PROJECT REPORT

REAL-TIME RIVER WATER QUALITY MONITORING AND CONTROL SYSTEM

NALAIYA THIRAN PROJECT BASED LEARNING ON PROFESSIONAL READLINESS FOR INNOVATION, EMPLOYNMENT AND ENTERPRENEURSHIP

A PROJECT REPORT

Submitted by

R.KANTHIMATHI	***950819106026***
M.MATHY BALA	***950819106701***
K.DURGA DEVI	***950819106014***
S.KRISHNAVENI	***950819106032***

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Date	**18 Nov 2022**
Project name	**Real time river water quality monitoring and control system**
Team ID	**PNT2022TMID33851**

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1.INTRODUCTION

1.1Project Overview

The river water quality can be monitored real time by the web application by means of Nodered application and the values of the parameters can be viewed in the User End application by means of MIT App inventor
This project is useful in Alerting the authorities if the water quality is not good so that they can go and announce the localities not to drink that water.

- Sending random pH values and turbidity values will be sent to the IBM IoT platform
- Sensors values can be viewed in the Web Application
- Notifies the admin the random values cross the threshold value

1.2 Purpose

The system consists of several sensors which are used for measuring physical and chemical parameters of water. The parameters such as temperature, pH, and dissolved oxygen of the water can be measured. Using this system a person can detect pollutants from a water body from anywhere in the world.
To protect, restore, and enhance environmental quality towards good public health, environmental integrity, and economic viability.

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2.Literature Survey

2.1 Existing problem

Major water pollutants include microbes, nutrients, heavy metals, organic chemicals, oil and sediments; heat, which raises the temperature of the receiving water, can also be a pollutant. Pollutants are typically the cause of major water quality degradation around the world Pesticides and fertilizers can be carried into lakes and streams by rainfall runoff or snowmelt, or can percolate into aquifers. Human and animal waste. Human wastes from sewage and septic systems can carry harmful microbes into drinking water sources, as can wastes from animal feedlots and wildlife.

2.2 Reference

- **Heterogeneous wireless sensor networks for flood prediction decision support systems**

In this paper, we propose a new architecture for building decision support systems using heterogeneous wireless sensor networks. The architecture is built around standard hardware and existing wireless sensor networks technology. We show the effectiveness of the proposed architecture by applying it to a flood prediction scenario.

- **An IoT-belief rule base smart system to assess autism**

An Internet-of-Things (IoT)-Belief Rule Base (BRB) based hybrid system is introduced to assess Autism spectrum disorder (ASD). This smart system can automatically collect sign and symptom data of various autistic children in real-time and classify the autistic children.
The BRB subsystem incorporates knowledge representation parameters such as rule weight, attribute weight and degree of belief. The IoT-BRB system classifies the children having autism based on the sign and symptom collected by the pervasive sensing nodes

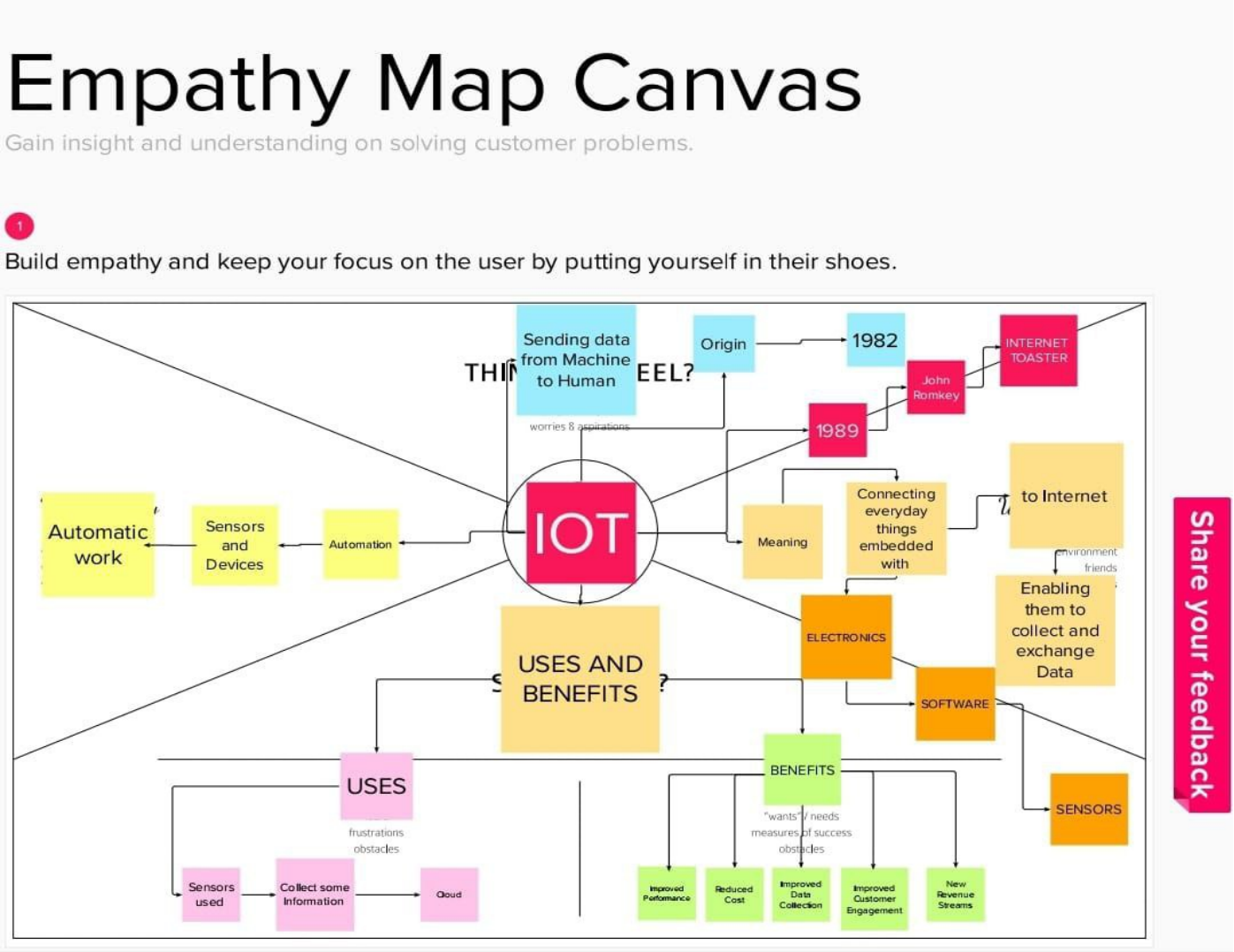
- **The use of artificial neural networks for the prediction of water quality parameters**

This paper presents the use of artificial neural networks (ANNs) as a viable means of forecasting water quality parameters. A review of ANNs is given, and a case study is

presented in which ANN methods are used to forecast salinity in the River Murray at Murray Bridge (South Australia) 14 days in advance. It is estimated that high salinity levels in the Murray cause $ US 22 million damage per year to water users in Adelaide.

3.IDEATION AND PROPOSED SOLUTION

3.1Empathy map canvas



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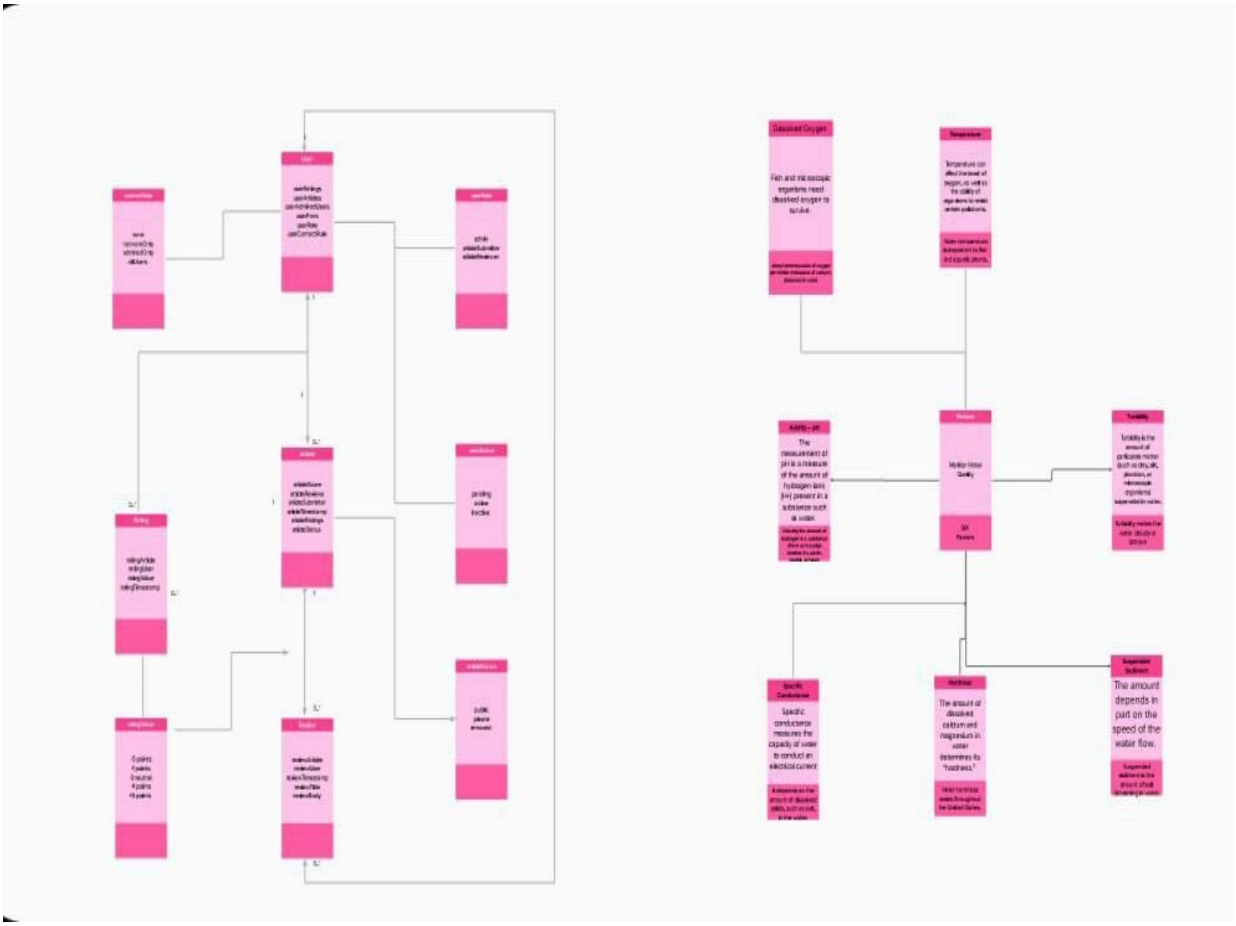
Definition	Connectiong every day things embedded with electronics to internet	Enabling them to collect and exchange data
Origin	1982	Sending data from machine to human
Process and automation	Sensors and devices	Automatic work
Uses	Sensors used to collect information	from cloud
Benefits	Input performance, Data collection	Reduce cost, new revenue scheme

3.2Brainstorming



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Kanthimathi	Aim is to control the movement of water resources	To maximize efficient technique for beneficial use	To minimize damage to life and property
Krishnaveni	Aims at flood prevention	Improve performance across water supply	Helps in extension to farmers on water management at the local level
Mathy Bala	Improve the transparency of all the process In water supply chain	Automation and optimized use of human resources	Sustainability goals
Durga Devi	System make the most rainfall forecast information	To save and conserve water for future use	Important insides on the state of water resources

Group ideas:

- Chlorination process for treatment of stored rainwater
- Implementing ground water dams
- Properly dispose of hazardous products put up signs

Prioritize:

- To determine the purpose of monitoring
- Measurement of concentration of dissolved oxygen
- Amount of salt
- Using water filter can removed bacteria

3.2Proposed solution

S.No	Parmaters	Description
1.	Problem Statement (Problem to be solved)	River water quality monitoring is essential because that is important for all the living beings in the water also people are drinking the river water if anything toxic it may

		kill many people
2.	Idea / Solution description	This process is based on sensor used water quality monitoring system and can be done by internet of things technology
3.	Novelty / Uniqueness	With the help of sensors by deteting the amount of substance in the water and managing the quality of water
4.	Social Impact / Customer Satisfaction	By getting good quality of water all living beings may be get good health because water is an essential one
5.	Business Model (Revenue Model)	Our model will be benefitted for all creatures living in the world
6.	Scalability of the Solution	By detecting the good condition of sensor and other electronic components we can manage this proces

3.3Problem solution fit

Business problem	If the quality of water is not checked and maintained regularly, most of us get affected	It is dangerous for the creatures for living in water and people who drinking
Business Outcomes	Clean water supports diversity of plants and wildlife	Maintaining visible agricultural protection
User Benefits	80% of disease and 50% of child related to poor water quality is prevented	To obtain quantitative infomation on physical and chemical and biological characteristics of water

Solution ideas	Using sensors "smart passive sensing"	Real time display of water quality using ledscreens
Need	Properly dispose of hazardous products	Dispose of harmful materials properly
Importance	Monitoring provides the objective evidence necessary to make decision on managing water qualities	Water quality monitoring is used to alert us to current, on going and emergency problem
Solution ideas	Wireless sensors based monitoring system	System that use short range communication like bluetooth

4.Requirement Analysis

4.1Functional Requirements

FR No.	**Functional Requirement (Epic)**	**Sub Requirement (Story / Sub-Task)**
FR-1	User Registration	Registration through Form Registration through Gmail Registration through LinkedIN
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Objective	The objective is to obtain quantitative information on the physical, chemical and biological characteristics of water.

FR-4	Testing	It is used for monitoring the water quality by determining pH, turbidity, conductivity and temperature.

4.2 Non-functional Requirements

FR No.	**Non-Functional Requirement**	**Description**
NFR-1	**Usability**	The main aim is to develop a system for continuous Monitoring of river water quality at remote places using wireless sensors networks with low power consumption, low cost and high Detection accuracy.
NFR-2	**Security**	
NFR-3	**Reliability**	The consequences of using poor quality data include faulty decisions, higher risk to the environment or human health, Wasted resources and loss of credibility.
NFR-4	**Performance**	The system consist of several sensors which is used to measure Physical and chemical parameters of the water. It can be done

		by using remote monitoring and Internet of Thin gs(IoT)
NFR-5	**Availability**	Consideration is given to demands from human and ecosystem Needs. Equitable apportionment of water among uses, and indicators of stress to the water resource.
NFR-6	**Scalability**	It obtains quantitatitve information on the physical, chemical. And biological characteristics of water via secchi disks, probes, nets. Gauges and metres.

5.Project design

5.1 **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.

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority
Customer (Mobile user)	Registration	USN-1	As a user, I can register	I can access my account /	High

			for the application by entering my email, password, and confirming my password.	dashboard	
		USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High
		USN-3	As a user, I can register for the application through Facebook	I can register & access the dashboard with Facebook Login	Low
		USN-4	As a user, I can register for the application through Gmail	I can register & access the dashboard with gmail login	Medium
	Login	USN-5	As a user, I can log into the application by entering email & password	I can register & access the dashboard with email login	High
	Dashboard	USN-6	As a user, after login to	I can watch the videos	High

			the ibm account, click on dashboard	and use the templates	
Customer (Web user)	Login and dashboard	USN-7	As a user, I can login to the application by gmail and after login to the ibm account click on dashboard	I can login to the app using the same email and password and access the resources.	High
Customer Care Executive	Login	CCE-1	As a CCE I can login to app using my id and password and I can interact with user	I can login using my mail and password	High
Administrator	Login and dashboard	A1	As an administrator, I can login and access dashboard and manage and direct activities.	I can login using my company id and password	High

5.2Solution and Technical Architecture

Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	How user interacts	RFID,NFC,LTE – A, Low Energy Radio

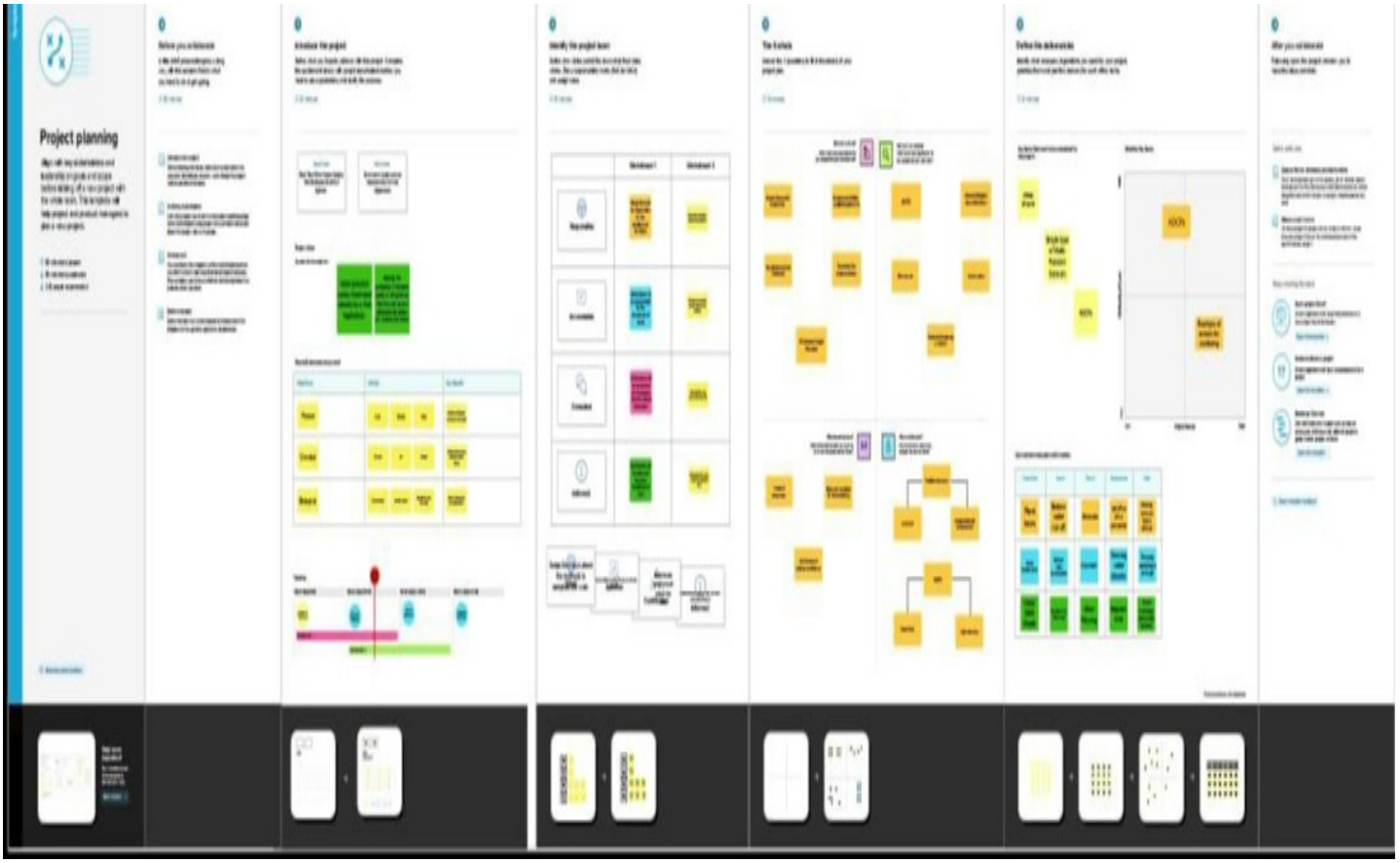
		with application	Protocols, Raspberry Pi, Rocket chat
2.	Application Logic-1	Logic for a process in the application	MIT App Inventor
3.	Application Logic-2	Logic for a process in the application	Ai2. App Companion
4.	Cloud Database	Database Service on Cloud	IBM cloudant
5.	File Storage	File storage requirements	IBM Block Storage or Other Storage Service or Local Filesystem
6.	External API-1	Purpose of External API used in the application	Speech to text recognition Application
7.	Infrastructure (Server / Cloud)	Application Deployment on Local System / Cloud Local Server Configuration: Cloud Server Configuration :	Local,Kubernetes, etc.

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	List the open-source	Technology of

		frameworks used	Opensource framework
2.	Scalable Architecture	Justify the scalability of architecture (3 – tier, Micro-services)	Technology used
3.	Availability	Justify the availability of application	Technology used
4.	Performance	Design consideration for the performance of the application	Technology used

6.Project planning and scheduling



6.1 Sprint Planning and estimation

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Sprint	Functional Requirement(epic)	User Story number	User story/Task	Story points	Priority	Team members
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	2	High	Kanthimathi Krishnaveni
Sprint-1		USN-2	As a user, I will receive confirmation email once I have registered for the application	1	High	Krishnaveni Durga Devi
Sprint-2		USN-3	As a user, I can register for the application through Facebook	2	Low	Mathybala Kanthimathi
Sprint-3		USN-4	As a user, I can register for the application	2	Medium	Krishnaveni Mathybala

			through Gmail			
Sprint-4	Login	USN-5	As a user, I can log into the application by entering email & password	1	High	Mathy Bala Durga Devi

6.2 Sprint Delivery Schedule

Sprint	Total Story points	Duration	Sprint start date	Sprint end date	Story points Completed	Sprint release date(actual)
Sprint-1	20	6 days	24 Oct 2022	29 Oct 2022	20	20 Oct 2022
Sprint-2	20	6 days	31 Oct 2022	05 Nov 2022	30	30 Oct 2022
Sprint-3	20	6 days	07 Nov 2022	12 Nov 2022	45	06 Nov 2022
Sprint-4	20	6 days	14 Nov 2022	19 Nov 2022	50	07 Nov 2022

6.3 Reports from JIRA

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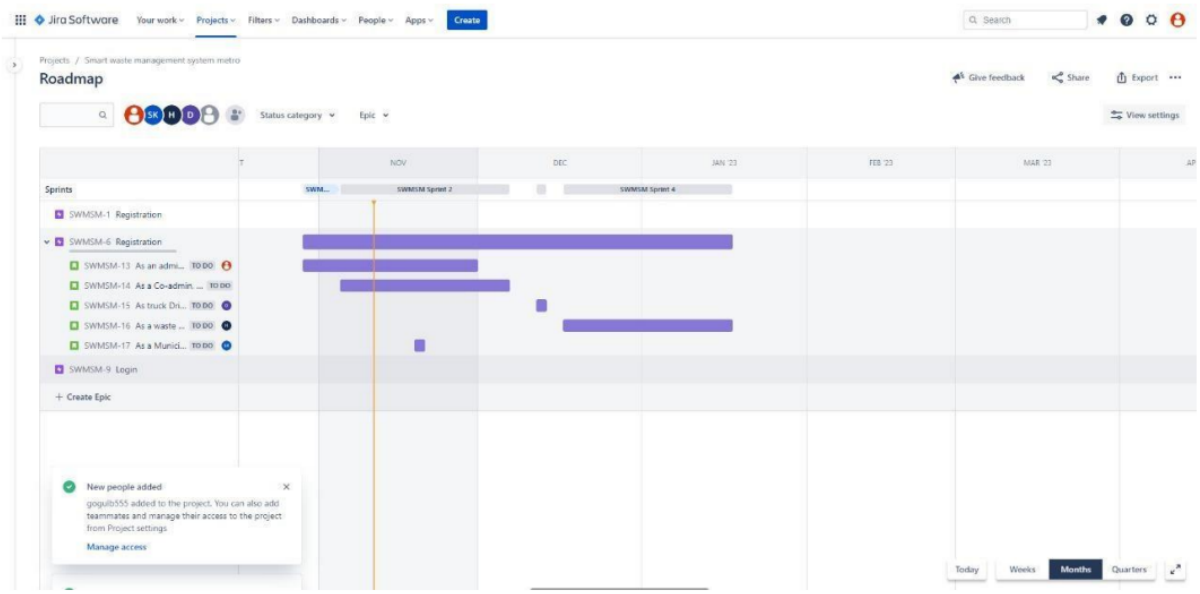

7.Coding and solutioning

7.1 Feature

```
import time
import sys
import ibmiotf.application
import ibmiotf.device
import random
from twilio.rest import Client
import keys
#Provide your IBM WatSON Credentials
organization = "eo8548" #replace the ORG ID
deviceType = "sensor"#replace the Device type wi
deviceId = "12"#replace Device ID
authMethod = "token"
authToken = "123456789" #Replace the authtoken
# Initialize GPIO
#Receives Command from Node-red
def myCommandCallback(cmd):
```

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```
 print ("Command received: %s" % cmd.data['command'])
 status=cmd.data['command']
 if status=="turbidity<50":
  if status =="temp<17 " :
   if status == "ph>=7" :
    if status=="do>7":
     print("Portable water for drinking and bio-life")
   print("Acidic")
  print ("Affects bio-life")
 print ("Unfit for consumption")
try:
 deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "auth-
method":authMethod, "auth-token":authToken}
 deviceCli = ibmiotf.device.Client(deviceOptions)
except Exception as e:
 print("Caught exception connecting device: %s" % str(e))


sys.exit()
# Connect and send a datapoint "hello" with value "world" into the cloud as an event
oftype "greeting" 10 times
deviceCli.connect()
while True:
#Get Sensor Data from DHT11
 temp=random.randint(0,100)
 ph=random.randint(0,14)
 turbidity=random.randint(0,100)
 do=random.randint(0,10)
 data = { 'temp' : temp, 'ph': ph, 'turbidity': turbidity,'do':do }
#print data
def myOnPublishCallback():
 print ("Published Temperature = %s C" % temp, "ph = %s %%" % ph, "turbidity =
%s%%"% turbidity, "do=%s %%"% do,"to IBM Watson")
 success = deviceCli.publishEvent("IoTSensor", "json", data,
qos=0,on_publish=myOnPublishCallback)
if not success:
 print("Not connected to IoTF")
 time.sleep(5)
```

```
deviceCli.commandCallback = myCommandCallback
# Disconnect the device and application from the cloud
deviceCli.disconnect()
```

8.Testing

8.1 Test Cases

Test Cases	Feature Type	Component	Test Scenario	Steps to execute	Expected Result	Actual Result	Status
Login Page 1	UI	Node Red	Verify whether the details got from the sensor are presentable on the Web UI App	The details will be stored in the IBM Cloud and it is got through the Nodered Application in form of http link	The value of the parameters as collected from the IoT sensors are displayed as key:value pair	Working as Excepted	Pass
Login Page 2	User Page Details	MIT App Inventor	Verify whether the user can be able to get the details in the Mobile App	The App's back end is to made ready such that it is ready to accept the values from the cloud	The values are displayed in the App screen in the User's Mobile Application	Working as Excepted	Pass

8.2 User Acceptance Testing:

This report shows the number of test cases that have passed,failed and untested

Section	**Total cases**	**Not tested**	**Fail**	**Pass**
Data entry to Cloud	25	0	4	21
Details from Cloud to Nodered	15	0	5	10
Nodered to Web UI	15	0	2	13
MIT App details	10	0	0	10
Temperature parameter	20	0	0	20
pH parameter	20	0	0	20
DO2 parameter	20	0	2	18
Turbidity parameter	20	0	3	17

9.Results

9.1 Performance Metrics

Model Performance Testing

Project Team shall fill the following details in Model Performance Testing Template

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S.No	Parameter	Values
1	Dashboard Design	Nodered Dashboard and MIT App Dashboard
2	Data Responsiveness	Random Values collected from the sensor
3	Utilization of Data Filters	Threshold values were fixed by the Python Script
4	Effective Data Collected	Data were collected and displayed as Web UI and MIT App
5	Descriptive Details	Graphs were drwan from the values got from the sensor

10.Advantages & Disadvantages

- **Helps in continuous monitoring of water quality on REAL time basis**.
- Raises alarms in case the water quality is not as per required standards.
- Helps the treatment plant operators to take immediate corrective actions if the water quality is not as per required standards.
- **The system is less effective as sensors are installed very deep inside the water and their positions are fixed**.
- The sensors are very expensive.
- Moreover their maintenance cost is also very high.

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11.Conclusion

Monitoring of Turbidity, PH & Temperature of Water makes use of water detection sensor with unique advantage and existing GSM network. The system can monitor water quality automatically, and it is low in cost and does not require people on duty. So the water quality testing is likely to be more economical, convenient and fast. The system has good flexibility. Only by replacing the corresponding sensors and changing the relevant software programs, this system can be used to monitor other water quality parameters. The operation is simple. The system can be expanded to monitor hydrologic, air pollution, industrial and agricultural production and so on. It has widespread application and extension value.

12.Future Scope:

- In future we use IOT concept in this project
- Detecting the more parameters for most secure purpose
- Increase the parameters by addition of multiple sensors
- By interfacing relay we controls the supply of water

13.Appendix

APPENDIX : AUTOMATIC WATER QUALITY MONITORING

General considerations

The analytical methods employed with automatic water quality monitors (or on-line instruments) are, in the main, fundamentally the same as those used in the laboratory. The main difference

between laboratory instrumentation and on-line instrumentation is to do with the robustness of construction and the addition of automatic systems for sample preparation, instrument/sample line cleaning and instrument calibration.

GIT-HUB link : https://github.com/IBM-EPBL/IBM-Project-41926-1660646233

Project Video link : https://drive.google.com/file/d/1yJLgPlWwrhNgnEs6hQ8VxcjLEGzes_Qk/view?usp=drivesdk