Ideation Phase
Ideation

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TEAM ID	PNT2022TMID17727
PROJECT NAME	Real Time River Water Quality Monitoring and Control System
MAXIMUM MARKS	4 Marks

Introduction:

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 real-time 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

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 andhigh 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:

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 inhabit. 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 utilise 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, indicatingits 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 inthe water.

The muddiness of the open cut food is ordinarily between 255 NTU. Irrigate is visibly at levels above 80 NTU. The standard for intemperance liquid is 130 NTU to 250 NTU. Theturbidity 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 waterclarity, 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 intothe 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 israttling commonly victimised 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 canuse Wi-Fi study permit private computers, video-game consoles, smart phones, 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 threeparts:

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

a) IoT Platform:

The quality parameters are labeled data sets 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 modeling 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.

b) Neural network models in Big Data Analytics andwater 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 in1, In 2, In 3, In 4, In 5in 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 :

$F(X) = 1 / (1 + \exp(-\Sigma jwjxj - b))$

c) 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 HBse 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.