

Water Quality Monitoring Using Machine Learning And Iot

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Abstract: Water is one of the most essential element for the existence of life. The safety and accessibility of drinking-water are major concerns throughout the globe. Health risks may arise from consumption of water contaminated with infectious agents, toxic chemicals etc. In this paper a system is proposed to check the water quality and warn the user before water gets contaminated .There are different parameters that can contaminate the water. These parameters are taken into account and used for predicting when to clean the water. The system uses technologies such as IoT and Machine Learning. It consist of the physical and chemical sensor to measure pH, turbidity ,colour, DO, conductivity etc. to check the parameters .The data obtained from the sensors are recorded in the database and further sent for analysis. The neural network algorithm is used for predicting the result. It is used to obtain non-linear relationship for predicted output. The system sends the alert message to user when any of the parameters are lower than the standard values. This helps the user to know beforehand about the contamination of water in their residential tanks. This technique can not only be limited upto residential tanks but can also be used in water treatment plants and industries.

Index Terms: IoT, machine learning, neural network, prediction, sensors, storage tanks, water quality.

1 INTRODUCTION

Over the years, the conservation and quality of water is one of the major concern in the world. There is only 2% of fresh water resources available on the earth which are getting contaminated due to human activities. The contaminated water not only taste or look bad but is also harmful for the health. According to WHO, over 30% of people all over the world die due to consumption of unsafe water. The regular check on the stored water from the storage tank can be initial step to prevent contamination of water on the personal basis. This can avoid the harmful effects of the contaminated water on human. The paper discusses the quality of water using IoT and compares the predicted result with the measured data using neural networks and warns the user if necessary. On the basis of data collected from water quality monitoring system can map the relationship between the monitored data and the changes in the quality parameters which can be used to predict the water quality in future. The traditional practice of testing the water quality sample in the laboratory which consumes more time, labor and inefficient. And it becomes difficult to predict the water quality in time. In the recent times the development in the computer technologies has triggered the earlier practices. Internet of Things (IoT), it is one of the most trending technology used to connect the sensors and devices to the internet. IoT is the networks which connects devices with the internet and share the data with the user. These sensors continuously emit data which provides the working state of the devices .The IoT platform integrates the

2 INTERNET OF THINGS (IOT)

collected data from various sources, further analytics is performed on the data and valuable information is extracted as per the requirements.

3 NEURAL NETWORK

Neural Networks is the machine learning algorithm used for predicting the output from several inputs. It is the information processing system that is similar to the biological system of the brain which is used to predict the output using non-linear variables. It consists of several inputs called neurons which are associated with their weight that signifies its influence and strength with the interconnected neuron. The data is transferred from the input to the output via transfer function. The neural network consists three layers of interconnected neurons. The neurons of each layer are connected with each other. The input layer stores the data and the output layer responds to the input given. There is a intermediate layer which is hidden in between the input and output layer which performs the computation on the data.

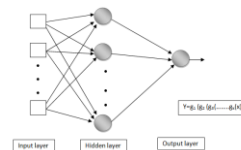


Figure 1: Neural Network

3 SYSTEM ARCHITECTURE

The proposed system consists of number of wireless sensors such as pH sensor, Turbidity sensor, conductivity sensor, colour sensor and DO sensor etc. which are connected to the NodeMCU controller. A GSM module is present in the microcontroller to communicate with the phone or other devices. The system is installed in the residential tanks to monitor the water quality. The sensors continuously transmit the data to the controller. The data is collected in the database and the result is sent to neural networks to analyze the data over the monthly basis. When the water is on the verge to get

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contaminated the user gets the message to take further action to avoid contaminated water. The proposed system is shown below:

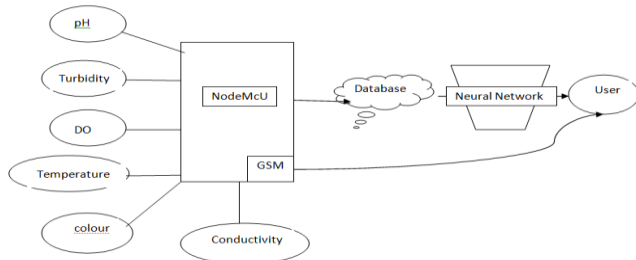


Figure 2: System Architecture

4 IMPLEMENTATION

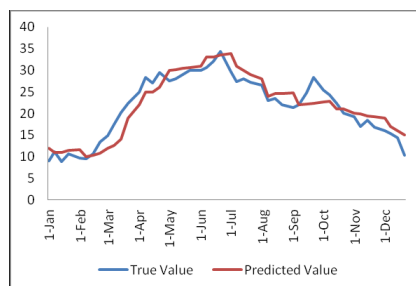
The system was installed in a residential tank to monitor the water on the weekly basis. The standard values of the parameters of the water were set as a limit for quality of water to measure the contamination.

4.2 HARDWARE IMPLEMENTATION

The system consists of a microcontroller named as NodeMCU. It is inexpensive controller made with the chip known as ESP8266. It has the Wi-Fi module to easily connect with the user and share the predicted result. In the proposed system, the pH sensor, temperature sensor, conductivity sensor, dissolved oxygen sensor, Total organic compound sensor, color sensor and turbidity sensor are connected to NodeMCU. These sensors collect the data from the water and send out the wave signal to the cloud server that collects the data from the gateway and store it in the database for analysis. The data collected is further used for predicting the contamination of water in advance using neural network algorithm.

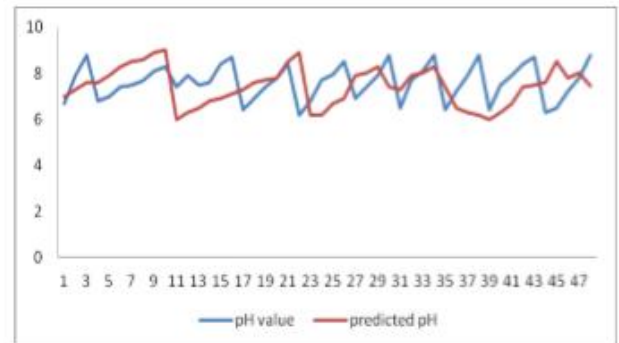
4.3 SOFTWARE IMPLEMENTATION

The software used for implementation was Matlab in which neural network algorithm was used to predict the result. Neural network are the better ways to analyze and modeling the data. It processes the data in interconnecting neurons. The model has one input layer, a hidden layer and a output layer. The datasets were obtained for the two consecutive years. The dataset are statistically consistent and represent same statistical problem. Total 198 datasets were used to predict the data. These datasets are passed through networks to generate outputs. The target output is obtained in the training phase. The data is divided into training, testing and validation



Graph 1: Temperature Parameter

that have influence on performance of the network. The training data has 80% data which comprises of 70% training set and 30% testing set. The network is trained on the training set. This trained network is applied on the dataset. A time frame is determined to predict the data. The number of neural network layer used was 100 to predict the accurate output. The graph is plotted for the true and the predicted value.



Graph 2: pH parameter

The neurons are assigned with the following function to calculate the prediction. Let 1...m be the number of neurons in the system which takes $x_1, \dots, x_n + 1$ biased inputs and outputs:

$$h_{w,b}(x) = f(\sum W_i x_i + b) \tag{1}$$

where f is the activation function.

$$f(z) = 1 / (1 + \exp(-z)) \tag{2}$$

TABLE I: STANDARD VALUES OF WATER

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

The Table.I. is formed by the data taken from the standard values prescribed by WHO (World Health Organization). These standard values were used to compare the predicted values and warn the user when any of the parameter reaches its extreme values before water gets contaminated.

5 CONCLUSION AND FUTURE WORK

The paper presents the economical solution to avoid contamination of water in residential overhead tanks. The quality of water is monitored using IoT devices and the future prediction of water contamination is achieved using machine learning algorithms. The proposed system consists of multi sensors connected to NodeMCU to collect the water parameters. And the alert message is sent to the user before the water gets contaminated. The system helps to save the water from contamination and is also cost effective. The future scope for this project is to detect the diseases caused by different parameters and finding the appropriate solution for to clean the tank. Also biosensors can be used to detect the microbacterias for better quality of water.

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