MEE1901 TARP REPORT

IoT-Based Water Quality Monitoring and Prediction

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1.) Introduction

Water conservation and quality have become one of the world's primary challenges throughout the years. Only 2% of the world's freshwater supplies are poisoned as a result of human activity. Contaminated water is not only unpleasant to drink or look at, but it is also hazardous to one's health. According to the World Health Organization, contaminated water kills about 30% of people worldwide. A frequent check on the stored water in the storage tank might be the first step in preventing personal water pollution. This can help humans avoid the negative impacts of polluted water. The project discusses the quality of water using IoT and uses neural networks to compare the predicted result to the measured data and warn the user if necessary. Based on data obtained from water quality monitoring systems, a map of the link between monitored data and changes in quality indicators may be used to forecast future water quality. The standard method of analyzing water quality samples in a laboratory wastes time and effort and is ineffective. It becomes increasingly difficult to anticipate water quality in real-time. The advancement of computer technology has sparked earlier behaviors in recent years. The Internet of Things (IoT) is a popular technology for connecting sensors and gadgets to the internet. The internet of things (IoT) is a network that connects devices to the internet and shares data with users. These sensors continually generate data that indicates how well the gadgets are performing. The polluted water is integrated into the IoT platform, and the user receives a notification to take additional action to avoid contaminated water.

2.) Literature Survey

After many years of research, water quality standards are put in place to ensure the suitability of efficient use of water for a designated purpose. Water quality analysis is to measure the required parameters of water, following standard methods, to check whether they are by the standard.

Selection of Methods-The methods of water quality analysis are selected according to the requirement. The factors playing a key role in the selection of methods are: (i) Volume and the number of samples to be analyzed (ii) Cost of analysis (iii) Precision required (iv) Promptness of the analysis as required Precision and Accuracy of Method Selected as Per Requirement What precision and accuracy to be maintained against a particular method is selected according to the need. The factors influencing this decision include: (i) Cost (ii) Parameter (iii) Usage

3.) Patent Survey

Water is one of the most important elements for life to exist. Drinking water safety and accessibility are major concerns all over the world. Health concerns may result from the drinking of water polluted with pathogenic pathogens, poisonous substances, etc. The traditional method of testing water quality samples in a laboratory wastes time and labour and is ineffective. And it becomes impossible to estimate the water quality in time. Our project, on the other hand, can monitor water quality and alert users before the water becomes contaminated. Water contamination can be caused by a variety of factors. These characteristics are taken into consideration and utilized for estimating when to clean the water. The system makes use of IoT and machine learning technology. To verify the parameters, it has physical and chemical sensors that detect pH, turbidity, colour, DO, conductivity, and so forth. The data collected by the sensors is stored in a database and then sent to be analyzed. However, in our prototype, we have only used only 3 sensors-temperature, conductivity, and Ph. The outcome is predicted using the neural network technique. It's used to get a non-linear relationship between predicted output and input. When any of the parameters fall below the standard values, the system sends an alarm message to the user. This permits the user to know earlier about the pollution of water in their household tanks.

4.) Problem Definition

Water is one of the major concerns in the world. There is only 2% of freshwater resources available on the earth which is getting contaminated due to human activities. The Contaminated water not only tastes or look bad, but is also harmful to health. The regular check on the stored water from the storage tank can be the initial step to prevent contamination of water on a personal basis. This can avoid the harmful effects of the contaminated water on human water conservation and quality have become one of the primary challenges throughout the years. Our project aims in bringing a simple, yet effective way to control this. Checking the water quality and predicting whether it is safe to use is a goal of our project. We hope our project idea might bring change in rural areas where the quality of water is been neglected.

5.) Detailed Methodology

The proposed system consists of several wireless sensors connected to the NodeMcU controller, including a pH sensor, turbidity sensor, conductivity sensor, color sensor, and DO sensor, among others. To interact with the phone or other devices, the microcontroller has a GSM module. However, we employed PH, conductivity, and temperature sensors in our prototype. The technology is used to check the water quality in household tanks. The data from the sensors are continually sent to the controller. Every month, the data is gathered in a database and the results are forwarded to neural networks for analysis. When the water is on the edge of becoming polluted, the user is alerted to take further steps to prevent drinking contaminated water.

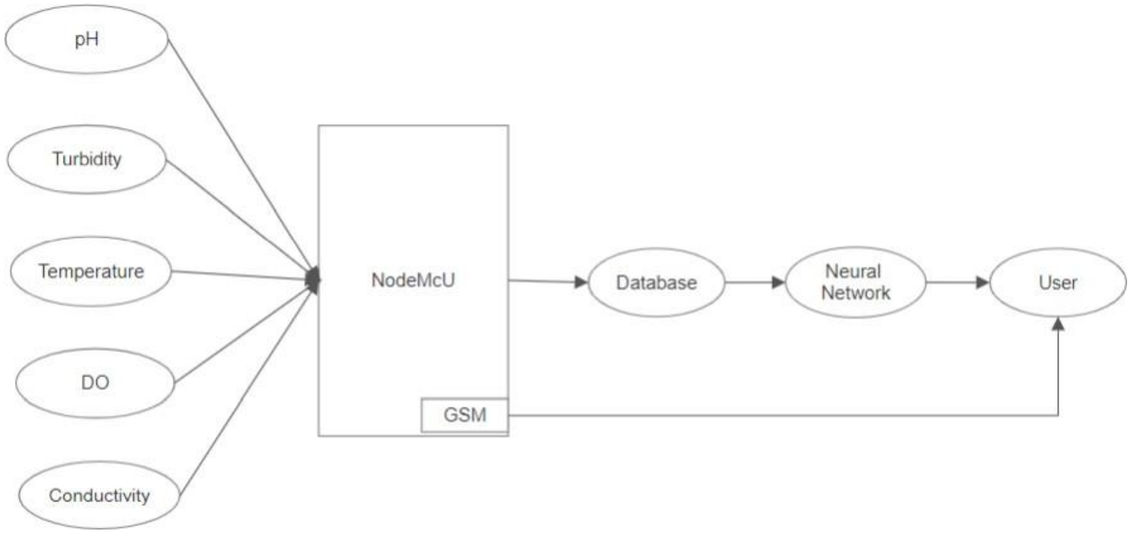


Fig 1: Schematic Diagram

5.1 Implementation:

The system was installed in a residential tank to monitor the water every week. The standard values of the parameters of the water were set as a limit for the quality of water to measure the contamination.

5.1.1 Hardware Implementation:

A microcontroller termed NodeMcU is at the heart of the system.It's a low-cost controller built around the ESP8266 chip. It features a Wi-Fi module that allows it to communicate with the user and share the expected outcome. pH, temperature, conductivity, dissolved oxygen, total organic compound, color, and turbidity sensors are all connected to NodeMcU in the proposed system. In our prototype we have only used temperature, conductivity and Ph sensor.These sensors capture data from the water and transfer it to a cloud server, which receives the data from the gateway and stores it in a database for the study. The information gathered is then utilized to apply a neural network algorithm to anticipate water pollution in advance.

5.1.2 Software Implementation:

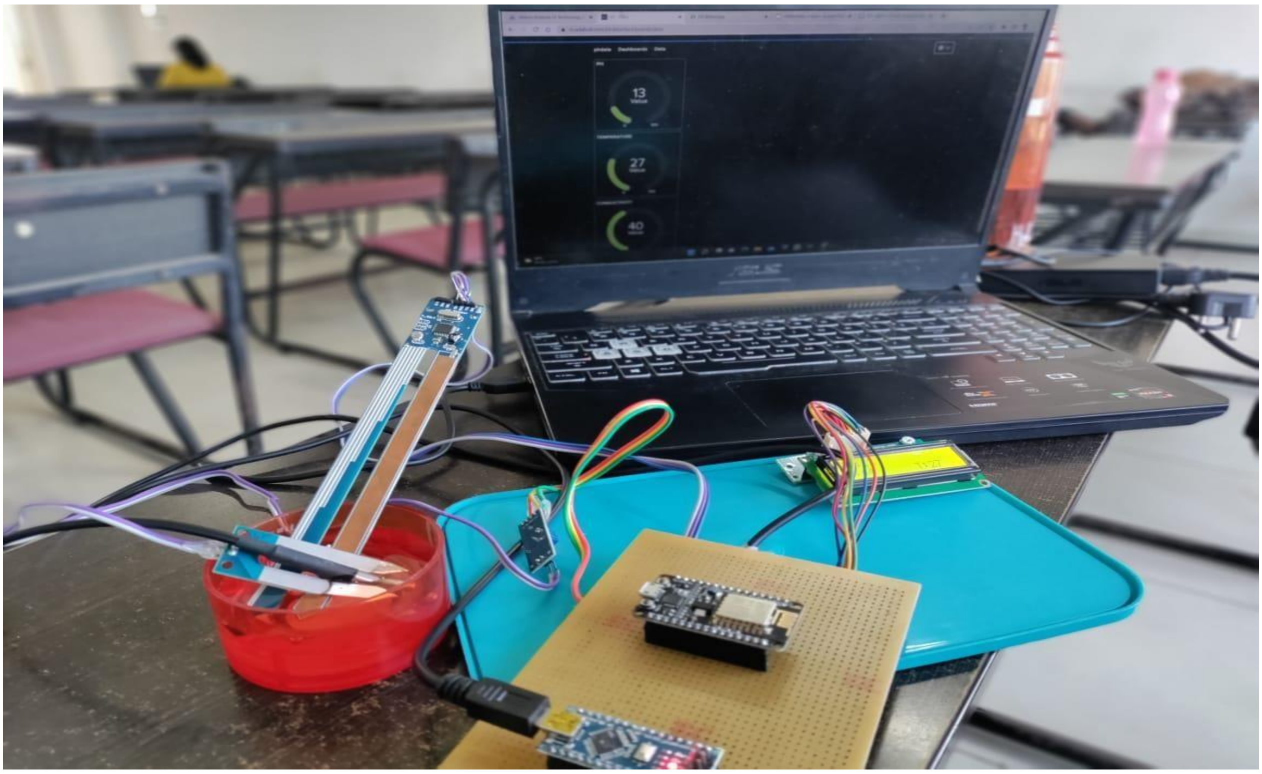
Jupyter Notebook was utilized to implement the project, and a neural network technique was employed to anticipate the outcome. Neural networks are the better approaches to examining and modeling the data. It uses interconnected neurons to process the information. One input layer, one hidden layer, and one output layer make up the model. The datasets were collected for two years in a row. The data is statistically consistent and shows the same problem. We utilized a dataset from the Kaggle website for our prototype because we didn't have enough time. To create outputs, these datasets are routed via networks. During the training phase, the desired output is obtained. The data is separated into three categories: training, testing, and validation, all of which have an impact on the network's performance. The training data contains 80% of the data, with 70% of the training set and 30% of the testing set. The training set is used to train the network. The dataset is run through this trained network. To predict the data, a temporal frame is established. To forecast the accurate output, a total of 100 neural network layers were employed.

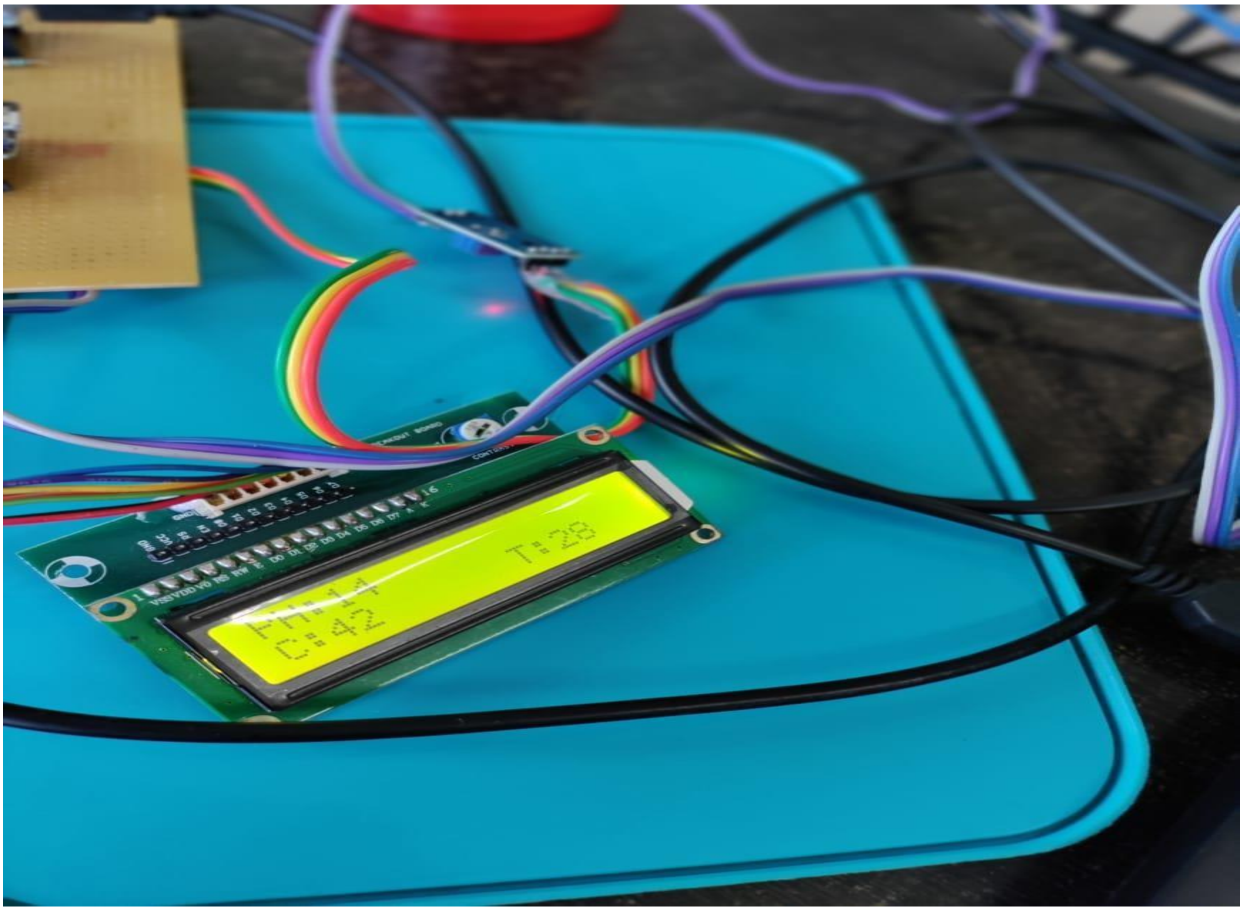
S.NO.	PARAMETERS	VALUES
1.	pH	6.5-8.0
2.	Temperature	140 F
3.	Turbidity	5.0
4.	Dissolved Oxygen	5.0 mg/l
5.	Conductivity	0.05 S/cm
6.	Total Organic carbon	56 mg/l
7.	Colour	Colourless

TABLE 1: Standard Values of Water

Table.I is made up of data taken from WHO's standard values (World Health Organization). These standard values were used to compare the anticipated values \sand notify the user when any of the parameter reaches its extreme values before water is polluted.

5.2.) OPERATION IMAGES (Project model)





6.) Results and Discussion

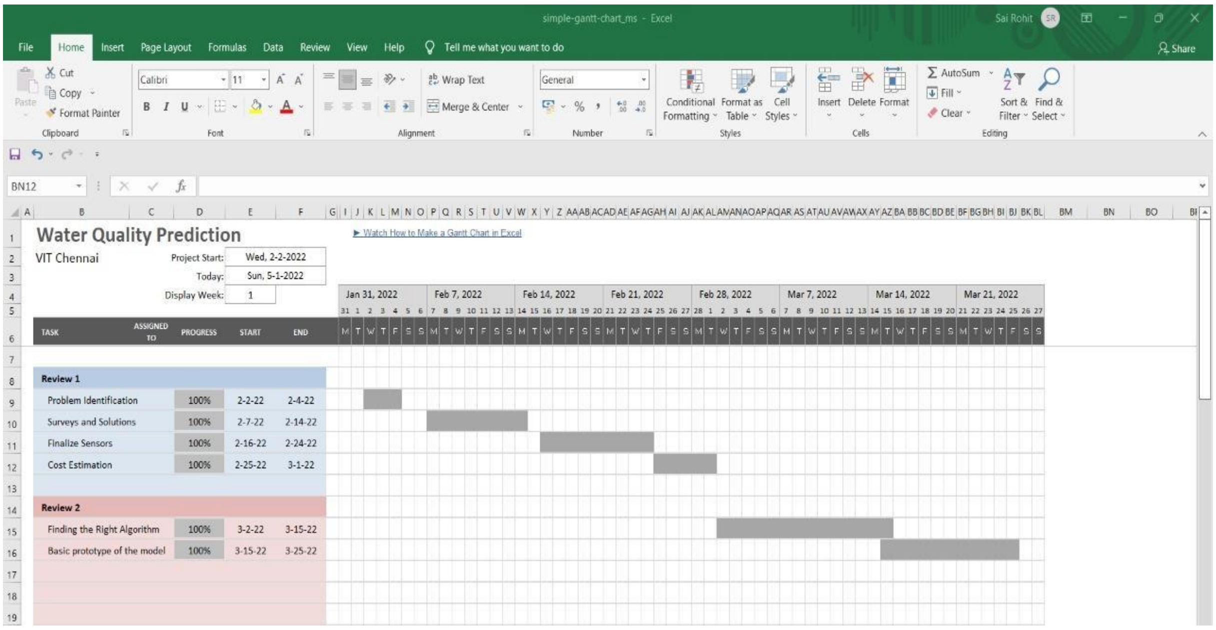
Water quality monitoring and prediction is important for several applications such as environmental monitoring of ponds and ecosystems, drinking water distribution and measurement, Contamination Detection in Drinking Water, etc. such applications need a separate technique for monitoring the water quality. In our proposed system, we can monitor the water quality parameters on the internet by using the cloud and can predict the water quality for the next coming month. The water quality parameters values are stored in a separate web server on the cloud. These parameters can be viewed by using a separate IP address.

In this project, the design and development of the real-time monitoring of the water quality parameters in the IoT environment are done, and our deep learning algorithm has an accuracy rate of 88%. The proposed system consists of various water quality parameter sensors, Arduino nano, and the WIFI module ESP8266. These devices are low cost, more efficient, and capable of processing, analyzing, sending, and viewing the data in the cloud and also through WIFI to the mobile device. This implementation is suitable for environmental monitoring, ecosystem monitoring, etc and the data can be viewed anywhere in the world. In the future, we plan to implement biological parameters of the water and install the system in several locations of the pond and in the water distribution network to collect water quality data and send it to the water board.

7.) Project Outcome in terms of Technical, Economical, Social, Environmental, Political and Demographic Feasibility

The project that we have made is very budget-friendly from a product point of view and therefore economically affordable for most people. From a technical aspect, the projects cover a few topics from Deep learning, IoT, etc., and are easily comparable to the present technology. It is feasible and does not need a professional setup. This project has also great future work development opportunities which is another major advantage. In future work, it will be interesting to explore optimal designing of smart wart quality monitoring system, exploring optimal portable sensors’ technology, usage of secure and reliable IoT servers, and devising resilient schemes mitigating potential security breaches. IoT-based water quality monitoring systems can be highly successful but they require intensive monitoring, control, and management. To get a good solution, many issues and tasks should be solved, among them: cost of the IoT solutions; interoperability of the devices from different manufacturers or even from a single brand with different protocols; availability of reliable electricity and mobile internet to the IoT based WQMS; security issues (the absence of a secure and properly encrypted network, the adoption of IoT could lead to security challenges and vulnerabilities); lack of highly qualified specialists in setting up and maintaining systems

8.) GANTT CHART



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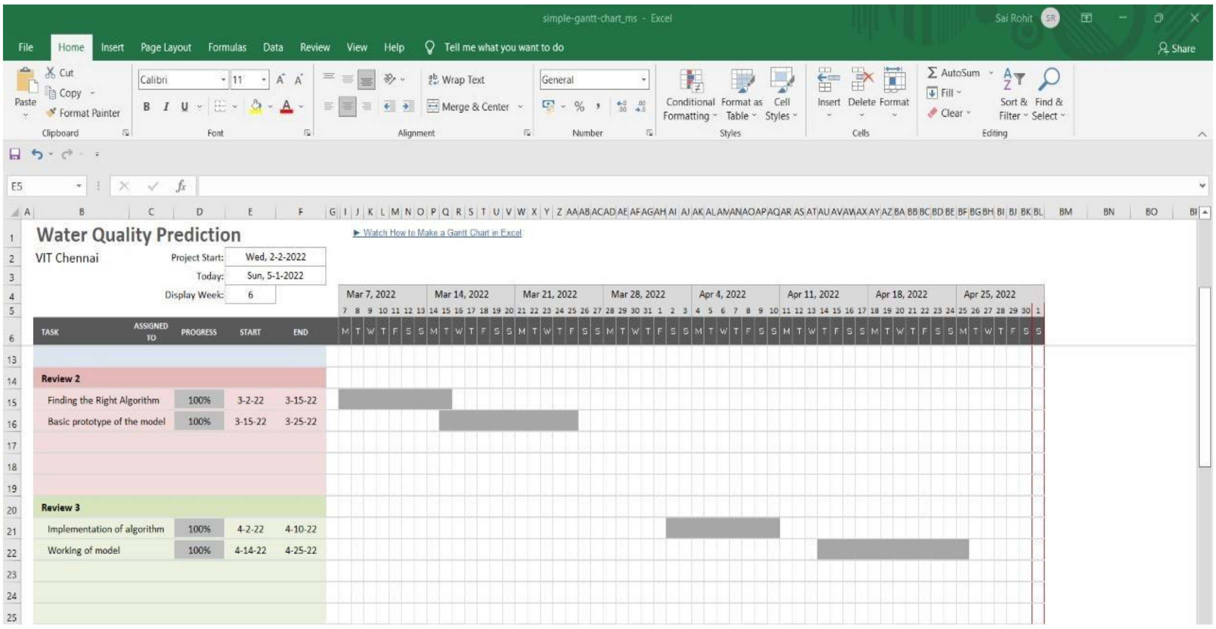

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9.) REFERENCES

[1] T. Perumal, N. Sulaiman, and C. Y. Leong, "Internet of Things (IoT) Enabled Water Monitoring System," 2015 IEEE 4th Glob. Conf. Consum. Electron. Internet, pp. 86–87, 2015.

[2] S. Madakam, R. Ramaswamy, and S. Tripathi, "Internet of Things (IoT): A Literature Review," J. Comput. Commun., vol. 3, no. 5, pp. 164–173, 2015.

[3] C.-W. Tsai, C.-F. Lai, and A. V. Vasilakos, "Future Internet of Things: open issues and challenges," Wirel. Networks, vol. 20, no. 8, pp. 2201–2217, 2014.

[4] J. E. Ibarra-Esquer, F. F. González-Navarro, B. L. Flores-Rios, L. Burtseva, and M. A. Astorga-Vargas, "Tracking the evolution of the internet of things concept across different application domains," Sensors (Switzerland), vol. 17, no. 6, pp. 1–24, 2017.

[5] H. Y. Kim and J. M. Kim, "A load balancing scheme based on deep-learning in IoT," Cluster Comput., vol. 20, no. 1, pp. 873–878, 2017.

[6] G. Barbon, M. Margolis, F. Palumbo, F. Raimondi, and N. Weldin, "Taking Arduino to the Internet of Things: The ASIP programming model," Comput. Commun., vol. 89–90, pp. 128–140, 2016.

[7] B. Jo and Z. Baloch, "Internet of things-based arduino intelligent monitoring and cluster analysis of seasonal variation in physicochemical parameters of Jungnangcheon, an urban stream," Water (Switzerland), vol. 9, no. 3, 2017.

[8] M. Ibrahim, A. Elgamri, S. Babiker, and A. Mohamed, "Internet of things based smart environmental monitoring using the Raspberry-Pi computer," 2015 Fifth Int. Conf. Digit. Inf. Process. Commun., pp. 159–164, 2015.

[9] R.Karthik Kumar, M.Chandra Mohan, S.Vengateshapandiyan, M.Mathan Kumar, R.Eswaran, "Solar based advanced water quality monitoring system using wireless sensor network," International Journal of Science, Engineering and Technology Research (IJSETR), vol. 3, Issue 3, March, pp. 385-389, 2014

[10] Jayti Bhatt, Jignesh Patoliya, IoT Based Water Quality Monitoring System, IRFIC, 21feb,2016.

[11]Mohammad Salah Uddin Chowdury, Talha Bin Emran, Subhasish Ghosh, Abhijit Pathak, Mohd. Manjur Alam, Nurul Absar, Karl Andersson, Mohammad Shahadat Hossain,IoT Based Real-time River Water Quality Monitoring System, Procedia Computer Science,Volume 155,2019,Pages 161-168,ISSN 1877-0509

[12] https://www.kaggle.com/datasets/adityakadiwal/water-potability