Ideation Phase

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TEAM ID	PNT2022TMID43379
PROJECT NAME	Real Time River Water Quality Monitoring and Control System
MAXIMUM MARKS	4 Marks

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

a) To measure water parameters such as pH, dissolved oxygen, turbidity, conductivity, etc.
b) using available sensors at a remote place.
c) To assemble data from various sensor nodes and send it to the base station by the
d) wireless channel.
e) To simulate and evaluate quality parameters for quality control.
f) To send SMS to an authorized person routinely when water quality detected does not
g) match the present standards, so that necessary actions can be taken.

Control surface:

The central component is an Arduino Mega. Mega 2560, the victimized Arduino, Since the Arduino board must be adjacent to multiple analogue sign sensors, this is necessary. It has a number of registers that work together with RAM. The assemblage grapheme also maps specific intent to know registers for on-chip component resources. All PIC devices have access to a variety of banking mechanisms that they can use to address additional faculty, and the addressability of stores varies depending on the instrumentation series. The move instructions for a subsequent series of devices can be achieved through the register in a covert manner. As a result, the mechanism works by utilizing built-in coding in the Arduino UNO R3 skate.

pH sensor:

The pH of a 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 varies from 0 to 14 pH. Uttermost pH values
also process the solubility of elements and compounds making them cyanogenic.

Mathematically pH is referred to
as, pH = -log [H+].

Turbidity sensor:

Turbidity train sensor is victimized to measure the clarity of element or muddiness utter in the water.
The open cut food typically has muddiness between 255 NTU. Irrigation is evident at levels higher than 80 NTU. 130 NTU to 250 NTU is the range for intemperance liquid standards. The transmitter must transmit an unsubtle bright signal in order for the turbidity device to be considered operational. Turbidity results in a decrease in water clarity, which is unsightly, slows the rate of photosynthesis, and raises water temperature.

Temperature sensor:

Here DS18B20 is old as the temperature device. Usually, its present use to perceive the temperature of life, if we sight the device wrong the conductor electrode and place it 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 found in a Countywide orbit of applications. A 16x2 LCD demo is the really fundamental power and is commonly victimized in varied devices and circuits. These modules are desirable over heptad segments and otherwise multi-segment LEDs.

Wi-Fi module:

Wi-Fi or Wi-Fi is a subject for wireless localized area scheme with devices. Devices that can use Wi-Fi study permit private computers, video-game consoles, smartphones, digital cameras, paper computers, digital frequency players and ultramodern printers. Wi-Fi matched devices can insert to the Cyberspace via a LAN web and wireless make a bushel. A reach quantity (or point) has a cap-ability of around 20 meters (66 feet) indoors and a greater compass outdoors. Wi-Fi 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:

a) IoT platform
b) Neural network models in Big Data Analytics and water quality management
c) Real-time monitoring of water quality by using IoT integrated Big Data Analytics

IoT Platform :

The quality parameters are labeled datasets including desired outputs of specific combinations 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 the Hadoop cluster. The advantages of using neural network based analytics are that Artificial Neural Networks (ANNs) are good in learning and modeling non-linear relationships, and high volatile data.

Though neural networks are prone to overfitting, the neural network model used in water quality monitoring systems is not complex enough to cause overfitting 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 the input layer, a hidden layer with four neurons and three neurons in the 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, the data management layer will be deployed and operational on the Apache Hadoop cluster. Hadoop helps distribute storing and processing of big data across clusters of computers. Also, such an 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 the Apache HBase NoSQL database to store big data as HBase runs on top of Hadoop . Hence, the data is distributed across the 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 nodes (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 Smartphones, laptops and desktops. The root users will be able to generate daily/monthly/yearly water quality reports from the data management layer and visualize in the client devices.