**REAL TIME RIVER WATER QUALITY**

**MONITORING AND CONTROL SYSTEM**

**Category: INTERNET OF THINGS**

**A PROJECT REPORT**

SUBMITTED BY

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**FROM**

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In fulfillment of project in IBM-NALAIYATHIRAN 2022

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**INTRODUCTION**

“A healthy life does not include polluted water in it”

Water is a key driver of economic and social development while it also has a basic function in maintaining the integrity of the natural environment. However, water is only one of a number of vital natural resources and it is imperative that water issues are not considered in isolation.

There are great differences in water availability from region to region - from the extremes of deserts to tropical forests. In addition, there is variability of supply through time as a result both of seasonal variation and inter-annual variation. All too often the magnitude of variability and the timing and duration of periods of high and low supply are not predictable; this equates to unreliability of the resource which poses great challenges to water managers in particular and to societies as a whole.

There is enough freshwater on the planet for seven billion people but it is **distributed unevenly** and too much of it is wasted, polluted and un-sustainably managed.

This document involves the use of IoT technology with the app to obtain the data of river water conditions and intimate the authorities if there is an alert. The data obtain in this app helps in knowing about the river state i.e., about its contamination, pH values and so on. By knowing this kind of information, one is able to know the availability of good water that is suitable for drinking.

The app frontend was designed using MIT App Inventor and backend is programmed using python script and Node RED. The user interface is designed in easier access manner.

Project Overview

Treatment plants are designed and operated to treat contaminants known to occur in water, comply with the drinking water standards. Unanticipated changes in quality or the presence of unusual contaminants in source water can adversely impact the ability of a utility to meet these objectives. Our app can improve a utility’s ability to detect variations in water quality.

Our project involves the measurement of various water quality parameters in water. Basic water parameters like temperature, pH, its flow rate and ppm that indicates the contamination levels of the water.

IoT technology involves temperature sensor for temperature measurement, pH sensor for pH value, conductivity sensor for ppm measurement and flow sensor measures flow rate.

**PURPOSE**

Water quality refers to chemical, physical biological and radio logical characteristics of Water. It is a measure of the condition of water relative to the necessities of one or more biotic species and or to any human need or purposes. Water quality monitoring is defined as a Sampling and analysis of the water in lake, stream, ocean and river and conditions of the water Body. Smart water quality monitoring is a process of real-time monitoring and the analysis of Water to identify changes in parameters based on the physical, chemical and biological Characteristics. Monitoring water quality is clearly important: in our seas, our rivers, on the Surface and in our ports, for both companies and the public. It enables us to assess how they Are changing, analyse trends and to inform plans and strategies that improve water quality and Ensures that water meets its designated use. There are several indicators determining water Quality. These include dissolved oxygen, turbidity, bio indicators, nitrates, pH scale and water Temperature. Monitoring water quality helps to identify specific pollutants, a certain chemical, And the source of the pollution. There are many sources of water pollution: wastewater from Sewage seeping into the water supply; agricultural practices (e.g., the use of pesticides and Fertilizer); oil pollution, river and marine dumping, port, shipping and industrial activity. Monitoring water quality and a water quality assessment regularly provides a source of data Identifying trends, short and long-term, in water quality.

● Data collected over a period of time will show trends, for example identifying

increasing concentrations of nitrogen pollution in a river or an inland waterway. The

total data will then help to identify key water quality parameters.

● Environmental planning methods: water pollution prevention and management.

● Collecting, interpreting and using data is essential for the development of a sound and effective water quality strategy. The absence of real-time data will however hamper the development of strategies and limit the impact on pollution control. Using digital systems and programs for data collection and management is a solution to this challenge.

● Monitoring water quality is a global issue and concern: on land and at sea. Within the European Union, the European Green Deal sets out goals for restoring biological biodiversity and reducing water pollution, as well as publishing various directives to ensure standards of water quality. Individual nation states, for example France, have also clear regulatory frameworks requiring the effective monitoring of water quality. In the United States, the Environmental Protection Agency (EPA) enforces regulations to address water pollution in each state. Across the world, countries increasingly understand the importance of effective water quality monitoring parameters and methods.

**LITERATURE SURVEY**

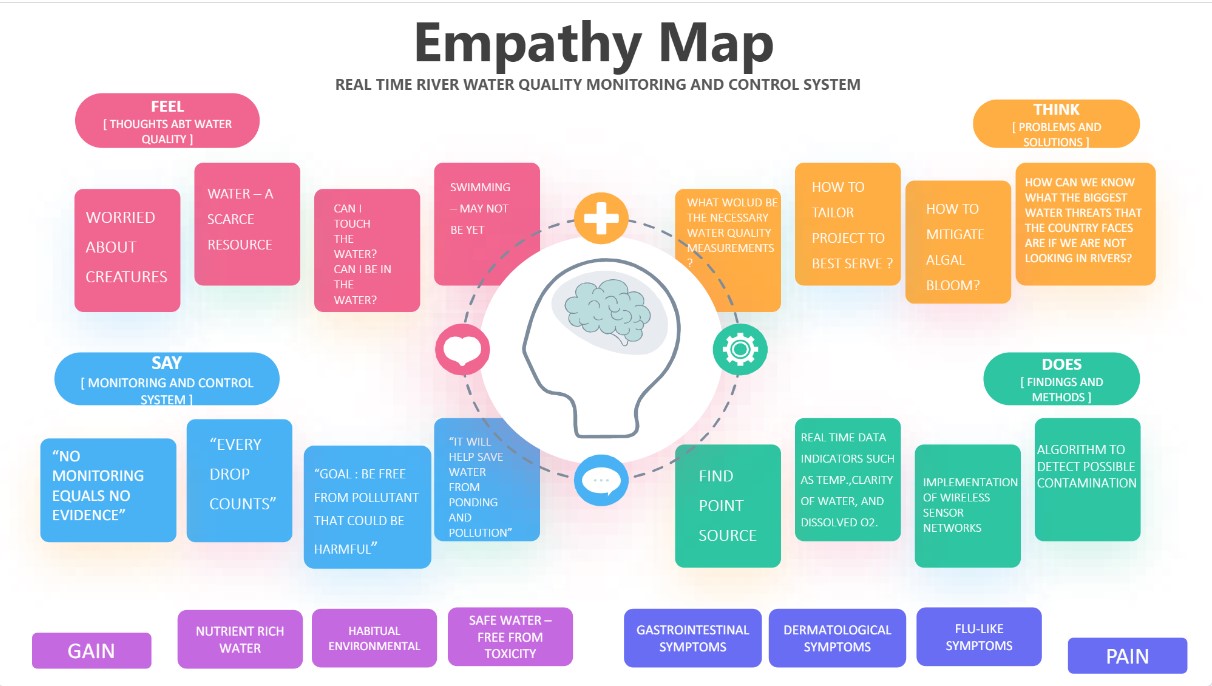
|  |  |  |  |
| --- | --- | --- | --- |
| WORKED MODELS | METHODOLOGY | PUBLISHED YEAR | JOURNAL  NAME |
| IOT Based Real-time River Water Quality Monitoring System | Real-time remote monitoring; Sensor technology; Telemetry | FEB 2004 | Journal of Experimental Marine Biology and Ecology |
| Water Quality Monitoring Using Wireless Sensor Networks | Sensor networks; Sensors and actuators | January 2017 | ACM Transactions on Sensor Networks |
| Using Synchronous Fluorescence Technique as a Water Quality Monitoring Tool | Water quality monitoring BOD  Source discrimination.; Fluorescence measurement | January 2008 | Springer |
| Real-time monitoring of water quality to identify pollution pathways | Diffuse and point sources, Mobile station, Online measurement  Pollution Sensor, Wet chemical analyser | October 2018 | Science of the Total Environment |
| Internet of things enabled real time water quality monitoring system | Water quality, Smart solution, Internet of things, Wi-Fi, Cloud storage | July 2017 | Springer Nature |
| IoT Based Real-time River Water Quality Monitoring System | Sensors**;** Water quality monitoring**;** Internet of things;Big Data Analytics System | August 2019 | Elsevier |
| A remote wireless system for water quality online monitoring in intensive Fish culture | web-server-embedded technology; mobile telecommunication technology; artificial neural network (ANNs) | October 2009 | Elsevier |
| Design of Smart Sensors for Real-Time Water Quality Monitoring | Water quality monitoring, flow sensor, pH sensor, conductivity sensor, temperature sensor, ORP sensor, ZigBee, wireless sensor networks | July 2016 | IEEE |

Problem statement

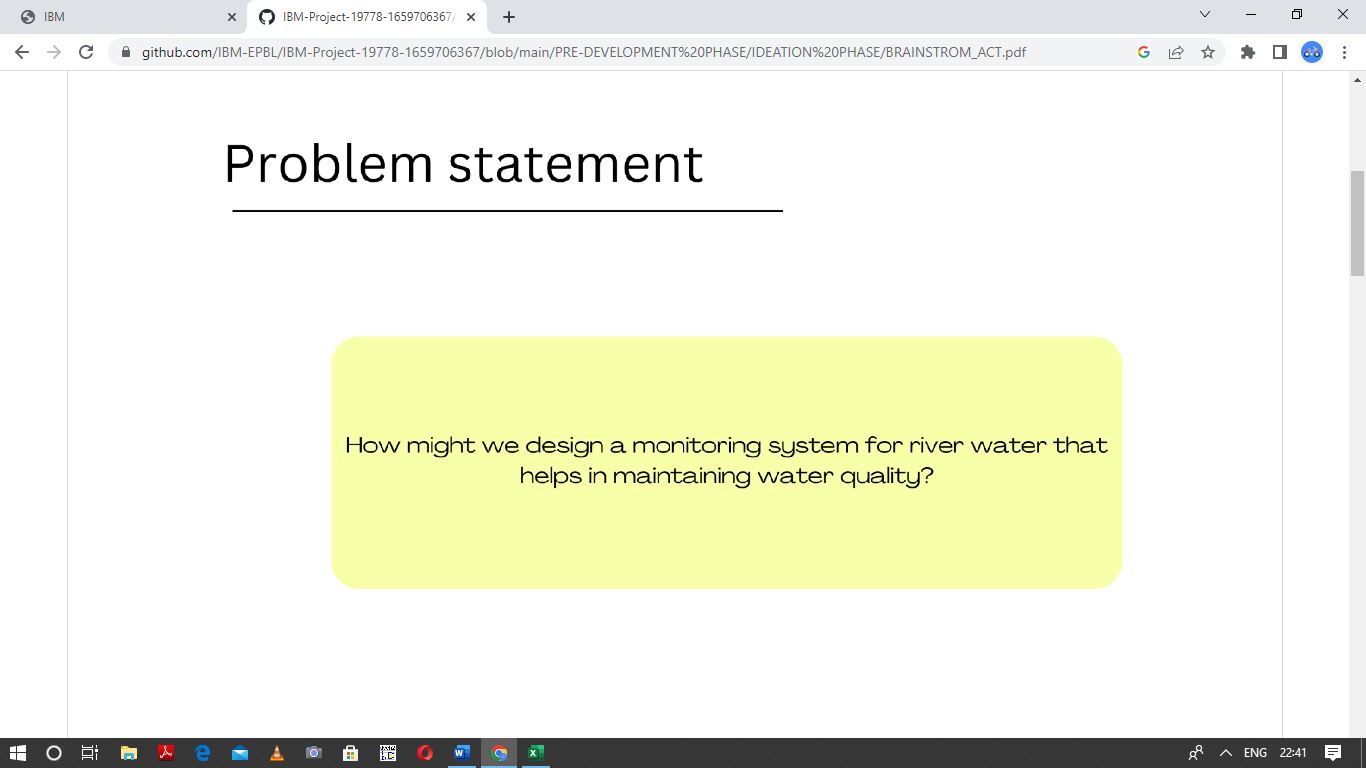
Due to the fast-growing urbanization supply of safe drinking water is a challenge for every city authority. Water can be polluted any time. So, the water we reserved in the water tank at our roof top or basement in our society or apartment may not be safe. Still in India most of the people use simple water purifier that is not enough to get surety of pure water. Sometimes the water has dangerous particles or chemical mixed and general-purpose water purifier cannot purify that. And it’s impossible to check the quality of water manually in every time. So, an automatic real-time monitoring system is required to monitor the health of the water reserved in our water tank of the society or apartment. So, it can warn us automatically if there is any problem with the reserved water. And we can check the quality of the water anytime and from anywhere. By keeping this mind, we designed this system especially for residential areas.

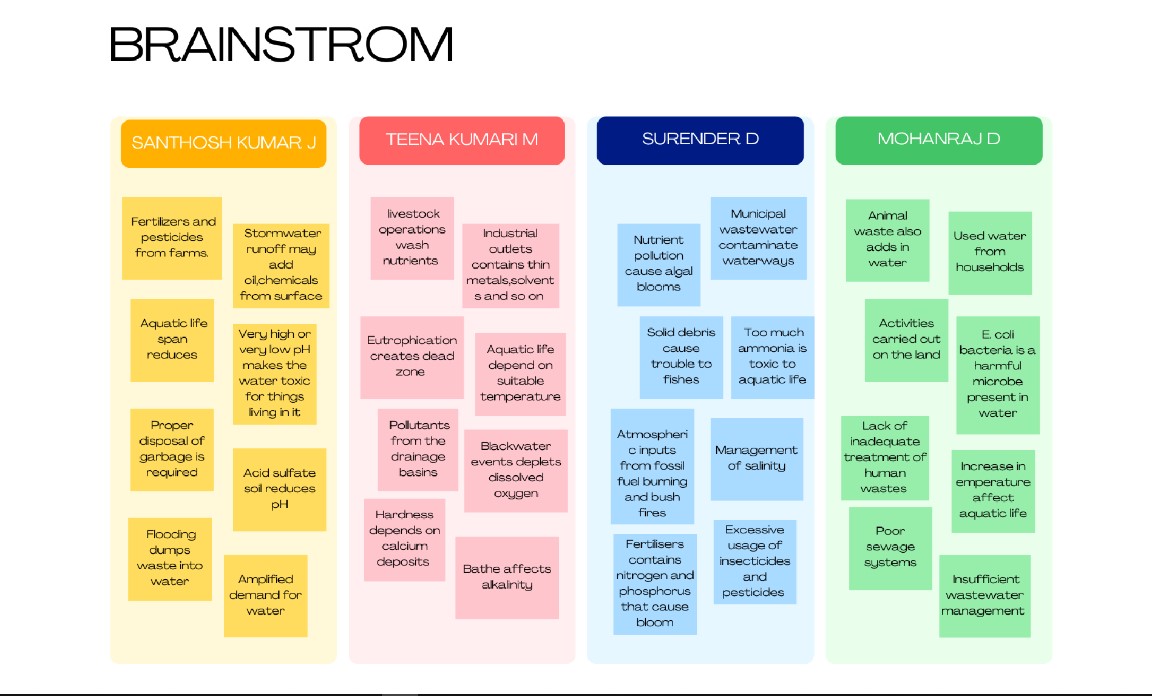
**IDEATION & PROPOSED SOLUTION**

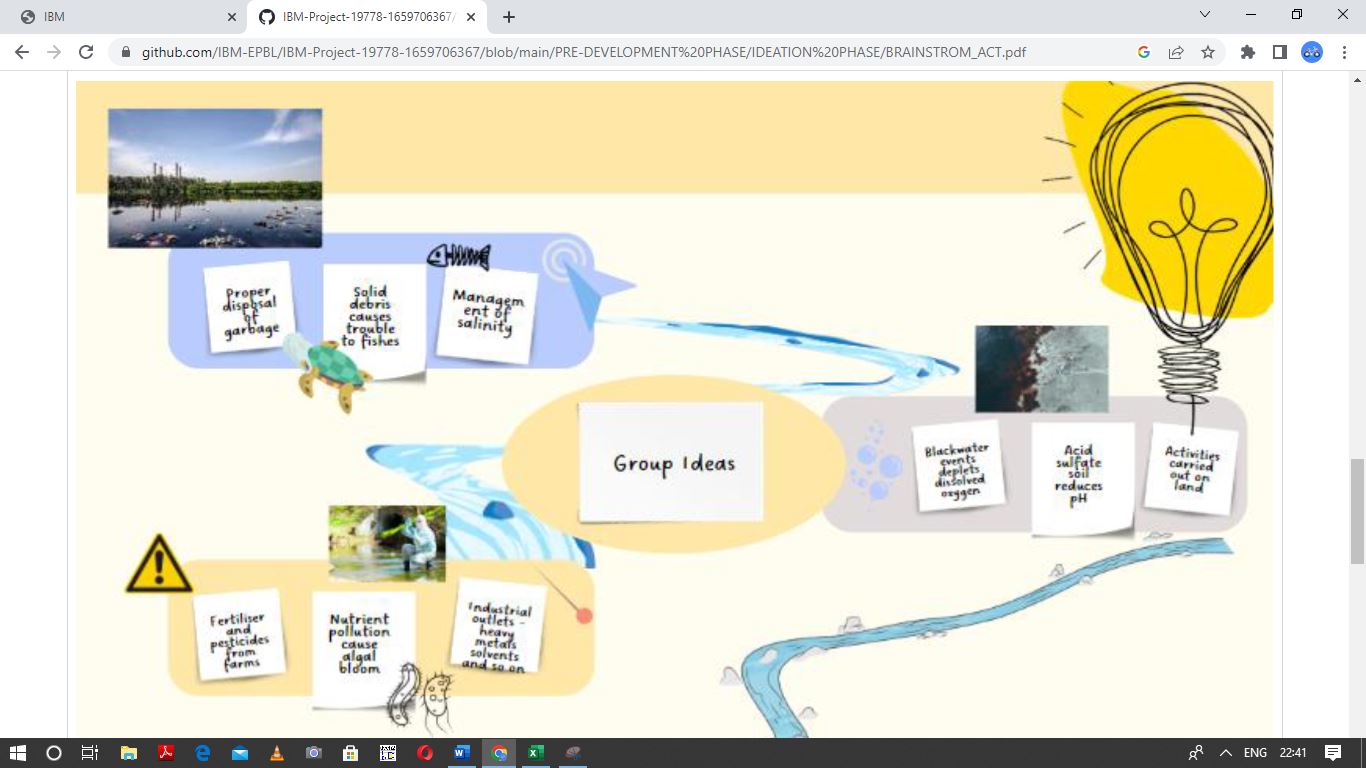
Empathy Map Canvas

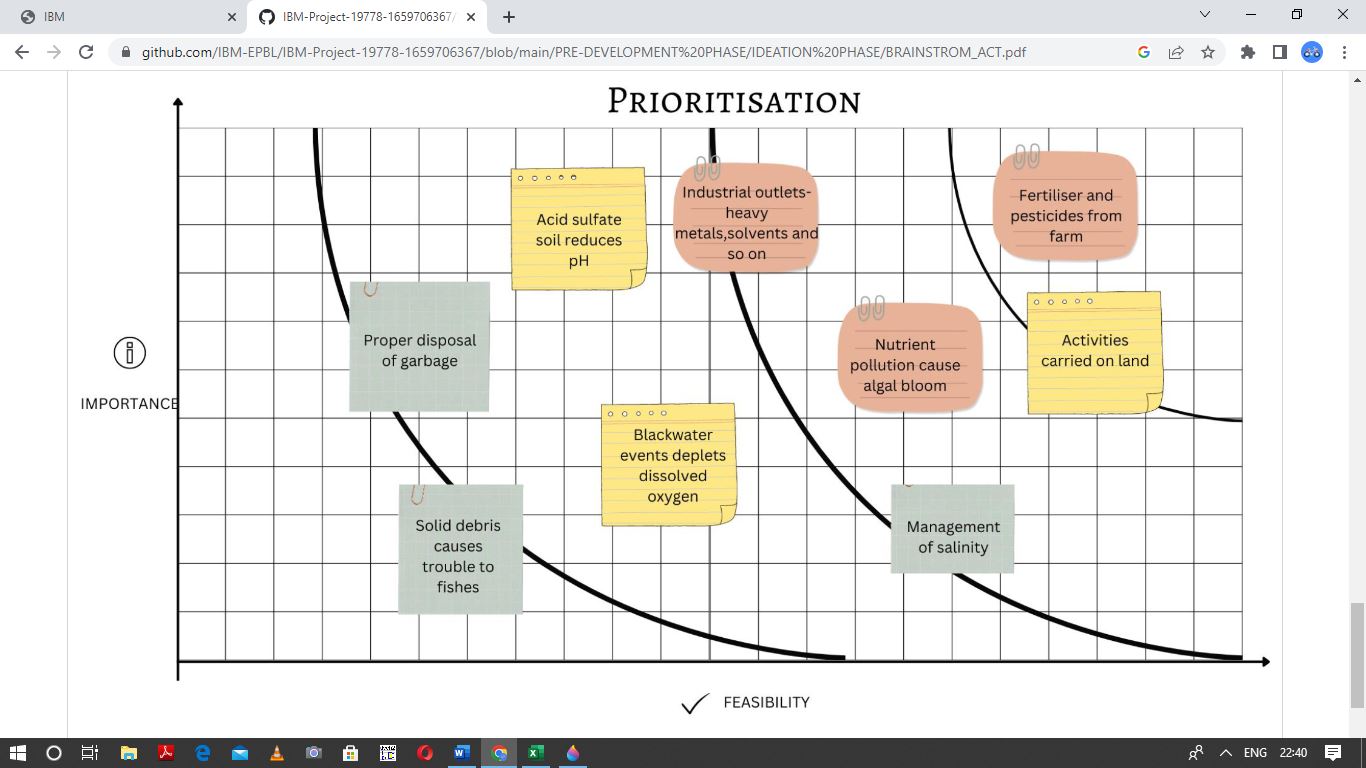
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Ideation & Brainstorming

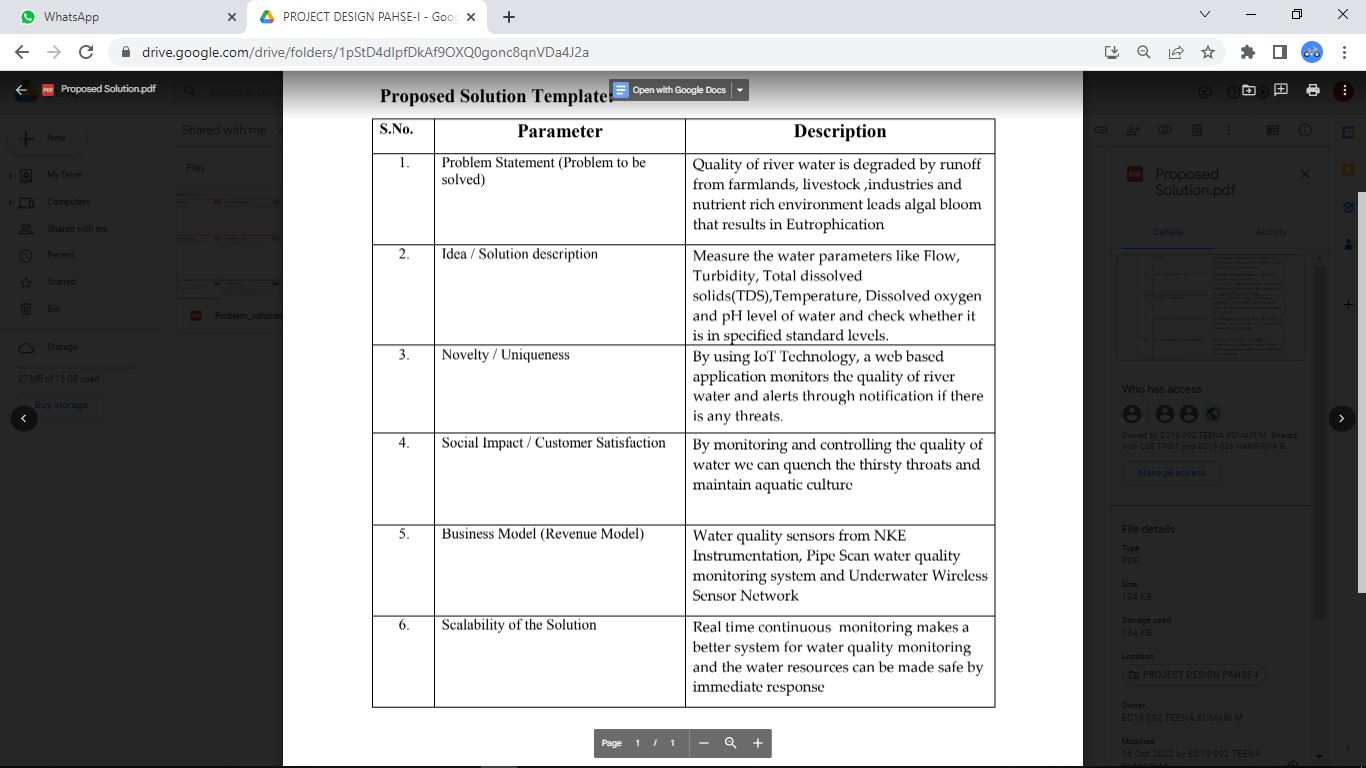




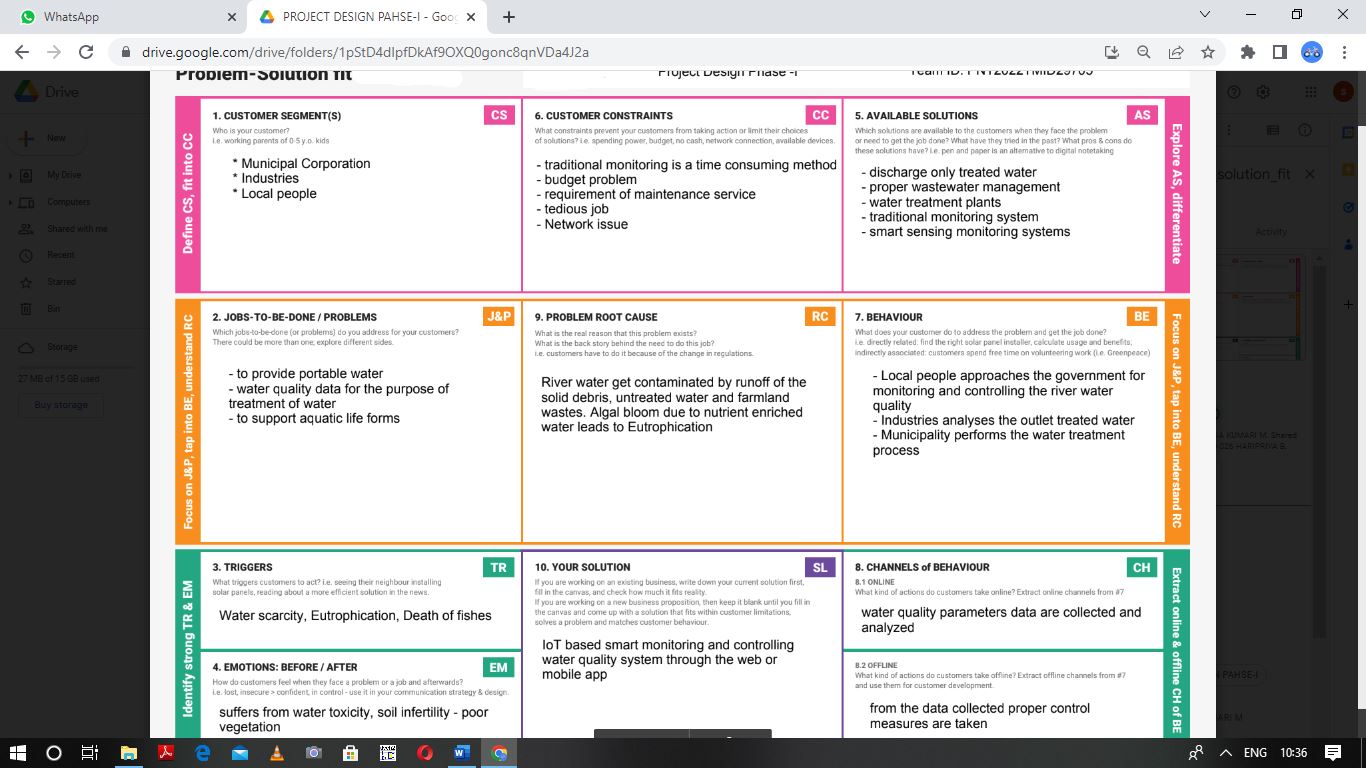


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Proposed Solution

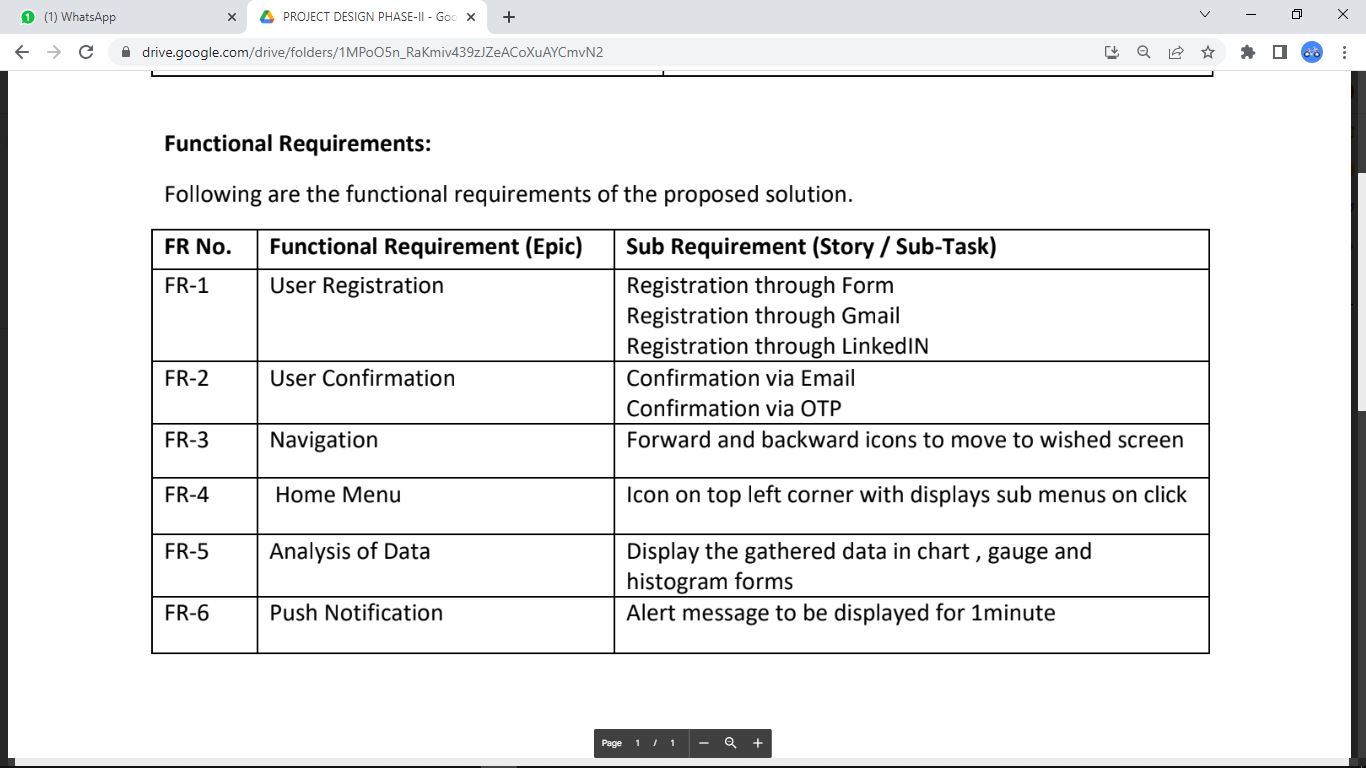


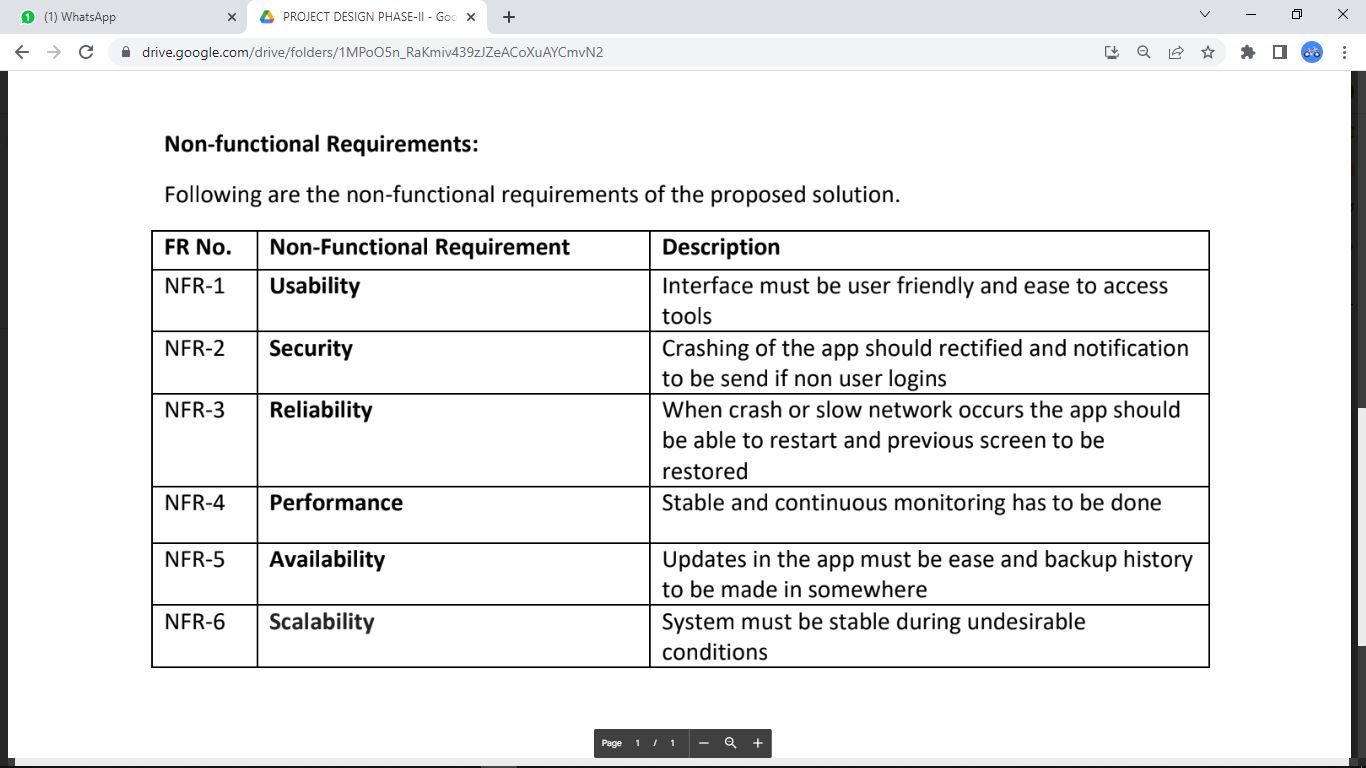
Problem Solution Fit



**REQUIREMENT ANALYSIS**

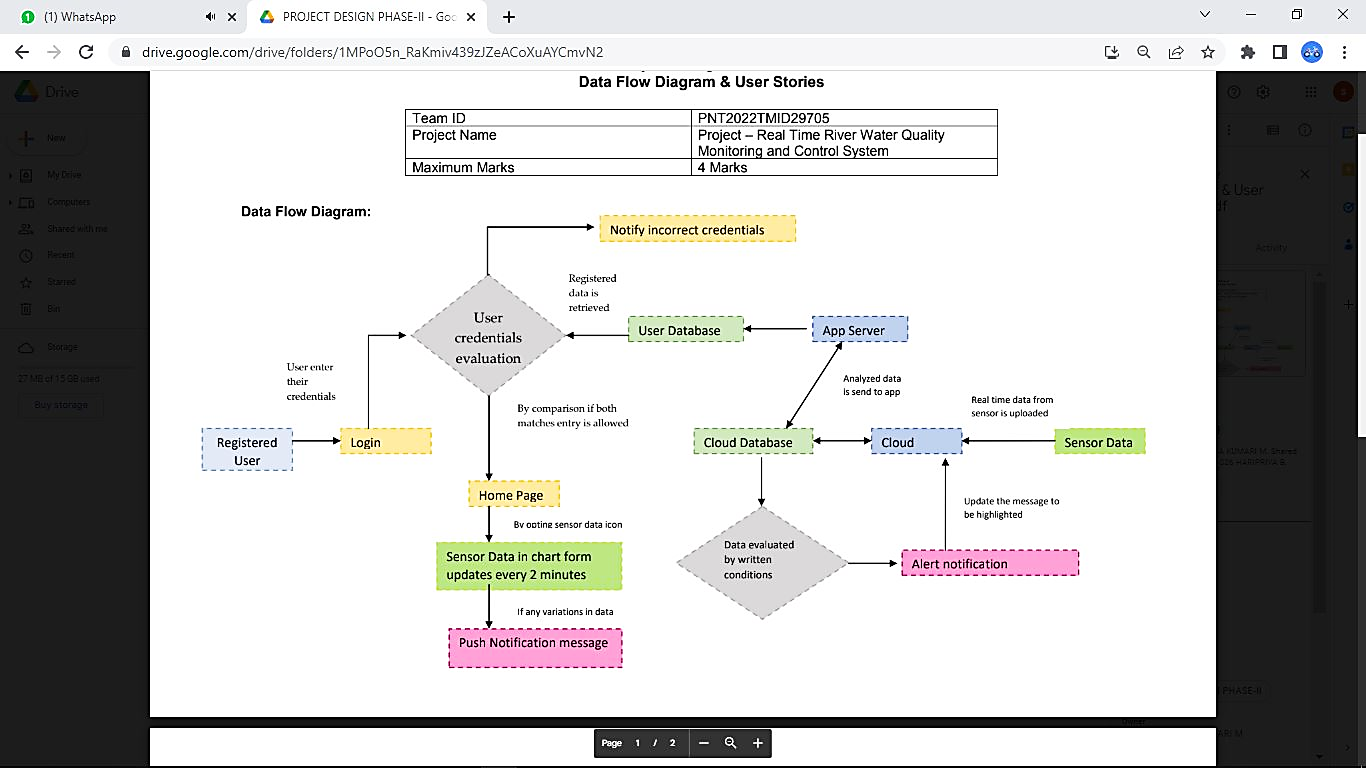
Functional Requirement



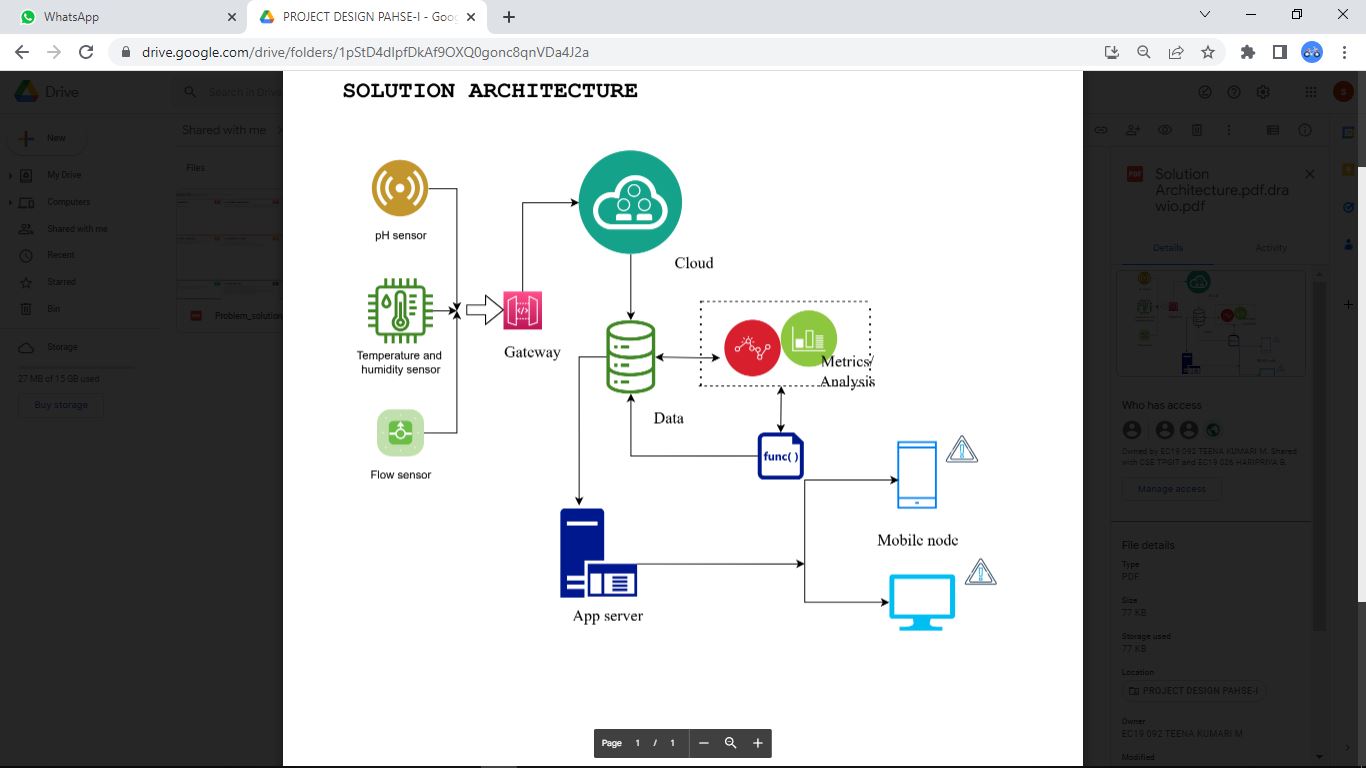
**N**on-Functional Requirements

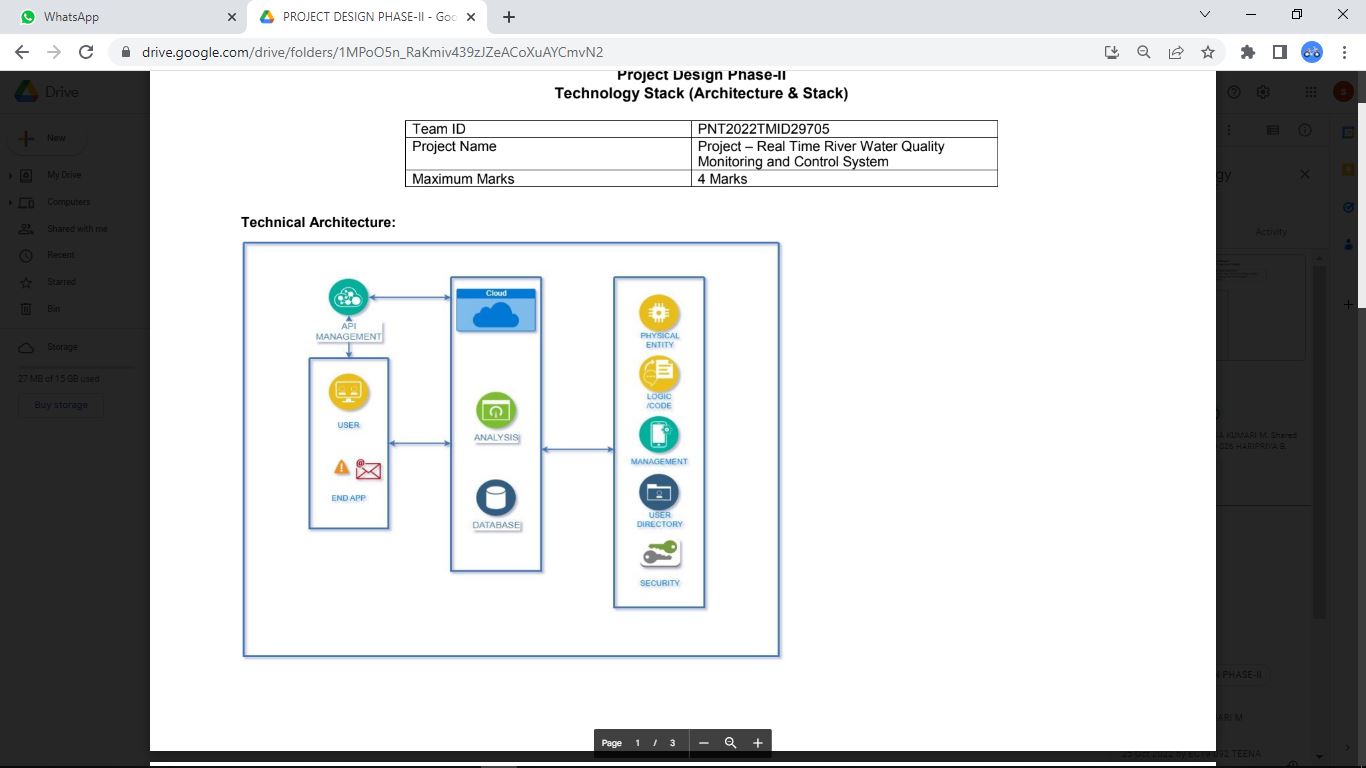
PROJECT DESIGN

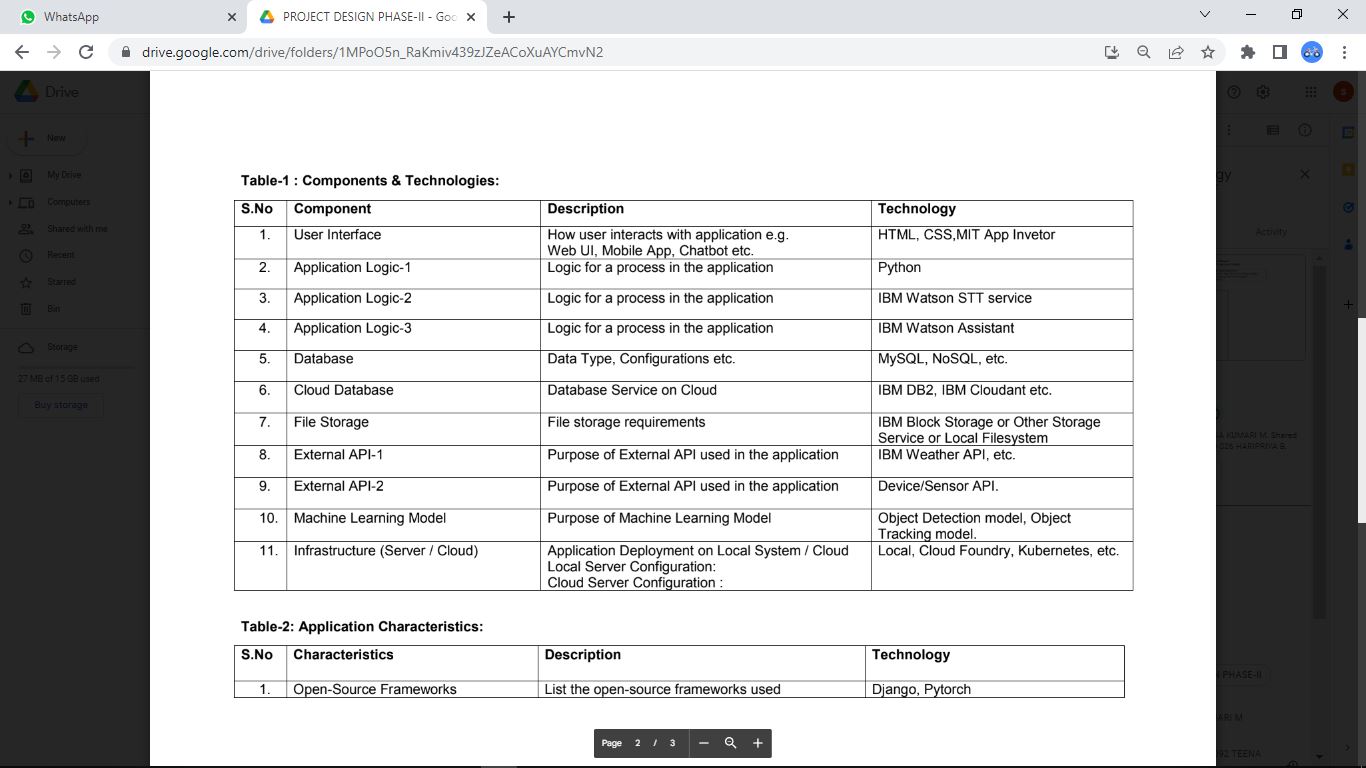
Data flow Diagrams

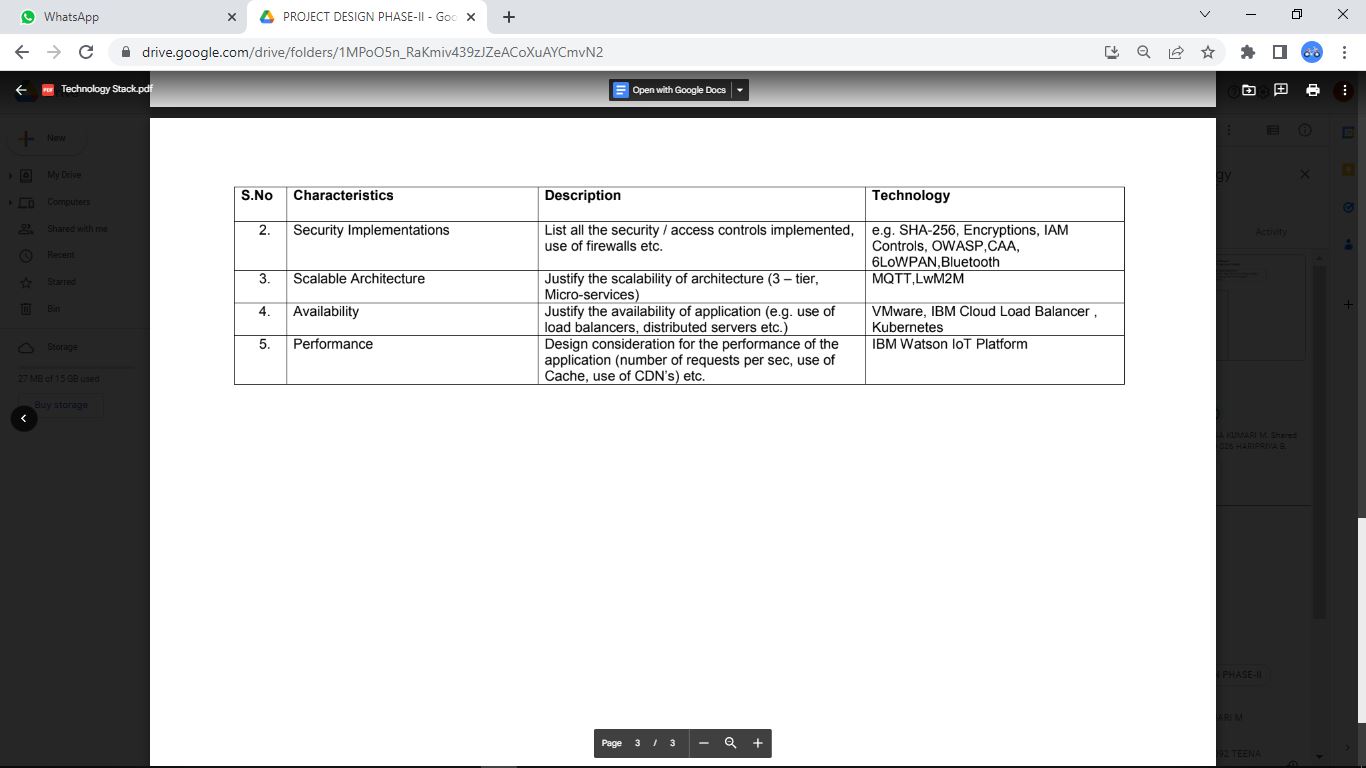


Solution &Technical Architecture

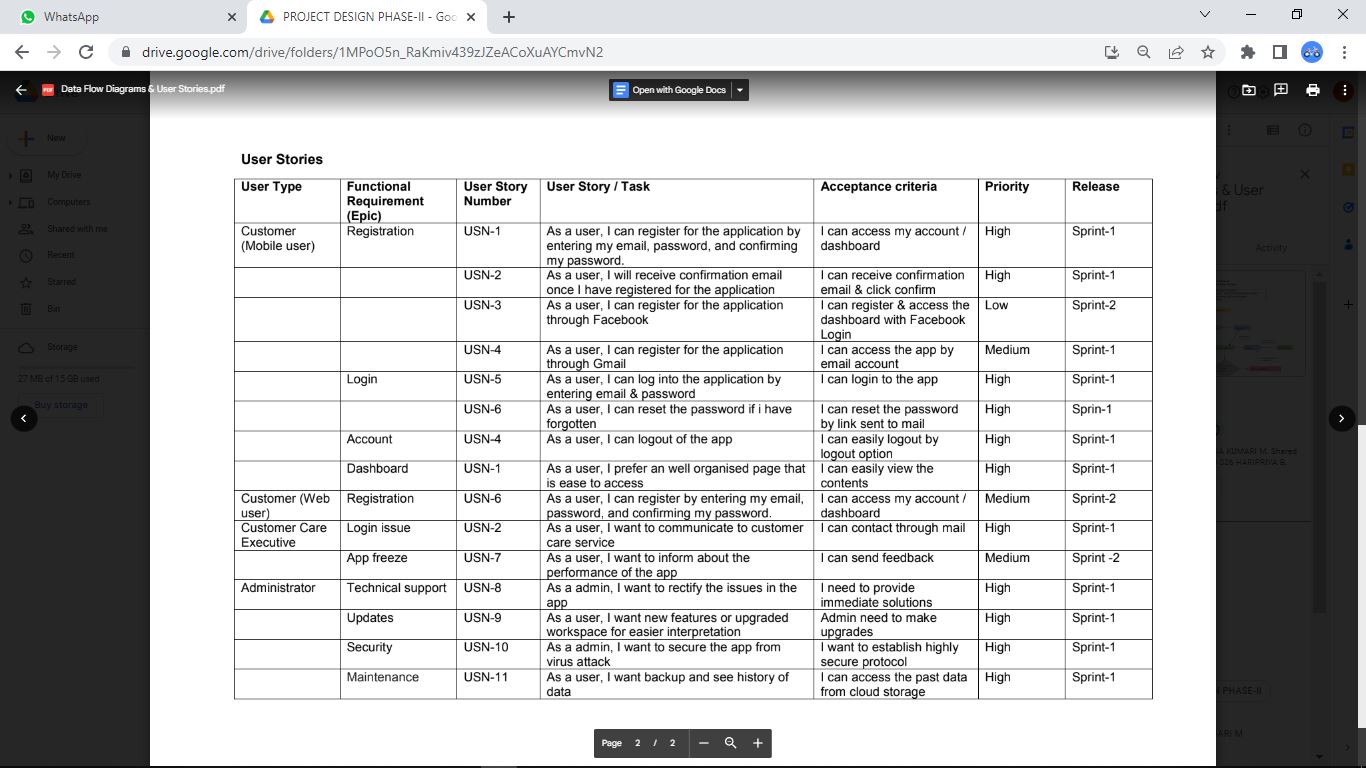


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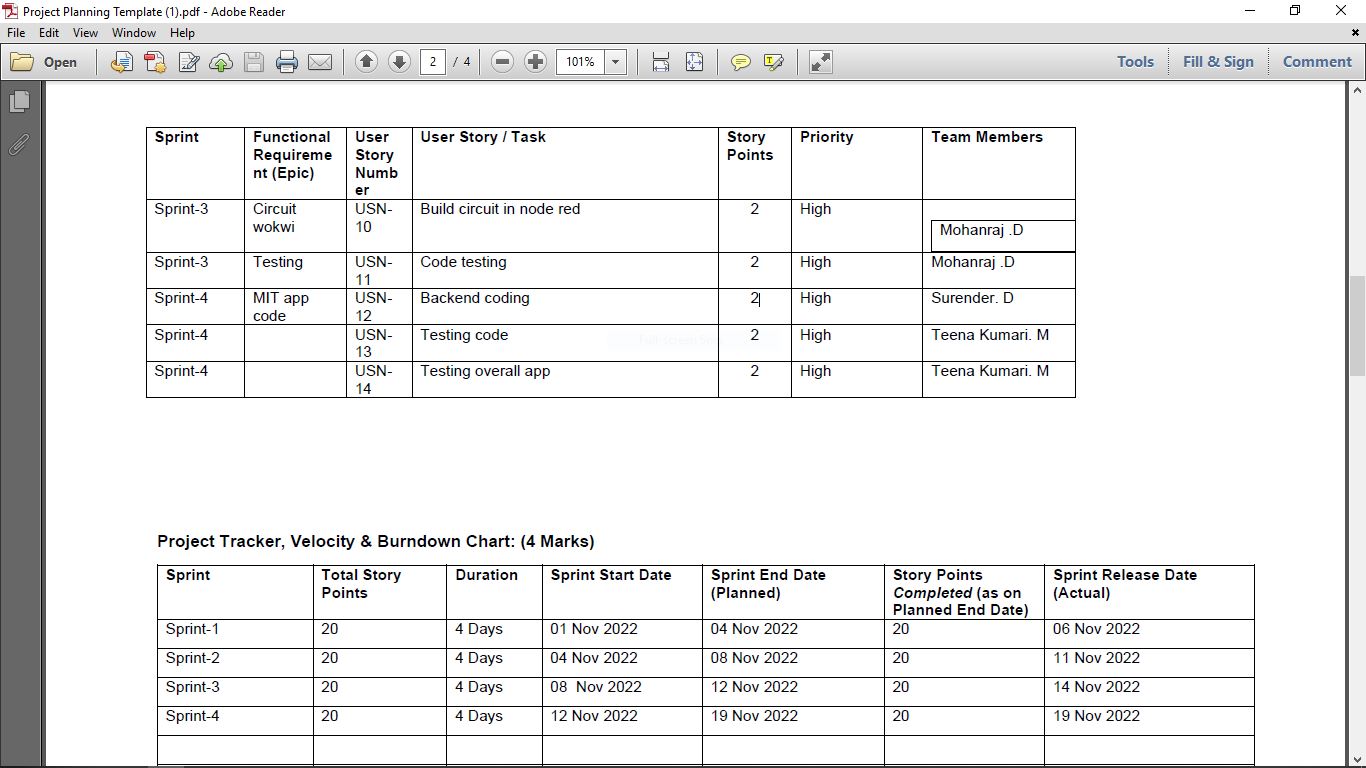
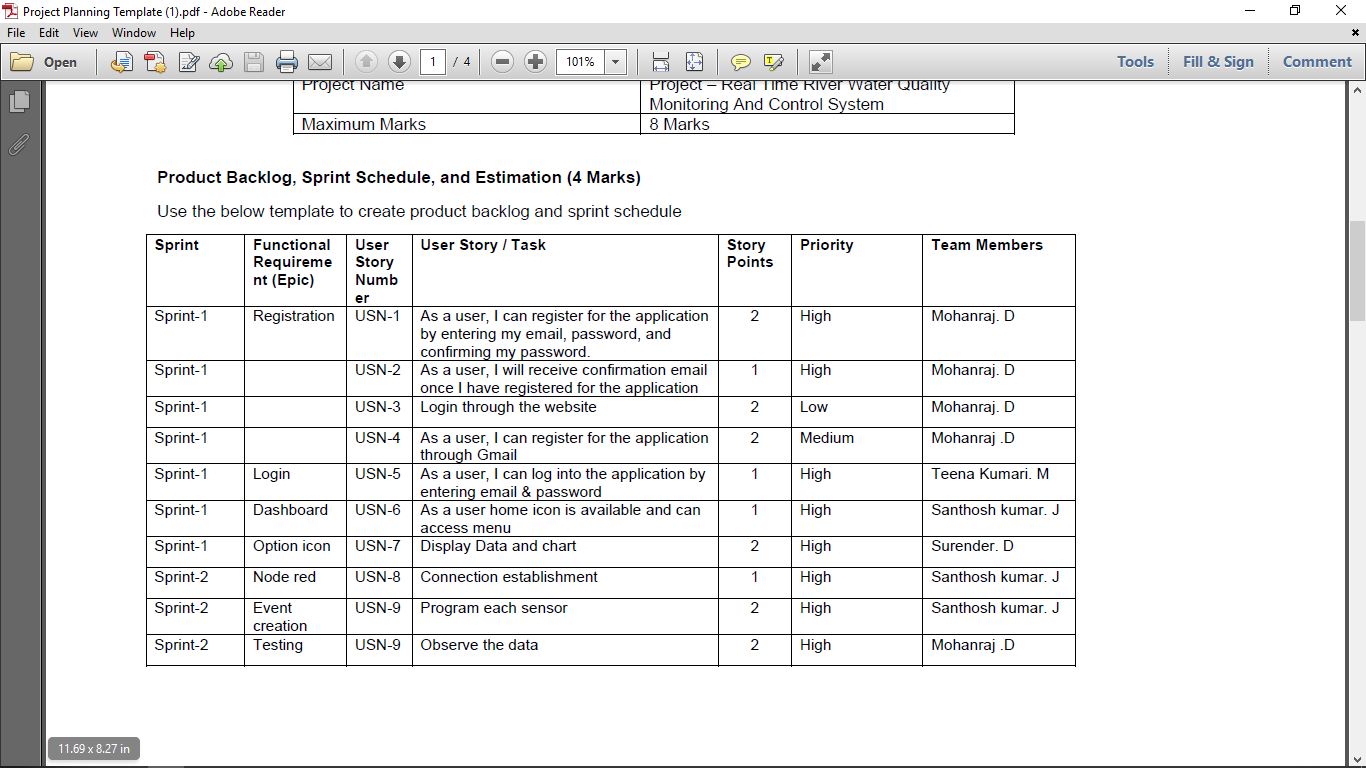
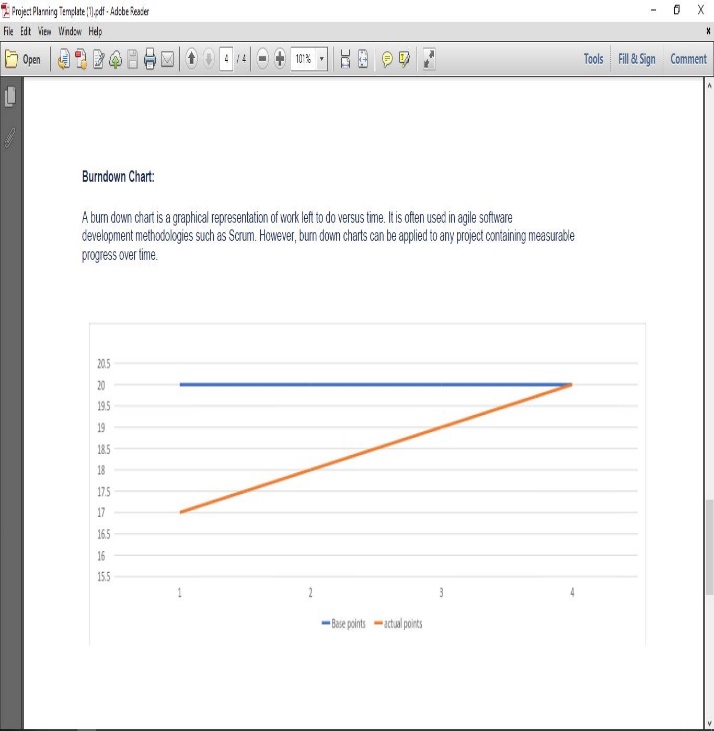
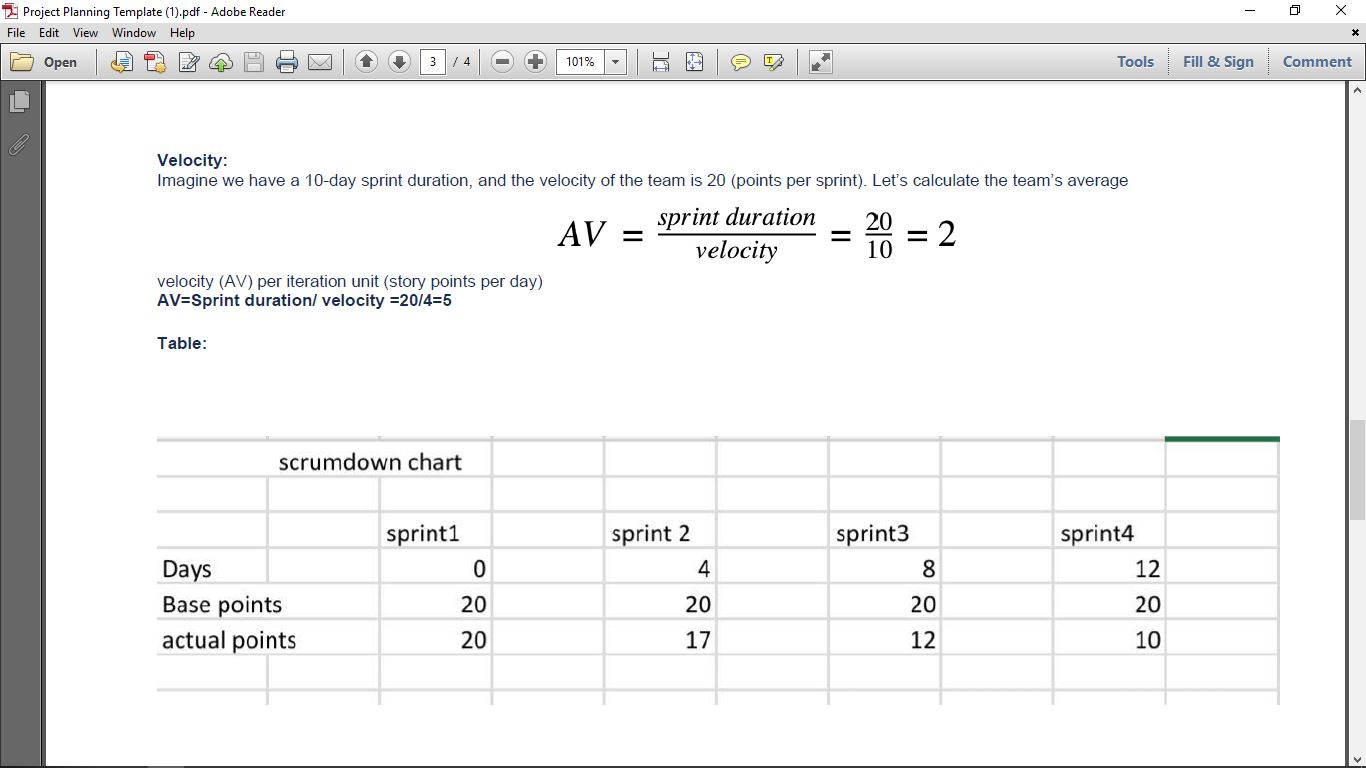
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User Stories

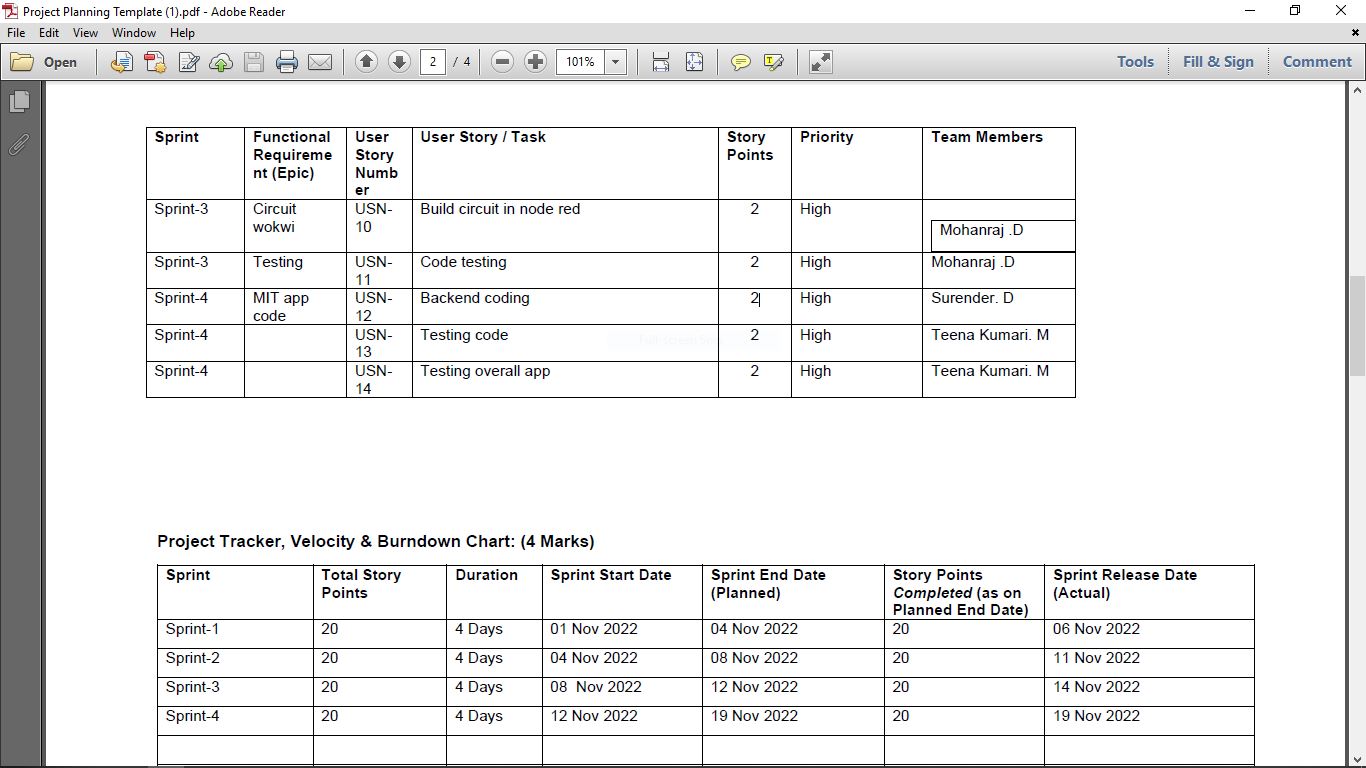


PROJECT PLANNING & SCHEDULING

Sprint Planning & Estimation

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Sprint Delivery Schedule



**CODING AND SOLUTIONING**

Python Code:

import time

import sys

import ibmiotf

import ibmiotf.device

import random

#Provide your IBM Watson Device Credentials

organization = "khwc4s"

deviceType = "check"

deviceId = "2468"

authMethod = "token"

authToken = "09876543"

# Initialize GPIO

def myCommandCallback(cmd):

print("Command received: %s" % cmd.data['command'])

status=cmd.data['command']

if status=="lighton":

print ("led is on")

elif status == "lightoff":

print ("led is off")

else :

print ("please send proper command")

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 of type "greeting" 10 times

deviceCli.connect()

while True:

#Get Sensor Data from DHT11

temp=random.randint(0,100)

ph=random.randint(0,14)

ppm=random.randint(0,1000)

flow=random.randint(0,200)

data = { 'temp' : temp, 'ph': ph,'ppm':ppm,'flow':flow }

#print data

def myOnPublishCallback():

print ("Published Temp = %s C" % temp, "ph = %s " % ph,"ppm = %s ppm" % ppm,"flow = %s l/m" % flow, "to IBM Watson")

success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0, on\_publish=myOnPublishCallback)

if not success:

print("Not connected to IoTF")

time.sleep(10)

deviceCli.commandCallback = myCommandCallback

# Disconnect the device and application from the cloud

deviceCli.disconnect()

**TESTING:**

* Testing is the most important part of the software development process.

Some of the reasons for its importance are as follows:

● Testing helps find and fix the bugs in the software which prevent the

program from performing as required or as efficiently as needed.

● Bug fixing in the early development stages helps to save a lot of time

and effort.

● Testing is very essential to make sure that the final output product will

work well without any errors once deployed.Testing improves the

quality of the software.

● Validation is the process of ensuring that the software built is in

accordance with the expected business requirements.

User Acceptance Testing

# Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the [Real time River water quality monitoring and control system] project at the time of the release to User Acceptance Testing (UAT).

# Defect Analysis

This report shows the number of resolved or closed bugs at each severity level, and how they were resolved

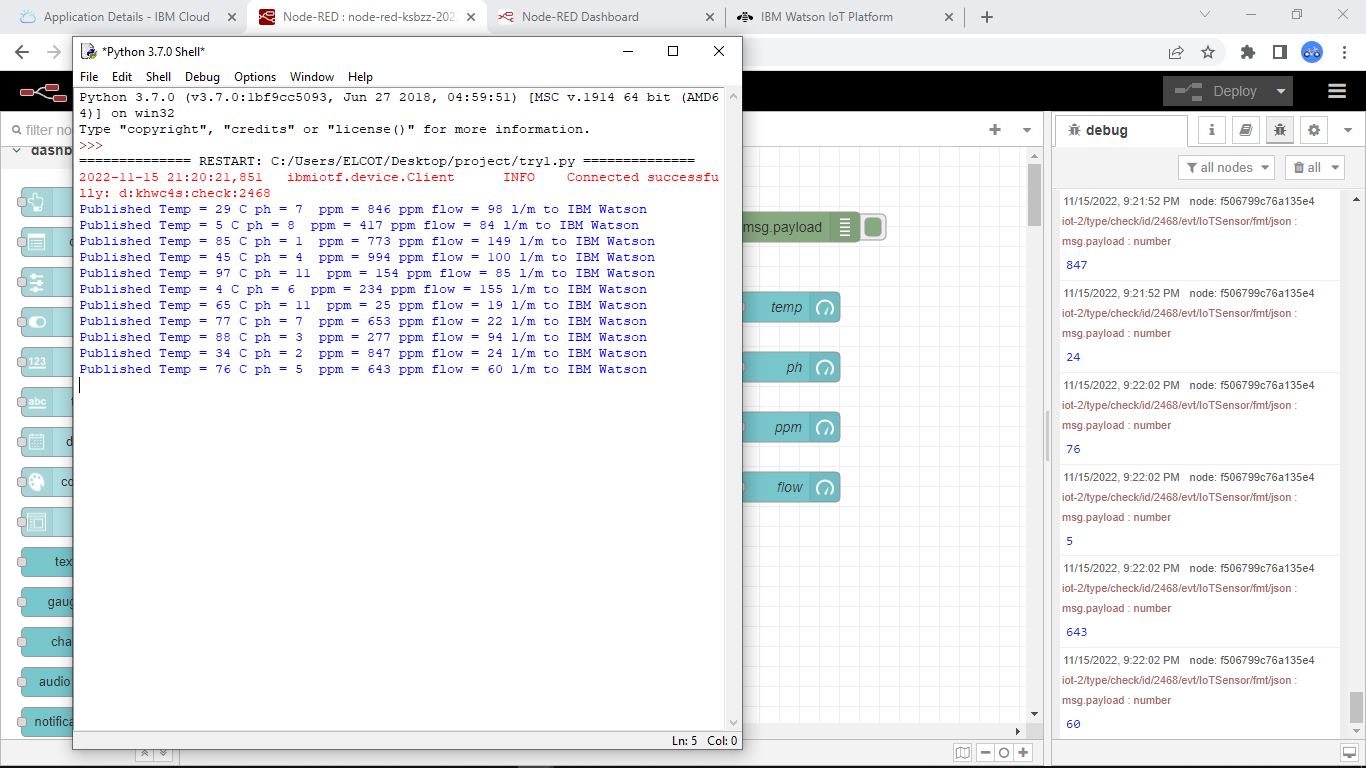
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| --- | --- | --- | --- | --- | --- |
| **Resolution** | **Severity 1** | **Severity 2** | **Severity 3** | **Severity 4** | **Subtotal** |
| By Design | 8 | 4 | 2 | 3 | 17 |
| Duplicate | 1 | 0 | 4 | 0 | 5 |
| External | 2 | 3 | 0 | 1 | 6 |
| Fixed | 10 | 2 | 4 | 16 | 32 |
| Not Reproduced | 0 | 0 | 1 | 0 | 1 |
| Skipped | 0 | 0 | 1 | 1 | 2 |
| Won't Fix | 0 | 2 | 2 | 1 | 5 |
| Totals | 21 | 11 | 14 | 22 | 68 |

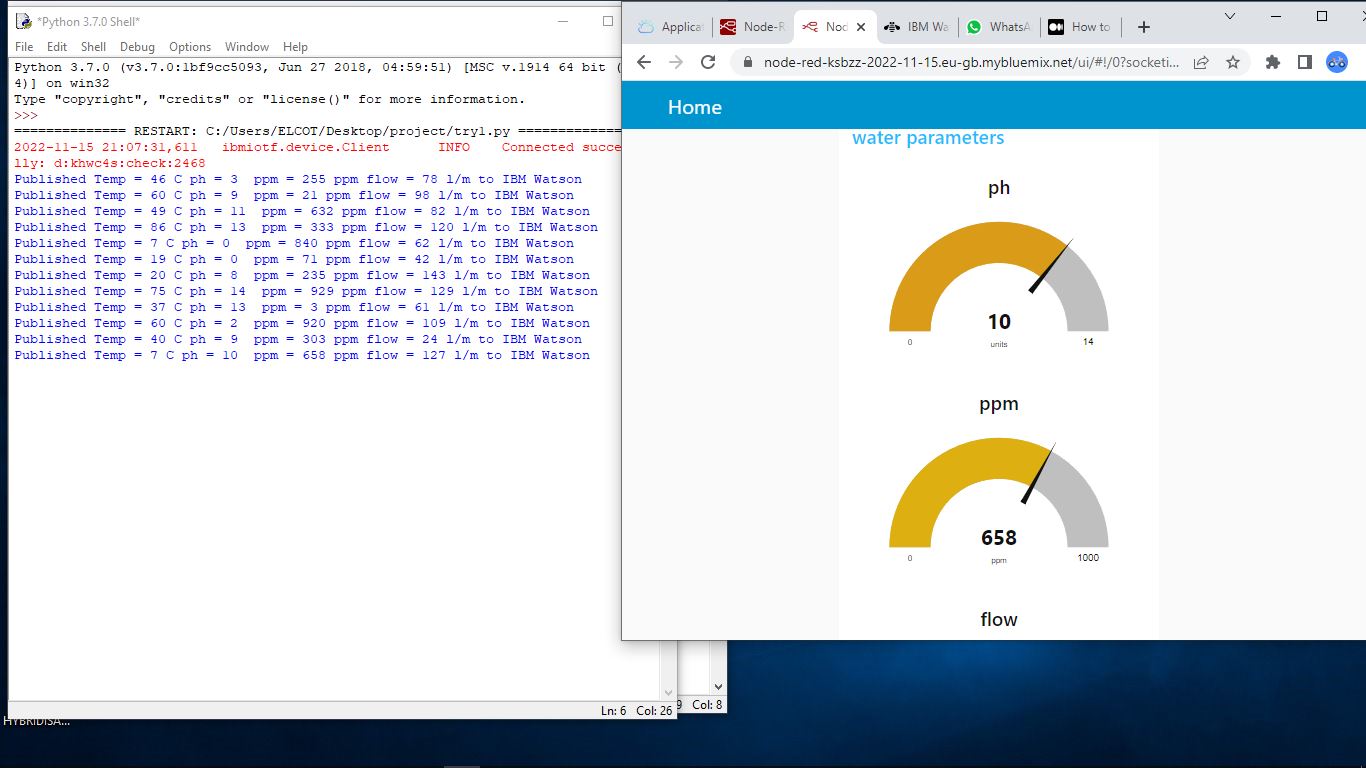
# Test Case Analysis

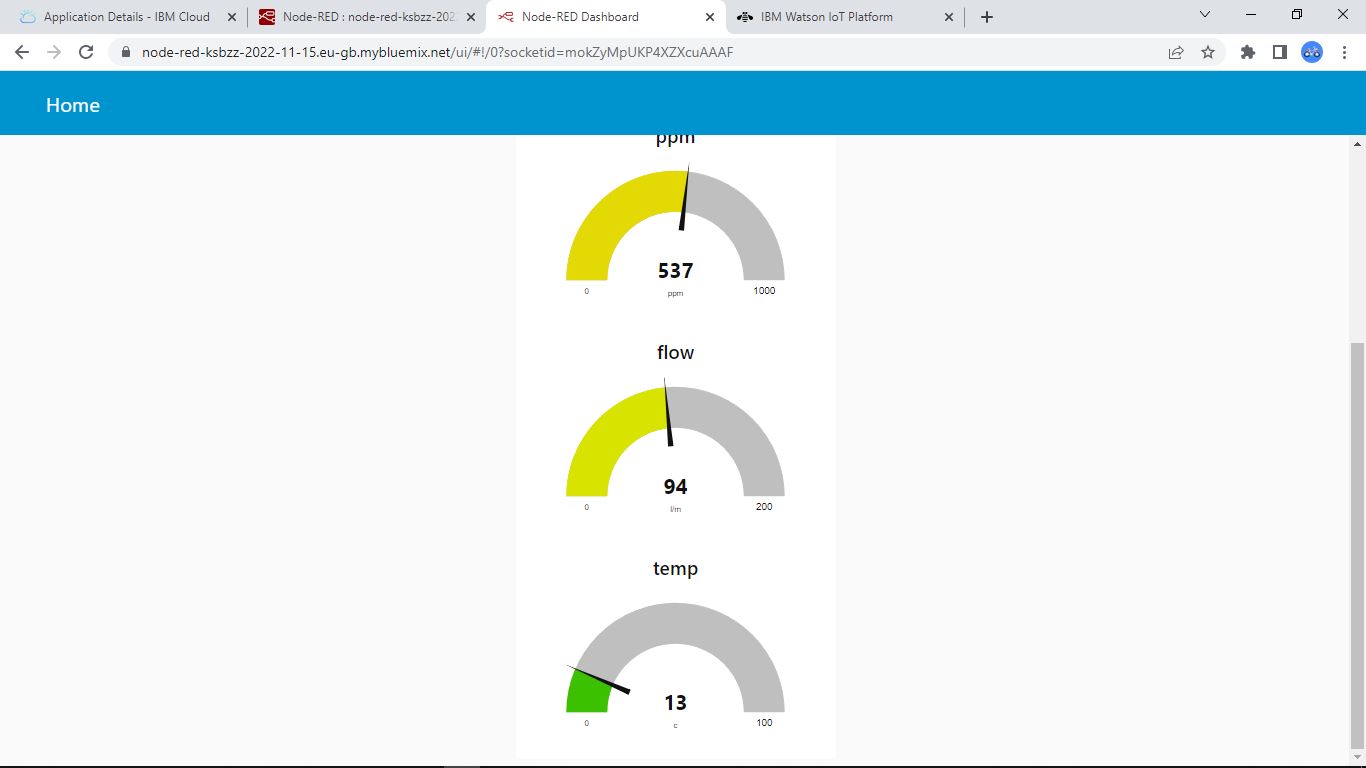
This report shows the number of test cases that have passed, failed, and untested

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Section | Total Cases | Not Tested | Fail | Pass |
| Print Engine | 2 | 0 | 0 | 1 |
| Client Application | 5 | 0 | 0 | 3 |
| Security | 2 | 0 | 0 | 2 |
| Exception Reporting | 4 | 0 | 0 | 3 |
| Final Report Output | 2 | 0 | 0 | 2 |
| Version Control | 2 | 0 | 0 | 2 |

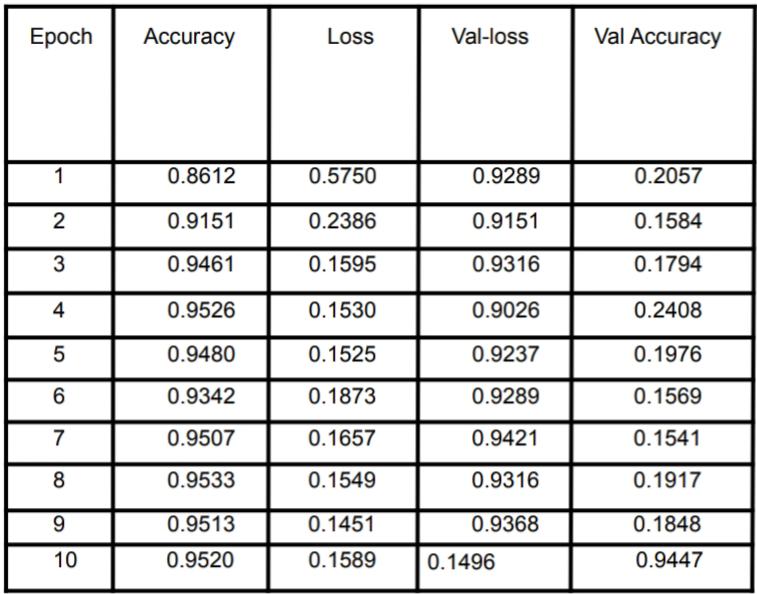
**RESULT**







Performance metrics



ADVANTAGES & DISADVANTAGES

Advantages

Identifying the health of your water will help you to discover where it may need some help. Ultimately, finding a source of pollution, or remaining proactive with your monitoring will enable you to save money in the long term.

The more information that you can obtain will assist you with your decision on what product you may need to improve the condition of your water. Simply guessing and buying products based on a hunch or a general trend is ill-advised, as each body of water has unique properties that can only be discovered through testing.

Measuring the amount of dissolved oxygen in your water is another important advantage of water quality testing, as typically the less oxygen, the higher the water temperature, resulting in a more harmful environment for aquatic life.

These levels do fluctuate slightly across the seasons, but regular monitoring of your water quality will allow you to discover trends over time, and whether there are other factors that may be contributing to the results you discover.

Disadvantages

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.

The sensors which work on power source may often required to be replaced in case of malfunctioning.  
Mounted Sensors may get damage during natural disasters and often by aquatic animals.

CONCLUSION

Real-time monitoring of water quality by using IoT will immensely help people to become conscious against using contaminated water as well as to stop polluting the water. The research is conducted focusing on monitoring river water quality in real-time. Therefore, IoT is appeared to be a better solution as reliability, scalability, speed, and persistence can be provided.

FUTURE SCOPE

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.

APPENDIX Source Code:

PROGRAM:

import time

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import ibmiotf.device

import random

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#..............................................

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ppm=random.randint(0,1000)

flow=random.randint(0,200)

data = { 'temp' : temp, 'ph': ph,'ppm':ppm,'flow':flow }

#print data

def myOnPublishCallback():

print ("Published Temp = %s C" % temp, "ph = %s " % ph,"ppm = %s ppm" % ppm,"flow = %s l/m" % flow, "to IBM Watson")

success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0, on\_publish=myOnPublishCallback)

if not success:

print("Not connected to IoTF")

time.sleep(10)

deviceCli.commandCallback = myCommandCallback

# Disconnect the device and application from the cloud

deviceCli.disconnect()

**GITHUB LINK:** [**https://github.com/IBM-EPBL/IBM-Project-19778-1659706367**](https://github.com/IBM-EPBL/IBM-Project-19778-1659706367)

**https://drive.google.com/file/d/1pmpR30xteVwbb5HcXnvy1vq4Up1BZXZu/view?usp=drivesdk**