

REAL-TIME RIVER WATER QUALITY MONITORING SYSTEM

TEAM ID : PNT2022TMID36354

Team Leader : VINEGA K

Team member : ASMA S

Team member : SARANYA S

Team member : DIVYA G

1. ABSTRACT

Nowadays water is the most valuable for all the human beings drinking water utilities faces challenges in real- time operation. These challenges occurred because of growing population, limited water resources, ageing infrastructure etc. Hence there is a need of better methodologies for monitoring the water quality.

To reduce the water related diseases and prevent water populationWorld health Organization (WHO) has also stated thiscrisis as "the largest mass poisoning of a population in history.The main goal of this prohect to build a Sensor- based Water Quality Monitoring System.

KeywordspH, Temperature and Turbidity sensors, arduino board.

technique is very high due to the operation cost, labor cost and equipment cost, and it is difficult to make critical decisions in the real time.

2. INTRODUCTION

Water is the primary need of all living beings and living without water is impossible. With the advancement of technology and industrialization, environmental pollution have become a major concern. Water pollution is one of the most serious types of this environmental pollution. Our lives depend on the quality of water that we consume in different ways, from juices which are produced by the industries. Any imbalance in the quality of water would severely affect the humans health and at the same time it would affect the ecological balance among all species. Water quality refers to the chemical, biological, radiological, and biological parameters of the water.

3. LITERATURE SURVEY

Lonar is one of the youngest Lake and is unique in the world for its and salinity of the water. But its alkalinity, pH and salinity go on decrease day by day. An attempt has been made to examine environmental analysis of Lonar Lake. Objective:

This paper aims at improving the water quality in the lakes from hyper-eutrophic to minor eutrophic conditions.

Methods:

The physical and chemical parameters were analyzed as per APHA. Results:

It is found that major spirulina species of algae was found in lake water. This species Spirulina having medicinal value for human body. This species occupied the Lonar lake water phytoplankton about 90.0% and above. Rest of 10% are other members of Chlorophyceae, Cyanophyceae and Bacillariophyceae also found in this lake. Lonar lake water was found to be very rich in mineral nutrient contents. No fish species was recorded in the lake water body.

Conclusions:

Hence this World heritage lake should be preserved for its alkalinity and salinity. Use of agrochemicals on crater floor; nuisance of tourists; sewage disposal in the lake; constructions on the crater rim; etc. are some of the problems requiring attention. The lake urgently needs to take immediate protection from pollution and save and preserve for future generations.

Water quality assessment of lake water: a review

Rachna Bhateria , Disha Jain Abstract

- Ever increasing population, urbanization and modernization are causing problems of sewage disposal and contamination of surface waters like lakes. Natural water gets contaminated due to weathering of rocks, leaching of soils and mining processing, etc.
- Various types of problems in lake which cause nutrient enrichment in lake have been reviewed. Land use change and longer growing seasons could increase the use of fertilizers with subsequent leaching to watercourses, rivers and lakes, increasing the risk of eutrophication and loss of biodiversity.
- Water quality can be assessed by various parameters such as BOD, temperature, electrical conductivity, nitrate, phosphorus, potassium, dissolved oxygen, etc. Heavy metals such as Pb, Cd, Fe, Hg, etc. are of special concern because they produce water toxic poisoning in aquatic animals.
- Harmful algal blooms are becoming increasingly common in freshwater ecosystems globally. Pollution by plastic debris is an increasing environmental concern in water bodies, where it affects open-water, shoreline and benthic environments. Surface water densities of plastics are as high as those reported for areas of litter accumulation within oceanic gyres.
- Different methods have been used to analyse the water quality of lake such as Hyperion, water quality index and hazard quotient. It is recommended that pollution prevention and water re-use should be adopted in combination with the recycling of nutrients in controlled urban agriculture.

Evaluation of water quality index for River

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Sabarmati. Gujarat, India Kosha A. Shah¹ • Yeeta S. Joshi¹ Abstract

An attempt has been made to develop water quality index (WQI), using 12 water quality parameters pH, dissolved oxygen, biochemical oxygen demand, electrical conductivity, nitrate nitrogen and total coliform measured at three different stations along the Sabarmati river basin from the year 2005 to 2008

- Rating scale is developed based on the tolerance limits of inland waters and health point of view.
- Weighted arithmetic water quality index method was used to find WQI along the stretch of the river basin. It was observed from this study that the impact of human activity and sewage disposal in the river was severe on most of the parameters.
- The station located in highly urban area showed the worst water quality followed by the station located in moderately urban area and lastly station located in a moderately rural area.
- It was observed that the main cause of deterioration in water quality was due to the high anthropogenic activities, illegal discharge of sewage and industrial effluent. Lack of proper sanitation, unprotected river sites and urban runoff.
- Effect of nitrate nitrogen Excess nitrate nitrogen can cause eutrophication of water. Once water due to overstimulation of growth of aquatic plants and algae.
- It causes anaerobic conditions in the water bodies leading to fish kills, and can even "kill" a lake by depriving it of oxygen.

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- High levels of Nitrate nitrogen can cause the respiration efficiency of fish and aquatic invertebrates to lower down, leading to a decrease in animal and plant diversity, and affects use of the water for fishing, swimming, and boating.

High levels of Nitrate nitrogen in water can cause serious health hazards.

- The acute health hazard associated with drinking water with elevated levels of nitrate occurs when bacteria in the digestive system transform nitrate to nitrite.

Phytoplankton communities of eutrophic freshwater bodies

(Kerala, India) in relation to the physico-chemical water quality parameters

- Joseph George Ray.
- Prdanthkuiuar Santliakumaran &
- Santhoshkurnai Kookal

Abstract

- Algal bloom of eutrophic freshwaters is important from different aspects of sustainable developmental perspectives.
- Apart from the identification of the algal species which multiply fast in response to eutrophication, phytoplankton studies concerning water quality parameters of eutrophic waters help environment inventory of such fast-growing algal species
- The knowledge of specific environment requirements of fast-growing algae is highly significant in the control of toxic algal blooming and industrial utilization of non-toxic species in phytoremediation or as new bioresources for fuel, food or feeds. In this context, seasonal dynamics of the phytoplankton community in seven different kinds

- o1 eutrophic waters thorn 66 representative locations of Kerala, South India, was measured in two seasons.

Euglenophyceae and Chrysophyceae. Species diversity was highest in summer (March) and lowest in winter season (November) in all the sample stations indicating its close correlation with ambient temperature. Species richness was fairly high in all live stations throughout the study period. Present study indicated that dissolved oxygen, nutrients and turbidity are the limiting factors for the phytoplankton biomass.

The estuary was in eutrophic condition (Chlorophyll-a $10 \mu\text{g/L}$) in winter. During the month of May phytoplankton biomass declined and at high salinity level (21.2 PSU) new phytoplankton species take over, which are definitely better resilient to the high saline environment. Bioindicator species like *Polykrikoides schwaartzii*, *Dinophysis norvegica* and *Prorocentrum concavum* points to moderately polluted water quality of the estuary.

Conclusion: Eutrophication as well as presence of toxic Dinoflagellates and Cyanophyceae in the tidal creek of Sundarban estuary definitely revealed the deteriorated status of the water quality. The structure and function of the mangrove food web is unique, driven by both marine and terrestrial components. But little attention has been paid so far to the adaptive responses of mangrove biota to the various disturbances, and now our work unfolds the fact that marine status of Sundarban estuary is highly threatened which in turn will affect the ecology of the mangrove. This study indicates that ecosystem dynamics of the world heritage site Sundarban may facilitate bioinvasion putting a question mark on the sustainability of mangroves. Iot Based Real-time River Water Quality Monitoring System

The system development used Wi-Fi enabled microcontroller to connect with the IoT environment and store the data in the IoT cloud server.

- The microcontroller used is Arduino UNO that interacts with three types of sensor probes which are pH, turbidity and temperature probe. All the data measurements are transferred using a Wi-Fi module which is ESP8266. The IoT cloud used to utilize the data frame is ThingSpeak.
- This system was implemented on Randar Pereda Lake and Deraa River in Pulau Pinang with two systems implemented at each location.
- The sensors were placed on the water surface for more accurate measurements. This system continuously measures the readings of pH, turbidity and temperature on the lake/river floor every 1 hour.
- Twenty readings were taken for every 1 hour within the first 20 minutes with 1 minute interval and the readings were stored in the IoT cloud server.

IoT-based System for Real-time Water Pollution Monitoring of Rivers

Mohammad Arilul Islam Khan; Mohammad Akidul Hoque; Sabbir Ahmed IkliL September 2021

- The research proposes a system to remotely monitor the water quality of a river so that the authorities can gather better insights about the condition of that Particular river and predict the critical future phenomena.
- Consequently, they will be able to take auspicious steps in order to protect the rivers and save the environment.

4. IDEATION AND PROPOSED SOLUTION

The main aim is to develop a system for continuous monitoring of river water quality at remote places using wireless sensor networks with low power consumption, low-cost and high detection accuracy. pH, conductivity, turbidity level, etc. are the limits that are analysed to improve the water quality. Following are the aims of idea implementation.

- a)* To measure water parameters such as pH, dissolved oxygen, turbidity, conductivity, etc.
- b)* using available sensors at a remote place.
- c)* To assemble data from various sensor nodes and send it to the base station by the
- d)* wireless channel.
- e)* To simulate and evaluate quality parameters for quality control.
- f)* To send SMS to an authorized person routinely when water quality detected does not
- g)* match the present standards, so that, necessary actions can be taken.

Control surface:

An Arduino mega is utilized as a core person. The Arduino victimized here is mega 2560. Because multiple analog sign sensors probe requisite to be conterminous with the Arduino inhabit. It has a set of registers that use as a solon use RAM. Specific intend to know registers for on-chip component resources are also mapped into the assemblage grapheme. The addressability of store varies depending on instrumentation series and all PIC devices someone several banking mechanisms to utilise addressing to additional faculty. Subsequent series of devices have move instructions which can covert move had to be achieved via the register. Thus the mechanism functions with the exploit of coding intrinsically in the Arduino UNO R3 skate. **pH sensor:**

The pH of thing is a useful constant to display because graduate and low pH levels can hump large effects on the author. The pH of a statement can grasp from 1 to 14. A pH sensor is an instrumentation that measures the hydrogen-ion density in a bleach, indicating its tartness or alkalinity. It constitute varies from 0 to 14 pH. Uttermost pH values also process the solubility of elements and compounds making them cyanogenetic. **Mathematically pH is referred as, $\text{pH} = -\log [\text{H}^+]$.**

Turbidity sensor:

Turbidity train sensor is victimised to measure the clarity of element or muddiness utter in the water. The muddiness of the open cut food is ordinarily between 255 NTU. Irrigate is visibly at levels above 80 NTU. The standards for intemperance liquid is 130 NTU to 250 NTU. The turbidity device consists of soft sender and acquirer, the transmitter needs to transmit unsuitable bright, it is said to be turbid.

The consequence of turbidity is a reduction in water clarity, aesthetically unpleasant, decreases the rate of photosynthesis, increases water temperature.

Temperature sensor:

Here DS18B20 is used as the temperature device. Usually, its present use is to perceive the temperature of the life, if we site the device wrong the conductor electrode and placed into the H₂O, it can discover the temperature of H₂O also. **The normal temperature of the people is (25 - 30)° LCD display:**

LCD (Liquid Crystal Display) is a flat plate electronic exhibit power and finds in a Countywide orbit of applications. A 16x2 LCD demo is the really fundamental power and is rattling commonly victimised in varied devices and circuits. These modules are desirable over heptad segments and otherwise multi-segment LEDs.

Wi-Fi module:

Wi-Fi or Wi-Fi is a subject for wireless localized area scheme with devices. Devices that can use Wi-Fi study permit private computers, video-game consoles, smartphones, digital cameras, paper computers, digital frequency players and ultramodern printers. Wi-Fi matched devices can insert to the Cyberspace via a LAN web and wireless make a bushel. Much a reach quantity (or point) has a capableness of around 20 meters (66 feet) indoors and a greater compass outdoors. Wi-Fi subject may be utilised to render the Internet reach to devices that are within the capability of a wireless meshwork that is connected to the Internet.

Software design:

The proposed water quality monitoring system based on WSN can be divided into three parts:

IoT Platform :

The quality parameters are labelled datasets including desired outputs of specific combination of inputs. The neural network will produce output to classify water quality as

dangerous, be careful, and good. The classification layer will run on top of Hadoop cluster. The advantages of using neural network based analytics are like Artificial Neural Networks (ANNs) are good in learning and modelling non-linear relationships, and high volatile data. Though neural networks are prone to over fitting, the neural network model used in water quality monitoring system is not complex enough to cause over fitting problem. Also, there are many countermeasures to avoid over fitting.

Also, computation overload is not going to delay the response of system as there are only a few water quality parameters.

The use of artificial neural networks for the prediction of water quality parameters has already been investigated long before . Multi- layer neural network model is depicted below having five inputs in 1, In 2, In 3, In 4, In 5 in input layer, a hidden layer with four neurons and three neurons in outputlayer.

There are two bias input neurons connected to hidden layer neurons and output layer neurons. In the neural network model 5 inputs can be pH value, temperature, turbidity, ORP, and conductivity and 3 outputs will be dangerous, be careful, and good. Before training the neural network model few other parameters need to be set; as for example: Learning rate = 0.01, Learning algorithm = Back Propagation, Bias input =1, Connection weights = randomly assigned, Activation function = sigmoid function.

IoT devices use various types of sensors to collect data about turbidity, ORP, temperature, pH,conductivity, etc. of river water continuously. Also, IoT devices have capability to stream the array of collected data wirelessly to the remote Data Aggregator Server in the cloud. Moreover, the volume of semi structured data increases with time in such a velocity that only the Big Data Analytics applications can efficiently store and analyse the data constantly . The system should be

reliable and scalable. So, data management layer will be deployed and operational on the Apache Hadoop cluster. Hadoop helps distributed storing and processing of big data across cluster of computers. Also, such operational environment is horizontally scalable i.e. nodes or computers can be added to a cluster later while volume and velocity of data streaming will be increasing. Hadoop cluster is fault tolerant as jobs are redirected automatically to the running nodes when nodes are failed. The data in Hadoop is highly available as multiple copies of data are stored in data nodes managed by name node, standby name node, journal nodes and failover controller. IoT applications need high speed

of read/write of data and highly available data in the database. So, the system will use Apache HBase NoSQL database to store big data as HBase runs on top of Hadoop . Hence, the data is distributed across Hadoop distributed file system (HDFS) . Besides, HBase is capable of executing real-time queries as well as batch processing. High- availability of data is provided by the HBase as it is stored in HDFS. Hadoop clusters are spanning over many servers which are managed by Apache Zoo Keeper. Such centralized management of the cluster is required to provide cross-node synchronization services and configuration management. Applications can create z node (a file which persists the state of the cluster in the memory) in zookeeper. Nodes will register to z node to synchronize task executions across the cluster by sharing and updating status changes in nodes through the use of zookeeper z node. Apache HBase is managed by Apache Zoo Keeper.

The IoT application will help the users to visualize the water quality analysis results produced by the data management layer over different time series continuously. The data visualization application runs on client devices such as Smart phones, laptops and desktops. The root users will be able to generate daily/monthly/yearly water quality report from data management layer and visualize in the client devices

Proposed Solution Template:

Project team shall fill the following information in proposed solution template

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	IOT Based Real Time River Water Quality Monitoring and Control System
2.	Idea / Solution description	<ol style="list-style-type: none">1. To monitor the quality of water using sensors like temperature, potentiometer(pH), turbidity, salinity and soon.2. Collecting those data and storing it in cloud and perform analyse to check if the water is contaminated or not for drinking.3. If the water is contaminated an alert is made to the user/ local authority through SMS or can be viewed through web application anytime.
3.	Novelty / Uniqueness	1. Based on the collected data prediction is made whether the water can be used for cultivation of specific crops and suitable for the aquatic animals.
4.	Social Impact / Customer Satisfaction	Algal growth, fertilizers, pesticides cause river pollution which can impact all living beings. Better monitoring and control measures can impact health and vegetation massively.
5.	Business Model (Revenue Model)	Service based product is developed to serve the local people to know the quality of water before consuming it or using it for any purpose. This prevents health issues or at most loss of living being.
6.	Scalability of the Solution	Developing the product as both web and mobile application it is portable, and data can be accessed from anywhere anytime. provide a real-time monitoring and a feasible solution for remote or distant places where water quality laboratory is not present.

5 . REQUIREMENT ANALYSIS

Problem-Solution Fit canvas

Purpos e / V ision

V ers ion:

Define CS, fit into CL	1. CUSTOMER SEGMENT(S) Local Authorities and Common people	6. CUSTOMER LIMITATIONS EG. BUDGET , DEVICES Costly, do not know if accurate, not available for all localities.	5. AVAILABLE SOLUTIONS PLUSES & MINUSES Accurate measuring of water quality using various sensors, make it available in all remote places	Explore AS, differentiate
	2. PROBLEMS / PAINS + IT S FREQUENCY Consuming contaminated water leads to various problems for all living organisms.	9. PROBLEM ROOT / CAUSE The water may be contaminated by means of nutrient pollution (Industry), Eutrophication, Algal blooms and so on.	7. BEHAVIOR + ITS INTENSITY If there is even a small change in water's parameter, then there is said to be some sort of contamination in water, so the sensors should be capable to analyse that small change and should predict it accurately.	
Identify strong TR & EM	3. TRIGGERS TO ACT Here the motive is to predict the contamination of river water and create awareness among people for the same.	10. YOUR SOLUTION The water should be monitored by using sensors and gather its temperature, Ph value, Turbidity value should be measured so that the user(Who consumes the water) be aware of the water he/she consumes and prevents consuming when the water is contaminated.	8. CHANNELS of BEHAVIOR ONLINE Customer uses web application to analyse various parameters of water.	Extract online & offline CH of BE
	4. EMOTIONS BEFORE / AFTER The output is predicted accurately regarding the contamination of water, so as to avoid consumption of contaminated water by the people		OFFLINE The customer receive message in mobile phone if there is any change(Contamination) in water.	



Problem-Solution fit canvas is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License. Designed by Daria Nepriakhina / IdeaHackers.nl - we tailor ideas to customer behaviour and increase solution adoption probability.

IdeaHackers .NL

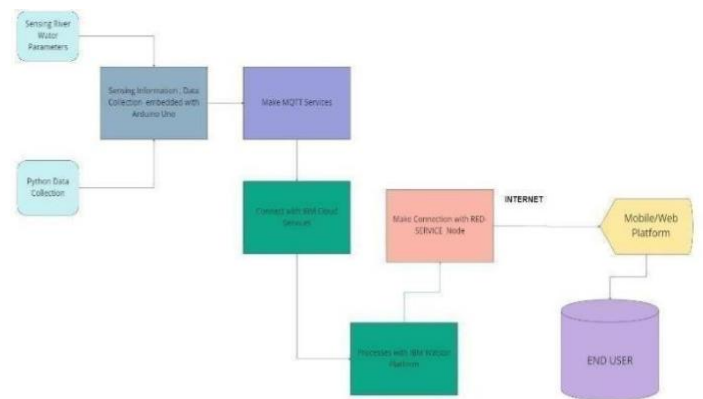
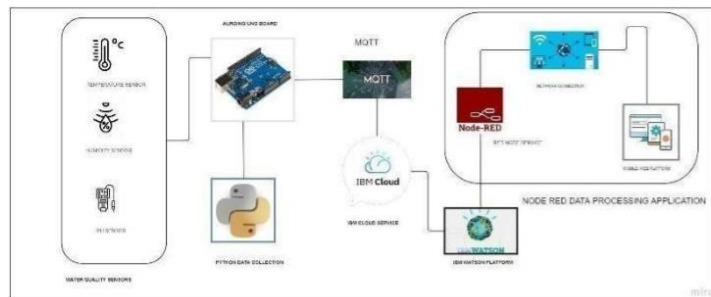
6. PROJECT DESIGN

Data Flow Diagrams:

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.

DATA FLOW:

DATA FLOW DIAGRAM:



Sensing the water Parameter with sensors and Collecting Water parameter Data using Python.

Made Several Embedded Connection with Ardiuno Uno Board and also have some MQTT Service Connection.

Make IBM Cloud Connectivity and Also with IBM Watson Service.

Made Connection with RED-Service Node

Finally End Users can monitor the information through Mobile/Web Platform

SOLUTION REQUIREMENTS

Functional Requirements:

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	Make Easier to Use ,More Efficiency to Use,Reduction of Errors While Using this Techniques

NFR-2	Security	end by end encrypted protocol in Data Authentication, Sensitive data protected personally identifiable information(PII) other information details of users and networks
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Following are the functional requirements of the proposed solution.

FR No.	FunctionalRequirement(Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through registered credentials register confirmation e-mails
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP/SMS
FR-3	Log in to the System	Enter the OTP Check the Credentials Check the Access/Server
FR-4	Manage the Modules	Manage the system Admins of user Manage and Monitor Details of System User Manage the User Roles Manage the User Accessibility and User Permission Manage User Details Privacy
FR-5	Check Process Details	Temperature Details PH Details Turbidity Details dissolved oxygen level in water presence of chemical substances in water
FR-6	Log out	Save the existing measurements Exit

Non-functional Requirements:

Following are the non-functional requirements of the proposed solution.

NFR-3	Re liability	Provides the objective evidence necessary to make decisions on managing water quality today and in future also. Thistechniquesmake good communication between the user and the networks and it also achieves a better trade-off between costs and reliability
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NFR-4	Performance	Implementing Monitoring River Water, by using sensing sensor to monitor the river water parameters making more useful for various environmental Usage.
NFR-5	Availability	PH Monitoring, Conductivity Analysis, CDOM (Dissolved Organic Matter), Measure of Carbonate and bicarbonate levels in water, this techniques made possible by linking information in water
NFR-6	Scalability	Automatic Water Sampler, PH testing, Recording the water temperature, chlorophyll fluorescence analysis measuring the dissolved oxygen levels.

7 .RESULTS

10:44 AM

ENTER LOGIN DATA

User Name 1234

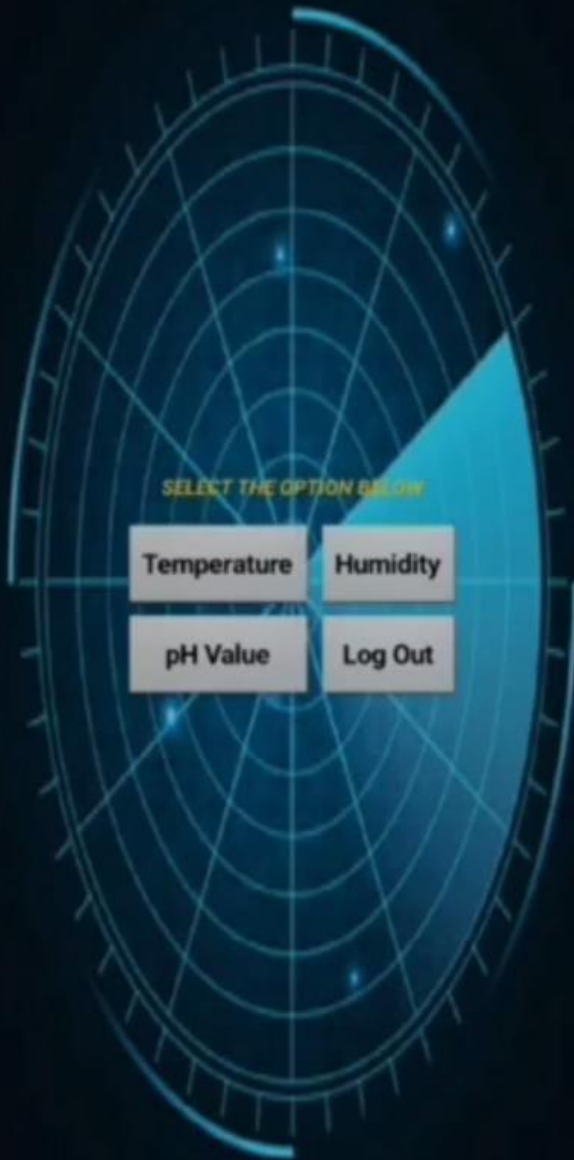
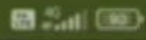
Password •••4

LOGIN

Forget Password

Sign in with Gmail Sign in with Email

10:44 AM



SELECT THE OPTION BELOW

Temperature

Humidity

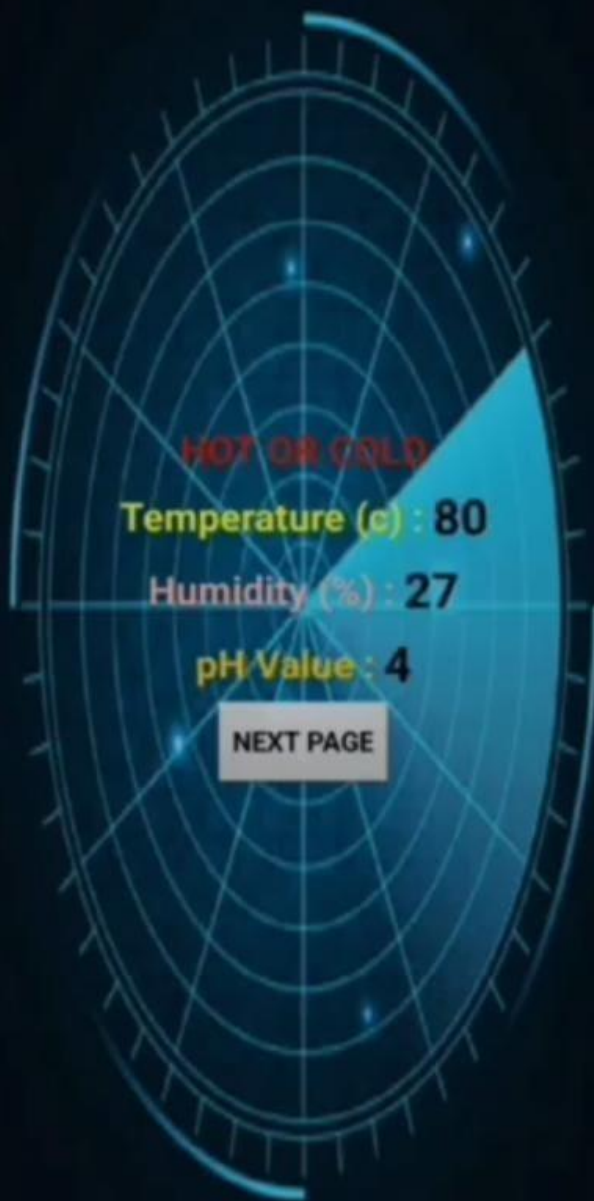
pH Value

Log Out



10:44 AM

5G 2.4G 90



8. CONCLUSION

In this work, the design and demonstration of a prototype remote, automatic, portable, real time, and low cost water quality monitoring system is described. In this system, low cost components i.e. microcontroller, LCD screen and other components are used to achieve the objectives of the proposed design with acceptable accuracy

The results of the test for all times have been successful. We conclude that all the objectives of the proposed system have been achieved. To test more parameters of the water quality for some applications, other sensors can be included in the system. The system has wide application and it is usable and affordable by all categories of users.

9. APPENDIX

Demo Link : <https://youtu.be/hifEg-U1k68>