Aqua Sync-Tech Smart Water Meter for Billing and Monitoring with Mobile Application.

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***Abstract -The Aqua Sync project in Sri Lanka aims to revolutionize water consumption tracking and historical billing records by developing an Arduino-based device with a water flow sensor and RTC Module. The device provides real-time and precise water usage data, promoting responsible water usage, timely billing cycles, and informed decision-making. The project aims to streamline processes, reduce manual billing calculations, and automate monthly water usage reports and bills. It also helps identify potential leaks or anomalies in real time, allowing users to take prompt actions. The mobile application also offers geographical tracking. This project aligns with sustainable water management goals and addresses water conservation challenges.***

***Keywords - Water flow sensor, RTC Module, Water consumption tracking, Historical billing records, LED screen, Real-time data, Anomalies, Geographical tracking***

**Literature Review**

IOT-based water metering system is an important and innovative solution with many benefits for consumers and water management authorities. The Aqua Sync Tech system tackles issues in water management encompassing everything from conserving resources to improving efficiency. And this help to Sri Lanka water Board to Labor Cost. By utilizing technology for real time data and automation it offers a solution that brings advantages to consumers, water boards and the environment. It signifies a stride, towards a conscientious and sustainable utilization of our invaluable resource, Water.

The research inquiries presented tackle the drawbacks and difficulties of water billing systems and underscore the advantages of integrating technology driven solutions, such, as Aqua Sync Tech. They delve into the effects of readings on billing precision and efficiency factors contributing to delays and mistakes user awareness regarding water consumption approaches to enhance awareness, resource allocation challenges in allocating resources efficiently and how technology can optimize it. Additionally, these inquiries evaluate the extent of water wastage caused by leaks, its impact on revenue and the environment and how automated systems can address these concerns. The research questions are supported by the necessity to improve efficiency conserve water resources reduce impact while achieving financial savings.

There have been many past projects. This project is used to measure the water consumption recodes and the volume of water measured is compared with the manual measurement. If there is a difference between manual reading and sensor readings the system can generate the output that water consumption is wrong, and it has ability to close the main valve once the determined amount of water is reached.

**Introduction**

In this era characterized by advancements and a focus, on preservation effective water management is of most importance. The Aqua Sync System in Sri Lanka is a project that utilizes Arduino based technology. It incorporates water flow sensors and an RTC Module to provide real time data on water consumption. This innovation simplifies the billing process reduces errors and facilitates decision making. Additionally, it has the added advantage of detecting any abnormalities or potential leaks. To complement the hardware there is also a user app available that allows for geographical tracking while aligning with sustainability objectives. This project signifies a step in promoting responsible water usage achieving financial savings and building a more sustainable future.

Upon examination of the Aqua Sync project, it becomes clear that it effectively addresses standing challenges in water billing systems. It does not resolve delays and inaccuracies in billing. Also enhances consumers understanding of their own water consumption patterns. Also, it tackles issues related to resource allocation as the economic and environmental impacts associated with wasteful use of water. By combining real time data analysis with automation techniques this project represents a breakthrough in water management – not just within Sri Lanka but also as an exemplary model, for other regions facing similar challenges.

**2. Methodology**

**2.1 Requirements and Analysis**

The smart water meter system is the best solution design for water consumption monitoring, management, and preservation. This project incorporating hardware devices, cloud technology, and user-friendly mobile app. This project we intend to provide water leakage detection, accurate real time data, measure water usage, monthly water bills and remote controlling valve for effective and efficient water usage.

**Hardware integration and components**

The project most important components such as the ESP8266 microcontroller, water flow sensor, TDS water conductivity sensor. The ESP8266 is the brain of our project. It connects to the internet, reading data from sensors and communicates with cloud services and database after sending the mobile app to provide real time data and controlling. Using this flow sensor calculates flow rate, water unit and total water usage(liters). These components accurately measure and record real time water usage. This means users can access up-to-date information about their water usage. This immediate awareness users to identify leading to more aware usage.

**Water quality monitoring**

Using water conductivity sensor users measure water quality and detect pollution . This feature can make decisions to safeguard health and contribute to water management. This error-free monitoring authorizes users to understand water usage patterns and make and control decisions. If whether water is not fit for use, then the system sends notifications and alerts the user mobile phone.

**Interfaces and water controlling**

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The mobile app is designed for both users and administrators. The interfaces allow users to view their water usage data in real time. This instant access ensures that users can response when raising water usage and make decisions quickly. With the solenoid valve, the most important function of this mobile interface is if water leakage detection users can automatically turn off the water meter from anywhere . Water leak detection algorithms prevent water wastage. This function will send notifications and alerts to users of mobile phones. Quick detection helps users minimize water wastage and reduce cost.

**Device tracking and water leakage detection**

However, the administrators allow to view and track water meter anywhere using this GPRS/GSM module . This function is thoughtful to find out users’ location. Also, admins can add unaccustomed users and devices in this system using separate interfaces.it will be useful to tracking devices and find whether authorized users. Water leak detection algorithms prevent water wastage. This function will send notifications and alerts to user mobile phones . Quick detections help users minimize water wastage and reduce cost.

Eventually, the smart water meter system is about the next level of technology. It allows be understanding and control their water usage, encourages a sense of responsibility and ownership over this valuable resource. Our system is being developed for improving water conservation with modern technology to minimize the difficulties in the current system.

**2.1.1 Functional Requirements**

Functional requirements for detect the water quality

TDS sensor serves as the project’s guard for water quality, as well measuring the electrical conductivity of the water and by that implying the immersion of dissolved solids like salt and minerals. This data allows to users to use the quality of the water they consume, helping to detect polluted.

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| Input | Detect the water quality by the TDS sensor. |
| Process | Send the unhealthy water percentage to the mobile application measured with TDS values. |
| Output | Display mobile application interface and a solenoid valve will close when unhealthy water increase. |

Functional requirements for detect the water leakage

The valve allows for remote and automatic control water supply, for example detect leak or bad water quality, the solenoid valve can be immediately shut off, reduce damage and health risks.

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| Input: | Detect the water leakage.t the water leakage |
| Processing: | Detect the water leakage, send the notification user mobile phone, mobile application shows that warning massage and turn off the valve automatically. the water leakage, |
| Output: | Automatically turn off valve and send text massage to user mobile. mobile phone and send |

Functional requirements for detect the water flow rate

Flow sensor measure and records real time water usage (water units/total litters, flow rate), enabling users to gain information about their water usage and possibly detect anomalies like water leaks. This data understanding uses to make decisions about their water usage and promoting efficient water usage practices.

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| Input: | Detect the water flow by the flow sensor.t the water flow by the flow sensor |
| Processing: | Send the water flow rate, calculate water units, and measure total water usage(liters) to mobile application and LCD display. the water flow rate, calculate water units, and measure total water usage(liters) to mobile application and TFT display. |
| Output: | Display mobile application interfaces and TFT display show this data real-time. mobile application interfaces and TFT display show this data real-time |

Functional requirements for detect the location

This module allowing for tracking of the system’s physical location. This location data can be helpful for applications like tracking water quality monitoring stations. Other hand this module uses to send notification like bad water quality and water leakage for user’s mobile phone.

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| Input: | Detect the location by the GPS/GPRS module. |
| Processing: | Monitoring the live device location using the mobile application. |
| Output: | Display the live location in mobile application. |

**2.1.2 Non-Functional Requirements**

Performance Requirements

* Want power supply.
* Make sure the user & device connected to the internet connection.

Safety Requirements

* System's power suppliers will not be situated on too close to the sensors
* Don't cover the sensor when it is fixing.

Security Requirements

* Do not replace the given gas sensor.
* Do not turn off the connection between the devices.
* Do not change situation positions to the gas sensor.

Hardware Quality Attributes

* Display gives clear details about gas composition.
* Water flow sensor is highly sensitive to water flow.
* TDS sensor is highly sensitive to monitoring of liquid water and salt dynamics.
* Solenoid valve is used for automatic turn on/off the water supply.

**2.2 Design**

**2.2.1 High level Architecture Diagram**

**2.2.2 Circuit Diagram**

**2.3 Implementation**

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**Physical circuit diagram**

**Development tools**

* Arduino IDE

Our main development tool is Arduino IDE. The open-source software known as the Arduino IDE is used to create & upload code to ESP8266 board. For different operating systems, include windows, Mac OS and Linux, the IDE program is appropriate. The programming languages C++ are supported. It helps us to build the codes and check they are correctly working or they have carried some errors. After building the codes we uploaded to the ESP8266 board via this software using cable. Then we are checking this build code is working properly with equipment by serial monitor. GSM module also we have used Arduino IDE.

* IntelliJ IDEA

Smart navigation and coding assistance, IntelliJ IDEA integrates the essential developer tools and lets we debug, analyze and version the code base of our application from within the IDE.it will helps us to implements good and efficient mobile.

* Firebase

It provides us to real-time data monitoring and store our valuable data on this database. Other hand it will help us to control and monitoring real-time data within our mobile application.