

Water Quality Data Analysis and Monitoring System in IoT Environment

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Abstract— *Water quality monitoring is an important aspect to provide safe drinking water to the environment and keep the naturally gifted resource safe from getting contaminated. Old method used for water quality monitoring is to send gathered samples to the lab and then test them to verify the different water parameters. The process may cause the potential errors as well as it is time-consuming and not the cost-effective solution. Solution need to real-time for the process of data acquisition, transmission, and processing of different parameters. This paper represents the system which is cost effective, less time as well as less power consuming solution for water quality monitoring with the help of innovative technology such as: Internet of Things, Wireless sensor network, Modern communication technology and data analysis techniques which will provide you the alert and preventive action to take in case of an emergency. Real-time water quality monitoring system implemented with various sensors (Parameters: Carbon Dioxide, pH, Turbidity, Temperature, Water Level) which will help to gather water parameter, ARM-based microcontroller (STM32 Nucleo-board) which will convert the analogue signal to digital signal, Zig-Bee module which is used to send the data to personal computer, then data analysis operation takes place which will notify the user wirelessly. The system keeps check on pollution of water as well as keep track through analysis on data optimized with the help of optimization data fusion algorithm, and if required, then alert the user to take the preventive action time to time.*

Keywords—*ARM-based Microcontroller; Data Analysis; IoT (Internet of Things); Robotics Process Automation, Sensors; ZigBee.*

I. INTRODUCTION

Water is the numerous important and free plain resources that require to the human being in their daily lives and has been gifted by nature. Its each and every one's responsibility to prevent it and keep safe for use. Due various development of community and number of different human behaviors speeded up the contamination and deteriorated the water resources [1]. The reason, why the WQM is necessary to get the data of any changes in water parameters to be sure about safety in real time. Water Quality Monitoring needs to be done to identify that the water quality is maintained or kept at the desired level. It is the excellent value to keep track and monitor water parameter on regular interval basis [2]. Water quality monitoring helps in keeping track, analyzing and

evaluating the nature and extent of corrective action to be taken and how much pollution control is necessary, and effectiveness of quality and pollution control measures which need to be taken by the observer [3].

Habitually, water quality monitoring commands to manually accumulation of water representations and Commission to the lab for examining and investigating [4]. To achieve this hard and tedious task and to demonstrate a reconfigurable, cost efficient and low power consuming system to confirm water quality for safe and secure drinking water to the environment and human body [5].

The system which can be utilized in a distant area to assemble the information concerning, water turbidity, water level, water PH, water temperature, and carbon dioxide quantity present on the top layer of water [13]. system evolve in process of achieving a required result of analyzing and monitoring the water quality and helps to use new emerging technologies such as Wireless sensor network, IoT (Internet of Things), different communication techniques and different data analysis techniques which will provide an alert in case of an emergency [14].

- Agriculture: Decision of selecting the proper irrigation system is the tedious task of considering the different parameters as, water salinity, water infiltration in agriculture soil. Physical and chemical parameters need to consider for determining the component of irrigation and crop management to avoid the further problems [6].
- Human Consumption: Water is nature's gift and need to keep it safe as it was provided. Necessary to maintain the salinity of water to keep it safe for human being [7].
- Industry: Water required in each aspect of life, for production and development operation water quality need to be optimized in such a way that, it will not affect the other water resource and will be useful for industrial use as well.
- Ambient water: recognizing different water species for the improvement and identifying the pollution happens [15].

The characterization of the system takes place which will demonstrate the system functioning when the operations are performed on the field. ARM based microcontroller is configured with the help of STM32cubeMX software. After the data being converted from analog to digital by the MCU, the data is transferred to the personal computer via Zig bee protocol [8].

The collected data is then processed in the structured format and then analysis performed on the data to Check the Predefined threshold value, Data Fusion algorithm with modification of more than once parameter is used for the optimization of data [9]. Then analysis is performed. If the parameter exceeds or it shows the captured data below the predefined value, then the alert will be generated with the preventive action.

Water pH, water temperature and water turbidity have the relation as when the turbidity of water increases it also increase the temperature of the water as well as the pH of water also changes [10]. The platform helps to identify the parameters which are out of survival range and for which a parameter the corrective action needs to take [11].

II. COMPONENT

The setup has sensors which are node and are giving data as input the microcontroller then data is transferred over the machines via Zig bee protocol. Received data is represented in the graphical format. Machine has hardware configuration for different zig bee communicator [12]. Main objective is to receive the data and present the accepted data in graphical format. In this machine or node arrangement can be used as single node configuration or multi node configuration. The functionality will be implemented by using multiple sensor node and zig bee transmitter and receiver.

A. Water level Sensor

Sensor is being used for capturing the water level; WQM system is using single wire protocol for sensor machine. Depend on downstream and upstream water level varies, and parameters being captured.

B. Water temperature Sensor

In water quality monitoring system, water temperature mainly used by the organization for measuring the temperature of water and it is measured in degree Celsius. One line data transfer takes place.

C. pH Sensor

In water quality monitoring system pH sensor is used to get the data about the pH changes happening over the data in day and night. pH probe is emerged in the water a certain level and fluctuation in measurement is calculated via system [16].

D. Radio Frequency Module

The WSN systems which is ZigBee base is simple to install as well as cheap to upgrade he version. The module has two Modules with the antenna, one is ZigBee USB adapter and other is the voltage adapter which communicate with the microcontroller. Also work in UAR Mode.

E. ARM Based Microcontroller

Microcontroller is used for data conversion from analog to digital signal. Archetypes with MCU SM32 also sharing different connector. Beam which is Nucleo can be easily continued. ARM Based Microcontroller provide flexibility for configuring controller with the system.

F. CO2 Sensor

Water surface Carbon Dioxide sensor is used to gather the data. Part per million is parameter use o measure he concentration. Sensor is waterproof and has high sensitivity, also work stable at low power and low temperature.

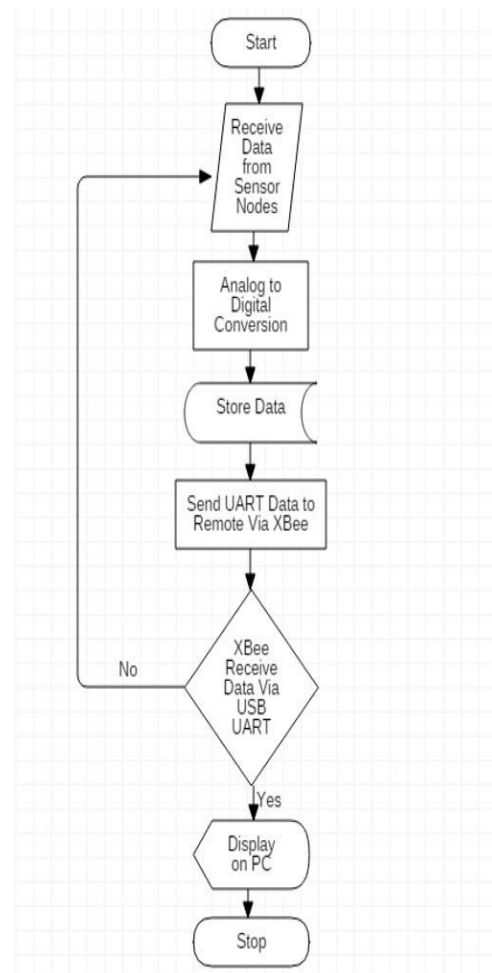


Fig. 1. Quality Monitoring System Flowchart

III. SYSTEM OVERVIEW

To outline items that fulfill their objective clients, a more profound comprehension is required of their client attributes and item properties being developed identified with sudden issues that the clients faces from time to time while building up a venture. The examination will prompt a collaboration show that gives a review of the connection between client characters and the classes.

Reliability: Programming Reliability is the likelihood of disappointment free programming task for a predefined time-frame in a predetermined domain. Programming Reliability is likewise imperative factor framework dependability. It contrasts from equipment unwavering quality in that it mirrors the plan, as opposed to assembling lawlessness. The high many-sided quality of programming is the major contributing variable of Software Reliability issues. We should deliberately choose the fitting model that can best suit our case [17].

Availability: The resources should be available in order for smooth functioning of the project various aspects can be considered as follows: Over-building, which is laying out systems to judgments better than slightest necessities. Programmed refreshing, which is keeps OS and applications current without client intercession. At the point when the security usefulness in a proposed item does not fulfill particular security prerequisites then the hazard presented must be assessed and extra controls must be reexamined preceding acquiring the item. Configuration surveys must be led at occasional interims amid the improvement procedure to guarantee that the proposed configuration will fulfill the useful and security prerequisites indicated.

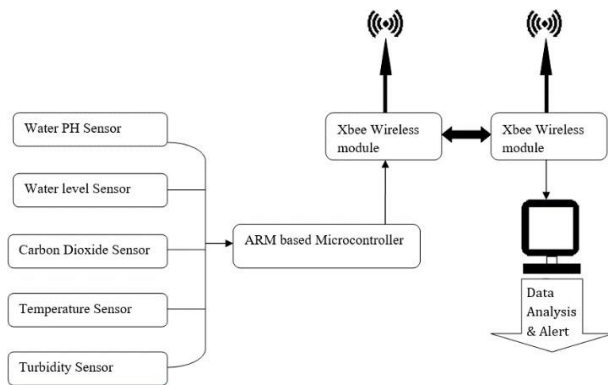


Fig. 2. STM32CubeMX software for board configuration

Data Collected by the different sensors is converted ADC then analysis operation is then performed on the collected data and required preventive action will be sent as an alert.

IV. SYSTEM ANALYSIS

Earth mass-balance equation is derived and some assumptions are considered as, Water and pollution is one directional, Turbidity not vary the property of water pollution density, Cube cross section of sample is solid for its concentration. t is time, y is coordinate along earth axis. A represent the area of cross section. b is the concentration. v is the velocity of mean. L is the distance between the downstream water and water at the head stream. J is the dispersion coefficient; R is the growth and decay constituent. at the initial condition of time, when time is zero then at the headwater ($t_0 = 0$), $c(x, 0) = c_0(x)$. When axis is zero or its equal to the length of headwater and down water. $c(0, t) = c_0(t)$, pivot become equal to length, $c(L, t) = c_L(t)$ respectively. At the last node ($x=L$) with assumptions as the dispersion is neglected with the help of decay and growth equation, R is $k.c$ where K is constant rate calculated.

Communication of system from input to generate output should be quite powerful for immeasurable representation. The classification determined to match with the execution is extremely transparent and reliable. Workload, scalability, response time, platform are the models which are established to engage the review.

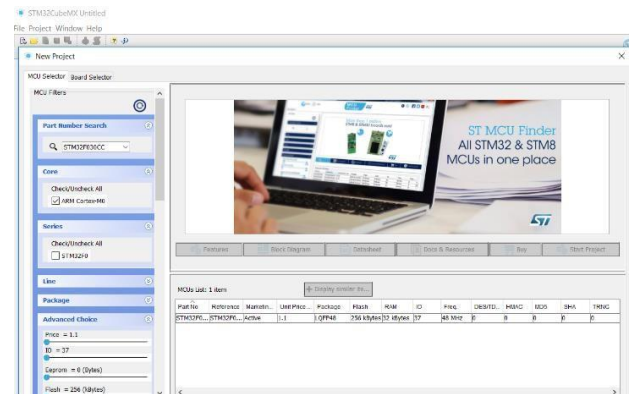


Fig. 3. STM32CubeMX software for board configuration

Different types of modules implemented for the desired output required. Authentication Module: Use authentication has done with this; any user can register as well as login with the system and performs the activity. Data preprocessing Module: Collect data from input source and store into database. Data representation Module: Graphical representation of data collected via data preprocessing module. Report execution module: Generate a report from data collected via data preprocessing module include query and procedure execution on database.

Water Quality Monitoring System

Select Sensor data File

--select--
▼

Select Port data File

--select--
▼

Time

Upload Sensor File

Status

Upload Port File

Fig. 4. Water Quality Monitoring System data upload.

Associating model between the info record and yield document thought to be sufficiently solid to increase better execution. The technique characterized to catch with the execution is powerful and immeasurable. Without any plan thought it will be hard to indicate the execution measures. Be that as it may, if engineer did not characterize a particular criterion the it resembles to free the execution of the framework.

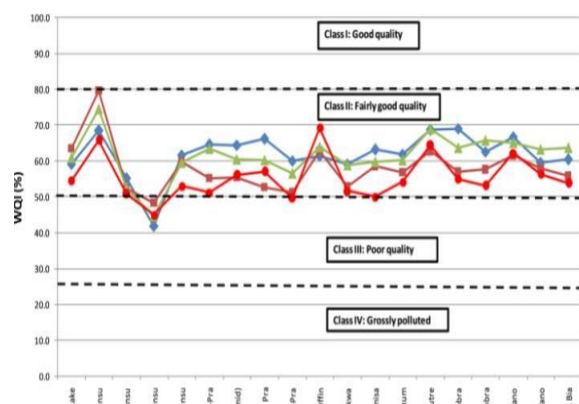


Fig. 5. Graphical Representation of water Quality Parameters

To maintain the software quality attributes such as performance, security, safety of the project is very essential. These attributes should meet the requirements with satisfactory result. Product is portable; it can run between two connected systems or a large network of computers. Product is maintainable; i.e. in future the properties of the product can be changed to meet the requirements.



Fig. 6. Mail Notification of water Quality Parameters

Using ARM based microcontroller that is STM32 Nucleo board improved the performance as well as a cost-efficient solution for water quality monitoring. We improve the performance of system wireless sensors networks is used. Zig bee protocol helps to communicate on remote location for data transfer to personal computer, then graphical representation of data helps to provide environment for safe drinking water.

V. CONCLUSION

Applications of the work can be given to analyses the impact happen in water quality due to petroleum-based industry, metal-based industry, sewage treatment, acid-based industry, land clearing, stock control, pest and weed control, fertilizer application, lawn and park care, light industry, household chemicals. System will provide you the potential impact happen like Loss of species, Degraded habitat, Loss of species, Threat to public health, degraded habitat, reduced biodiversity, fish kills, algal blooms, excess nutrients and this will be communicated with the help of different parameters measured via system like, turbidity, dissolved oxygen, pH, dissolved organic carbon. System requires Microsoft Visual Studio, STM32CubeMX, SSMS (SQL Server Management Studio) to be installed in the system with the version 1.1 and onwards. At the point when a client is introducing this system on their PC, It might realize that this applications will keep running on the Visual Studio stage, once you stack the task.

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