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Water usage Control and Management Based on IoT

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ABSTRACT

Water is the most important factor that contributes to the survival as well as the wellbeing of mankind. Keeping in mind the current scenario, a lot of water is used by household even in places where less water can work. This in turn leads to shortage of water making water cut necessary. The water bill that every owner receives is a constant one included in Maintenance Bill. Our idea is to detect the usage of water by individual flats and bill them accordingly using IOT sensors. Also, the owner will be kept updated in real time about their water usage via an android app. Thus, they can track their usage and avoid wastage of water to reduce their bill. Another advantage of the real time water usage tracking would be that if in case some tap is left open by mistake for a longer time than usual the sensor would sense a continuous water flow and send an alert to the mobile application. This would avoid unnecessary wastage of water. It will also provide an internet-enabled locking mechanism in the main source pipe which can be turned ON/OFF remotely from the android app. Thus, in scenarios where water tap is left open by mistakenly while leaving the house, an excess continuous water flow would trigger an alert in the app thus making the owner aware of the situation and he/she can turn the source pipe off from the mobile application. Also, the water quality information would be updated in app so as to ensure better health of the residents.

Keywords : Water Management, Flow Sensor, Ultrasonic Sensor, Solenoid Valve, ESP-8266 Wi-Fi-Module, PH-Sensor, Android Application.

I. INTRODUCTION

Water is an important resource for all the living things on the earth. Water Scarcity is the most common problem faced by the people of India. This happens mainly due to less available Supply and more people using it. Water consumption needs to be minimized to required amount and not wasted unnecessarily. A lot of extra water is used by the household where less water can be sufficient. Every flat in any given society gets equal amount of bill which is not based on usage. Here in this project, we propose a system which keeps a track of water usage and generate bill accordingly. Also, we have added real time water tracking which can be traced using an android application and the source can also be turned off using the application.

II. PROBLEM STATEMENT

Our world and community are facing excessive water usage either for domestic or commercial purposes. Climate change, such as altered weather-patterns, increased pollution, and increased human demand and overuse of water are the factors leading to water scarcity. Now days in India water distribution and management is not proper, also billing system is not

available properly. In this system we proposed automation instead of manual water management.

III. LITERATURE SURVEY

In this research paper, a water management system using the ZR16S08 microcontroller as IoT solution, for water distribution and loss prevention is being proposed. This system's operation takes place by the monitoring of the water flow through pipes of the distribution network of water, and its aim is to ensure the quality of the water supply and to know that water losses characterize one of the great problems in the world, as pipe holes may be open doors to water contaminants.[1]

In the era of IoT, automation is one of the essential attributes. This increases the convenience and comfort in the people's lives. The Authors would like to provide this in the domain of water management. Their motive here is to help the readers understand the importance of using water judiciously and equipping them with the knowledge of the functioning of water management system which is done by using Internet of Things (IoT). They also discuss how this project is the future of sustainable management of water in residences.[2]

The provision of water having good quality and quantity is important for utilities in urban areas due to increasing demand and Scarcity of water. The country of South Africa is a country with water scarcity where municipalities' average NRV (non-revenue water) is 37%. The municipalities have developed strategies for Water Conservation/Water Demand Management (WC/WDM) whose research study's goal was to establish if the strategies are successfully implemented or would result in NRW reduction. Structured questionnaires were prepared for the managers and engineers as means of data collection for the study. The result's indication was that there are strategies and policies in place for the WC/WDM implementations, but it was concluded that these are on a small because the NRW remains high. The municipalities are aware of water problems being faced by the industry and the capabilities of smart metering technology. Currently Prepayment metering is in use and smart metering technologies can be used in the future.[3]

Information and communications technology systems for control of water were facing interoperability problems due to the lack of support of standardization in monitor and control equipment. This problem affected different processes in water management, such as distribution of water, its consumption, identification of systems and maintenance of equipment. Object Linking and Embedding for Process Control Unified Architecture (OPC UA) is a platform independent service-oriented architecture to control the processes in the logistics and manufacturing sectors. On the basis of this standard the authors proposed a smart water management model combining business processes coordination and decision support systems with Internet of Things technologies. They provided an architecture for interaction of sub-system and a detailed description of the physical scenario in which they would test their implementation, allowing specific vendor equipment to be manageable and interoperable in the specific context of water management processes.[4]

In recent times, consumer-based humanitarian projects that could be rapidly developed using Internet of Things (IoT) technology were highly needed. In this paper, the Authors propose an IoT based water monitoring system that measures water level in real-time. Their prototype is based on the idea that the level of the water can be very important parameter when it comes to the flood occurrences especially in disaster prone areas. A water level sensor was used to detect the desired parameter, and if the water level reached the parameter, the signal

was fed in real- time to social networks like Twitter. The measurement of the water levels was displayed in remote dashboard.[5]

This project focused on monitoring of use of water, consider, by one block of houses in a flat system, where at the partition of pipeline from where the water gets diverted to various parts of a block.[6]

This paper presented an IOT device which help to manage and plan the usage of water. The system can be easily installed in residential societies. Sensors placed in the tank continuously informed the water level at the current time. This information was updated on the cloud and using an android application, user could visualize the water level on a Smartphone anywhere that was connected to the Internet. According to the level of water in the tank the motor functioning was automatically controlled, at low level of water, motor was automatically turn on and when tank was about to fill up it was cut off.[7]

IV. EXISTING SYSTEM

- A general water supply system exists that charges people a fixed amount irrespective of their usage.
- The water usage is calculated but at the society level and not at the flat level.
- People have no control over the flow of water remotely, in case they leave it open by mistake.
- People have no idea about the quality of the water they use, and the entire system is based on trusting the source that they send good quality of water.
- People have no idea about the quantity of water left in their tanks and thus cannot plan or prepare accordingly.

V. PROPOSED SYSTEM

- A water distribution system is proposed where every flat owner gets a separate bill according to their usage.
- The bill will also be updated on each flat owner's mobile application in real time.
- Also, in case a person leaves the tap open by mistakenly and leaves the house, he can turn the main tap off remotely from his android application.
- The quality of water is detected, and the data is sent to the flat owner on his android mobile application.
- The water levels in the tank are measured and the data about the quantity used or left is sent to the flat owner's android mobile application.

VI. REQUIREMENTS

1. HARDWARE REQUIREMENTS:

- Flow Sensor
- Solenoid Valve
- ESP-8266 Wi-Fi Module
- pH Sensor
- Ultrasonic Sensor
- A Water Pump
- A tank
- Pipes

2. SOFTWARE REQUIREMENTS:

- OS:
  WINDOWS 7 and Android
- Languages:
  Embedded C, Java, XML
- Tools:
  Android Studio, Arduino IDE
- Database:
  MySQL

VII. METHODOLOGY

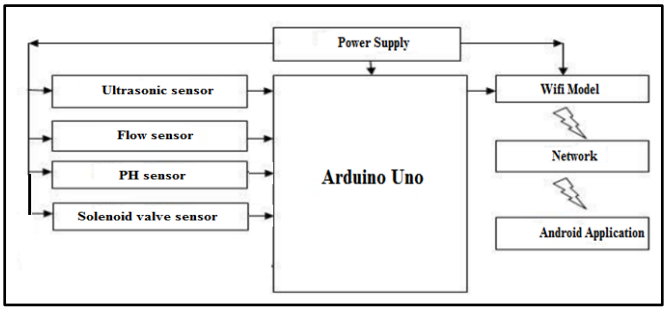


Fig 1. System block diagram

The different proposed features and their methods of implementation are as under:

1. FLOW DETECTION:

- The flow of the water is being detected with the help of a Flow Sensor.
- The water flows through the flow sensor.
- It has a rotor inside which rotates as the water flows.
- The rotating blade generates a frequency signal proportional to the flow rate.
- This is sensed by a magnetic pickup which transfers it to the database.
- The database in turn provides that data to the Android Application.

2. TURNING OFF THE FLOW REMOTELY:

- The flow Sensor is followed by a Solenoid Valve.
- The Solenoid Valve is Electromechanically operated.
- Through this valve, Water can only flow in one direction.
- The rotating blade generates a frequency signal proportional to the flow rate.
- We connect it to the Arduino/ESP-8266 Wi-Fi Module.
- The Wi-Fi Module is connected to our Application via a database.
- Thus, we can turn the Water Flow ON or OFF remotely via our Application which will send a signal to the database which will turn the valve on/off as needed.
- Also, by putting a flow speed threshold in the flow sensor programming, leakage is being detected.

3. BILL GENERATION:

- The Flow Sensor detects the amount of water passed through it.
- This data is then sent to the database.
- There the water usage is accounted for as per the per unit rate.
- For example: In Maharashtra the rate of water is ₹5/1000Litres.
- Thus, for every litre of water usage, 0.5 paisa will be charged (₹0.005/Litre).
- This amount will be updated on the mobile application as soon as the water is used.
- i.e. The bill will be generated in real time.

4. QUALITY DETECTION:

- The pH Sensor is placed in the tank of individual homes or in the main society tanks where individual tanks aren't permitted.
- pH in chemistry stands for potential of Hydrogen which tells us the acidity or basicity of different solutions.
- pH of water that is pure is around 7(neither acidic nor basic)
- Thus, a pH sensor detects that and sends the data regarding the quality of water we are using.

5. QUANTITY DETECTION:

- The Ultrasonic Sensor emits ultrasonic waves and the reflected waves are converted to electrical signals thus telling us the distance from any object.

- Here we use ultrasonic sensor to detect the water level in the tank.
- The sensor is placed at the top of the tank and it senses from where the waves get reflected, hence telling us the depth of the water in the tank and in turn we the water level gets calculated.
- In case of societies that do not allow individual tanks, this can be placed in the main tank and the data can be sent to the Society Authorities.
- In case of societies allowing individual tanks, this can be placed in the flat owner's personal tank and the data can be sent to his android application.

VIII. MATHEMATICAL MODEL

U= {I, O, f, S, F, D, NDD}
where,
I= {I1, I2, I3}
I1= {l1,l2…... ln} where n=size of tank and n>0
I2= f1 i.e. pulse counted using flow sensor
I3= pn i.e. size of the pipe

O= {O1,O2,O3}
O1= level of water present in the tank
O2= water consumed by the user
O3 = bill generated

f= {f1,f2,f3,f4}
f1=QUANTITY (n, I1)
f2 =FLOW_RATE (I2,I3, O2)
f3 =CONNECT ()
f4 =REP_GEN (f1, f2)

S: Success:

- Data send successfully
- Report generated or not

F: Failure:

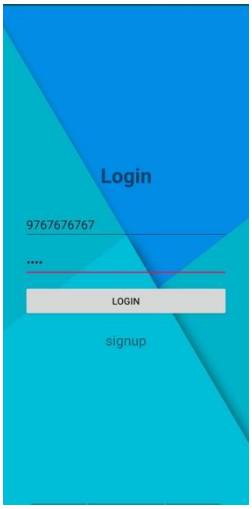
- Sensors not working properly
- Connection failure

D: Deterministic value, n
NDD: Non Deterministic Data value:

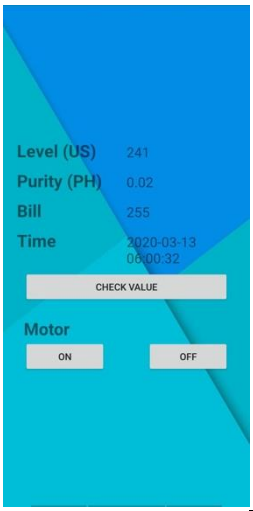
- Levels detected are randomly generated

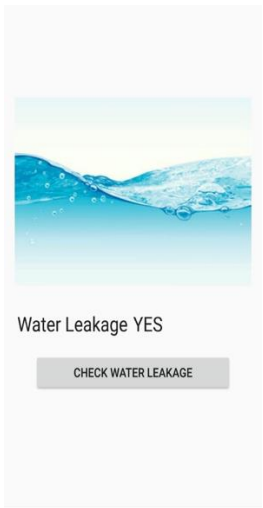
IX. RESULTS

1. SOFTWARE OUTPUT (Android App)



Registration page Login Page





Information Page Leakage Detection Page

2. HARDWARE CONNECTIONS

Sensors connection with Wi-Fi Controller

X. FUTURE SCOPE

- The system can be implemented not only at household level but also at schools, offices and other places.
- The water usage can be optimized more by implementing rainwater harvesting.
- Machine Learning can be integrated to find relevant water usage patterns and thus conserve more water and electricity

XI. CONCLUSION

To control and monitor the usage of water for a single flat, an electronic water management system is designed. The water bill is generated according to the usage. This system is designed to automatically display and control the water flow. The proposed system eliminates the traditional manual monitoring and controlling for domestic users. The system achieves proper water management and thus enhances productivity with the help of automation.

XII.ACKNOWLEDGEMENT

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