SMART SENSOR MONITORING SYSTEM FOR WATER QUALITY CHECKING

Ganji Sindhuja [1]
Email: sindhu.ganji95@gmail.com

Katkoori Arun kumar[2]
Email: arun.katkoori@gmail.com

[1]M. Tech, CVR College of Engineering/ECE Department, Hyderabad, India.
[2]Assistant professor, CVR College of Engineering/ECE Department, Hyderabad, India.

***Abstract*:** Water pollution is one of the biggest fears for the green globalization. In order to ensure the safe supply of the drinking water the quality needs to be monitor in real time. Clean drinking water is very important for the health of Human being. Water distribution system facilitates the delivery of water to consumers but these systems are prone to contamination – which may be intentional or accidental. Infrastructure of the drinking water distribution system is very complex in the environment. This paper presents a low cost and holistic approach to the water quality monitoring problem for drinking water distribution systems as well as for consumer sites. Our approach is based on the development of low cost sensor nodes for real time and in-pipe monitoring and assessment of water quality on the fly. To observe the contamination factor in water sensor setup is installed in water tank the parameters needed to be monitor is temperature, turbidity value of water which is very important and even water level of tank is monitored and all these data is transmitted to control room through Zigbee wireless communication to alert the authorized persons.

Keywords: *Microcontroller, Temperature Sensor, Water Level Sensor, Turbidity Sensor, Zigbee*.

INTRODUCTION

Currently drinking water is very prized for all the humans. In recent times all the humans and creatures on the earth all the human beings and creatures on the earth facing troubles because of growing population, aging infrastructure etc. So it's too important to find the solution for water monitoring & control system Drinking water utilities are facing new challenges from exploration, storage, treatment and safeguarding of drinking water distribution systems in their real time operations. Traditional methods of water quality control involve the manual collection of water samples at various locations and at different times, followed by laboratory analytical techniques in order to characterize the water quality. Such approaches are no longer considered efficient. Although, the current methodology allows a through analysis including chemical and biological agents.

This paper will contribute in designing and development of low cost Wireless Sensor network based system. The system can be used at the premises of Water distribution system for continuous monitoring of water quality.

RELATED WORK

NazleeniSamihaHaron, MohdKhuzaimi B Mahamad, Izzatdin Abdul Aziz, MazlinaMehat developed a water quality monitoring system for eliminating costconsuming jobs of manual monitoring. In this system the measured data of water quality monitoring sensors are collected by the data kit which gives data to the data processing unit through GSM modem. In data processing unit the data from different sensors are differentiated and it is continuously compared with the ideal parameters of the sensor value. If the water isn't meeting its quality parameter value the alert signal is there which is connected to the buzzer. This system is not reliable for long distance also it will apply to only single unit of water source

There are few online water monitoring systems available E.g, J-MAR BioSentry, Hach HST Guardian Blue but such systems are very bulky and costly In a research paper "Detection of water-quality contamination events based on multi-sensor fusion using an extended Dempster–Shafer method presented by –" Dibo Hou1, Huimei He1, Pingjie Huang1, Guangxin Zhang1 and Hugo Loaiciga2" The author has presented a method for detecting contamination events of drinking water sources based

on the Dempster–Shafer (D-S) evidence theory. The purpose of this system is to protect water supply systems against intentional and accidental contamination events. Research paper Titled "Contamination of Water Distribution Systems" By Walter M. Grayman, PhD, PE presents Mathematical hydraulic and water quality models of water distribution systems which can be used to estimate the movement of a contaminant in a distribution system. In paper "Integrated Solid-state Sensors Monitoring Water Quality for the Next Generation of Wireless Sensor Networks " By -Serge Zhuiykov1, Eugene Kats1 1CSIRO the research has been dedicated to the development of solid-state sensors which can be used for real-time monitoring of water quality parameters such as pH and dissolved oxygen (DO), dissolved organic carbon (DOC) at relatively high spatial resolutions. The USACERL (U.S. Army Corps of Engineers Construction Engineering Research Laboratory) is working on a project to develop a more seamless and effective online water quality monitoring system.

It has several drawbacks:

- The lack of real-time water quality information to enable critical decisions for public health protection (long time gaps between sampling and detection of contamination).
- Poor spatiotemporal coverage (small number locations are sampled).
- It is labor intensive and has relatively high costs (labor, operation and equipment). Therefore, there is a clear need for continuous on-line water quality monitoring with efficient spatio-temporal resolution.
- Absence of tangible water monitoring information for assisting the critical decisions for public health (long delay between sample Collection & analysis).
- Manual operation is cost expensive (equipment and maintenance).Hence there a vibrant need for better online monitoring with precise event detection.

PROPOSED METHOD

In this project we overcome the drawback present in existing system by monitoring water quality problem for drinking water distribution systems as well as for consumer sites. Our approach is based on the development of low cost sensor Nodes for real time and in-pipe monitoring and assessment of water quality on the fly. Figure 1 represent, the block diagram of the water quality monitoring system. This architecture is used for the entire system of the Raspberry Pi board due to the significant flexibility to deal with a copout between communication and processing. The sensor nodes are placed at the bank of the water. The data of water parameter are collected with the help of the sensor nodes and sent to Raspberry Pi board. The analogue data of sensors is input for Analogue to Digital converter.The Water level sensor and Turbidity sensor are interfaced to I/O pins. The transmitted data from sensor nodes are received by the gateways; interface transfers the incoming data through the UART interface to the processor. The UART is used to connect the processor to the ZigBee hardware for wireless transmission. The main sensor node consists of Temperature, Turbidity and water level sensors which can be used to monitor the water quality. From the sensor node we are sending monitored values to Raspberry Pi board through GPIO Pins. The controller transmits the data to PC through Zigbee Technology.

OVER HEAD TANK SECTION

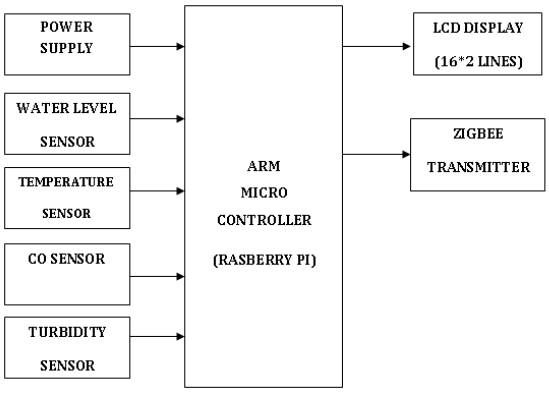


Fig.1 Block diagram of water tank.

MONITORING SECTION

At monitor section data will be observed by the monitor and take the appropriate decision.

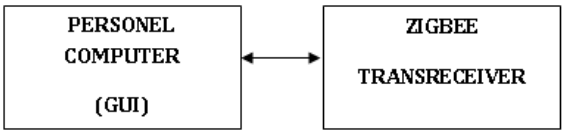


Fig.2 Monitoring section.

METHODOLGY AND WORKING

The system is comprised of two Units Measurement Unit and Control Unit. Measurement Unit consists of the measurement node which is Raspberry Pi board that collects measurements of water quality from different sensors which are interfaced to the microcontroller. Based on these measurements the controller decides the water quality. The water quality parameters which are collected and detected by the sensors are turbidity, Water level, and Temperature. By comparing all these detected values with the standard values system will determine that whether the water is clean water or contaminated water. ZigBee is the emerging communication technology which is used in the proposed system for acquiring different water quality parameters from the water distribution system. This information is then transferred to the remote centre.

Board Hardware Resources Features

Temperature Sensor:

A Thermistor is a type of resistor whose resistance varies significantly with temperature, more so than in standard resistors. The word is a portmanteau of thermal and resistor. Thermistor are widely used as inrush current limiters, temperature sensors, self-resetting over current protectors, and self-regulating heating elements. Thermistor differ from resistance temperature detectors (RTD) in that the material used in a thermistor is generally a ceramic or polymer, while RTDs use pure metals. The temperature response is also different; RTDs are useful over larger temperature ranges, while thermistor typically achieve a higher precision within a limited temperature range, typically −90 °C to 130 °C.

Turbidity sensor:

The turbidity sensor detects water quality by measuring level of turbidity. It is able to detect suspended particles in water by measuring the light transmittance and scattering rate which changes with the amount of total suspended solids (TSS) in water. As the TTS increases, the liquid turbidity level increases.

ZigBee

Zigbee is a specification for a suite of high level communication protocols using small, low-power digital radios based on the IEEE 802.15.4-2003 standard for Low-Rate Wireless Personal Area Networks (LR-WPANs), such as wireless light switches with lamps, electrical meters with in-home-displays, consumer electronics equipment via short-range radio needing low rates of data transfer. The technology defined by the ZigBee specification is intended to be simpler and less expensive than other WPANs, such as Bluetooth. ZigBee is targeted at radio-frequency (RF) applications that require a low data rate, long battery life, and secure networking.

ZigBee is a low-cost, low-power, wireless mesh networking standard. First, the low cost allows the technology to be widely deployed in wireless control and monitoring applications. Second, the low power-usage allows longer life with smaller batteries. Third, the mesh networking provides high reliability and more extensive range.

Fig.3.ZIGBEE MODULE

Raspberry PI

The raspberry pi is a small credit-card sized computer that plugs into monitor, keyboard or touch display. The raspberry pi has Broadcom BCM processor. It is high powered ARM cortex based

quad-core processor and It has 40 pin GPIO Header for interfacing the external devices to communicate with processor. The communication media's are like I2C, CAN, SPI and in this project GSM is used by direct connection with TRX and RXI pins in GPIO. It has quad USB ports, 10/100 Base T Ethernet socket, DSI Display connector, Micro SD card slot, 5v Micro USB, HDMI port, CSI camera connector and 4-pole 3.5mm jack. This raspberry pi works on the basis of Raspbian OS (NOOBS). Different types of raspberry pi are work on different operating systems. Raspbian is an open source operating system based on Debian optimize for the Raspberry Pi hardware.

Qt Creator is used in this project to create the application. Qt creator is uses C++, JavaScript and QML integrated development platform and which is part of the SDK for the Qt GUI Application development. It contains a visual debugger and forms designer. It has editor's features include pattern symbols highlighting and completion automatically. Qt Creator uses different compilers for different operating systems. For Linux C++compiler from the GNU Compiler is used and On Windows it can use Min GW or MSVC with the default install.

Fig.4. Raspberry Pi board

FLOW CHART

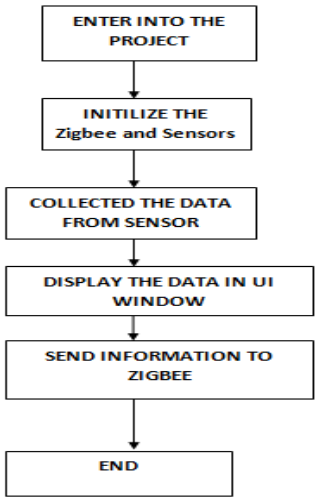


Fig.5. Flow chart of the Project

RESULTS

In this water quality monitoring application we are using sensors, RPI board, Zigbee Module for performing the application this entire are interfaced as shown in below figure

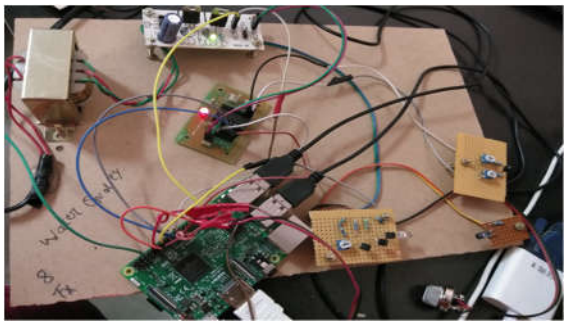


Fig.6. Shows Hardware model of water quality monitoring system.

After completing the all setup on the Rpi board and connect the monitor initially Rpi board perform booting like our system.

After completing the booting click on Lx terminal and Icon now our application is start to perform the measuring the quality of water and update the data in UI window and LX terminal as shown below fig 7, 8.

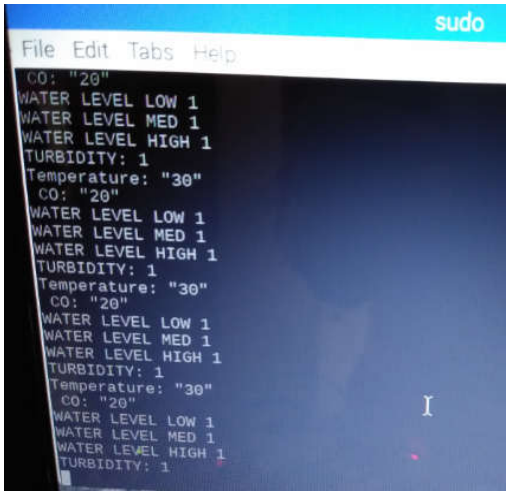


Fig 7 Shows LX Terminal information.

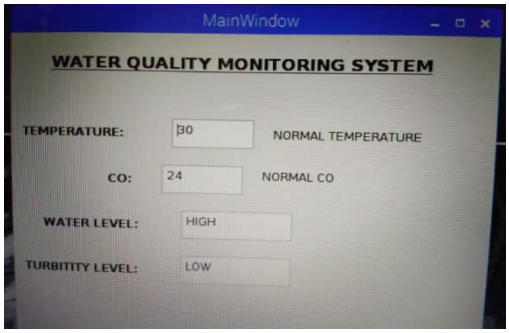
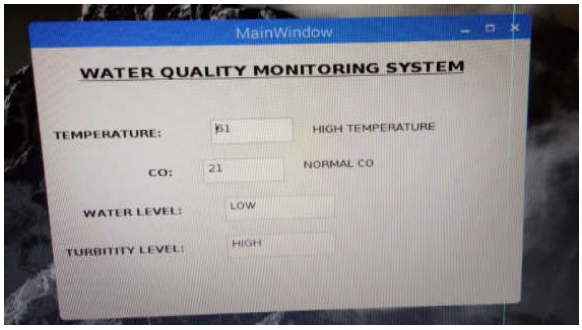


Fig 8 Shows UI window information.

In this above fig indicate the temperature and CO, Turbidity of water normal.



In this above fig indicate the temperatures of water, Turbidity of water are HIGH and CO normal and also water in the tank LOW.

After getting this information will be updated into the Monitoring section by using Zigbee Technology the information shown in PC by using Hyper terminal or Flash magic as shown in below figure

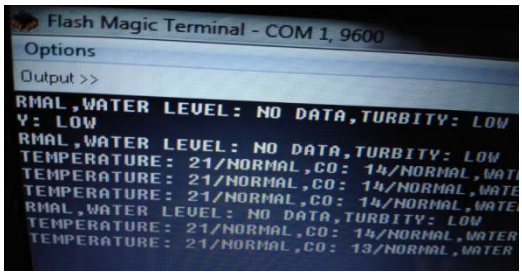


Fig 9 Shows Zigbee received data in PC .

CONCLUSION

With the urbanization of our society and Environment change, water pollution problems have become more complex, which requires continuous on-line monitoring and multi-stage treatment process. Traditional methods of water quality analysis which can called as Offline approach, involves the manual collection of water samples at various locations and at different times followed by coming to the laboratory and carrying a range of analytical tests in order to characterize the water .It is very time consuming an also not much efficient. This is because It involves relatively high labor costs as well as the costs associated with maintaining a laboratory. In This paper we have designed a system with the help of Wireless sensor network and Embedded System technology which will monitor and detect the water contamination in Drinking water distribution system. The water parameters selected for the monitoring are Turbidity, pH, Electrical Conductivity and Temperature. The secure and continuous monitoring is possible no need to go on field for monitoring so manual work has reduced it makes system more efficient, reliable, low cost and accurate

FUTURE WORK

We can extend our project with voice speaker has been added which gives voice

announcements for different thresholds and also the data has been updated to GPRS webpage.

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