Smart Well Monitoring System

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Abstract

Water is a basic need for human survival. In India, 60 % of population lives in villages. Wells and bore-wells are the important sources of water for the farmers and the villagers. However, due to the vast increase in global industrial output, pollution and the over-utilization of land resources, the quality of water available in wells and bore wells to the villagers has deteriorated. The high use of chemical fertilizers in farms has also contributed immensely to the overall reduction of water quality in villages. Therefore, there must be mechanisms put in place to vigorously test the quality and quantity of water and guide the villagers about the utilization of the water available to them. The availability of good quality water and the knowledge about its utilization is paramount in preventing outbreaks of water-borne diseases as well as improving the quality of life. The wells and the bore wells in villages requires a frequent data collecting network for the water quantity and quality monitoring and IoT can improve the existing measurement and also an user-friendly android application providing the information to the villagers and farmers about the well water in their area will be a boon. Today, Internet of Things (IoT) and sensing techniques are used in different area of research for monitoring, collecting and analysis data. This paper presents a smart well water quality and quantity monitoring system based on IoT, Cloud computing and android application.

Keywords—Water Quality, Sensors, Quantity testing, Quality testing , cloud storage, android app.

I. INTRODUCTION

Water is one of the most essential natural resources that has been gifted to the humankind. India is a land of villages where wells and bore wells are an important source of water for the villagers. However, the problem of water scarcity and water pollution is a matter of concern for the rural community of India and hence proper utilization of well water is necessary.

Due to the vast increase in industrial output, pollution and the high use of chemical fertilizers, the quality of available in wells and bore wells to the villagers has deteriorated.

In view of this situation, water quality monitoring is necessary to identify any change in water quality parameters from time-to-time to make sure it is safe in real time. This paper puts forward a real-time monitoring system based on IoT for water quality monitoring of wells and bore wells.

We need to measure the quality of the water by ensuring the appropriate pH, transparency level, salinity levels. The setup involves inspection of the quality of the well water by measuring important parameters. The sensors will sense and collect the information, which will be passed to cloud using GSM and GPRS network, and then all the information will be displayed in the app. The project will help farmers and villagers to put water of the wells to the best utilization without causing the wastage and pollution. Having proper knowledge of the water in their vicinity will boost the agriculture, as well as water-borne diseases will be prevented.

II. LITERATURE SURVEY

Various technical papers on assessment of water quality of water reservoirs have been presented at research level. Following are the papers referred:

A.N.Prasad, K. A. Mamun, F. R. Islam, H. Haqva has published a paper 'Smart Water Quality Monitoring System' . This paper presents a smart water quality monitoring system for Fiji, using IoT and remote sensing technology. Fiji Islands are located in the vast Pacific Ocean, which requires a frequent data collecting network for the water quality monitoring. The system has proved its worth by delivering accurate and consistent data throughout the testing period and with the added feature of incorporating IoT platforms for real time water monitoring.

M. S. Islam, B. S. Ismail, have presented a paper whose purpose of the study was to assess the hydrological properties and water quality characteristics of Chini Lake in Pahang, Malaysia. Seven sampling stations were established at the main Feeder Rivers of Chini Lake for measurement of stream flow. 10 monitoring stations covering the study area were selected for water sampling. Fourteen water quality parameters were analyzed based on in-situ and ex-situ analysis for two seasons and laboratory analyses were carried out.

Brinda Das, P.C. Jain published paper 'Real-time water quality monitoring system using Internet of Things' based on IoT for monitoring water quality. The ZigBee module in the system transfers data collected by the sensors to the microcontroller wirelessly, and a GSM module transfers wirelessly the data further from the microcontroller to the smart phone/PC. The system also has proximity sensors to alert the officials by sending a message to them via the GSM module in case someone tries to pollute the water body. ThingSpeak is an IoT applications open source (OS) which can store and retrieve data from sensors or things using Local Area Network (LAN) or HTTP over Internet. ThingSpeak channel supports 8 data fields, elevation, latitude, longitude, and status. ThingSpeak can send sensors data to cloud to store data in a channel using sensors and websites.

'Reconfigurable Smart Water Quality Monitoring System in IoT Environment' was the paper published by Cho Zin Myint, Lenin Gopalm, and Yan Lin Aung. A real time water quality monitoring is remotely monitored by means of real-time data acquisition, transmission and processing. This paper presents a reconfigurable smart sensor interface device for water quality monitoring system in an IoT environment. The smart WQM system consists of Field Programmable Gate Array (FPGA) design board, sensors, Zigbee based wireless communication module and personal computer (PC). The FPGA board is the core component of the proposed system but it is very expensive. Zigbee modules used are very costly.

In the paper 'Design and development of a water quality monitoring network and system' put forward by Yunze Li; Ying Wang; Min Cong; Haoxiang Lang a powerful sensors node with the mobility was proposed and developed by using a waterproof UAV. This paper proposed a water quality monitoring network and system for real time water parameter acquisitions, water quality monitoring and estimations. A low cost measurement unit of water quality was designed and developed which was considered as a sensor node. The UAV model used are not 100 percent water-proof and hence can damage the components and thus is not reliable.

Brokerless architecture was used by Alif Akbar Pranata, Jae Min Lee1 , Dong Seong Kim. Their work is shown in the paper 'Towards an IoT-based Water Quality Monitoring System with Brokerless Pub/Sub Architecture'. On the system, sensors sense the water measurement metrics, including temperature, pH, and dissolved oxygen level. All collected data are stored in a database and computed stochastically for further analysis on water quality. A complementary experiment compares the proposed pub/sub architecture and MQTT, a lightweight protocol on which IoT mostly uses, to show better performance of the proposed architecture in case of network latency and throughput for diverse message payload size, thus suggesting the future IoT implementation of the system. But the deployment and maintenance cost of the system is very high.

'Design and Development of A Portable Low-Cost COTS-based Water Quality Monitoring System' paper presents a low-cost and portable water quality monitoring system for a researcher, consumer and also drinking water distribution systems. This system consists of main controller unit based on Commercial off-the-shelf (COTS) single board computer and equipped with LCD touch screen to display data information, the central measurement unit is interfaced to the multi-parameter sensor array to collect data from environment and communication unit that bring connection from the sensor device to The Internet. Though COTS is reliable, the software security is a serious risk of using COTS software.

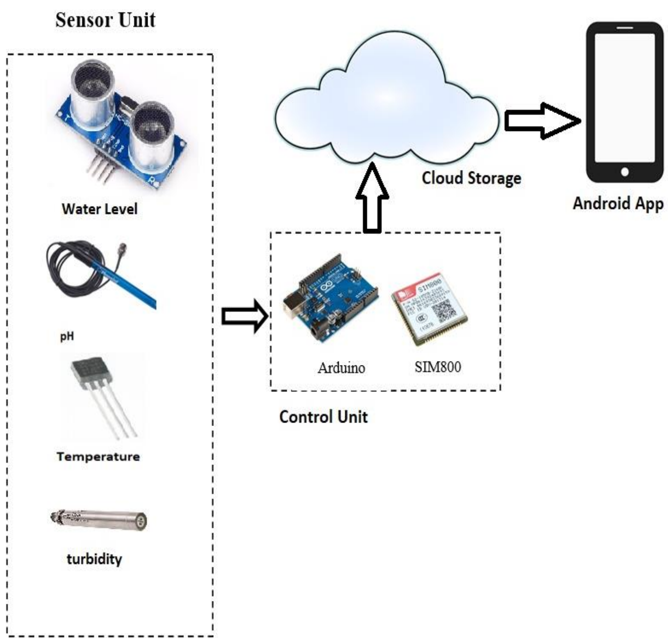
'Wireless Acquisition System For Water Quality Monitoring' presented by Vinod Raut and Sushama Shelke is a small scale project. The system provides the wireless water quality-measuring tool with remote data collection. The data is collected at the receiver section and depending on the pH level and turbidity level, the data are classified and water quality is decided. The system predicts the drinkable water quality and displays the readings on the LCD, which can be mounted inside the individual home. However not every house can afford an LCD display screen. Zigbee module is used for remote sensors and data collection. These zigbee modules are costly and is therefore not reliable.

III. PROPOSED SYSTEM

A. The Overall System

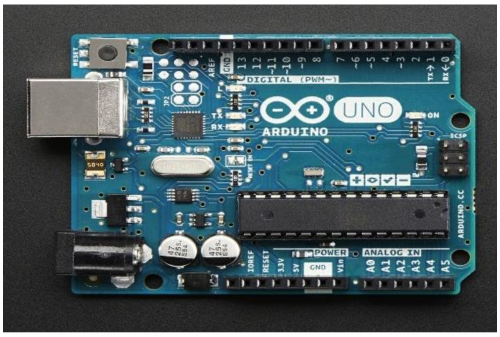
This project is build on IoT based SMART Well Monitoring System. The hardware part of the project consists of sensors, which will sense the pH level of the water, turbidity, dissolve oxygen, water level in the well and other such parameters. Microcontroller is used in the system and all these sensors will be interfaced on the microcontroller. All the data collected will be stored on a cloud. The project involves building an android application for the villagers, which will show all the statistics of the parameters detected by sensors. The application will also provide guidelines for the utilization of the water and purification of the water. This will help the farmers to know which type of water can be used for the cultivation of the given crop and which water is fit for drinking, etc. thus water can be used to the best of their knowledge which will avoid the wastage of water and the pollution of water.

B. Block diagram:



C. Arduino Uno :

Arduino, as a microcontroller is used in the system. By interfacing different sensor to µC mentioned below we constructed a complete data collector unit.The Arduino Uno R3 is a microcontroller board. It is based on the ATmega328. It contains everything needed to support the microcontroller. We just need to simply connect it to a computer with a USB cable or power it with a AC-to- DC adapter or battery to get started.



Arduino UNO

Sensor unit: The sensor unit of the system consists of following sensors-

1. pH probe: The pH probe SEN0161 is used as the pH sensor with the BNC connector. It provides the output voltage in millivolts with respect to the hydrogen ion concentrations in the solution, when dipped into the solution. The output voltage range is from -414mV to +414mV with the operating temperature range of 0-60 degree Celsius. It has the accuracy of 0.01ph. The output voltage is positive for the acidic solution and negative for the alkaline solution. For neutral solution, it gives zero output. The output pH range for SEN0161 is from 0 to 14. The pH sensor v1.1 is used as the signal amplification circuit to boost the output from mV to volts.
2. DS18B20 temperature sensor: SENO189 turbidity sensor: The gravity Arduino turbidity sensor detects water quality by measuring the levels of turbidity. Using light, it measures the light transmittance and scattering rate by detecting suspended particles in the water. The rate changes with the amount of total suspended solids (TSS) in water. The liquid turbidity level increases as TSS in the water increases.

This liquid sensor provides analog and digital signal output modes. In digital signal mode, the threshold is adjustable.

3. HC-SR04 ultrasonic sensor: The sensor is very cheap and thus is economical. It has a ranging accuracy up to 3mm and provides 2cm to 400cm of non-contact measurement functionality.. Each HC-SR04 module consists of ultrasonic transmitter, a receiver and a control circuit. There are only four pins on the HC-SR04: VCC (Power), Trig (Trigger), Echo (Receive), and GND (Ground).
4. Turbidity Sensor: The turbidity sensor used is SEN0189 module. The SEN0189 module measures the turbidity i.e. amount of suspended particles of the water in the wells. It has operating voltage of 5V and operating current of 40mA. It has operating temperature range from 5 to 90 degree Celsius. It has analog output from 0 to 4.5V with the response time of 500mS or less.

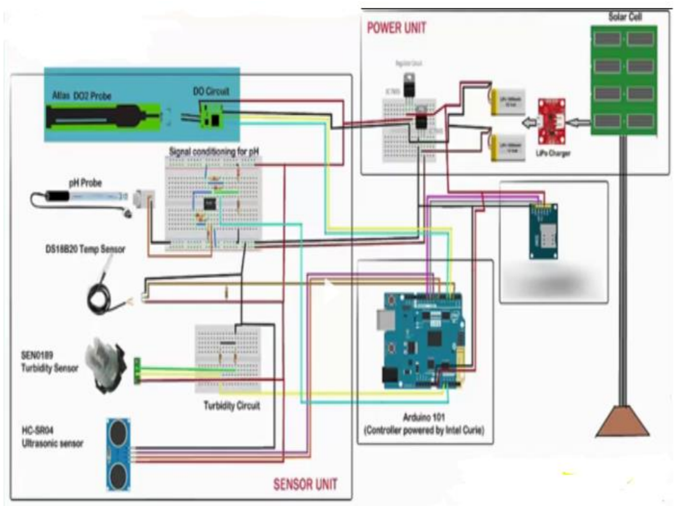
D. GPRS/GSM module-

For this, we have used SIM800.
General features of SIM800: Quad-band 850/900/1800/1900MHz**,** GPRS multi-slot class 12/10**,** Compliant to GSM phase 2/2+, [Class 4 (2 W @ 850/900MHz), Class 1 (1 W @ 1800/1900MHz)], Bluetooth: compliant with 3.0+EDR, Control via AT commands (3GPP TS 27.007, 27.005 and SIMCOM enhanced AT Commands), Low power consumption, Operation temperature: -40℃ ~85℃.
Specifications for GPRS Data: GPRS class 12: max. 85.6 kbps (downlink/uplink), Coding schemes CS 1, 2, 3, 4, PPP-stack, CSD up to 14.4 kbps, PBCCH support, USSD, Non-transparent mode.
Specifications for SMS via GSM/GPRS: Point to point MO and MT, SMS cell broadcast, Text and PDU mode.
Software features: 0710 MUX protocol, Embedded TCP/UDP protocol, FTP/HTTP, MMS, E-MAIL, DTMF, Jamming Detection, and Audio Record.

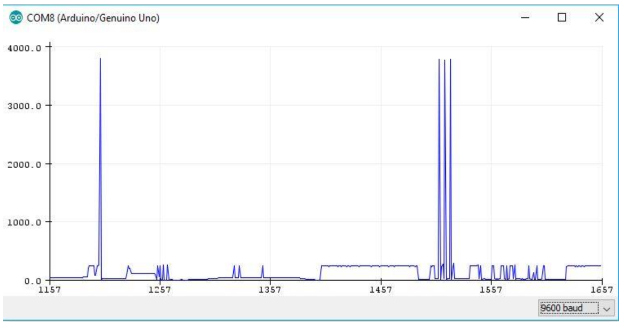
E. Cloud storage and Android app:

In order to store this data and perform various analytics, the system is interfaced with cloud using GPRS packet. The cloud IBM Bluemix is used to store and analyze data because it enables web and mobile applications to be rapidly and incrementally composed from services. It has a dashboard which is used to show the various analytics. An android app is build for the farmers and the villagers, which will show all the statistics of the parameters detected by sensors. The application will also provide guidelines for the utilization of the water and purification of the water. This will help the farmers to know which type of water can be used for the cultivation of the given crop and which water is fit for drinking, etc. thus water can be used to the best of their knowledge which will avoid the wastage of water and the pollution of water.

F. Circuit diagram



G. Graph



IV. CONCLUSION AND FUTURE SCOPE

A reliable, low cost, efficient, real-time well water quality monitoring system has been implemented and tested. Through this system, the level of the well water and the quality is tested. The application built will give the farmers and the villagers the idea about the type of water in the well and will enable them to put the water to correct use. The application will guide them which water could be put to use where. Thus, wastage of water is avoided; people will get to drink the water that is fit for drinking and water that are suitable for a particular crop can be used for irrigation purpose.

The project can be implemented on a large scale for water monitoring of wells of villages connected to each other. The same project can be implemented for water monitoring of lakes and other water reservoirs. The app could be made more advanced by integrating such systems and gathering a large data.

V. REFERENCES

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