Jawaharlal Nehru New College of Engineering, Shimoga
Dept. of CSE

"Final Phase Project Seminar"

An Intelligent Real-time Water Containment Measurement System

Submitted By

PREMA E V	4JN17CS060
SHARADHI S S	4JN17CS083
SOUJANYA S D	4JN17CS097
VARSHA R SANNAGOUDAR	4JN17CS109

Under the Guidance of :

Dr. CHETAN K R

B.E, M.Tech., PhD

Assoc. Professor

Coordinators

Dr. Jalesh Kumar,
B.E, M.Tech., PhD
Professor

Mrs. Ganavi M,
B.E, M.Tech., (PhD)
Assistant Professor

Dr. Chetan K R,
B.E, M.Tech., PhD
Associate Professor

Mrs. Ayesha Siddiqa,
B.E, M.Tech.
Assistant Professor

Date: 09-08-2021 Time: 11.30am – 2.30pm

Abstract

Water is an important resource for life of every living organism. Water Pollution is a major global problem. It has been surveyed that water pollution is the leading cause of deaths and diseases in human and marine life. So an IoT based model for water quality monitoring is put forth in this project. The water quality measurement parameters such as pH, turbidity, conductivity are collected using web page. The data is analysed through ML algorithms. Later the water potability is predicted based on the inputs given. The containment quality of the water predicted is mailed to the user. Data predicted from different users are reflected in admin dashboard.

Outline & Content

- Introduction
- Literature Survey
- Problem Statement
- Objectives
- System Architecture
- Hardware Design
- Algorithms/Flowcharts of each modules
- Applications
- Conclusion
- References

Introduction

- Environment around us consists of five key elements. These are soil, water, climate, natural vegetation and land forms.
- Among these, water is the most essential element for human to live. It is also important for the survival of other living habitants.
- It is used for drinking, domestic use, and food production or recreational purposes, safe and readily available water is must for public health.
- More water is wasted in many uncontrolled ways. So, Water resources is not handled properly in highly populated regions, for example, discharge of toxic chemicals, climate changes, growing population, untreated sewage and other human activities.
- Therefore, efficient use and water monitoring are potential constraint for home or office water management system.

Literature Survey

AUTHOR	NAME	FOCUS	ADVANTAGES	LIMITATIONS
Jamil Wahid and Q. Ahsan (2014)	Detection of impurities in water by measuring capacitance.	Here, impurities with different concentrations in water are detected by measuring capacitance.	Simple to design and easy detection of a small variation of capacitance even in the range of Pico farad (10-12).	The copper plate is corroded easily.
Maindalkar, A and Ansair, S M (2014)	Design of Robotic Fish For Aquatic Environment Monitoring.	Robotic fish is deployed in water, which measures chemical and natural threats.	The Robotic fish will move at a speed of 1 m/s preventing from bumping into rocks and even ships.	There is a chances of battery depletion.
A.N.Prasad, K. A. Mamun, F. R. Islam, H. Haqva (2015)	Smart Water Quality Monitoring System.	They collect water data and send alarms.	System is accurate to predict the data through GSM in sea water.	This system only measures water quality in sea water.

AUTHOR	NAME	FOCUS	ADVANTAGES	LIMITATIONS
M. B. Kalpana (2016)	Online monitoring of water quality using raspberry pi3 model B.	This system can be used for commercial & domestic purposes to identify the cause of water diseases.	Due to automation it will reduce the time to check the parameter.	Its suitable for a particular area not for large system. And more man power is needed.
Cho Zin Myint, Lenin Gopal and Yan Lin Aung (2017)	Reconfigurable smart water quality monitoring system in IoT environment.	The results of the five water parameters are verified through Wireless communication.	Reduces power consumption. Minimizes the time and costs in detecting water quality.	It has high complexity Circuits.
J.M. Sudhakar, Prof. K. Prahlada Rao(2017)	An IoT based smart water monitoring system at home.	The Physical impurities of the water are monitored analyzed and report is send immediately.	Real time system and doesn't need any man machine interaction.	If water is impure it flushes out all water. So water is wasted.

AUTHOR	NAME	FOCUS	ADVANTAGES	LIMITATIONS
Arjun K L, Dr. Latha C A, Prithviraj (2017)	Detection of water level, quality and leakage using raspberry pi with internet of things.	It takes over the task of indicating the water level in the overhead water tanks.	It's a real time system and doesn't need any man machine interaction	The limitation of this system is it relays on residential water tanks and if any issues found treating it may be harder to common people.
Cho Zin Myint, Lenin Gopal and Yan Lin Aung (2017)	Development of Surface Vehicle for water quality monitoring and measurement.	A Surface Vehicle capable of navigating throughout complex inland water storages and measuring a range of water quality properties.	It is Portable, battery-operated Wi-Fi access point for surface communication between a PC or handheld device and the vehicle.	It needs a person to deploy it, which is a risk for human health if water is contaminated.

Problem Statement

Due to the fast-growing urbanization supply of safe drinking water is a challenge. In India most of the people use simple water purifier which is not enough to get surety of pure water. Using traditional approaches of monitoring water quality in the water management system are not completely safe and time consuming. *So, an automatic real-time monitoring system is proposed to monitor the health of the water.*

Objectives

- The main objective is to measure the water quality as it is pure or contaminated. Measuring water quality will help to take measures to reduce pollution that are caused due to hazardous substances and other human causes.

- Ensuring pure water availability: Water should be purified in a fastest way possible before it's fully contaminated.

- Automate the process of checking water quality: Web application does all of the work and it will be faster than the normal process.

- To make system is to be more economical, convenient and the system is easy for maintaining and user friendly.

Functional Requirements:

The following are the functional requirements to be met in this project:

- Data collection : Initially the dataset is collected to train the model. Then the user input is taken through a designed web page which is to be predicted for contamination.
- Water quality assessment : The parameters such as pH, conductivity, turbidity are given input through web page. Based on the values, an machine learning algorithm is used to predict whether water is safe or unsafe.
- Admin login in web page : This page is designed for the authority to view the total percentage of safety of water in a pie chart and can view the percentage of safety in a particular city in a bar graph.
- Android Application : A mobile application is provided which is an interface to check water quality in particular place. The authority and user can check the compatibility at a particular place by logging in.

Non-functional Requirements:

- Accuracy in predicting the safety of water : The water safety prediction should be accurate to avoid the issues or health hazards caused due to contaminated water.
- Reliability : The system is reliable in terms of contamination prediction. The reliability is increased with regular enhancement of performance with the updated data from the users.
- Responsiveness : The process of prediction should take minimal time to retrieve the data and do the computations without any latency. So that the system becomes more and more responsive for the user.
- Deployability : The application can be installed on any basic smart phone which can be used with a user authentication procedure.

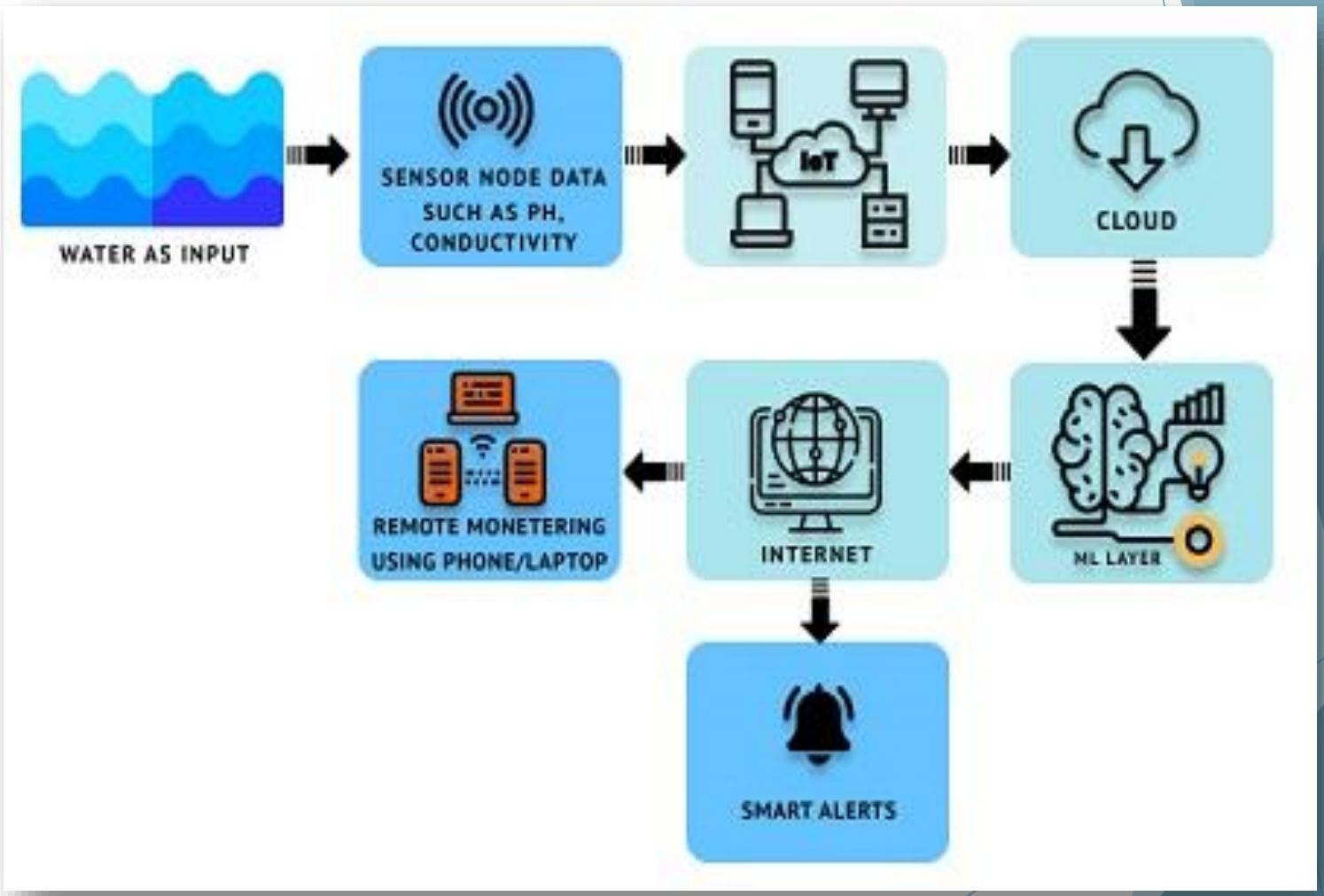
Software Requirements:

- Programming Language used : Python with ML library
- Front End : XML, HTML and CSS
- Back End : Firebase
- Operating System : Windows 7 and above
- Kotlin mobile application development in android studio
- Flask micro-framework

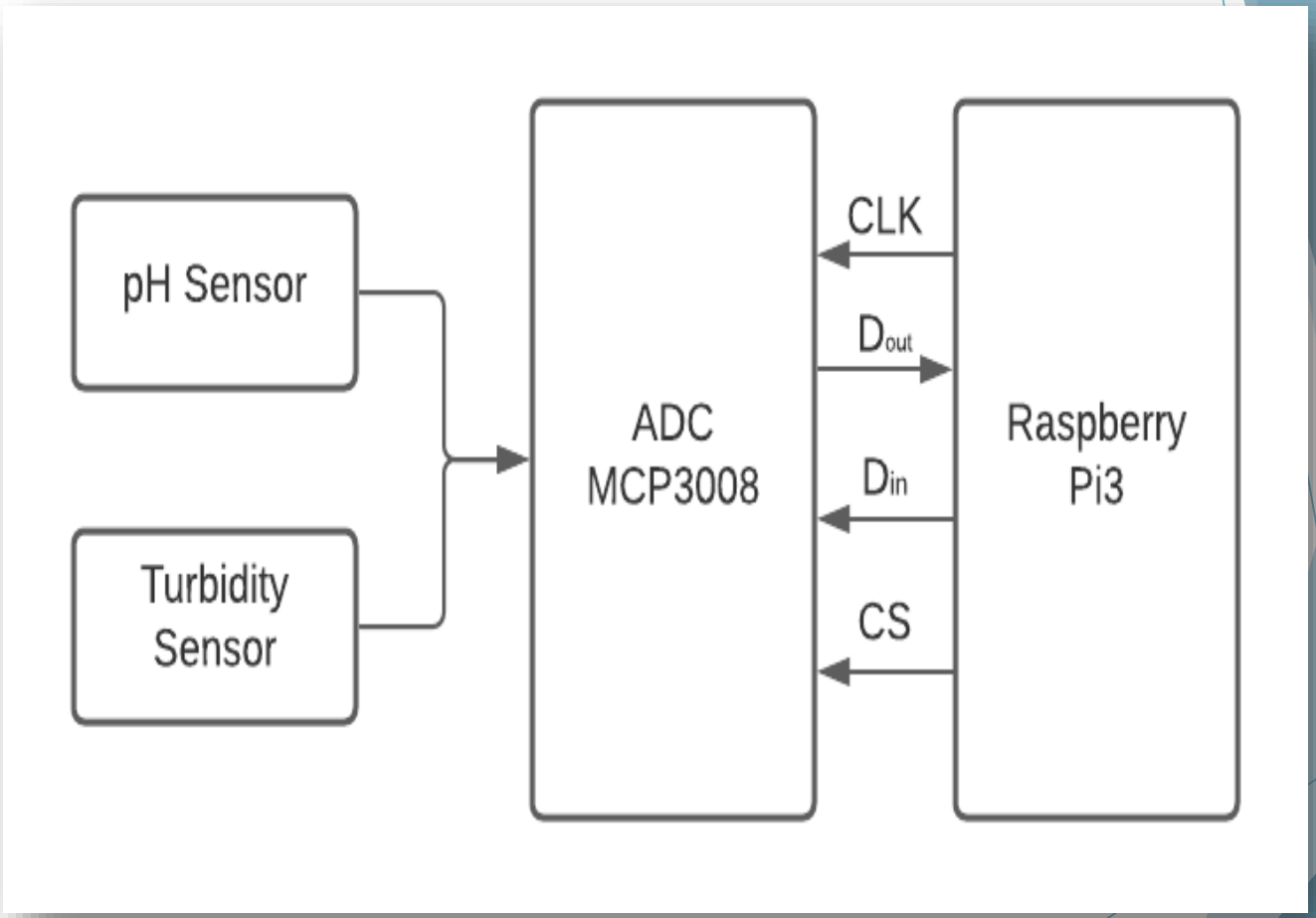
Hardware Requirements:

- Raspberry Pi 3 Model B
- pH sensor (Grove pH), Turbidity Sensor
- Bread board
- Power Source
- Analog to Digital Converter – MCP3008
- Jumper wire

System Architecture



Hardware Design



Raspberry pi3

- Raspberry Pi 3 Model B comes with **64 bit quad core processor**, on board Wi-Fi, Bluetooth and USB features.
- The **CPU** of this device is responsible for executing numbers of instructions based on mathematical and logical operation.
- The Pi 3 comes with **GPIO** (General Purpose Input Output) pins that are essential to maintain connection with other electronic devices. These input output pins receive commands and work based on the programming of the device.
- The **Ethernet port** is incorporated on this device that sets a pathway for communicating with other devices. Ethernet port is connected to the router to maintain a connection for internet. The Board has four **USB ports** that are used for communication and **SD card** is added for storing the operating system.
- **Power source connector** is a basic part of the board that is used to provide 5 V power to the board. Any source can be used to set up a power for the board.

Analog to Digital Converter

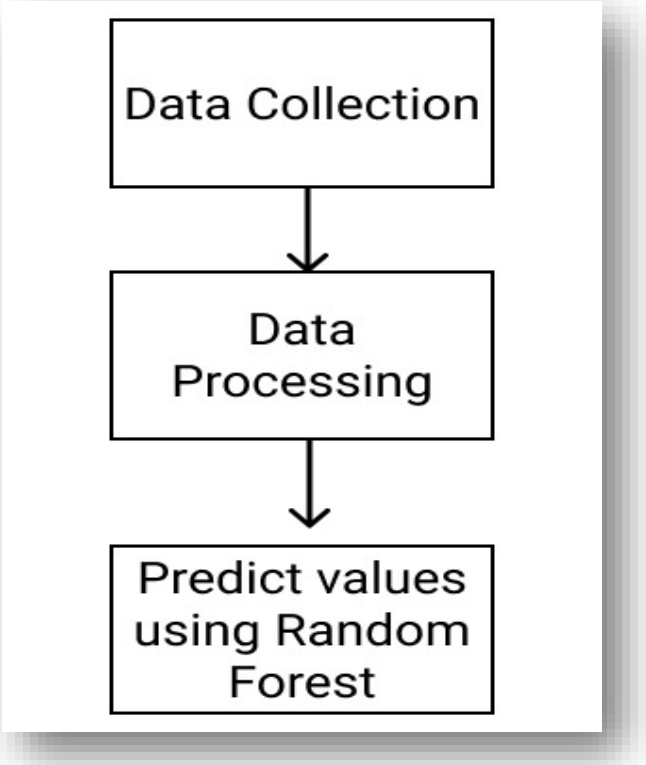
- The MCP3008 is a low cost 8-channel 10-bit analog to digital converter. The precision of this ADC is similar to that of an Arduino Uno, and with 8 channels you can read quite a few analog signals from the Pi.
- The Serial Peripheral Interface (SPI) is a synchronous serial communication interface specification used for short-distance communication, primarily in embedded systems. The MCP3008 CLK, DOUT, DIN, and CS/SHDN pins need to be swapped to any other free digital GPIO pins on the Raspberry Pi to get output.

Working of Sensors

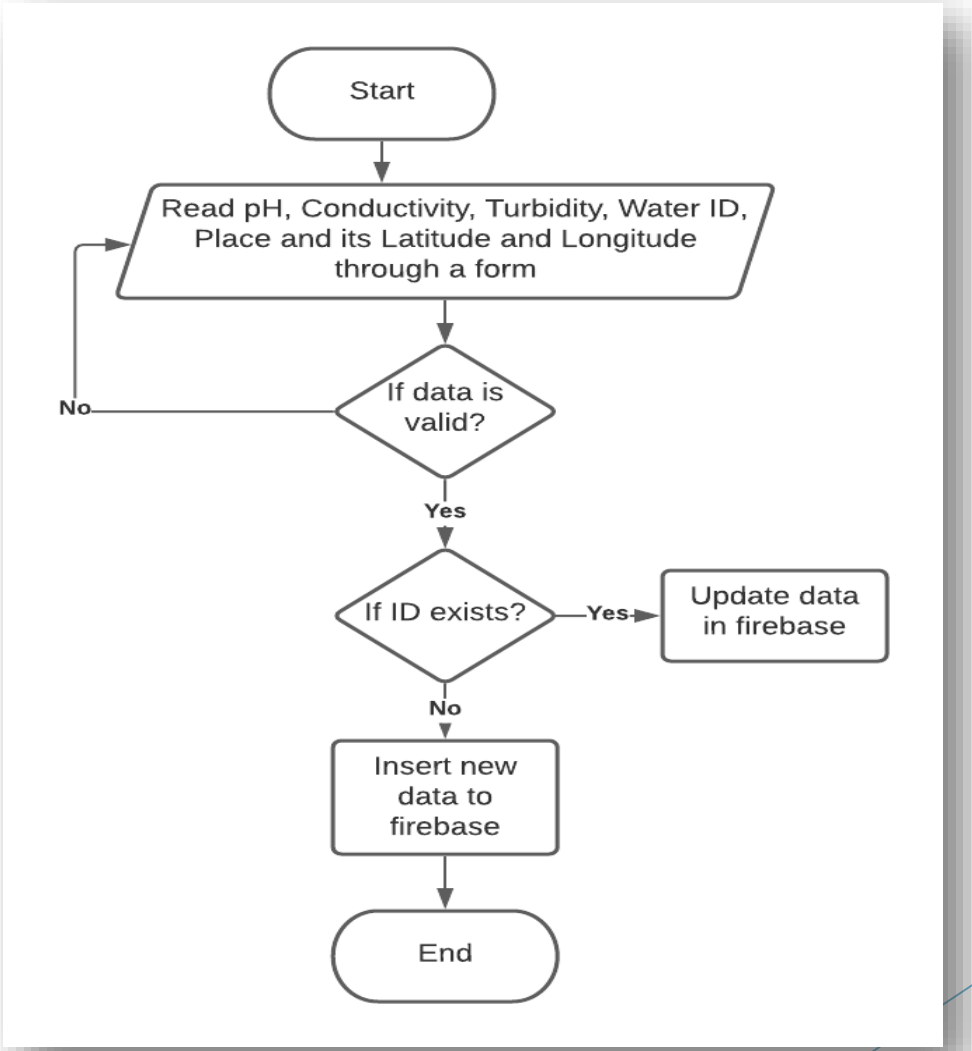
- The **pH sensor** measures the hydrogen-ion activity in water-based solutions, we usually use it to measure the pH of a liquid. It is widely used in the chemical industry, the pharmaceutical industry, the dye industry, and scientific research where acidity and alkalinity testing is required. The drive board in this kit support both 3.3V and 5V system.
- The **Turbidity Sensor** is an electronic monitoring module. It is very efficient, the Turbidity Sensor is able to detect the quality of the water. The Turbidity Sensor emits at its end an infrared light capable of detecting particles that are suspended in water which changes according to the Amount of TSS (Total Suspended Solids).

Algorithms/Flowcharts of each modules:

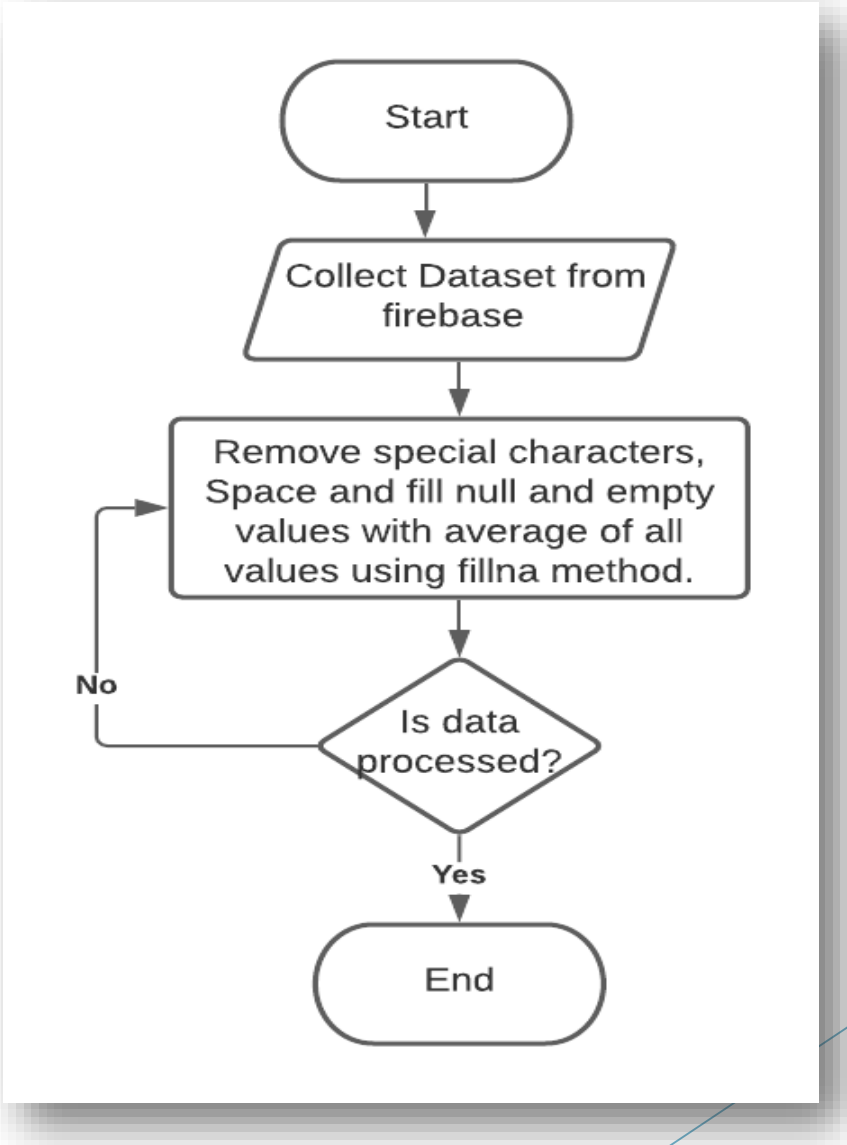
The modules discussed in this project are:



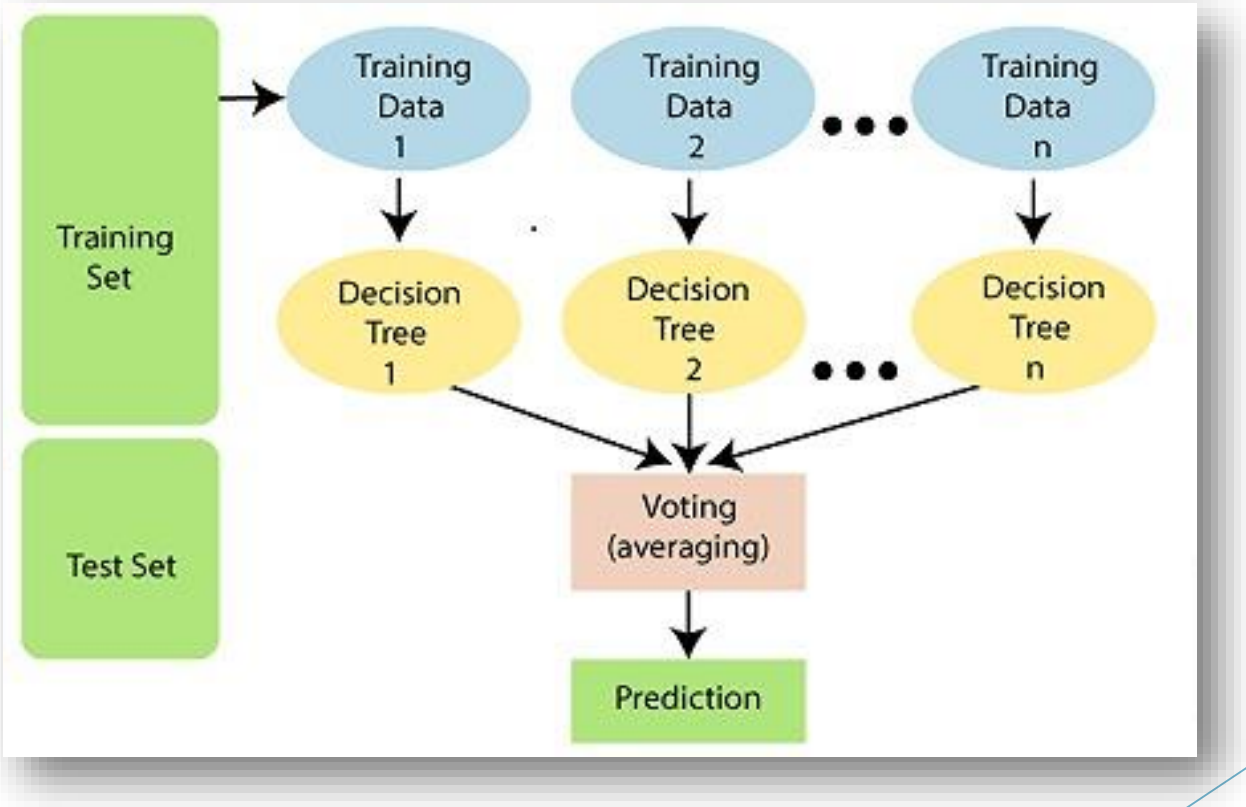
Data Collection:



Data Processing:



Predict Values using Random Forest:



Web Application API:

	CODE	DESCRIPTION
Firebase Connection	//firebase api key app.config['SECRET_KEY']='4ELu2SHMwsMQYS*******'	Here, it connects the firebase using the API key of the firebase.
Firebase Authentication	fb = firebase.FirebaseApplication('https://water-quality-42101-default-rtdb.firebaseio.com/',None)	It authenticate the Firebase by giving its real time URL. Flask will refer to the given URL to store the data.
Get data from firebase	result = fb.get('/water', None)	get method is used to retrieve the data from the firebase. Fb will contain firebase url. In that it will search for the desired branch
Open csv file	with open('checkwater.csv', 'w', newline='') as write_obj:	It opens a csv file called checkwater in write mode. For this , open function is used.
Convert data to string	csv_writer = writer(write_obj)	Return a writer object responsible for converting the water's data into delimited strings on the given file-like object. *csvfile* can be any object with a write() method
Write to csv file	csv_writer.writerows(lst2)	Write all elements in *lst2* (an iterable of *row* objects as described above) to the writer's file object, formatted according to the current dialect.

	CODE	DESCRIPTION
Split the data	X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.5, random_state=0)	Split arrays or matrices into random train and test subsets
Train the model	model=RandomForestClassifier() model.fit(X_train,y_train)	It fits a number of decision tree classifiers on various sub-samples of the dataset and uses averaging to improve the predictive accuracy
Message sent through yagmail	Import yagmail yag = yagmail.SMTP(email_txt,password_txt) yag.send(to=email, subject="",contents=message)	*yagmail* is a GMAIL/SMTP client that aims to make it as simple as possible to send emails using send() method
Pie chart	var chart = new google.visualization.PieChart(document.getElementById('pie')); chart.draw(data, options);	Google visualization is used to draw pie chart using method draw(). A pie chart that is rendered within the browser using svg.
Bar graph	var chart2 = new google.visualization.ColumnChart(document.getElementById("barchart_values")); chart2.draw(data2, options);	Column chart method is used to draw the Vertical bar graph. It targets id in html and Draws chart using draw() method.

	CODE	DESCRIPTION
Upload predicted data using POST	fb.post('/predicted', {'ph':ph});	POST method is used to push the data to the firebase.
Updating using put	fb.put("predicted/"+i,"Email",email)	PUT method is used to write to existing data to the firebase.
Predict ML data	model.predict()	given a trained model,it predict the label of a new set of data. This method accepts one argument, the new data X_new (e.g. model.predict(X_new)), and returns the learned label for each object in the array.

Android Application API:

	CODE	DESCRIPTION
Firebase Authentication	FirebaseAuth.getInstance().	To obtain an instance of this class by calling getInstance() .
Sign in	signInWithEmailAndPassword(email, password)	Tries to sign in a user with the given email address and password.
Complete Listener	addOnCompleteListener(new OnCompleteListener<AuthResult>() {}	To handle success and failure in the same listener
Intent in Android	intent = Intent(this@LoginActivity, MainActivity::class.java)	An intent is a description of an operation to be performed. Its most significant use is in the launching of activities, where it can be thought of as the glue between activities.
Toast	val toast = Toast.makeText(applicationContext, text, duration)	A toast provides simple feedback about an operation in a small popup. It only fills the amount of space required for the message and the current activity remains visible and interactive. Toasts automatically disappear after a timeout.

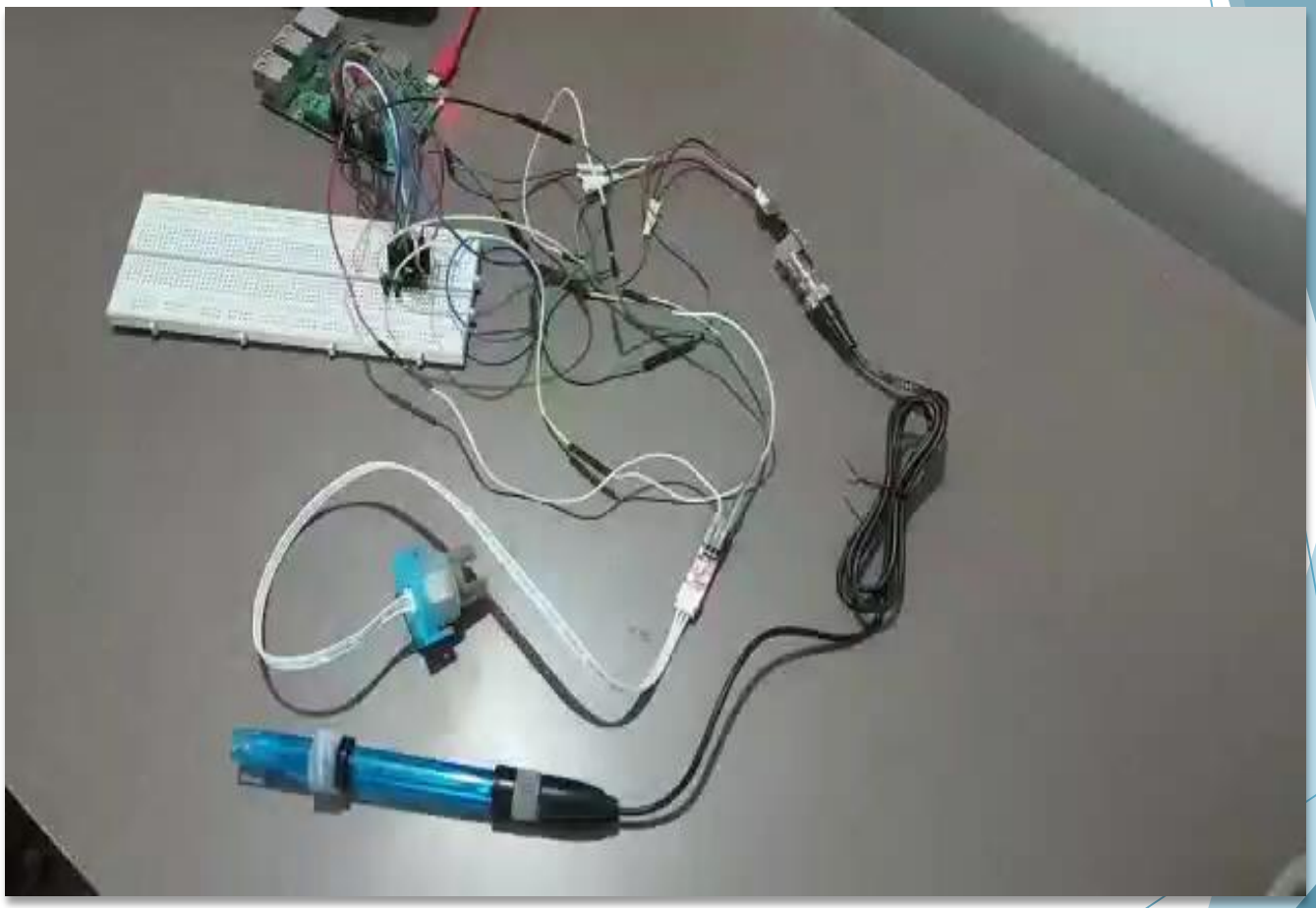
	CODE	DESCRIPTION
Get reference of child	getReference().child("predicted")	A Reference represents a specific location in your Database and can be used for reading or writing data to that Database location.
On data change	onDataChange(dataSnapshot: DataSnapshot)	**onDataChange**() is called whenever data at the specified node changes. Such as adding a new zip code. It will return a **dataSnapshot** object, which is essentially a read-only copy of the Firebase state.
Put and get data through intent	**putExtra()** and **getExtra()**	**putExtra()** adds extended data to the intent. It has two parameters, first one specifies the name which of the extra data,and the second parameter is the data itself. **getExtra()** fetches data which was added using putExtra().

	CODE	DESCRIPTION
Add marker with icons	GoogleMap.addMarker(markerOptions)	Markers identify locations on the map. The default marker uses a standard icon, common to the Google Maps look and feel. It's possible to change the icon's color, image or anchor point via the API. Markers are objects of type marker, and are added to the map with this method.
Animate camera	GoogleMap map = ...; map.animateCamera(CameraUpdateFactory.zoomIn());	A class containing methods for creating CameraUpdate objects that change a map's camera
Move camera	GoogleMap map = ...; map.moveCamera(CameraUpdateFactory.newLatLng(locs));	To move the camera in order to focus the map to a specific location

Applications

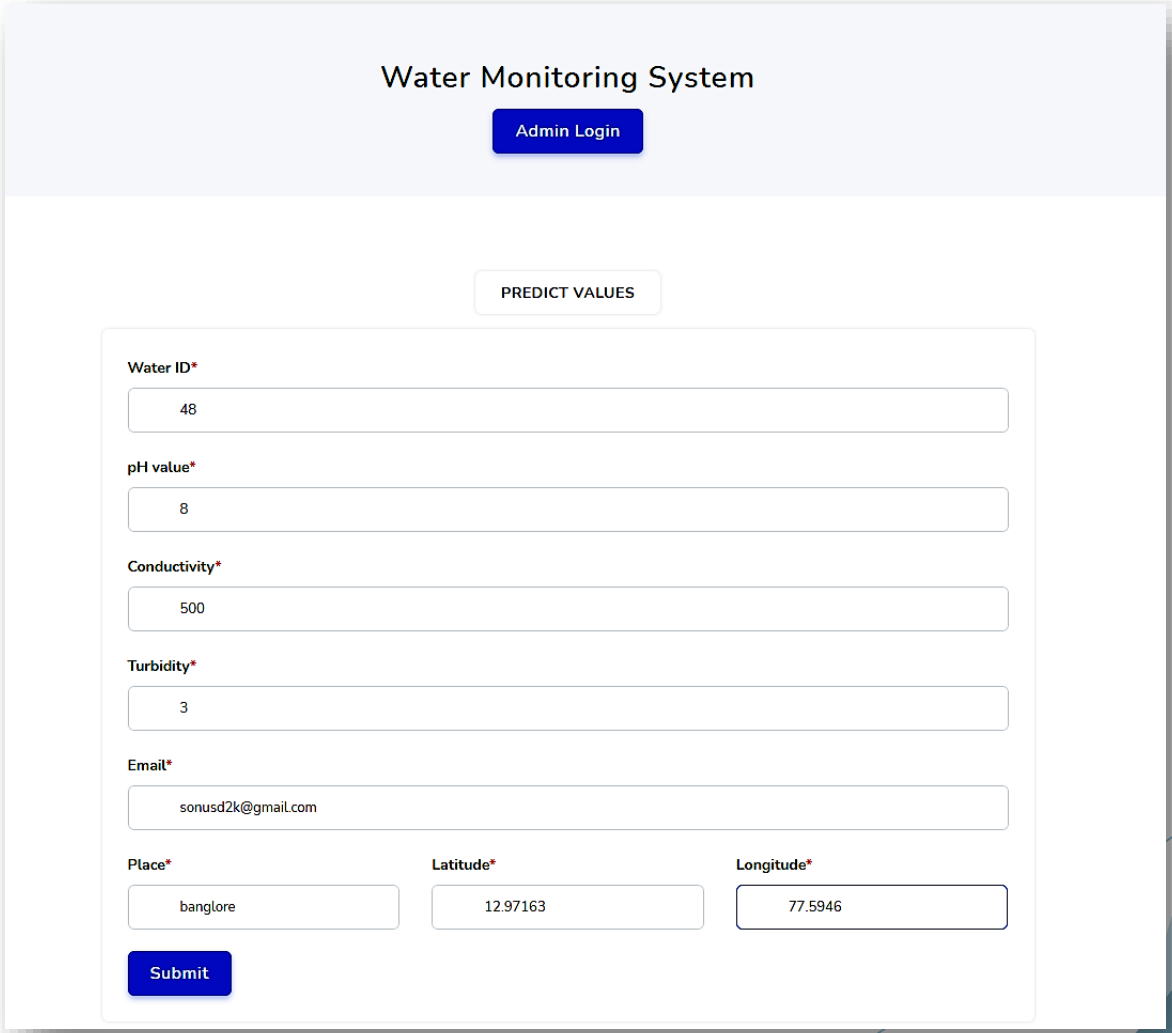
- This system can be used to be implement as real time portable product for measuring water containment levels.
- In distribution tanks to provide adequate water supply with good quality water to each house, industry, and others.
- In helping authorities to monitor the water quality accurately as it will achieve a stronger accuracy of the prediction in the water level.
- Smart cities can be enabled by performing analytics on the use of water.

Demo Video:



Results and Snapshots

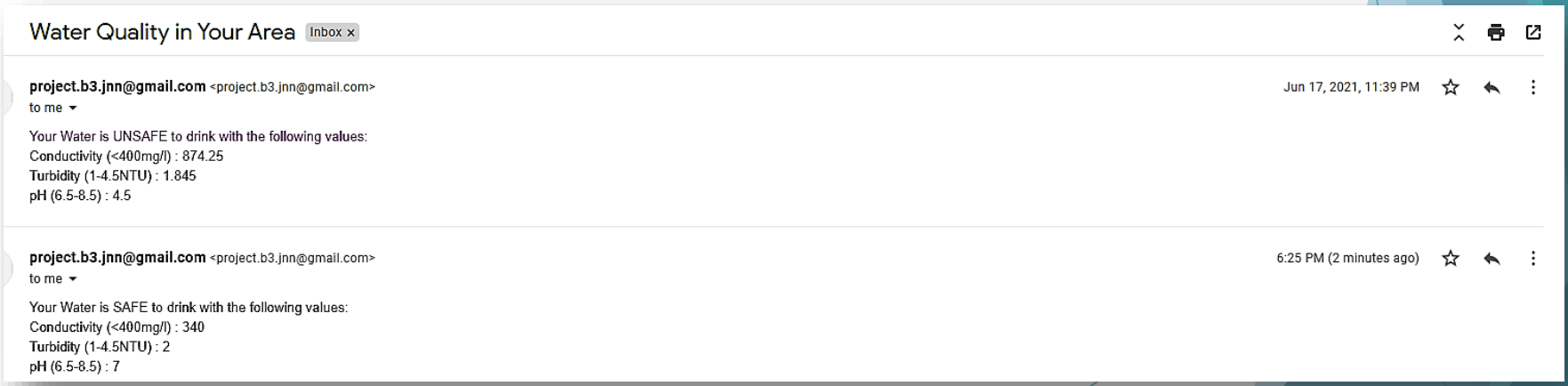
Form interface



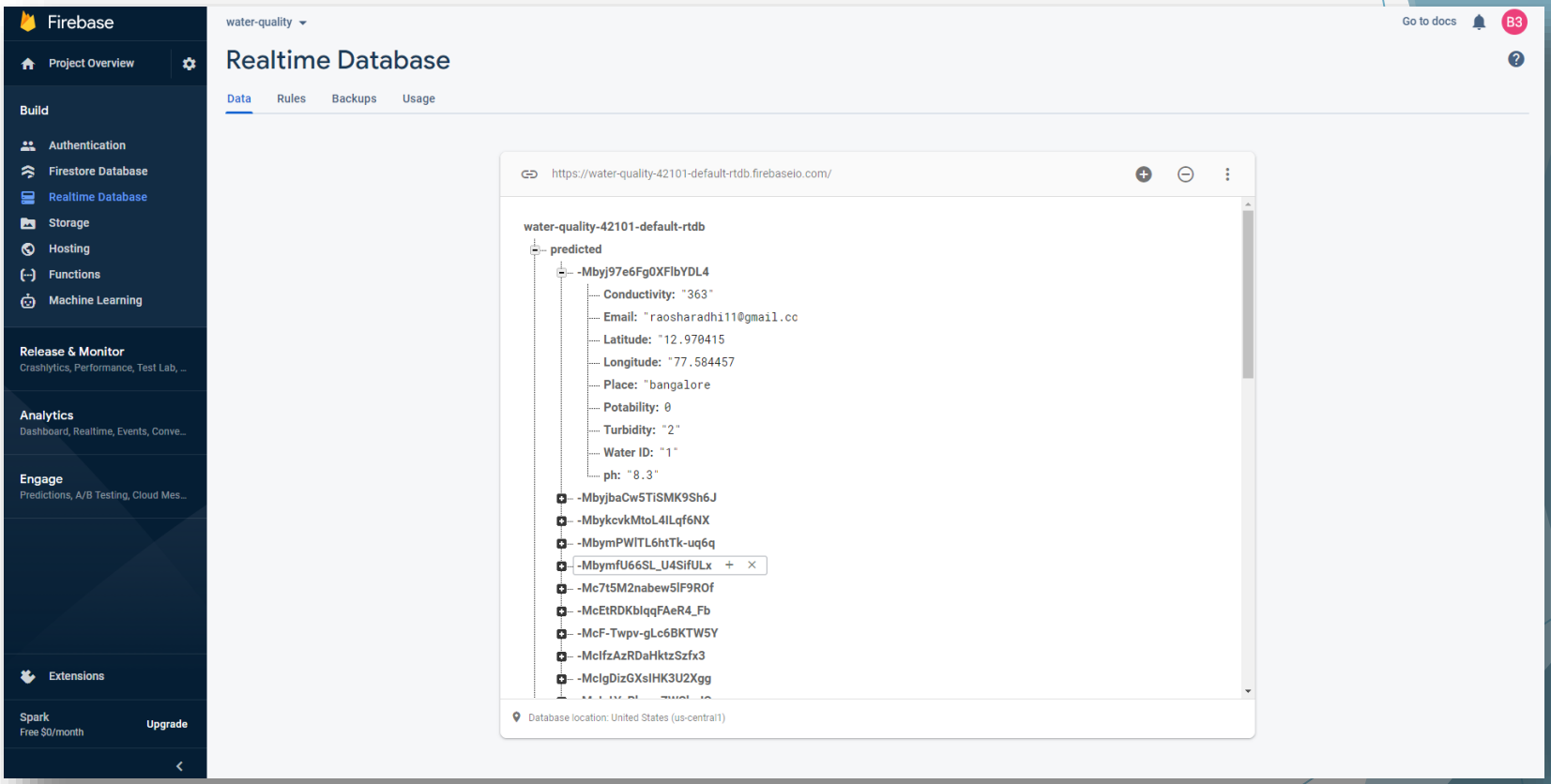
Prediction of water Quality

water at your place is UNSAFE to drink

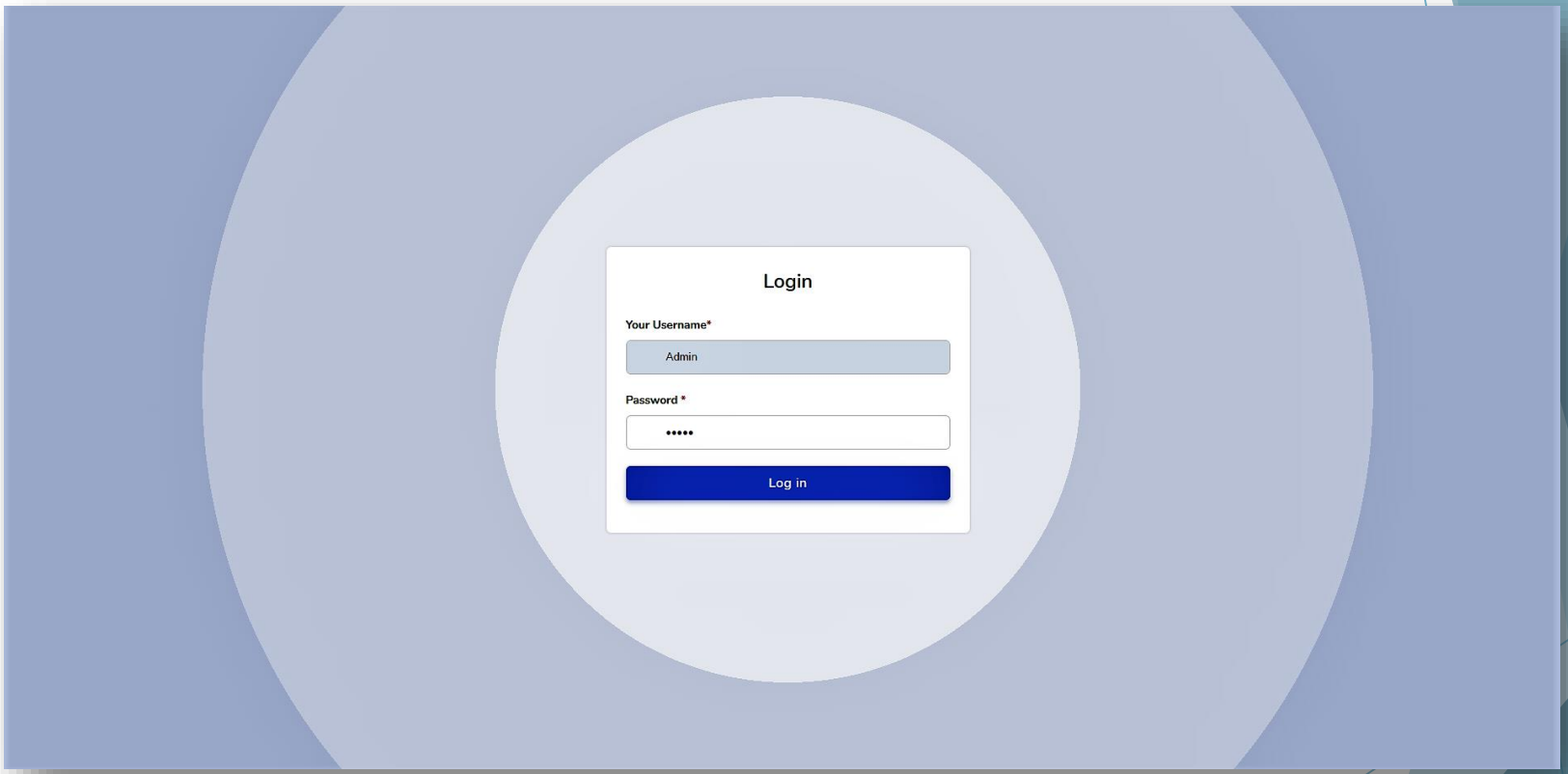
Notification sent through mail



Predicted data stored in firebase

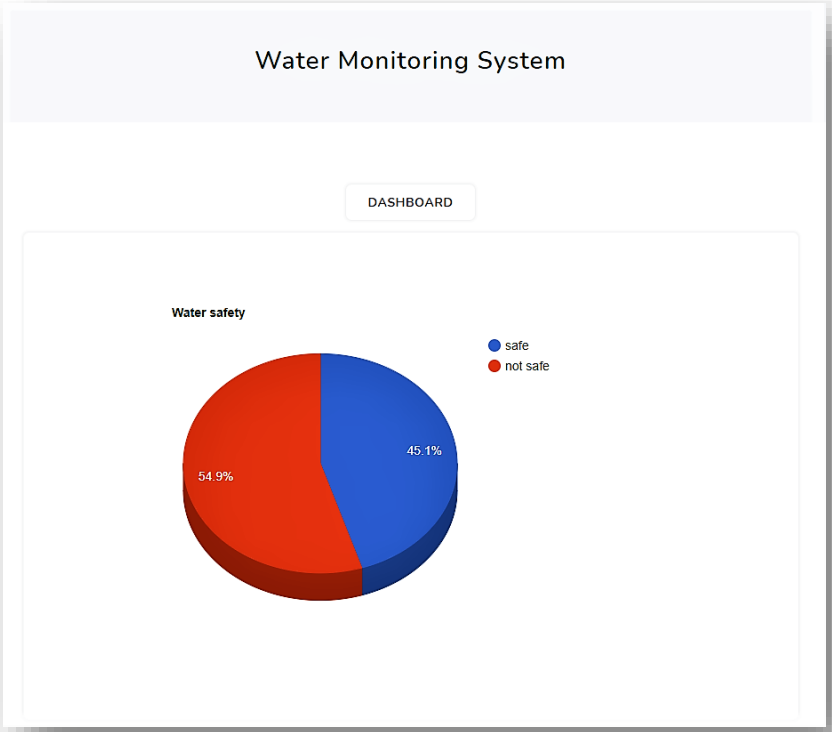


Admin login

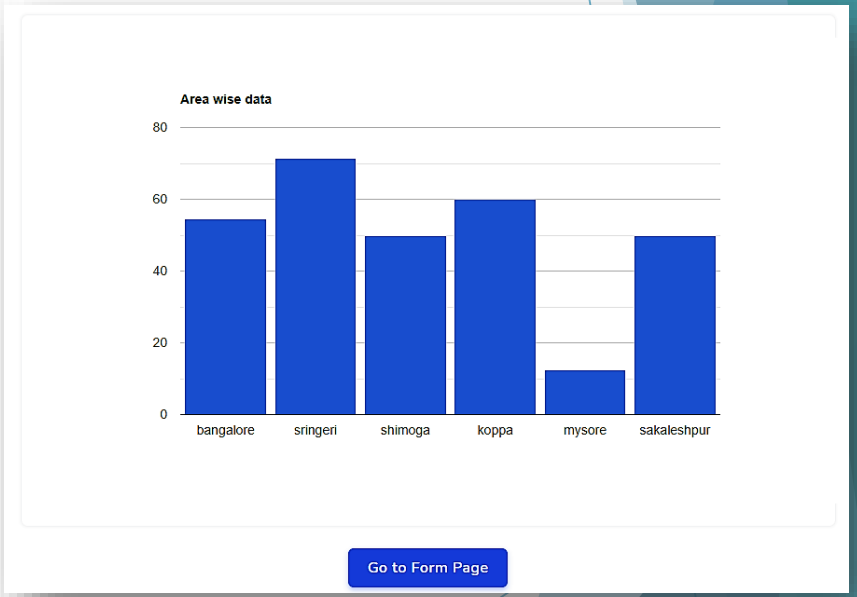


Visualization of predicted Data

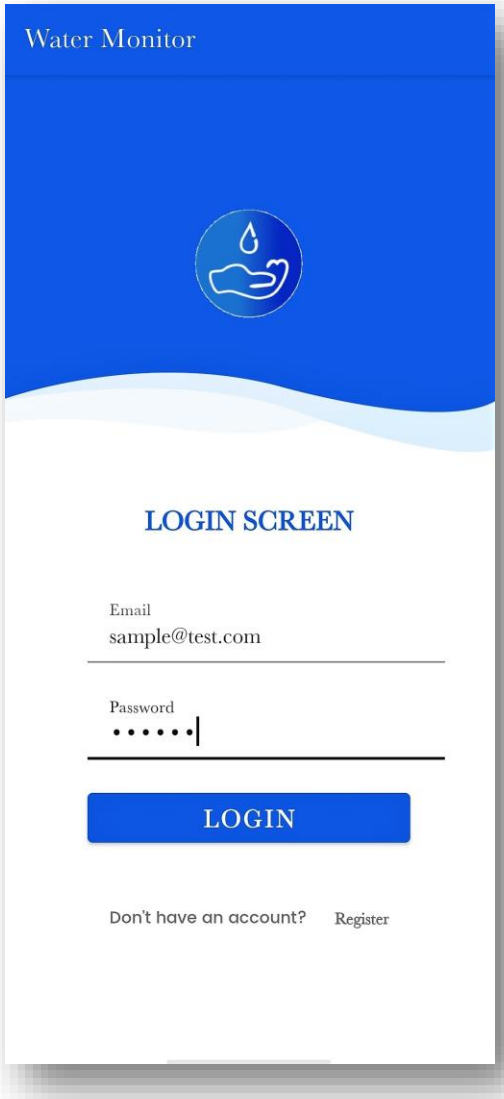
Pie chart



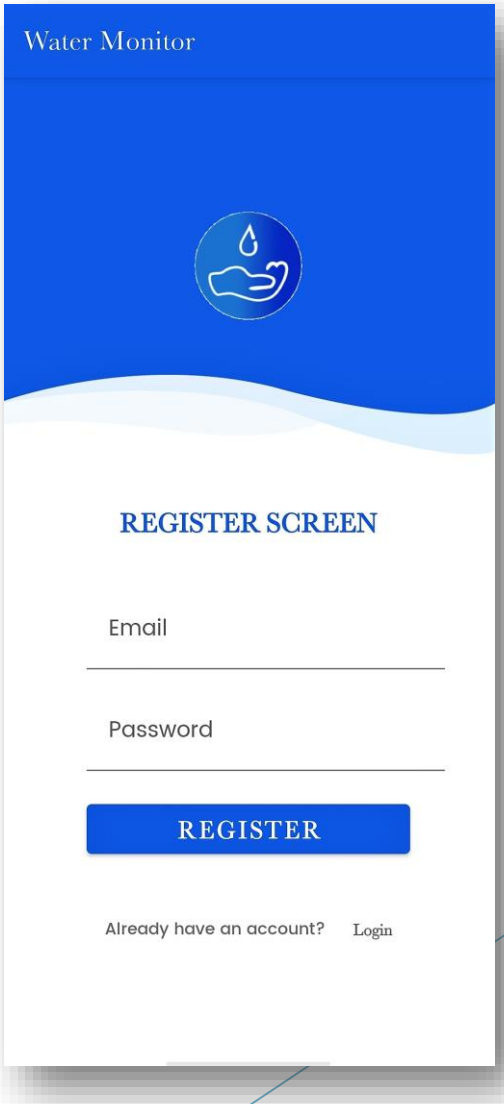
Bar chart



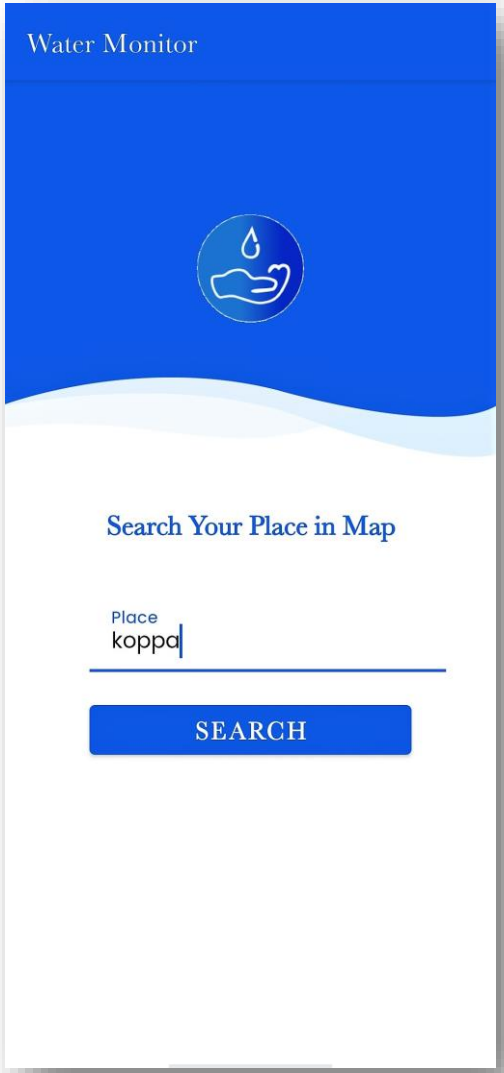
Login screen



Register screen



Location search screen



Map

Conclusions

- Water is basic need for all living beings. If that water is contaminated, it will cause harmful effects on human as well as other living beings.

- So, by keeping this in mind an intelligent water quality monitoring system is done which predicts the water safety accurately.

- This system prevents any health hazards to people caused due to particular contents and does not require people on duty.

- The system is likely to be more economical, convenient, fast and portable.

Future Scope

- The project can be enhanced by implementing wireless sensor network and taking real time data.

- The number of parameters to be sensed can be increased by the addition of multiple sensor data to measure dissolved oxygen (DO), chemical oxygen demand (COD), biochemical oxygen demand (BOD), ammonia nitrogen, nitrate, nitrite, phosphate.

- The system can be expanded to monitor air pollution, industrial and agricultural wastes and so.

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THANK YOU