CHAPTER 1

INTRODUCTION

The environment consists of five key elements e.g., soil, water, climate, natural vegetation, and landforms. Among these water is the utmost crucial element for human life. It is also vital for the persistence of other living habitats. Whether it is used for drinking, domestic use, and food production or recreational purposes, safe and readily available water is the need for public health. So it is highly imperative for us to maintain water quality balance. Otherwise, it would severely damage the health of the humans and at the same time affect the ecological balance among other species. Water pollution is a foremost global problem which needs ongoing evaluation and adaptation of water resource directorial principle at the levels of international down to individual wells. It has been studied that water pollution is the leading cause of mortalities and diseases worldwide. The records show that more than 14,000 people die daily worldwide due to water pollution. In many developing countries, dirty or contaminated water is being used for drinking without any proper prior treatment. One of the reasons for this happening is the ignorance of public and administration and the lack of water quality monitoring system which makes serious health issues . In this paper, we depict the design of Wireless Sensor Network (WSN) that assists to monitor the quality of water with the support of information sensed by the sensors dipped in water. Using different sensors, this system can collect various parameters from water, such as pH, dissolved oxygen, turbidity, conductivity, temperature, and so on. The rapid development of WSN technology provides a novel approach to realtime data acquisition, transmission, and processing. The clients can get ongoing water quality information from far away. Now a day's Internet of things

(IOT) is an innovative technological phenomenon. It is shaping today's world and is used in different fields for collecting, monitoring and analysis of data from remote locations. IOT integrated network if everywhere starting from smart cities, smart power grids, and smart supply chain to smart wearable. Though IOT is still under applied in the field of environment it has huge potential. It can be applied to detect forest fire and early earthquake, reduce air population, monitor snow level, prevent landslide, and avalanche etc. Moreover, it can be implemented in the field of water quality monitoring and controlling system. Water quality monitoring has gained more interest among researchers in this twenty-first century. Numerous works are either done or ongoing in this topic focusing on various aspects of it. The key theme of all the projects was to develop an efficient, cost-effective, realtime water quality monitoring system which will integrate wireless sensor network and internet of things. In this research, we monitor the physical and chemical parameters of water bodies inside Chittagong city by using an IOT based sensor network.

1.1 PROJECT OVERVIEW:

The system consists of several sensors which is used to measure physical and chemical parameters of the water. The main components of Wireless Sensor Network (WSN) include a microcontroller for processing the system, communication system for inter and intra node communication and several sensors.

1.2 PURPOSE:

The major goal is to create a system that uses wireless sensor networks to continuously monitor river water quality at remote locations with low power consumption, low cost and high detection accuracy. pH, conductivity, turbidity level and other parameters are measured in order to enhance water quality.

CHAPTER 2

LITERATURE SURVEY

With the advent of this new era of water crisis, save water is the cry all over. Water sources are encroached from every existence on Earth. Saving water needs a systematic monitoring approach to determine its quality. Availability of Internet of Things (IOT) and remote sensing techniques mark the ease of congregating, analyzing and handling of real time data to further accelerate measures taken upon. Real-time water quality monitoring and management initiates prompt alarm ensuring timely response to water contamination in protecting and conserving the aquatic habitat, improving crop production by controlling quality of irrigated water, etc. This paper upheavals the water quality parameters required due consideration for monitoring real time water quality along with the available remote sensors. Also it briefs the review of parameters covered so far. Further it proposes the methodology suitable to the needs of detecting real time water contaminations based on the challenges of existing management system and IOT

- Water leaving the treatment plant should be safe and of good quality, but contamination could easily happen along the distribution pipelines. This is due to factors like rusty pipes that cause heavy metals to leach and dissolve in water, damaged or broken pipes that let soil and other contaminants or sewage enter the water. Sediment, scale and algae could also build up on water storage tanks over time. In order to keep track of water quality, this study is aimed to develop a real-time water quality monitoring system in water storage tanks that can be implements in society, residential areas and restaurant and food service industry by utilizing Internet of Things (IOT)

technology .The intelligence system can alert users at real-time in case of failing water quality

- Water pollution is one of the biggest fears for the green globalization. In ensure the safe supply of the drinking water the quality needs to the monitor in real time. In this paper we present a design and development of a low cost system for real time monitoring of the water quality in IOT. The system consist of several sensors is used to measuring physical and chemical parameters of a water. The parameters such as temporary, PH, turbidity, flow sensor of the water can be measured. Finally, the sensor data can be viewed on internet using WI-FI system.
- Water pollution is one among the most important fears for the green globalization .In order to ensure the safe supply of the drinking water the quality needs to be monitor in real time .In this paper we present a design and development of a coffee cost system for real time monitoring of the water quality in IOT .The system contains several sensor is employed to measuring physical and chemical parameters of the water.
- The history, culture, current and future socio-economic status, and environmental sustainability of Egypt and its people is intricately linked with the River Nile. The Nile River is the primary source of water for a multitude of strategically important water uses such as drinking, fishing, industrial use, livestock and irrigation and there is a critical need to ensure the security of the Nile River against any natural or anthropogenic threats and to develop an effective Water Resources Management System. This paper outlines the concept behind the environmental monitoring network, its scope, and environmental benefits. The paper discusses the progress made to date. It highlights the challenges encountered in establishing the environmental security and water resources management system. The paper presents the results of the initial application of the Egyptian Water Quality Index including how the challenge of the scarcity of use based

water quality guidelines was overcome. The paper also outlines how Egypt plans to expand the index network to address trans-boundary monitoring of Nile River and the monitoring of Groundwater and Drainage Water.

- The economical and effective system of water quality observation is the toughest implementation of impure water. Drinking water could be terribly precious for all people as water utilities face more challenges. These challenges arise due to high population, less water resources etc. So, different methods are used to monitor in the real time water quality. To make sure that safe distribution of water is done, it should be monitored in real time for new approach in IOT based water quality has been projected. Real time water quality observation is monitored by data acquisition, method and transmission with increase in the wireless device network technology in internet of things. The measured values from the sensors are interfaced by microcontroller and the processed values remotely to the core controller ARM with a WI-FI protocol. This projected water quality observation interfaces sensors with quality observation with IOT setting. WQM selects parameters of water like temperature, pH level, water level and CO2 by multiple different device nodes. This methodology sends the information to the web server. The data updated at intervals within the server may be retrieved or accessed from anyplace within the world. If the sensor do not get into abnormal then a buzzer will be ON.
- The need for effective and efficient monitoring, evaluation and control of water quality in residential area has become more demanding in this era of urbanization, pollution and population growth. Ensuring safe water supply of drinking water is big challenge for modern civilization. Traditional methods that rely on collecting water samples, testing and analyses in water laboratories are not only costly but also lack capability for real-time data capture, analyses and fast dissemination of information to relevant stakeholders for making timely and informed decisions. In this paper, a real

time water quality monitoring system prototype developed for water quality monitoring in Residential home is presented.

- Current water quality monitoring system is a manual system with a monotonous process and is very time-consuming. This paper proposes a sensor-based water quality monitoring system. The system consists of several sensors which is used to measure physical and chemical parameters of the water. The main components of Wireless Sensor Network (WSN) include a microcontroller for processing the system, communication system for inter and intra node communication and several sensors. Realtime data access can be done by using remote monitoring and Internet of Things (IOT) technology. Data collected at the apart site can be displayed in a visual format on a server PC with the help of Spark streaming analysis through Spark MLlib, Deep learning neural network models, Belief Rule Based (BRB) system and is also compared with standard values. If the acquired value is above the threshold value automated warning SMS alert will be sent to the agent. The uniqueness of our proposed paper is to obtain the water monitoring system with high frequency, high mobility, and low powered. Therefore, our proposed system will immensely help Bangladeshi populations to become conscious against contaminated water as well as to stop polluting the water.

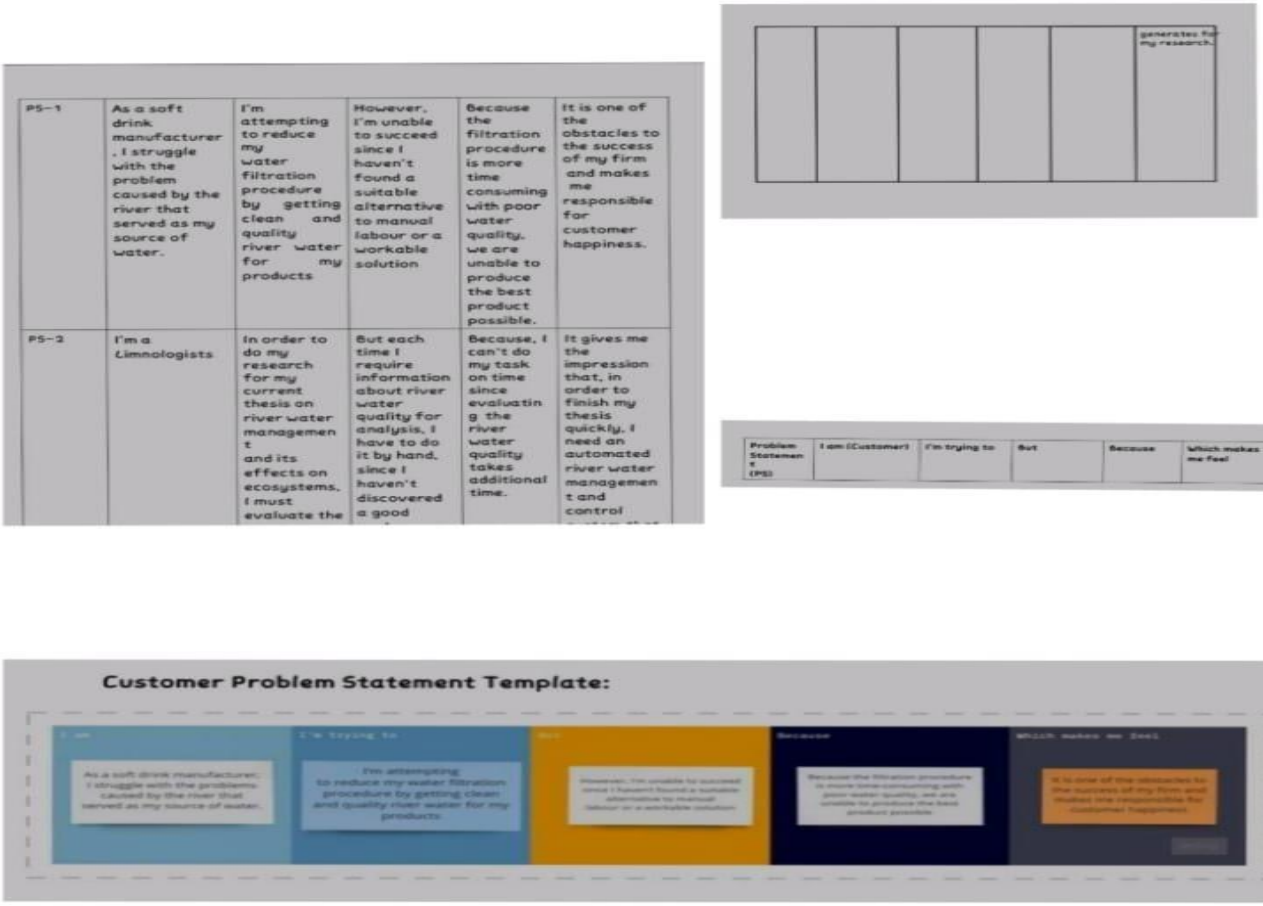
2.1 EXISTING PROBLEM:

- The key issue with river systems in cities is water pollution, point sources such as waste water from a tributary drain, sewage draining and grey water, industrial effluents and wastewater.
- Rivers and streams drain water that falls in upland areas. Moving water dilutes and decomposes pollutants more rapidly than standing water, but many rivers and streams are significantly polluted all around the world.

2.2 REFERENCE:

- M.S.P.A.,T.K.AND C.B.K., 2020-2020. Water quality monitoring system based on IOT. In: 2020 5th International conference on devices, circuits and system (ICDCS). 2020 5th international conference on device circuits and system (ICDCS). Coimbatore, India ,pp. 279-282.
- Nidal Nasser, Asmaa Ali, Lutful Karim, Samir Belhaouari, IEEE. Eoin O'Connell,Michael Healy,Sinead O'Keeffie, Thomas Newe and Elfed Lewis, IEEE sensor joirnal, vol. 13, no.7,July 2013,1530-437x.CCME. (2001). "Canadian water quality guidelines for the pH
- Canadian Water Quality Index 1.0 Technical Report". Canadian Environmental Quality Guidelines, Winnipeg, Manitoba. CCME. (2003).
- Stankovic JA, "Research directions for the Internet of Things", IEEE Internet Things J., Vol.1, No.1, (2014), pp.3–9. Abdel-Gawad, Shaden and Khalil, Bahaa M. (2003). "Site Registry For The Nile River Water Quality Monitoring Network", Report No.: WQ-TE0307-011-FN, National Water Quality and Availability Management Project, National Water Quality Monitoring Component.
- Rundel, E. A. Graham, M. F. Allen, J. C. Fisher, and T. C. Harmon, "Environmental sensor networks in ecological research," New Phytologist, vol. 182, pp. 589-607, 2009

2.3 PROBLEM STATEMENT DEFINITION:



PS-1	As a soft drink manufacturer . I struggle with the problem caused by the river that served as my source of water.	I'm attempting to reduce my water filtration procedure by getting clean and quality river water for my products	However, I'm unable to succeed since I haven't found a suitable alternative to manual labour or a workable solution	Because the filtration procedure is more time consuming with poor water quality. we are unable to produce the best product possible.	It is one of the obstacles to the success of my firm and makes me responsible for customer happiness.
PS-2	I'm a Limnologists	In order to do my research for my current thesis on river water management and its effects on ecosystems, I must evaluate the	But each time I require information about river water quality for analysis, I have to do it by hand, since I haven't discovered a good	Because, I can't do my task on time since evaluating the river water quality takes additional time.	It gives me the impression that, in order to finish my thesis quickly, I need an automated river water management and control

FIGURE 1 PROBLEM STATEMENT DEFINITION

CHAPTER 3

IDEATION & PROPOSED SOLUTION

Ideation is the process where you generate ideas and solutions through sessions such as Sketching, Prototyping, Brainstorming, Brainwriting, Worst Possible Idea, and a wealth of other ideation techniques. Ideation is also the third stage in the Design Thinking process.

3.1 EMPATHY MAP CANVAS:

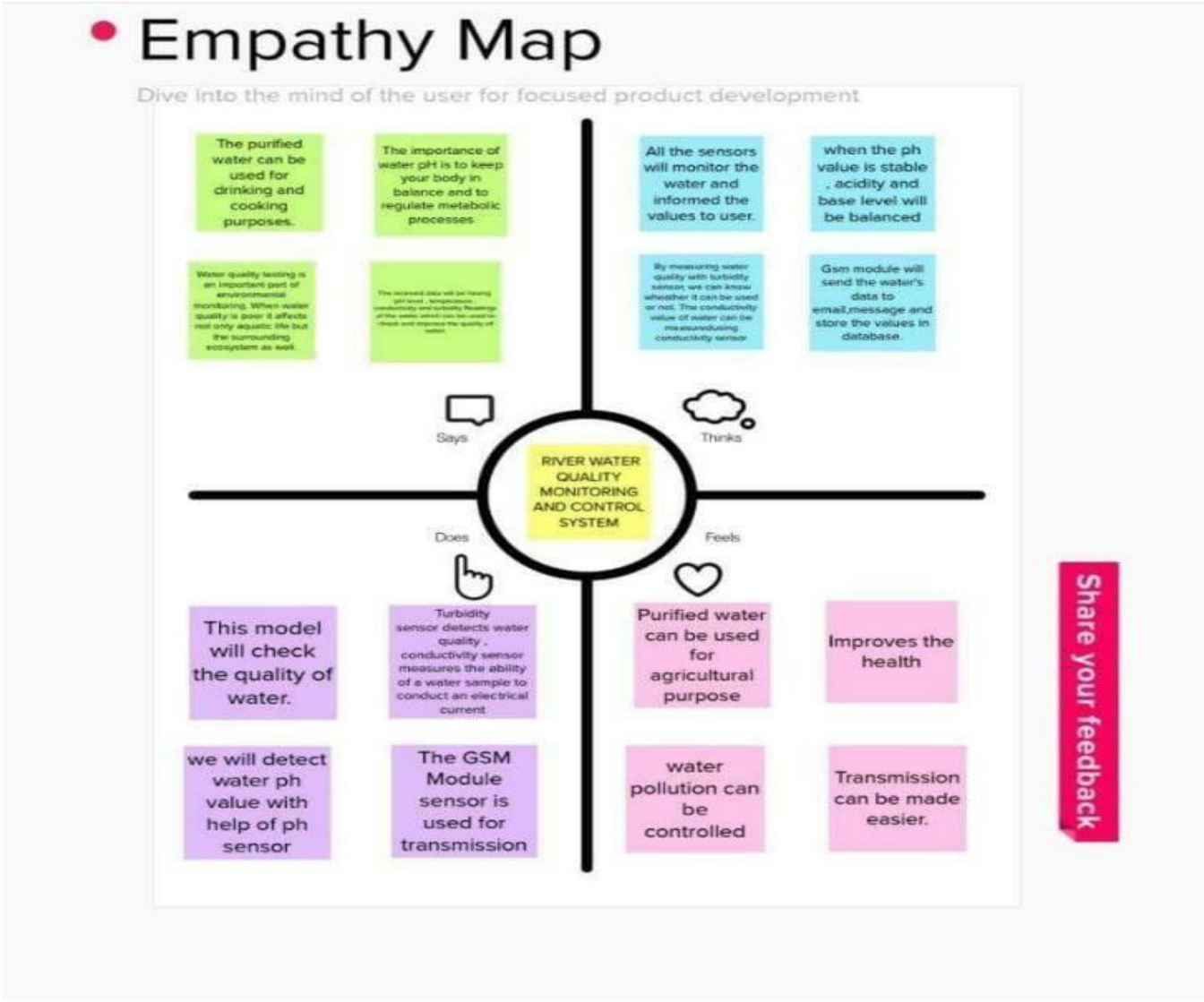


FIGURE 2 EMPATHY MAP CANVAS

3.2 IDEATION & BRAINSTORMING:

Ideation phase:

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 analyzed to improve the water quality. Following are the aims of idea implementation.

- To measure water parameters such as pH, dissolved oxygen, turbidity, conductivity, etc.
- Using available sensors at a remote place.
- To assemble data from various sensor nodes and send it to the base station.
- Wireless channel.
- To simulate and evaluate quality parameters for quality control.
- To send SMS to an authorized person routinely when water quality detected does not 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 in habit. 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 utilize 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 victimized 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) ‘ C.

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 victimized in varied devices and circuits. These modules are desirable over heptad segments and otherwise multisegment 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 utilized 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
- Neural network models in Big Data Analytics and water quality management
- Real-time monitoring of water quality by using IOT integrated Big Data Analytics **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. Neural network models in Big Data Analytics and water quality

Management:

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. The output of sigmoid function neuron with inputs: Xj, weights: Wj and bias b is :$F(X) = 1 / (1 + \exp(-\Sigma\, jwjxj - b))$

Real-time monitoring of water quality by using IOT integrated Big Data Analytics:

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 analyze 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.

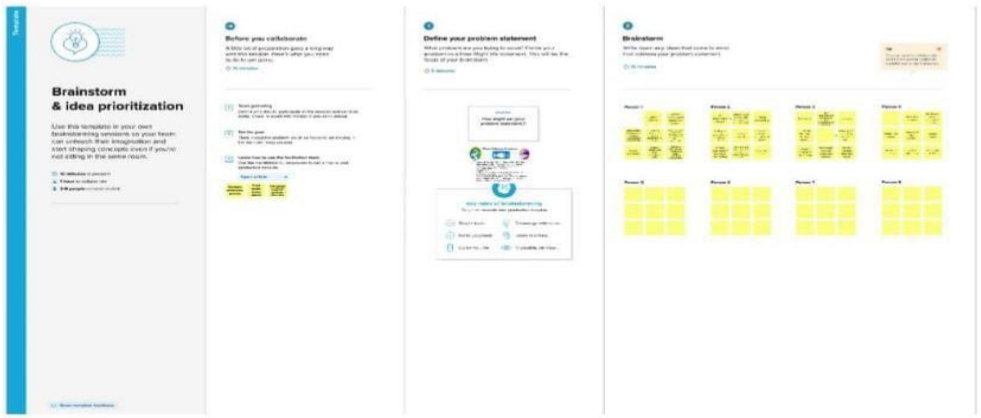
Brainstorming:

Brainstorming provides a free and open environment that encourages everyone within a team to participate in the creative thinking process that leads to problem solving. Prioritizing volume over value, out-of-the-box ideas are welcome and built upon, and all participants are encouraged to collaborate, helping each other

develop a rich amount of creative solutions. Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

Reference: https://www.mural.co/templates/empathy-map-canvas

Step-1: Team Gathering, Collaboration and Select the Problem Statement and idea listing and grouping.



Step–2: Idea Prioritization

FIGURE 3 BRAINSTORMING:

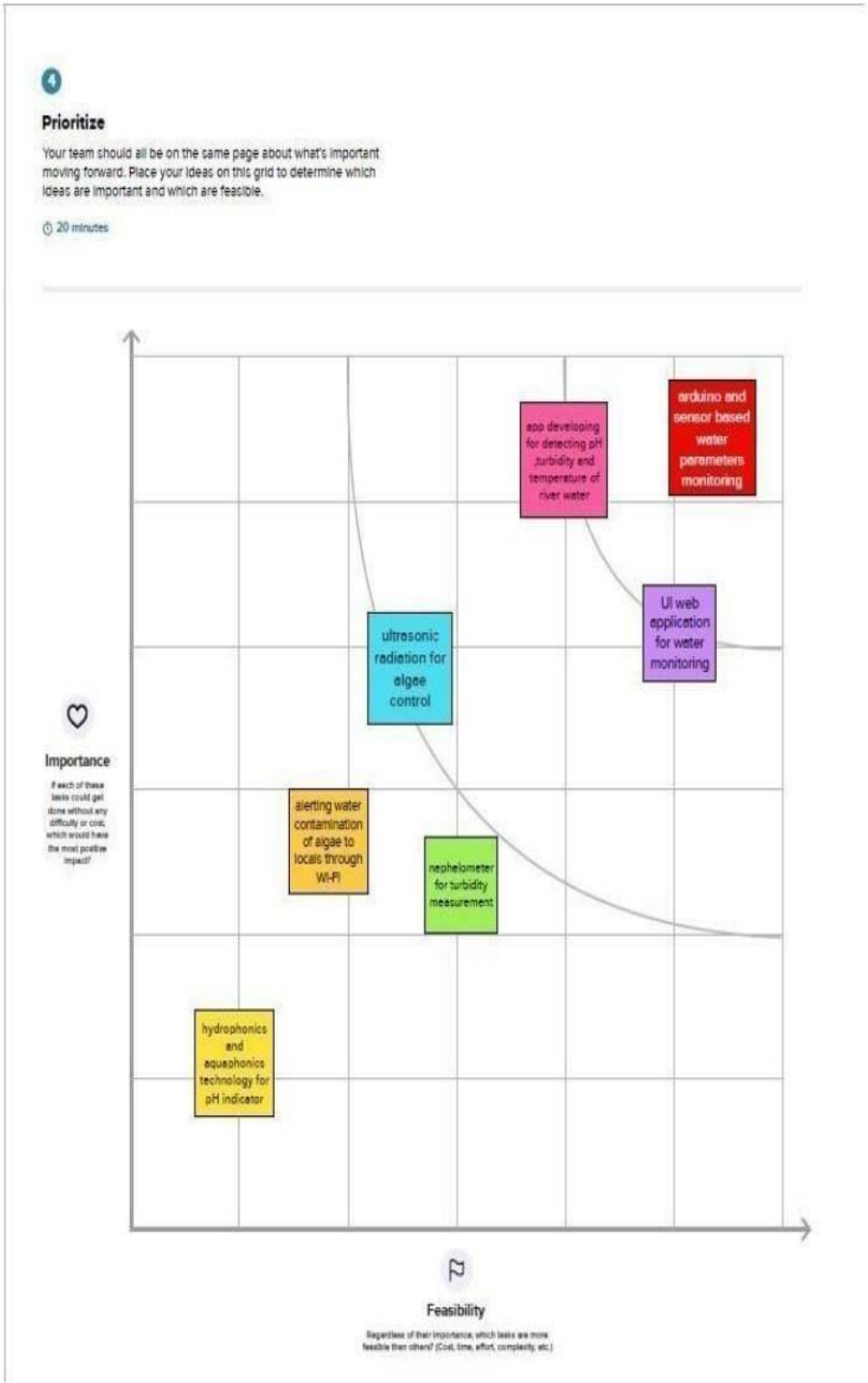


FIGURE 4 BRAINSTORMING:

3.3 PROPOSED SOLUTION :

Project team shall fill the following information in proposed solution template.

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)	Massive growth of algae called eutrophication leads to pollution(monitoring and controlling the quality of river water)
2.	Idea / Solution description	Detecting the dust particles, PH level of water, Dissolved oxygen and temperature to be monitored and altering the authorities if water quality is not good.
3.	Novelty / Uniqueness	River water quality can be monitored by web application. Quality parameter will track continuously with standard measurements.
4.	Social Impact / Customer Satisfaction	Localities will not get suffered by poor quality of water by alerting them when the water quality is not good.
5.	Business Model (Revenue Model)	Water quality monitoring system by Aeron systems for industrial water treatment plant, river bodies, aqua forming, digital loggers.
6.	Scalability of the Solution	Measuring of real time values and continuous monitoring helps in maintaining the quality of water.

FIGURE 5 PROPOSED SOLUTION

3.4 PROBLEM SOLUTION FIT:

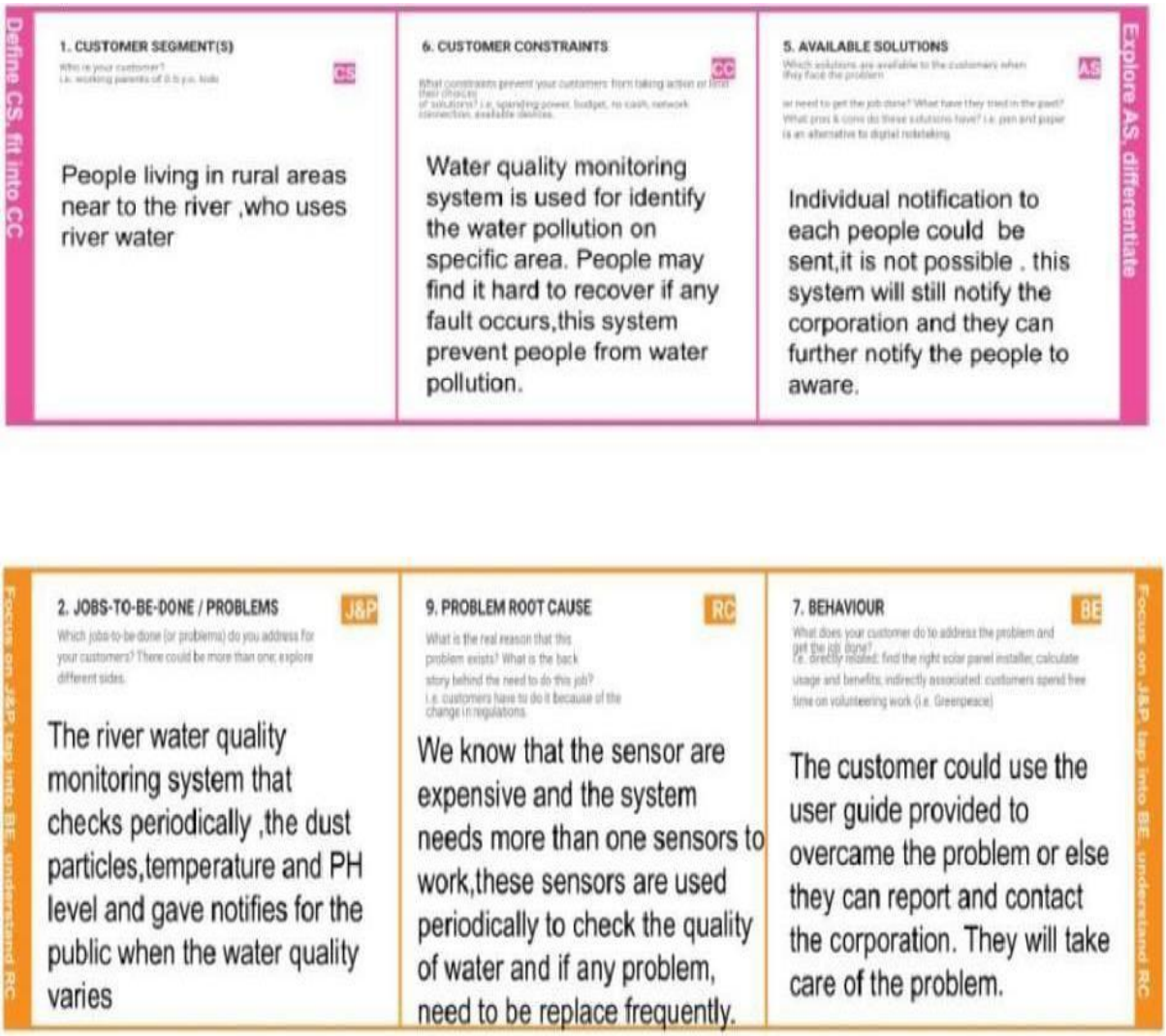


FIGURE 6 PROBLEM SOLUTION FIT

CHAPTER 4

REQUIREMENT ANALYSIS

Analysis, is needed to determine what is needed to build a river monitoring IOT system. This needs analysis is of course preceded by conducting a literature study related to the system to be built. This needs analysis and literature study will form the basis of system design. The needs or research instruments to create a river monitoring IOT system. System planning is carried out to plan the river monitoring IOT system. This planning stage is certainly based on a previous need's analysis. System planning aims to finalize the system plan to be made and plan what will be done before making the system. The system architecture to be created refers to the LoRaWAN architecture in which there are end nodes, gateways, network servers, and application servers.

4.1 FUNCTIONAL REQUIREMENT:

RS Hydro supply a range of technologies for water quality monitoring including multi parameter meters and sondes , CTD's, pocket testers, colorimeters, samplers and online process monitors.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration can done through Gmail.
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Visualizing data	Using IBM cognos Analytics user can visualize if any delay of flights.
FR-4	Generating Report	User can view the delay of flights report.

FIGURE 7 FUNCTIONAL REQUIREMENT

4.2 NON FUNCTIONAL REQUIREMENT:

What are the key types of non-functional requirements? The most common ones are performance, scalability, portability, compatibility, reliability, availability, maintainability, security, localization, and usability.

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	Users can easily understand and use the features in an effective manner. The application is very simple to use and it is a user -friendly graphical interface. Actions will be performed in just a few clicks.
NFR-2	Security	The proper login mechanism should be used to avoid hacking.This is the main security concern in user account. The organization system should not disclose personal information of users and other organization details to public.
NFR-3	Reliability	If the system is disconnected or logout due to over access at the same time, it should save all the process of the users made up to the point of abnormal happenings.
NFR-4	Performance	While browsing through the catalogue the system should require a fair amount of speed
NFR-5	Availability	User can access at anytime.The system shall be available 24 hours a day 7 days a week.
NFR-6	Scalability	Wide range of users can make access of the websites.

FIGURE 8 NON FUNCTIONAL REQUIREMENT

CHAPTER 5

PROJECT DESIGN

Project design is an early phase of the project lifecycle where ideas, processes, resources, and deliverables are planned out. A project design comes before a project plan as it's a broad overview whereas a project plan includes more detailed information.

5.1 DATA FLOW DIAGRAMS:

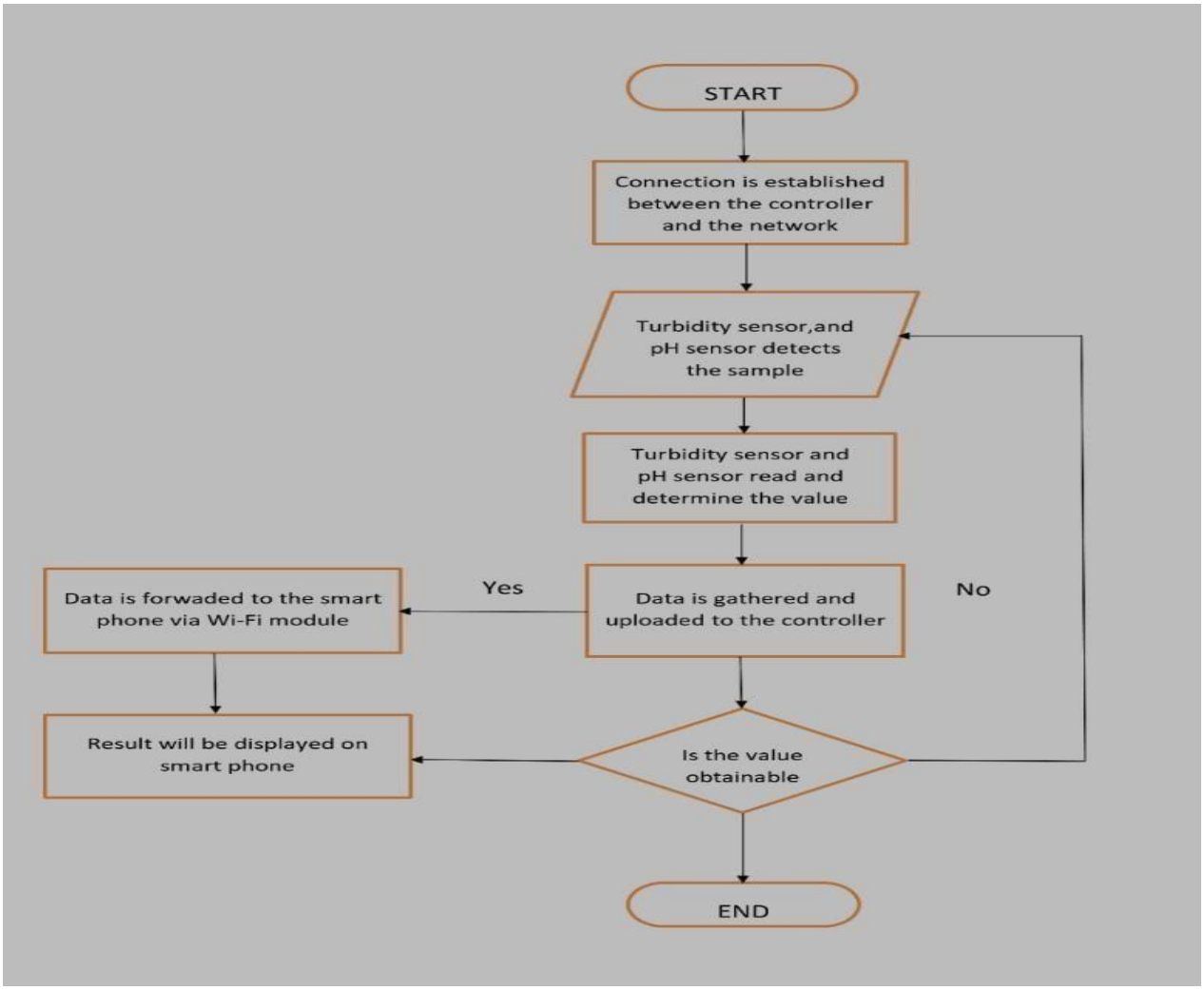


FIGURE 9 DATA FLOW DIAGRAMS

In this system, Data are sent to a cloud via GSM installed in the Arduino in a text-based notification. In the second article, integration between a Supervisory Control and Data

Acquisition system and the IOT was proposed for real-time water quality monitoring to identify contaminated water and water leakage in pipelines. In this system, temperature, pH, flow, and color sensors were utilized and data were sent using the GSM module. It is one of the major threats to sustainability. Currently, the water resources (i.e., rivers, lakes, seawater) are contaminated due to the rapid growth of human beings and the industrial companies that dump their wastes in the water. However, water pollution contributes to various disasters despite the reduction of the available sources of drinking water. The existing communication technologies (e.g., 3G, Bluetooth, WiFi, and Zigbee) suffer from short communication ranges and high power consumption. Transferring the data between the sensors and core network using satellite-based communication is considered slow and very costly. Currently, water quality parameters are collected using fixed location sensors, which reduces the accuracy of the measured data .

5.2 SOLUTION AND TECHNICAL ARCHITECTURE:

Solution architecture:

Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. its goals are to:

- find the best tech solution to solve existing business problems.
- describe the structure, characteristics, behaviour, and other aspects of the software to project stakeholder
- define features, development phases, and solution requirements.
- provide specifications according to which the solution is defined, managed, and delivered

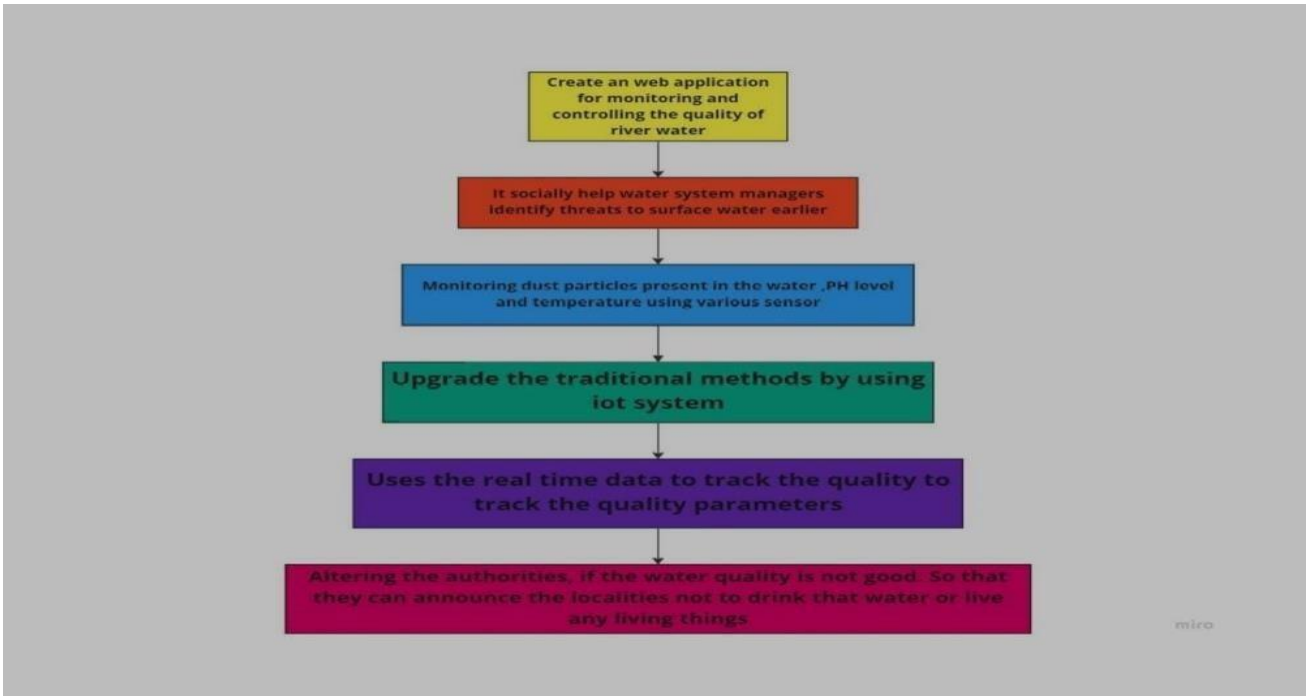


FIGURE 10 SOLUTION ARCHITECTURE

Technical Architecture:

It is a form of IT architecture that is used to design computer systems. It involves the development of a technical blueprint with regard to the arrangement, interaction, and interdependence of all elements so that system-relevant requirements are met.

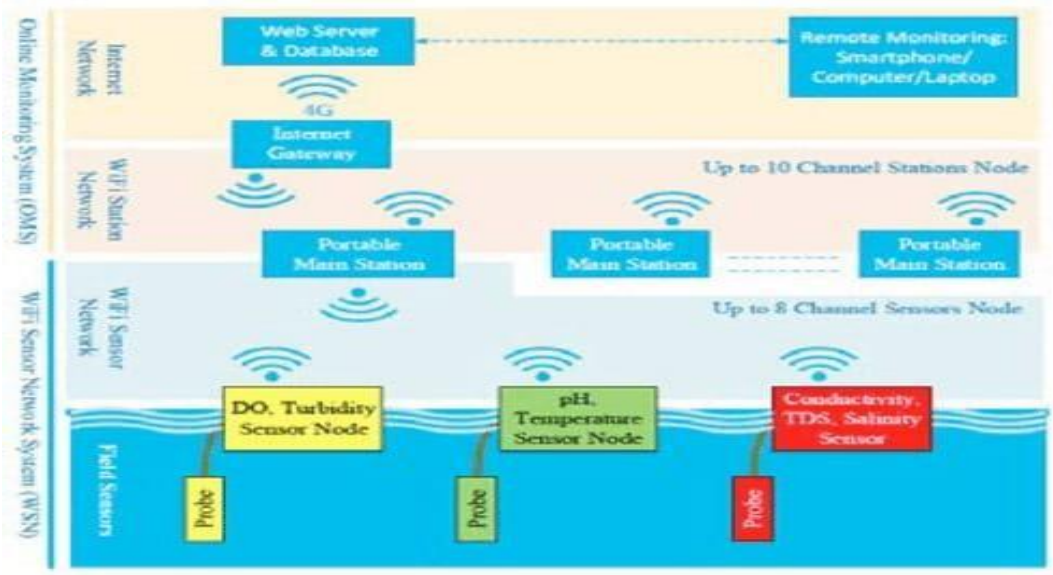


FIGURE 11 TECHNICAL ARCHITECTURE

5.3 USER STORIES

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Web user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High	Sprint-1
		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	Sprint-1
		USN-3	As a user, I can register for the application through Gmail.		Medium	Sprint-1
	Login	USN-4	As a user, I can log into the application by entering email & password.	I can get to access my web portal	High	Sprint-1
	Dashboard	USN-5	As a user, I can get to know what my dashboard consists of.	I can my details of my registration.	Low	Sprint-2
Customer Care Executive	Organization	USN-6	The organization which owns this airplane analysis system will enable the option to customers to reach out the organization if • they have any problem with the organization's system ofcustomer interaction or • airplane issues- delay, landing in a different location	The customer care workers will help out the customers in trouble.	High	Sprint-1
Administrator	Administration	USN-7	The organization takes in-charge of the administrative policies of different departments like: • registration • flight booking • delay visualization • generation of delay report	As an administrator, confirmation of user while registration is done.	High	Sprint-1

FIGURE 12 USER STORIES

CHAPTER 6

PROJECT PLANNING & SCHEDULING

'Project Planning and Scheduling', though separate, are two sides of the same coin in project management. Fundamentally, 'Project planning' is all about choosing and designing effective policies and methodologies to attain project objectives. While 'Project scheduling' is a procedure of assigning tasks to get them completed by allocating appropriate resources within an estimated budget and time-frame. The basis of project planning is the entire project. Unlikely, project scheduling focuses only on the project-related tasks, the project start/end dates and project dependencies. Thus, a 'project plan' is a comprehensive document that contains the project aims, scope, costing, risks, and schedule. And a project schedule includes the estimated dates and sequential project tasks to be executed.

6.1 SPRINT PLANNING & ESTIMATION:

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	IBM Watson IOT platform	USN-1	Creating devices and board and generating data	1	medium	Thangam T Teena sherin R Sujitha k Yogeshwari A
Sprint-2	Storing Data using node-red	USN-2	Storing the data in IBM Cloud DB through node -red functions	2	High	Thangam T Teena sherin R Sujitha k Yogeshwari A
Sprint-3	Frontend in App	USN-3	Creating the frontend for users to use the medicine reminder app in MIT App inventor	1	High	Thangam T Teena sherin R Sujitha k Yogeshwari A
Sprint-3	Backend in App	USN-4	Designing the block of backend for the app in MIT App inventor	2	Low	Thangam T Teena sherin R Sujitha k Yogeshwari A

FIGURE 13 SPRINT PLANNING & ESTIMATION

Sprint-4	User login	USN-5	As a user, I can register for the application through Gmail and login in to the app	2	Medium	Thangam T Teena sherin R Sujitha k Yogeshwari A
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	IBM Watson IOT platform	USN-1	Creating devices and board and generating data	1	medium	Thangam T Teena sherin R Sujitha k Yogeshwari A
Sprint-4	Reminder(TTS)	USN-5	Getting the speech reminder to users to take their tablet	1	High	Thangam T Teena sherin R Sujitha k Yogeshwari A

FIGURE 14 SPRINT PLANNING & ESTIMATION 6.2

Sprint delivery schedule:

Project Tracker, Velocity & Burndown Chart: (4 Marks)

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	31 Oct 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	07 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	14 Nov 2022

FIGURE 15 SPRINT DELIVERY SCHEDULE

Velocity:

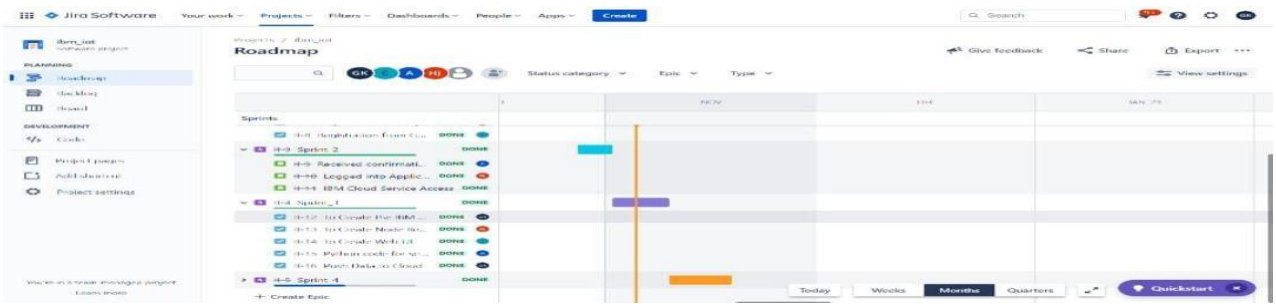
Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

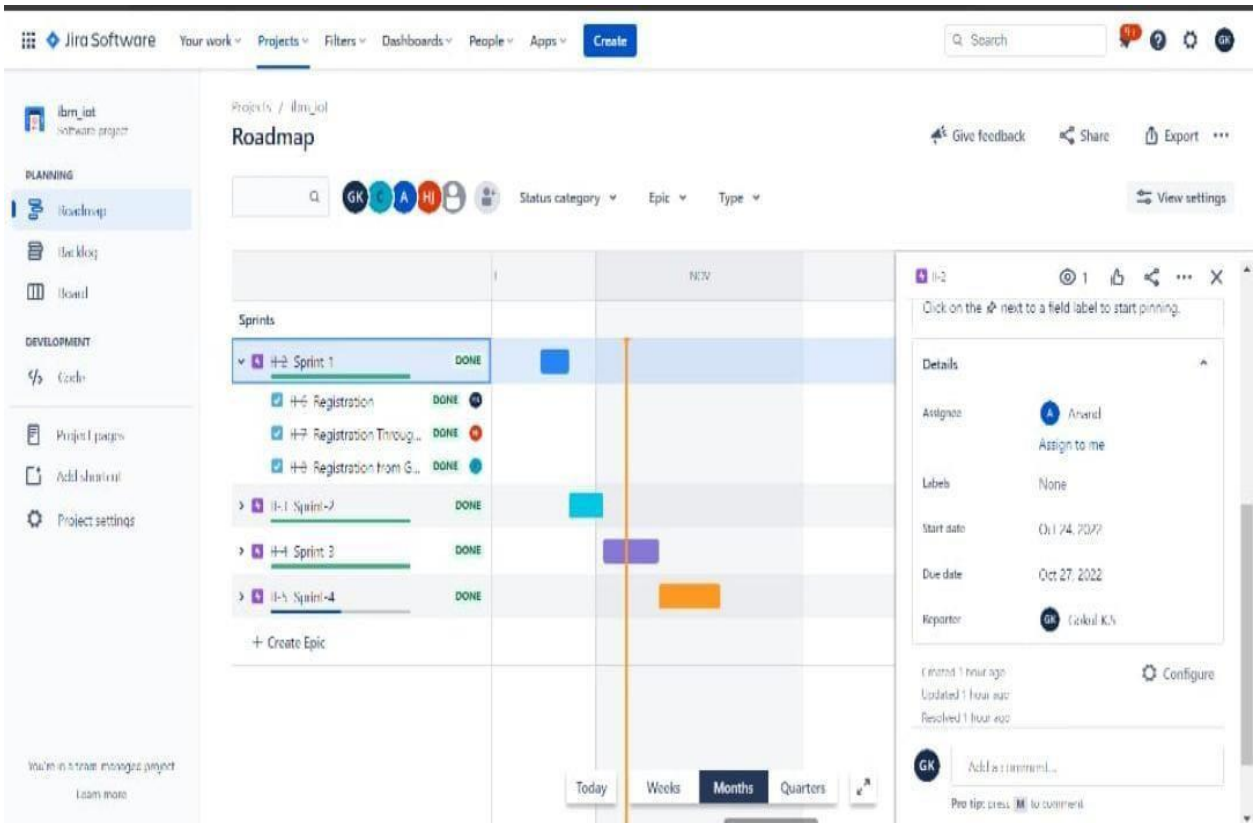
AV=sprint duration /Velocity=20/10=2

Burn down Chart:

A burn down chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such as Scrum. However, burn down charts can be applied to any project containing measurable progress over time.

6.3 REPORT FROM JIRA:





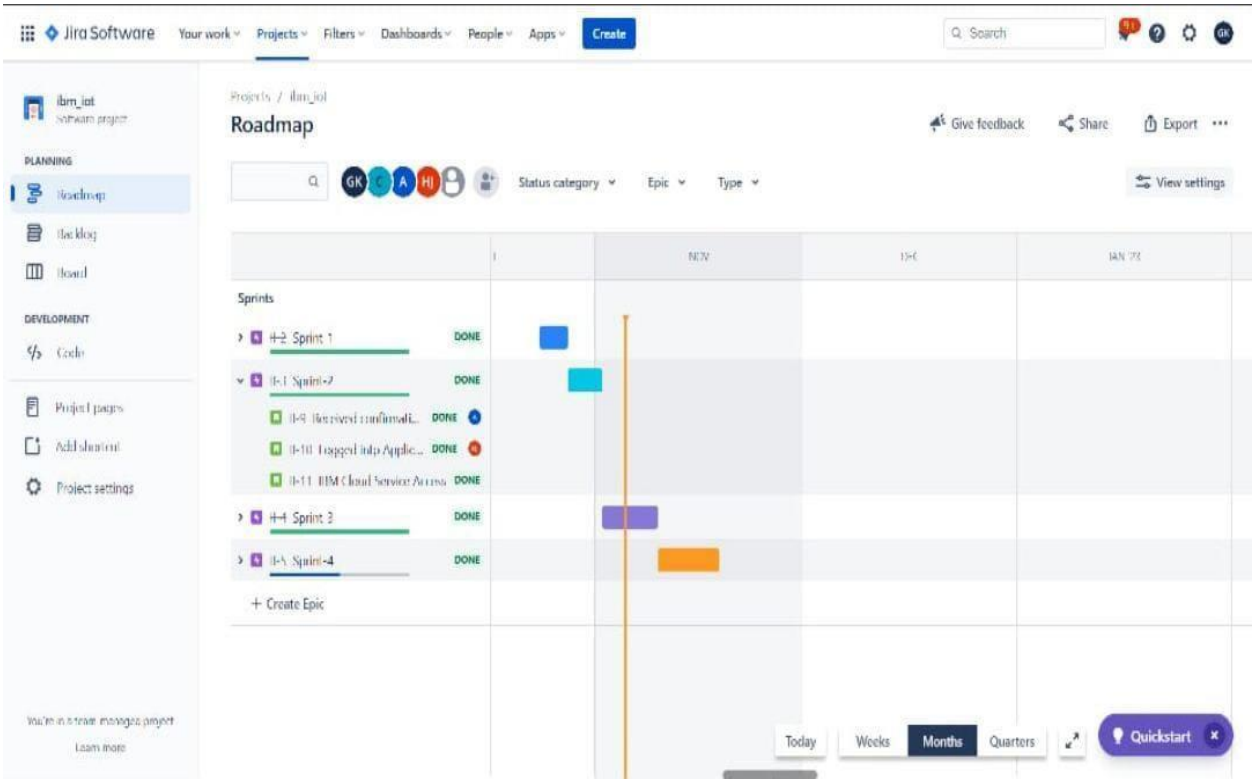


FIGURE 16 REPORT FROM JIRA

CHAPTER 7

CODING AND SOLUTIONING:

7.1-FEATURE 1

- To reduce the water related diseases and prevent water population World health Organization (WHO) has also stated this crisis as "the largest mass poisoning of a population in history. The main goal of this paper is to build a Sensor- based Water Quality Monitoring System".
- To overcome the drawbacks of the conventional water quality monitoring methods, sensors can be used. Sensor is an ideal detecting device which can convert non-power information to electrical signals which can easily be processed, transformed.

```
for i in range(5):
print("Test case:",i+1)
print("Welcome to Real-Time River Water Quality Monitoring and Control System")
Temperature = int(rand.randint(-40,125))
pH = int(rand.randint(0,14)) DO =
int(rand.randint(0,100))
TSS = int(rand.randint(0,3700))
Manganese = int(rand.randint(0,1000)) Copper
= int(rand.randint(0,2000)) ammonia_Nitrate
= int(rand.randint(0,100))
Hardness = int(rand.randint(0,1000))
Zinc = int(rand.randint(0,100))
Conductivity = f"{float(rand.uniform(0.001,2000)):.2f}"
Chloride = int(rand.randint(0,200))
Sulphate = int(rand.randint(0,1000))
print("Temperature:", Temperature, "\npH:", pH,"\nDO:", DO,"\nTSS:", TSS,"\nManganese:", Manganese, "\nCopper:", Copper,"\nAmmonia & Nitrate:",ammonia_Nitrate, "\nHardness:",Hardness,"\nZinc:", Zinc,
```

"\nConductivity:", Conductivity, "\nChloride:", Chloride, "\nSulphate:", Sulphate, "\n")

CODE OUTPUT:

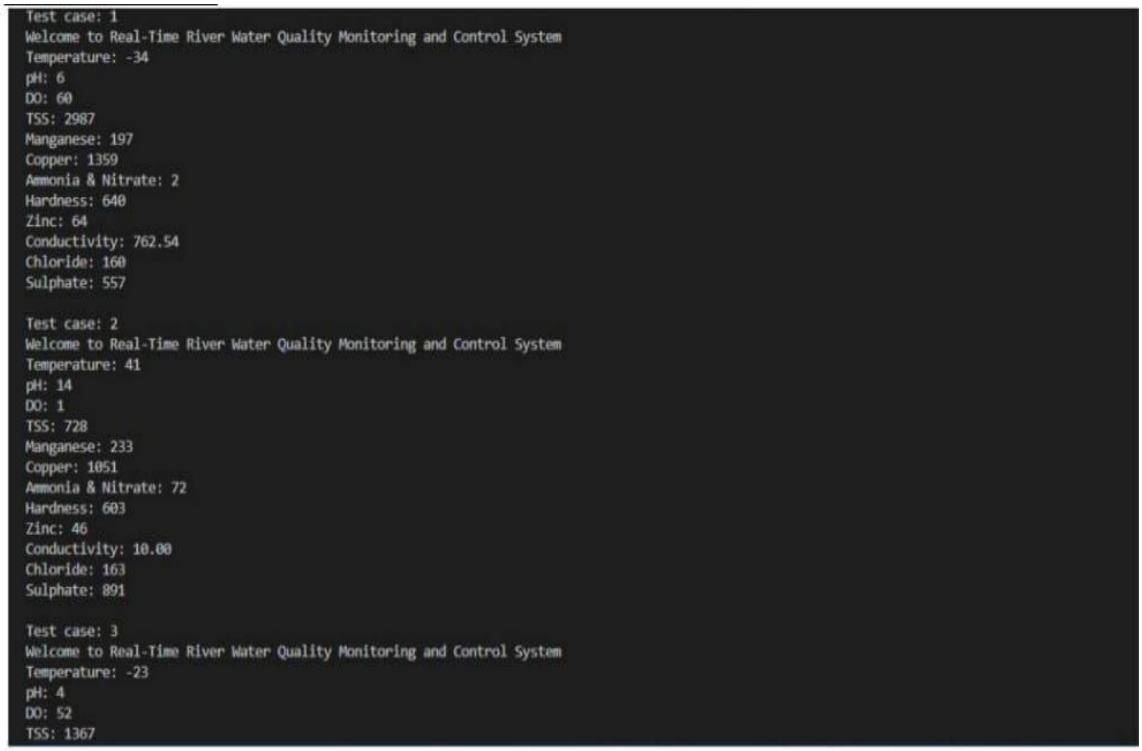


FIGURE 17 CODE OUTPUT

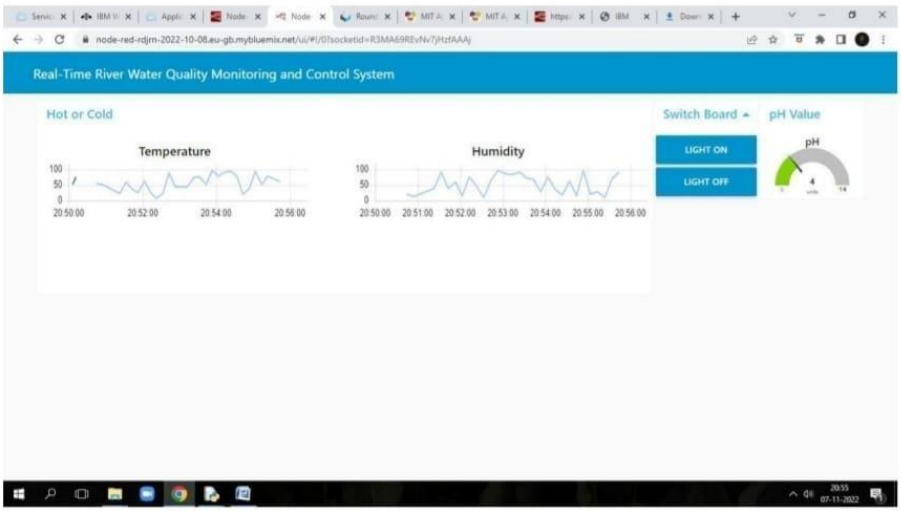


Fig. OUTPUT DISPLAYS IN NODE-RED PLATFORM

FIGURE 18 CODE OUTPUT

APPLICATION OUTPUT:

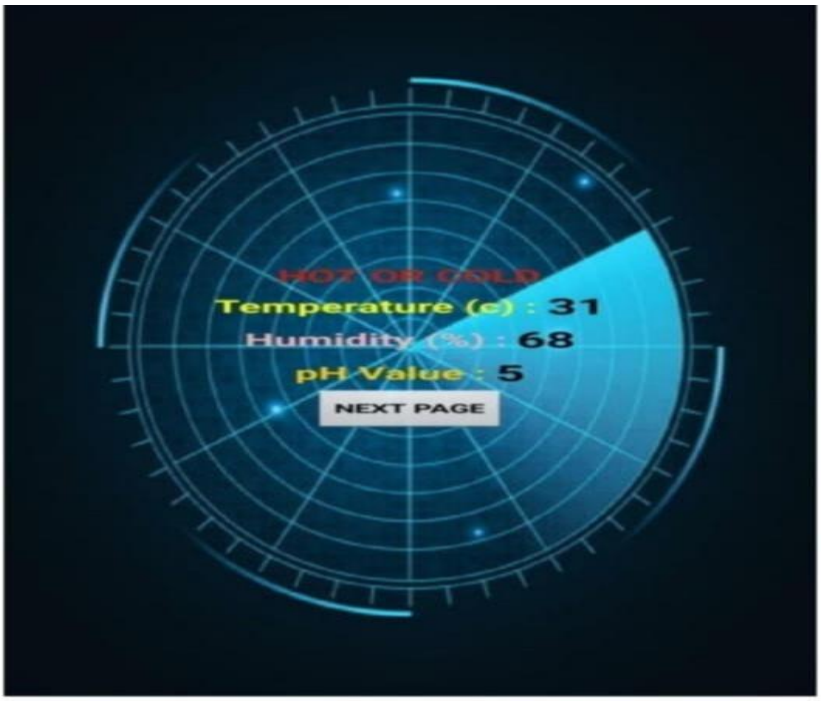


FIGURE 19 APPLICATION OUTPUT

7.2 FEATURE 2

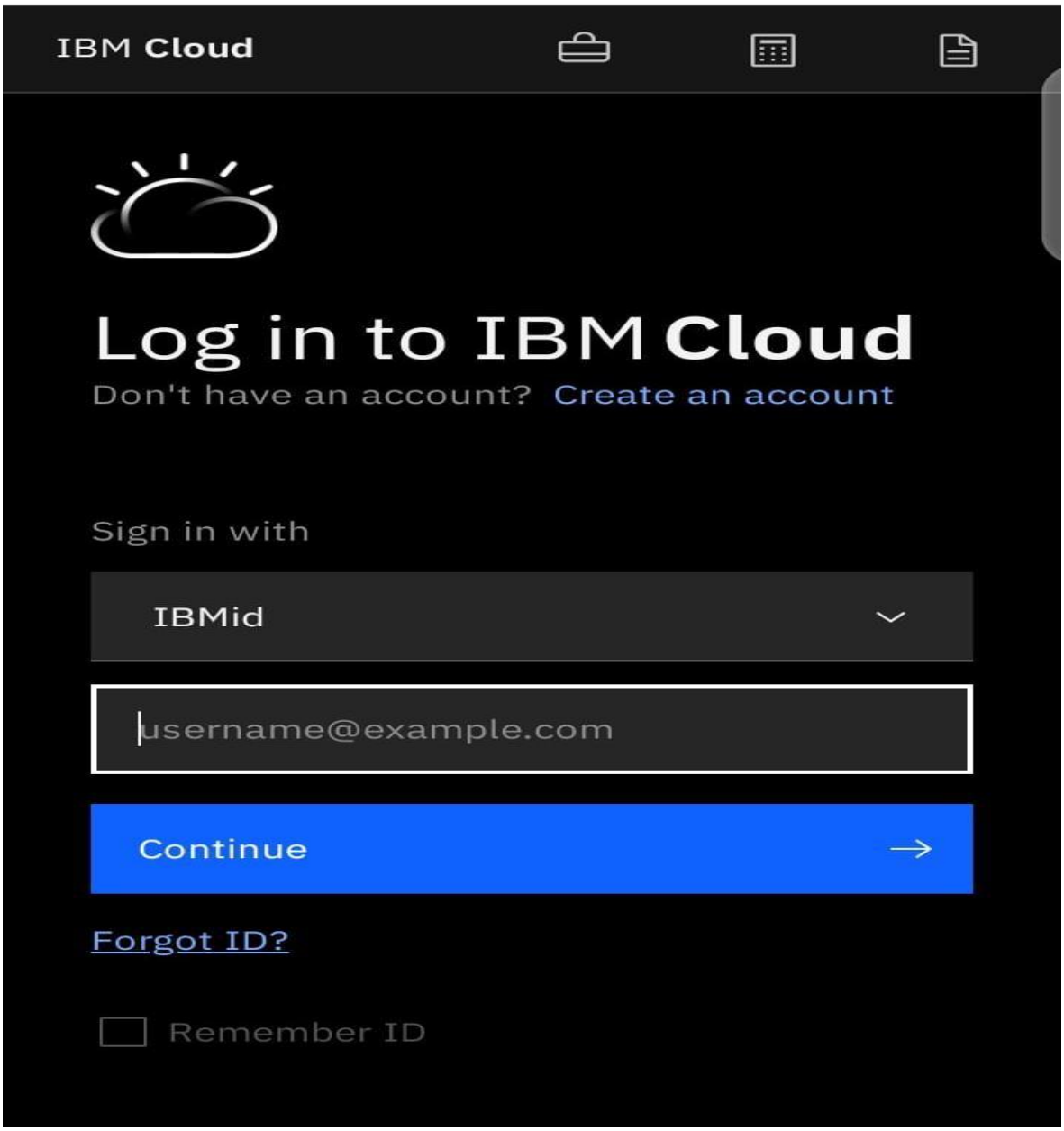
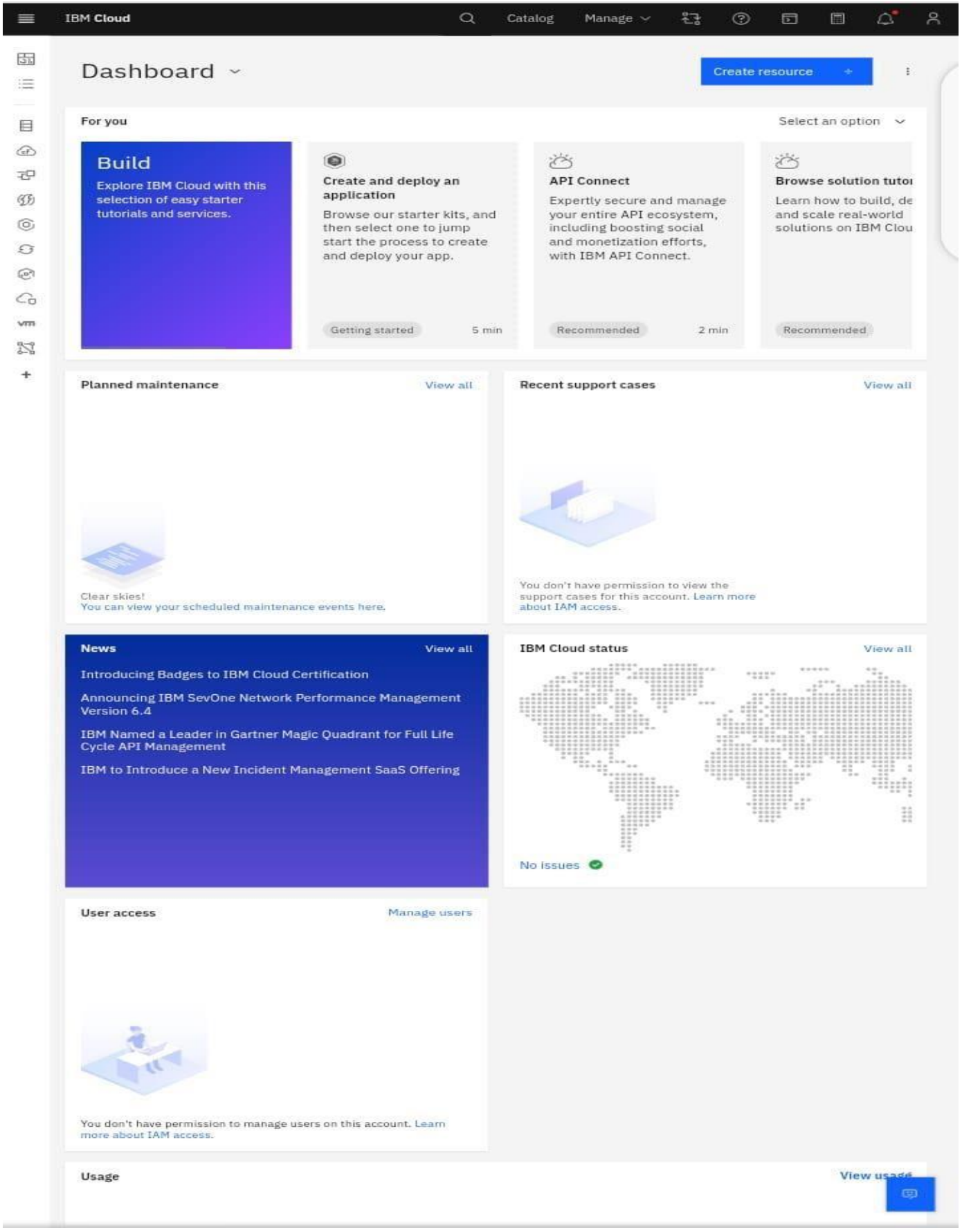


FIGURE 20 LOG IN


IBM Cloud
Catalog
Manage
Dashboard
Create resource
For you
Select an option
Build
Explore IBM Cloud with this selection of easy starter tutorials and services.
Create and deploy an application
Browse our starter kits, and then select one to jump start the process to create and deploy your app.
Getting started
5 min
API Connect
Expertly secure and manage your entire API ecosystem, including boosting social and monetization efforts, with IBM API Connect.
Recommended
2 min
Browse solution tutor
Learn how to build, de and scale real-world solutions on IBM Clou
Recommended
Planned maintenance
View all
Clear skies!
You can view your scheduled maintenance events here.
Recent support cases
View all
You don't have permission to view the support cases for this account. Learn more about IAM access.
News
View all
Introducing Badges to IBM Cloud Certification
Announcing IBM SevOne Network Performance Management Version 6.4
IBM Named a Leader in Gartner Magic Quadrant for Full Life Cycle API Management
IBM to Introduce a New Incident Management SaaS Offering
IBM Cloud status
View all
No issues
User access
Manage users
You don't have permission to manage users on this account. Learn more about IAM access.
Usage
View usage

CHAPTER 8

TESTING

8.1 TEST CASES

The port in question is situated in the mouth of an estuary. The town's water supply cannot provide the port with potable water and the port draws groundwater from a series of boreholes in and around the port area. The port's storage infrastructure consists of only one elevated concrete tank which cannot be taken out of service for cleaning. Ice is supplied by outside contractors.

Current laboratory test results were examined and found to be too consistent to reflect natural changes in the environment, pointing a finger of suspicion at the laboratory's Quality Assurance. A new laboratory with I.S.O. certification was selected to carry out the new tests. Water samples were taken by external technicians from the port's borehole, the auction hall's water taps, each and every one of the external ice suppliers and the harbour basin.

A sample report from the laboratory is shown in Table 2-1. In this table, the first column indicates the test parameter and the last column indicates the method used to determine the test result (sometimes, more than one method may be used to determine residuals). The second column indicates how the parameters are measured, the third column gives the actual test result which may then be compared to the values in the fourth column. The values in the fourth column are national standards or limits set by Governments and may differ from country to country. The values in the third column should not exceed those in the fourth column,

Standard Methods:

- Examination of the port's deep borehole test report revealed that whereas the iron and manganese levels were over the limit, indicating vegetable

matter in the aquifer, the sodium and chloride levels were low, indicating that the pump was not overdrawing. Both the nitrate and nitrite levels were low indicating that sewage intrusion into the borehole casing was not a problem. The total bacterial count, however, was very high, indicating that the water has to be chlorinated to lower the count.

- Examination of the auction hall's tap water test report (comparing them to the borehole water) indicates that the bacterial count is slightly lower but not enough to be considered sanitary and fit for drinking. The turbidity also dropped dramatically between borehole and tap, indicating deposition of solids inside the port's only storage tank. The nitrate level also drops as the nitrates are further converted to nitrites indicating bacteriological activity inside the overhead tank as well. As it turned out, chlorinating equipment was not installed.
- Examination of the ice test reports reveals that both sodium and chlorides are over the limit indicating either leaking cans at the ice plants (dirty brine water enters the ice water during the chilling operation) or overdrawing at the plant's borehole. Closer examination also revealed that the nitrite levels are very high (indicating decomposed sewage) and that coliforms were present in the ice. This pointed a finger at the borehole of one particular plant, which in fact was found to be overdrawing water to meet an increase in demand. The presence of the coliforms also indicated that the ice plant's own chlorinating equipment was not functioning properly.
- A close look at the river basin water indicated heavy contamination by sewage of the water course.The conclusions to be drawn from the above exercise are that:
  - The most likely source of contamination was the ice supplied to the fishermen, which in turn contaminated the fish in the holds;

- The port's own water supply and storage system was in need of an overhaul;
- The port's river water was not to be used in any of the fish handling processes

8.2 USER ACCEPTANCE TESTING:

User Acceptance Testing is the key factor for the success of any system. The system under consideration is tested for user acceptance by constantly keeping in touch with prospectivesystem users at the time of developing and making changes whenever required

S.NO.	TEST CASE	TEST PROCEDURE	PRE-CONDITION	EXPECTED RESULT	PASSED/FAILED
1	Data input	Enter no of details and click submit button	Enter no of details input	Alert "select data set, enter latitude, longitude"	Passed
2	Data input	Select data set and click submit button	Select data set and click submit button	Alert "select data set, enter latitude, longitude"	Passed

3	Data input	Select data set, enter latitude and click submit button	Select data set, enter latitude and click submit button	Alert “select data set, enter latitude, longitude”	Passed

FIGURE 21 USER ACCEPTANCE TESTING

Parameter	Unit	Test Remarks	Requirement	Methods
Physical & Chemical *):				
Colour	Pt. Co scale	3	15	Colorimetric
Odour	Pt. Co scale	negative	odourless	Organoleptic
pH	Pt. Co scale	6.50	6.5-8.5	Electrometric
Taste	Pt. Co scale	normal	tasteless	Organoleptic
Turbity	FTU	1	5	Turbidity
Aluminum	mg/l	below 0.20	0.2	AAS
Copper	mg/l	below 0.03	1.0	AAS
Iron Total	mg/l	below 0.04	0.3	AAS
Manganese	mg/l	0.06	0.1	AAS
Sodium	mg/l	96.93	200	AAS
Zinc	mg/l	0.047	5	AAS
Chloride	mg/l	140.41	250	Argentometric
Flouride	mg/l	0.09	1.5	Colorimetric
Nitrate	mg/l	below 0.11	10	Colorimetric
Nitrite	mg/l	0.96	1	Colorimetric
Sulphate	mg/l	below 0.94	400	Turbidimetric
Arsenic	mg/l	below 0.001	0.05	AAS
Barium	mg/l	below 0.10	1	AAS
Cadmium	mg/l	below 0.005	0.005	AAS
Cyanide	mg/l	below 0.01	0.1	Colorimetric
Chrom Hexavalent	mg/l	below 0.006	0.05	Colorimetric
Lead	mg/l	below 0.01	0.05	AAS
Mercury	mg/l	below 0.001	0.001	AAS
Selenium	mg/l	below 0.007	0.01	AAS
Organic Matter by $KMnO_4$	mg/l	3.06	10	Permanganantometric
Dissolved Solid	mg/l	431	1000	Gravimetric
Hydrogen Sulphide as H_2S	mg/l	below 0.01	0.05	Colorimetric
Total Hardness	mg $CaCO_3$	95.49	500	AAS
Bacteriological:				
Total Bacteria	per ml	6.9×10^2	1.0×10^2	Pour Plate
Coliform	per 100 ml	nil	nil	Filtration
E. Coli	per 100 ml	nil	nil	Filtration
Salmonella sp	per 100 ml	negative	negative	Filtration

CHAPTER 9

RESULTS

Five parameters namely conductivity, pH, turbidity, temperature and water level are measured using the experimental setup. The setup is connected to the Ubidots plat-form. The measured results are compared with drinking water quality standards defined by WHO. Table 9 lists the safe limit for the parameters considered in this work. Figure 5 shows the graphical representation of parameters monitored and stored in the cloud over a period of time. Further, experiments were conducted by placing the sensors in the different solutions of water collected in the college premises. Table 10 shows the value of parameters measured for three different samples. Figure 6 shows the above results as seen from the Ubidots platform. Further, to demonstrate the working of the system, and the various options for data analysis, measured quantity of contaminants such as salt and soil are mixed with 350 ml of pipe water and testing is performed. The test results are tabulated in Tables 11 and 12 respectively. Figure 7 shows the dashboard with widgets to view the results of data collected in the cloud for results in Table 11.The other feature is creation of events, based on measured parameter values. The events stored can be programmed to automatically send SMS, email and other forms of alerts to the user whenever any parameter exceeds the threshold limit. Figure 8 shows a sample of events created for different parameters under consideration in this work .Fig. 9 shows the alert SMS send to the mobile due to increased value of turbidity and conductivity.

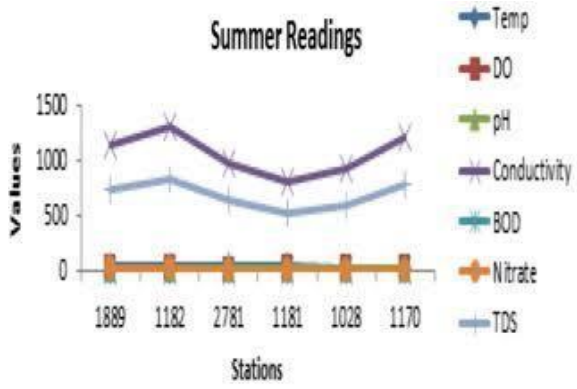
Table 12 Results of the parameters monitored by adding contaminants (salt)

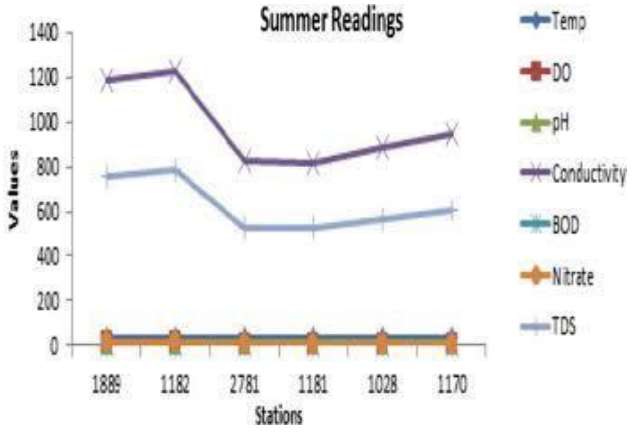
Amount of contaminants in mg	ph	Conductivity) (µS/cm)	(Turbidity) NTU)
5	7.9	428	5
10	8.1	358	6
15	8.0	448	5
20	7.9	590	7
25	8.0	787	7
30	8.3	895	8
35	8.2	998	8

FIGURE 22

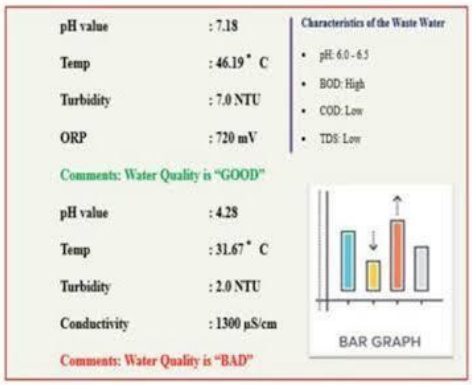
9.1 PERFORMANCE METRICES:

Performance metrics are considered among powerful tools widely used to evaluate the product's usability. They are cornerstones of usability and can tell the key decisions as if the new item is ready to launch. Performance metrics are based on user behavior instead of what they say,

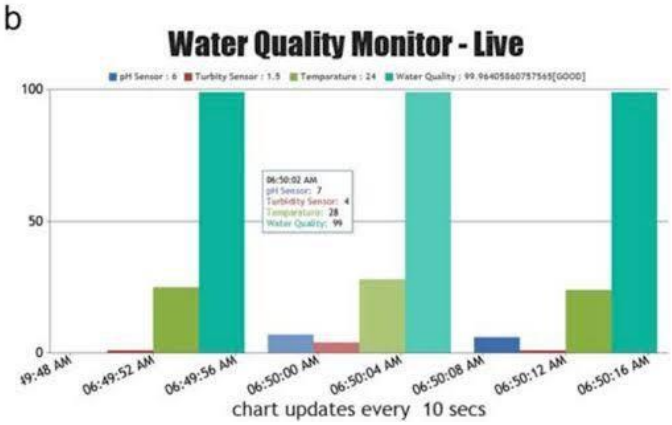




a



b



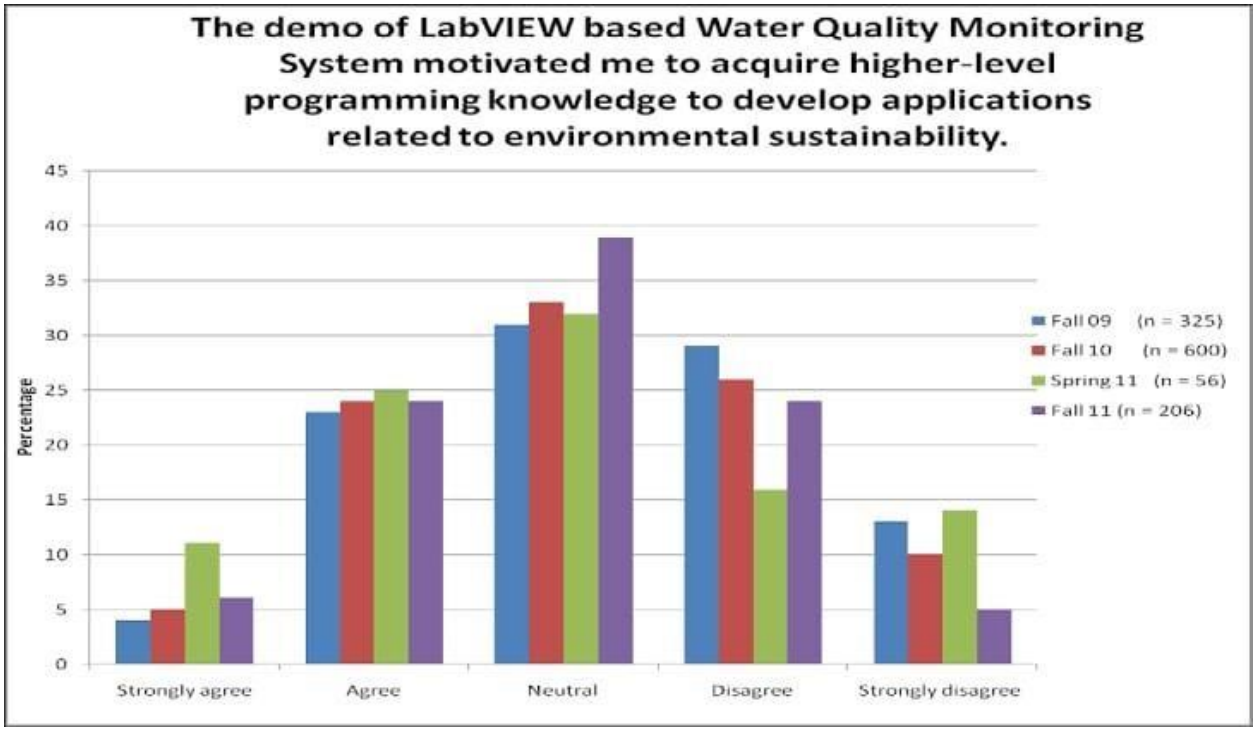

The demo of LabVIEW based Water Quality Monitoring System motivated me to acquire higher-level programming knowledge to develop applications related to environmental sustainability.
Percentage
45
40
35
30
25
20
15
10
5
0
Strongly agree
Agree
Neutral
Disagree
Strongly disagree
Fall 09 (n = 325)
Fall 10 (n = 600)
Spring 11 (n = 56)
Fall 11 (n = 206)

FIGURE 23

CHAPTER 10

ADVANTAGES &DISADVANTAGES

Advantages:

This system are highly scalable faster and also user friendly. The system is very cheap as the hardware and software does not cost much. Machine learning techniques have made it very easy to plot the data collected in various formats for proper analysis. Cloud storage platforms such as Adafruit, azure helps in storing the sensor data immediately and wirelessly to the robust servers.

Disadvantages:

That it is costly because of using smart sensors; also, the size of sensors is not reliable for water tap. Water pollution increases due to chemical and biological wastes.

CHAPTER 11

CONCLUSION

This paper is all about discussing many of the proposed systems to automate the traditional water quality monitoring. One of the major issues faced by the world is water scarcity. Another one is water contamination. Reasons for these two can be increased population, growth of urbanization to its peak and tremendous increase of industrialization. The proposed system can be implemented by including basic parameters checking and can be expanded by incorporating various features associated with water quality. These kinds of quality monitoring systems will help the society to achieve more secured future as water pollution can be controlled to a great extent through continuous monitoring. With minimal features implementation will be much easier.

CHAPTER 12

FUTURE SCOPE

Future scope of this project is monitoring environmental conditions, drinking water quality, treatment and disinfection of waste water etc. This system could also be implemented in various industrial processes. The system can be modified according to the needs of the user and can be implemented along with lab view to monitor data on computer.

CHAPTER 13

APPENDIX

13.1 SOURCE CODE:

https://github.com/IBM-EPBL/IBM-Project-538221661499328/tree/main/Final%20Deliverables/Final%20code

GITHUB & PROJECT DEMO LINK:

GitHub: https://github.com/IBM-EPBL/IBM-Project-53822-1661499328

DEMO LINK:

https://drive.google.com/file/d/1551Y0HgNw0DtPadENe8UdOvioOe72C0L/view?usp=share_link