REAL–TIME RIVER WATER QUALITY MONITORING SYSTEM

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1. ABSTRACT

Nowadays water is the 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 o1“LonarLake. Objective:

This papers aims at improving the water quality iB the lakes mom hyper-eutrophic to minor eutrophic conditions.

Methods:

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

It is found that majorspirulina species of algae was found in lakc watcr. This species SpiruliBa having medicinal value for human body. This specicsoccupicd the Lonar lakc watci phytoplankton about 90.0"% and abovc. Rests of 10 % arc othcr rncrnbcrs of Clilorophyceae, Cynophyceae and Racillariophyceae also found in this lake. Lonar lalce water was found to be very rich in mineral nutrient contents. No fish species was recorded in the saicc watcr body.

Conclusions:

Hence this World heritage lake should bepreserved for its allcalinity and salinity. Use o1” agrochemicals on crater floor; nuisance of tourists: sewage disposal in the lalce; constructions on the crater rim; etc. arc some of the problems requiring attention. The lake urgently needs to take immediate protection from pollution anc1 save and preserve for future generations.

Water quality assessment o1’ lake water: a review

Rachna Bhateria , Disha Jain Abstract

• Ever increasing population, urbanization and modernization are

]3OSl1ig problems o1“ sewage disposal and contaiuinatlon oI surface waters like lakes. Natural water gets contaminated due to weather ing

of”rocks, leachlng of" sOlls and mlning processing, etc.

• Various types of problems in lake which cause nutr rent 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 o1 eutrophication and loss of biodiverslty.

• Water quality can be assessed by various parameters such as BOD, tempeiatule, clectl”lCa1 conductlvity, nltrate, phosphorus, potassium, dissolved oxygen, ctc. Heavy metals such as Pb. Ci, Fc, Hg. ctc. arc of“spccial concern because thcy pioduce watcr oi chi onic poisoning in aquatic animals.

• Harmful algal blOOlTls are becomlng increasingly common in freshwatei ecosystems globally. Pollution by plastic debris is an increasing environmental concern in water bodies, where it a11”ects 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 i>ethod> have been used to analyse the water quality o1 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 o1 nutrients in controlled urban agricultui‘e.

Evaluation of water quality index for River

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

- An attempt has been made to develop water quality index (WQI),

uslng slX wflter quallty parameters pH, dissolved oxygen, biocheluical oxygen demaBd,electrica1 conductivity, nitrate nitrogen and total colifonv measured at thiee different stations along the Sabaimaati river basin from the year 2005 to2008

- Rating scale is developed based on the tolerance limits of inland waters and health point *o|" view.*

- Weighted arithmetic water quality index method was used to find WQI along the strctch of thc i ivcr basis. It was obscrvcd from this study that the lirpact of human activity and sewage disposal ln the rivcr was severe on host of' the pal"ametcrs.

- Thc station located ln highly urban area showed the worst water quality followed by the station located in modcratcly urban arca and lastly station located in a moderately rural aiea.

- It was obscrvcd that thc main causc of deterioration in water quality was due to the high anthropo $_S$ enic activities, illegal discharge of sewage and industrial effluent. lack o1"propcr sanitation, unpiotcctcd river sites and urban runoff.

- E1"fect of nitrate nitrogen Excess nitrate nitrogen can cause eutrophication *o1 "sw:Once* waters 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.

- High levels of Nitrate nitrogen can cause the respiration efficiency of fish and aquatic invertebrates to lower tlown. leading to adecrease 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 hazai ds.

• The acute health hazard associated with drinking water with elevated levels of’nitrate occurs when bacteria in the digestivesystem trans1oioa nitrate to nitrite.

Phytoplankton communities ot‘eutrophic t‘reshwater bodies

(Kerala, Indla) in 1”elation to thephyslcOchemical watcr quallty paramctcrs

• Joseph George Ray.

• Prdsanthkuiuar Santliakumaran &

• Santhoshkurnai Kookal

Abstract

• Algal bloom of eutrophic lreshwaters 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 o1 toxic algal blooming and industrial utilization or non-toxic species in phycoremediation or as new bioresources foi’ fuel, fooct or feeds. In this context, seasonal dynamics of the phytoplankton community in seven different l‹lnds 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 cvcrincss was fairly high in all live stations throughout the study period. Present study indicated that dissolved oxygen, nuti‘ieots and turbidity are the limiting factors for the phytoplankton biomass.

The estuai y was in eutrophic condition (Chlorophyll-a CIO pg/L) in winter. DuJ‘ing the month o1”May phytoplankton biomass dcclincd and at high salinity level (2 I .2PSU) new phytoplankton specles take over, which are definitely better resilient to the high sallne cnvii onmcnt. Bioindicator species like Polykri1‹os schwartzil, Dinophysis norvegica and Prorocentrum concavum points to moderately polluted water quality of”the estuary.

Conclusion: Eutrophication as well as presence of toxic Dinollagellates and Cyanophyceae in the tldal creek of Sundarban estuai y definitely revealed the deteriorated status of the water quality. The structure and function o1 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 or“ mangrove biota to the various disturbances, and now our work unfolds the fact that marine status o1 Sundarban estuary is highly threatened which in turn will af1”ect the ecology of the mangrove. This study indicates that ecosystem dynamics of the world heritage site Sundarban way facilitate bioinvasion putting a question mark on the sustainability o1 mangroves. Iot Based Real-time River Water Quality Monitoring System

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

- The microcontrollcr uscd is Arduino UNO that interacts with three types of sensor probes which are pH, turbidify and teluperature probe. All the data measurements is transferred using a Wi-Fi module which is ESP8266. The IoT cloud used to utilize the data frame is Thing Speak.

- This system was implelvented on Randar Pereda Lake and Dcraa River in Pulao Pinang with two systcms implemented at each location.

- Thc sensors were placed on the water surface for mod c accuratc mcasui cmcnts. This system continuously measures the readings of pH, turbldity dan ten Ol"ature on the lake/river fol" 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 tiir Real-time Water Pollution Monitoring of Rivers

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

- The research proposes a system to remotely monitor the water quality o1 a river so that the authorities can gather better insights

about thc condition of that particular rivcr 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, pH = -log [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 unsubtle 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 old as the temperature device. Usually, its present use 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) impede is a flat brace 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 cap ableness 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 output layer.

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 HB se 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	1. To monitor the quality of water using sensors like temperature, potentiometer(pH), turbidity, salinity and so on. 2. Collecting thosedataand storing it in cloud and perform analyse to check if the water is contaminated ornot fordrinking. 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 specificcrops and suitable forthe 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 forremote ordistant places where waterquality laboratory is not present.

5 . REQUIREMENT ANALYSIS

Problem-Solution Fit canvas

Purpose / Vision

Version:

Define CS, fit into CL

1. CUSTOMER SEGMENT(S) CS

Local Authorities and Common people

6. CUSTOMER LIMITATIONS EG. BUDGET, DEVICES CL

Costly, do not know if accurate, not available for all localities.

5. AVAILABLE SOLUTIONS PLUSES & MINUSES AS

Accurate measuring of water quality using various sensors, make it available in all remote places

Explore AS, differentiate

Focus on PR, tap into BE, understand RC

2. PROBLEMS / PAINS + ITS FREQUENCY PR

Consuming contaminated water leads to various problems for all living organisms.

9. PROBLEM ROOT / CAUSE RC

The water may be contaminated by means of nutrient pollution (Industry), Eutrophication, Algal blooms and so on.

7. BEHAVIOR + ITS INTENSITY BE

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.

Focus on PR, tap into BE, understand RC

Identify strong TR & EM

3. TRIGGERS TO ACT TR

Here the motive is to predict the contamination of river water and create awareness among people for the same.

4. EMOTIONS BEFORE / AFTER EM

The output is predicted accurately regarding the contamination of water, so as to avoid consumption of contaminated water by the people

10. YOUR SOLUTION SL

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 CH

ONLINE

Customer uses web application to analyse various parameters of water.

OFFLINE

The customer receive message in mobile phone if there is any change(Contamination) in water.

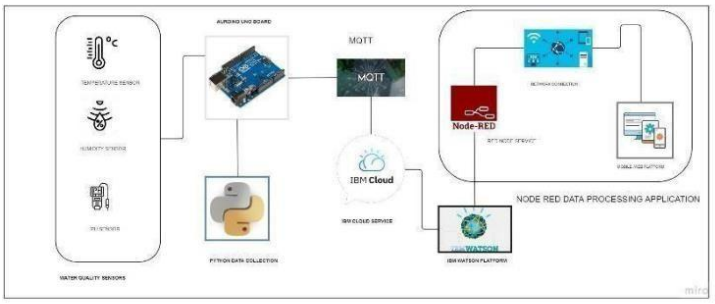
Extract online & offline CH of BE

6. PROJECT DESIGN

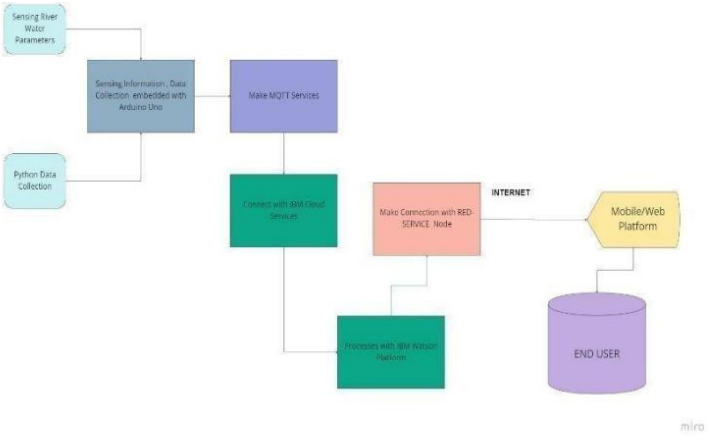
Data Flow Diagrams:

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:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (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

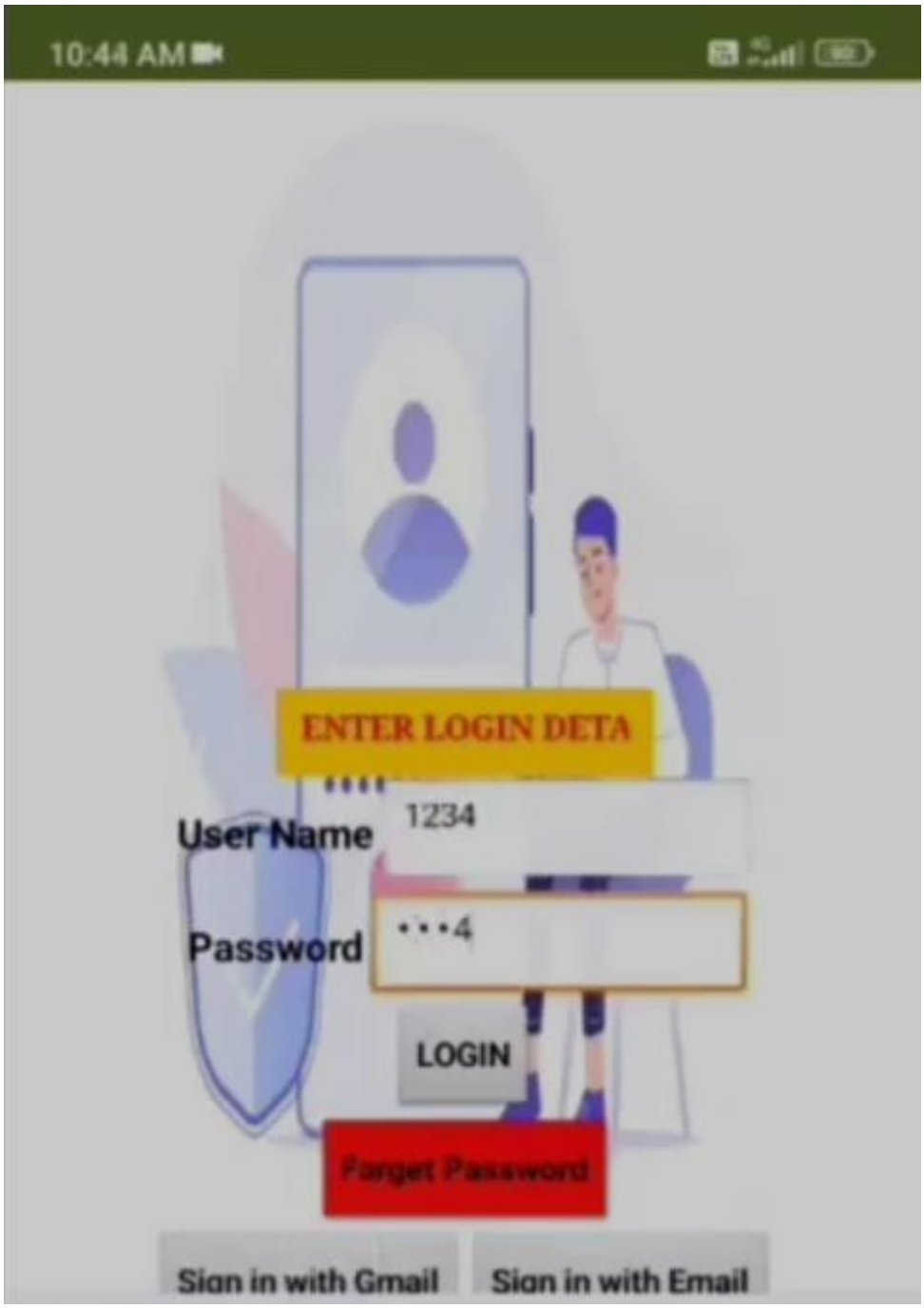
Non-functional Requirements:

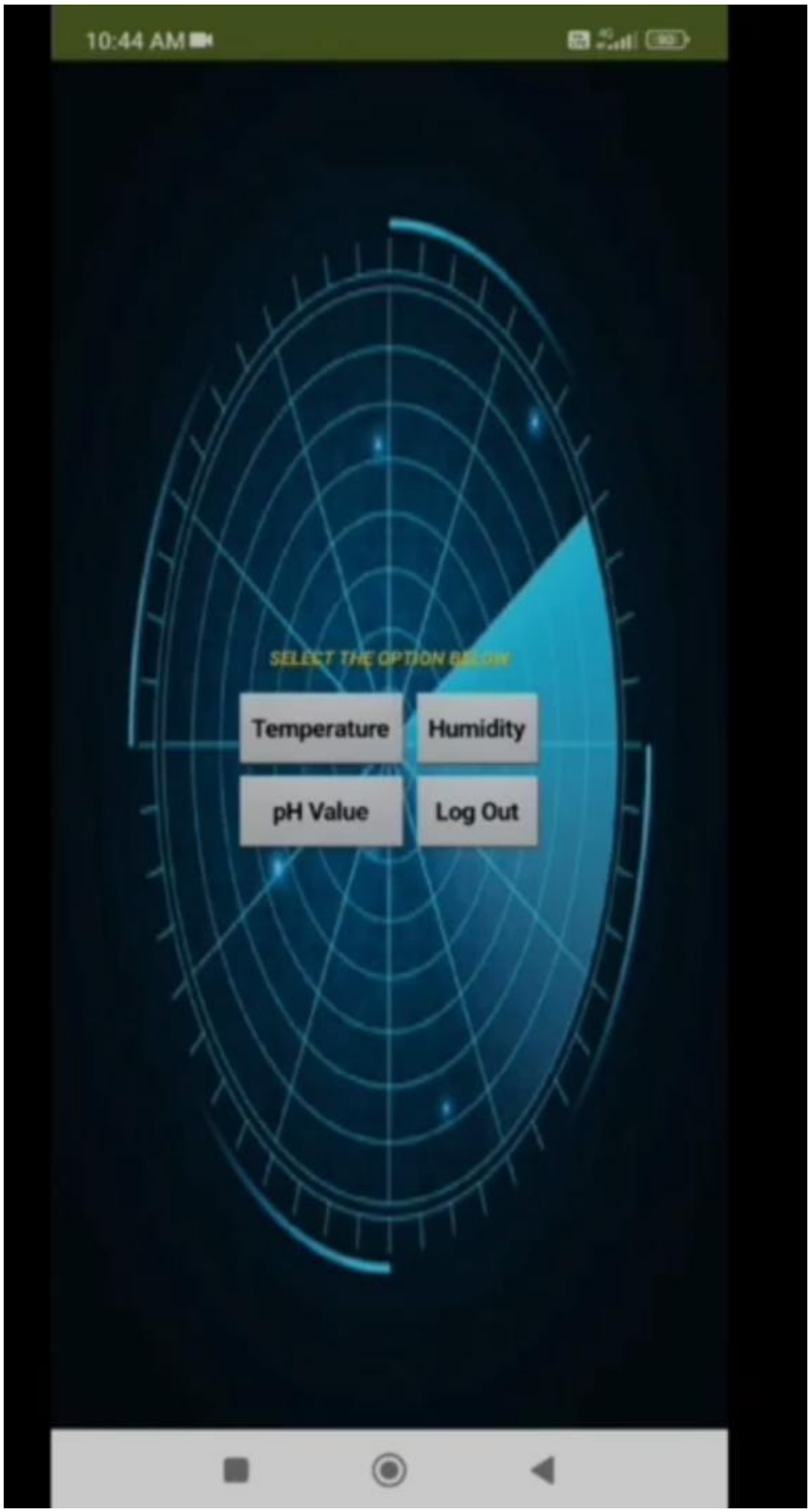
Following are the non-functional requirements of the proposed solution.

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

NFR-3	**Re liability**	Provides the objective evidence necessary to make decisions on managing water quality today and in future also. This techniques make good communication between the user and the networks and it also achieves a better trade-off between costs and reliability
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 DETA
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
HOT OR COLD
Temperature (c) : 80
Humidity (%) : 27
pH Value : 4
NEXT PAGE

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