Smart Water Monitoring System for Real-Time Water Quality and Usage Monitoring

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Abstract : Conventional water metering has a tendency of being unreliable, inaccurate, and a source of dispute and disquiet among customers, and hence it is considered to be one primary reason why water service providers perform poorly and have very low revenue collection. To develop a prepaid metering project to see whether or not prepayment can be considered to be an innovative way of addressing these concerns, especially how to provide better service, when providing water to the urban poor. To design and develop a water quality monitoring system, with the objective to notify the user of the real-time water quality parameters. Also, to measure physiochemical parameters of water quality, such as flow, temperature, pH, conductivity and the oxidation reduction potential. These physiochemical parameters are used to detect water contaminants.

Keywords **- Water quality monitoring, flow sensor, pH sensor, conductivity sensor, Communal prepaid metering.**

Introduction:

Clean water is one of the most important resources required to sustain life and the quality of drinking water plays a very important role in the wellbeing and health of human beings. Water supply to taps at urban homes and water sources available in more rural areas, is however, not necessarily safe for consumption. Even though it is the government's responsibility to ensure that clean water is delivered to its citizens, ever aging infrastructure, which is poorly maintained and continual increase in population, puts a strain on the supply of clean water. It is thus paramount to monitor the quality of water which will be used for consumption. In monitoring is defined as the collection of information at set locations and at regular intervals in order to provide data which may be used to define current conditions, establish trends, etc. Traditional water quality monitoring methods involve sampling and laboratory techniques. These methods are however time consuming (leading to delayed detection of and response to contaminants) and not very cost effective. There is thus a need for more extensive and efficient monitoring methods. Water meters are activated using tokens that are bought from the water service provider. The tokens are uploaded with credit at designated pay-points and water users can draw water up to the amount credited in the token. The prepaid meters were installed to improve the quality of water service delivery to increase collection of government.

Literature Survey:

Various studies involving the implementation of water quality monitoring systems using wireless sensor network (WSN) technology can be found in literature.

In a distributed system for measuring water quality is designed and implemented. Temperature, conductivity, pH and turbidity sensors are connected to a field point, wherefrom data is sent using a GSM (global system for mobile communications) network to a land based station. The focus of this study is however on the processing of the sensor data using Kohenen maps (auto associative neural networks). A WSN-based water environment system which senses and monitors video data of key areas and water parameters such as temperature, turbidity, pH, dissolved oxygen and conductivity is presented in Data is sent from the data

monitoring nodes and data video base station to a remote monitoring center using ZigBee and CDMA (code division multiple access) technology.

The water monitoring system implemented in analyses and processes water quality parameters (pH, conductivity, dissolved oxygen and temperature), and also sounds an alarm when there is a water contamination, or change in water quality. The parameters are measured with off-the shelf sensors and data is sent to a base station via GPRS (general packet radio service).

In a ZigBee based WSN water quality monitoring and measurement system is presented. The system enables remote probing and real-time monitoring of the water quality parameters and also enables observation of current and historical water quality status.

A river basin scale WSN for agriculture and water monitoring, called Soil Weather is implemented in [17]. The network uses GSM and GPRS technology for transmission of sensor data.

A turbidity system is proposed in which a low powered, small-sized, easy-to-use and inexpensive. In the DEPLOY project is introduced to monitor the spatial and temporal distribution of water quality and environmental parameters of a river catchment. It is intended to demonstrate that an autonomous network of sensors can be deployed over a wide area and the system measures parameters such as pH, temperature, depth, conductivity and turbidity and dissolved oxygen.

A microcontroller-based WSN system is proposed into measure pH, chlorine concentration and temperature in a pool. Data is transmitted using GSM and in sleep mode the sensor nodes are shown to consume 27 µA.

In a WSN system is used to measure the water quality of fresh water and uses solar daylight harvesting for optimized power management.

The data collected from the various sensor nodes are sent to a sub-base node and from there to a monitoring station using a GSM network. A low-cost, real-time, in-pipe sensor node with a sensor array for measuring flow, pH, conductivity, ORP and turbidity, is designed and developed in Contamination event detection algorithms are also developed to enable sensor nodes to make decisions and trigger alarms when contaminants are detected.

In a WSN based on ISO/IEC/IEEE 21451 standard for monitoring of surface water bodies is presented, to capture possible severe events and collect extended periods of data. As can be observed from the literature study, most water quality monitoring systems have sensing nodes, are able to perform wireless communication and process the data from the sensors to achieve meaningful results.

Proposed System:

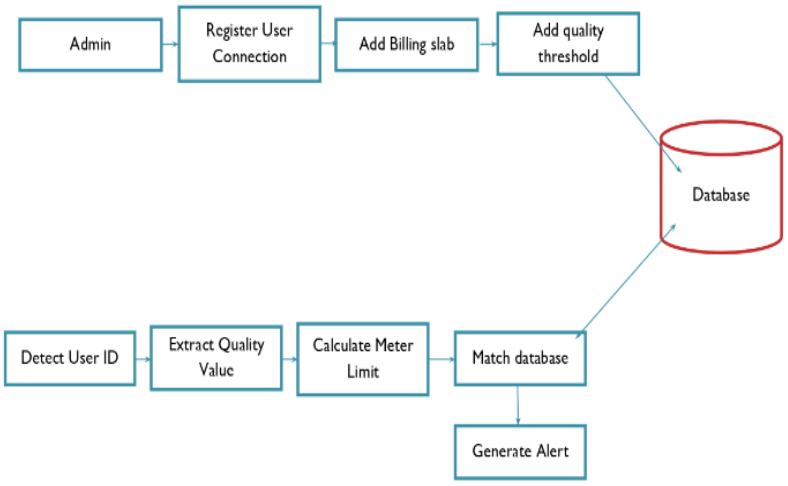

FIG 1. BLOCK DIAGRAM

(3.1). Admin:

Admin User is able to register new connection based on the eligibility.

(3.2). Add Funds:

To allocate funds or to prepaid recharge of the new connections.

(3.3). Add Quality Threshold:

To set quality threshold value of the water, this value will be used to check sensor values and generate alerts.

(3.4). Flow Algorithm:

Algorithm and the flowchart for the operation of system. The algorithm of operation based on the same is as follows:

• Once a user opts for a new water supply connection, a unique user ID is provided and the system is set up at the user's household.
• The water supply to the household starts.
• At the entry point to the house, the quality of the water is checked.
• The Water Quality sensor nodes collect the parameter values and serially send it to the Microcontroller.
• Based on the standardizing, the water supply to the house continues.
• Based on the prepaid recharge done, the water consumption is checked. After recharge limit is crossed, a notification is sent to the user as well as the authority mentioning the amount of water consumed from the start of the month till that point of time. The water flow continues until another limit is crossed. For each of the three limits, the cycle repeats.
• After another recharge of prepaid bill, the readings are reset and water supply for next month begins.
• In case the water is not fit for drinking, a notification is sent to the user and authority along with the physical parameter values of the water.
• The water supply is immediately stopped to prevent any accidental consumption of impure water, and the supply remains closed until the water quality issue is resolved.

Microcontroller:

Microcontroller interconnects all the other subsystems and some additional peripheries within the architecture. Its main purpose is to execute instructions regarding sensing, communication and self-organization. After the sensor has detected the targeted vehicle, the signals are transmitted to the microcontroller for further processing. Programming for proper working of the module is burned into the microcontroller. It is the main component for the effective working. All the programming is done in Arduino board and the Arduino board is responsible for determining the effective distance between the circuits.

FIG 3.ARDUINO MICRCONTROLLER

The Arduino Uno R3 is an open source microcontroller board based on the ATmega328 chip. This Board has 14 digital input/output pins, 6 analog input pins, Onboard 16 MHz ceramic resonator, Port for USB connection, Onboard DC power jack, An ICSP header and a microcontroller reset button. It contains everything needed to support the microcontroller. Using the board is also very easy, simply connect it to a computer with a USB cable or power it with DC adapter or battery to get started.

Features:

1. Microcontroller: ATmega328P.
2. Operating Voltage: 5V.
3. Input Voltage: 7-12V.
4. Digital I/O Pins: 14 (of which 6 provide PWM output).
5. Analog Input Pins: 6.
6. DC Current: 40mA.
7. Flash Memory: 32 KB.
8. SRAM: 2 KB.
9. EEPROM: 1 KB.
10. Clock Speed: 16 MHz

Water Flow Meter:

FIG 2. WATER FLOW METER

Effective water management involves supplying water according to the real requirement, and thus measuring water is very essential step in water management systems. There are many water flow measurement techniques as well as different types of water flow meters used to measure the volume of water flow in pipelines but these all are too costly. This article describes ideas for design and development of low cost automatic water flow meters, with the help of readily-available and low-cost water flow sensors.

YF-S201 Hall-Effect Water Flow Sensor:

Accurate flow measurement is an essential step both in the terms of qualitative and economic points of view. Flow meters have proven excellent devices for measuring water flow, and now it is very easy to build a water management system using the renowned water flow sensor YF-S201. This sensor sits in line with the water line and contains a pinwheel sensor to measure how much water has moved through it. There is an integrated magnetic Hall-Effect sensor that outputs an electrical pulse with every revolution. The "YFS201 Hall Effect Water Flow Sensor" comes with three wires: Red/VCC (5-24V DC Input), Black/GND (0V) and Yellow/OUT (Pulse Output). By counting the pulses from the output of the sensor, we can easily calculate the water flow rate (in liter/hour – L/hr) using a suitable conversion formula.

Water Moisture Sensor Module:

The sensor includes a potentiometer to set the desired moisture threshold. When the sensor measures more moisture than the set threshold, the digital output goes high and an LED indicates the output. When the moisture in the soil is less than the set threshold, the output remains low. The digital output can be connected to a micro controller to sense the moisture level. The sensor also outputs an analog output which can be connected to the ADC of a micro controller to get the exact moisture level in the water.

Specifications:

1. Operating voltage: 3.3V~5V.
2. Dual output mode, Analog output more accuracy.
3. A fixed bolt hole for easy installation.
4. With power indicator (red) and digital switching output indicator (green).
5. Having LM393 comparator chip, stable.

6. Panel PCB Dimension: Approx.3cm x 1.5cm.
7. Soil Probe Dimension: Approx. 6cm x 3cm.
8. Cable Length: Approx.21cm.
9. VCC: 3.3V-5V
10. GND: GND
11. DO: Digital output interface(0 and 1)
12. AO: Analog output interface

Connections:

1. VCC connect to 3.3V-5V
2. GND connect to GND
3. DO digital value output connector（0 or 1）
4. AO analog value output connector

Conclusion:

The Smart water quality check meter is automatic and does not require much human interference, thereby reducing the errors. The real-time monitoring provides immediate remote access to the water quality as well as quantity data for any household. All these measures aims at bringing down the unnecessary usage of water and prevention of health hazards caused due to consumption of impure water.

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