it to the faculties.

Chandru T, (B.Tech) Electronics and Communication Engineering from VIT Bhopal University Kothri kalan (M.P.), India – 466114. Worked on purity of water. There are some sensors and devices that can be used to check the purity of water, such as a TDS (total dissolved solids) device and a gravity analogue TDS sensor. I think a gravity analogue TDS sensor is a wonderful idea because it sends data to a control system for real-time water quality monitoring. However, it is costly. As a result, I've picked a TDS meter. TDS meters are also quite accurate, but a person is needed to monitor the water quality. TDS of less than 300 is considered outstanding, 300-600 is considered decent, while TDS of more than 600 is considered poor. In our project, we obtained a result of 394, which is suitable for drinking.

Sandeep S, (B.Tech) Computer Science Engineering from VIT Bhopal University Kothri kalan (M.P.), India – 466114. Worked on water level indication topic. I suggested the idea to know the water level as low, high and medium level in the tank. We can save water instead of overflowing, and with help of indication level we can refill the water in tank again. Also, I helped in leakage detection's simulation. Tried to test the circuit diagram in tinker cad I enquired some people regarding the water related issue near my neighbour.

Abishek Prabakaran Ramkumar, (B.Tech) Computer Science Engineering from VIT Bhopal University Kothri kalan (M.P.), India – 466114. Worked on track down of water spillage in the lines. The spillage of water in lines can be found by utilizing drove, Arduino and two water flow sensors. we need to track down the consistent progression of water. On the off chance that the stream is high, chart thunders to the most noteworthy pinnacle point then there is a spillage between the lines. On the off chance that the stream is low, chart will be untouched low. Subsequently there is no spillage in the lines.

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