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WATER QUALITY MONITORING & FORECASTING SYSTEM

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ABSTRACT:

Water is an essential resource in day-to-day life. Pollution and urbanization have led to higher susceptibility of source water to contamination. There is a pressing need to develop a water quality monitoring system to preserve the quality of source water and ultimately safeguard human health. This paper proposes a low cost, wireless water quality monitoring system, wherein the quality of water stored in overhead tanks is continuously monitored. The quality of water is measured by parameters that are critical quality indicators. The data encompassing these parameters are stored in a Cloud database (in real-time) along with its timestamp. The quality of water is ascertained based on the comparison of the monitored data to standard well-established thresholds. The data, annotated with its timestamp is treated as a time-series. A univariate non-seasonal Autoregressive Integrated Moving Average (ARIMA) model is employed to forecast individual water quality parameters. The results of forecasting are used to predict water quality deterioration. The model used is found to have mean square errors of 0.001 for pH, 0.076 for temperature and 0.001 for turbidity between the actual and forecasted values.

Keywords:ARIMA, Real time monitoring, turbidity.

1. INTRODUCTION:

Water used for commercial or domestic purposes is commonly stored in overhead tanks. The water being stored can become a breeding ground for various pathogens or harmful microorganisms. Contact with rainwater alters acidity, rendering this water unfit for consumption and other purposes. In the long run, harmful chemicals may be deposited on the walls of the tank. Exposure to open air can lead to contamination by particulate matter. Sedimentation of these particles can alter certain chemical properties of the water. Formation of rust resulting from improper maintenance of water collection pipes severely degrades the quality of water. Microbiological quality of water characterises ill-health. Infectious diseases like dysentery, giardiasis, cholera, typhoid, guinea worm, hepatitis, and schistosomiasis are spread through water contamination. These diseases may result from inadequate sanitation or poor hygiene. It is important to note that all factors regarding quality and availability of drinking-water is important and is implicated in public health. As a precursor to tackling these

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problems, a real-time system is proposed which continuously monitors and reports the quality of the water. The data monitored by the system truly captures the water quality. A useful analysis of this data can be used to predict the deterioration of water quality. This can be achieved by employing time-series forecasting. Autoregressive Integrated Moving Average(ARIMA) is a forecasting statistical technique that is used to analyse a time series based on history. A non-seasonal model is well-suited as it must be insensitive to any local short-lived trends within the time series. These trends do not contribute to the overall quality of water in the future.

2. LITERATURE SURVEY

A water quality monitoring system must first identify parameters to measure quality. It is important to know the details of different physical and chemical properties such as colour, temperature, acidity, hardness, pH, sulphate, chloride, Dissolved Oxygen, Biological Oxygen Demand, and Chemical Oxygen Demand[1]. Narrowing down the parameters suitable for measurement involves consideration of cost. Implementation in hardware after design and simulation in software proved to be costeffective in [2]. The parameters considered where pH, temperature and conductivity in [2], whereas temperature and turbidity are considered in [10]. To provide scalability, wireless transmission of data is an attractive attribute. A wireless sensor network(WSN) was developed in [3] wherein each node within the network consisted of a microcontroller, Xbee module and sensors. An important consideration in system design is power. Low power is achieved in [4] with the help of active and sleep states of each node within the wireless sensor network. Power supplied by solar panels solved the critical power issue in [3]. To avoid signal interference the Zigbee operating on the IEEE 802.15.4 standards was avoided and a UHF transceiver operating at 920MHz is used in [9]. Time series forecasting is used to predict the future data points based on values observed in the past. The prime objective is to obtain the best forecast function to fit the data points, i.e., to reduce the Mean Square Error(MSE) between the actual and forecasted values as far as possible, for each lead-time [5,6]. A popular linear model for time series forecasting is Auto-Regressive Integrated Moving Average (ARIMA). The ARIMA model used for measuring water quality in wetlands in [7] did not exceed an overall prediction error of 15%. A relative error of 4-12% between the actual and predicted values was seen in the ARIMA model used to predict water quality in coastal waters in [8]. Time series forecasting provides a way to forecast the changing qualities of drinking water, thus leveraging an idea for water quality prediction. A sensor system must be designed to monitor indispensable parameters for water quality. Cost trade-offs and power tradeoffs must carefully be considered. Scalability and accessibility of monitoring systems and their data are powerful aspects that refactor the system design.

EXISTING SYSTEM:

Water used for commercial or domestic purposes is commonly stored in overhead tanks. The water being stored can become a breeding ground for various pathogens or harmful microorganisms. Contact with rainwater alters acidity, rendering this water unfit for consumption and other purposes. In the long run, harmful chemicals may be deposited on the walls of the tank. Exposure to open air can lead to contamination by particulate matter. Sedimentation of these particles can alter certain chemical properties

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of the water. Formation of rust resulting from improper maintenance of water collection pipes severely degrades the quality of water.

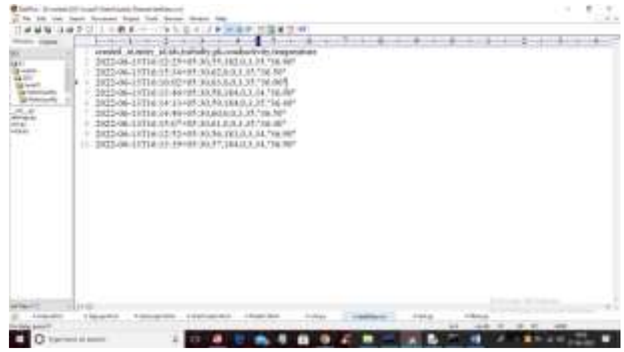
PROPOSED SYSTEM:

The flowcharts of the transmitter and receiver are shown in Figure 8 and Figure 9 respectively. The system is powered by either by solar or battery based on the instantaneous power requirements. In the case of less power flux density of solar, a control circuit switches between battery and solar. The major power source is solar and battery is utilized as a backup source in case of power fluctuations during the day. Since the user checks for quality on a daily basis, any failure in power to the transmitter can be noticed by the corrupt values in the database. the corrupted values arise due to instability of the microcontroller due to inadequate power supply. Figure 7 shows the block representation of the power source to the transmitter. Upon powering up the elements of the transmitter, the core waits for the sensors to stabilize. Upon achieving stability, the core processes the incoming data and applies AES encryption to secure the data. The encrypted data is sent to the RF module which transmits it wirelessly.

3. METHODOLOGY

Water Quality Monitoring & Forecasting System

In this project we are using water dataset to predict and forecast water quality by using algorithms such as LSTM and Random Forest and in both algorithms Random Forest is giving better accuracy. After training model we are applying test data on train model to predict the quality of the test data and below screen showing test DATA values

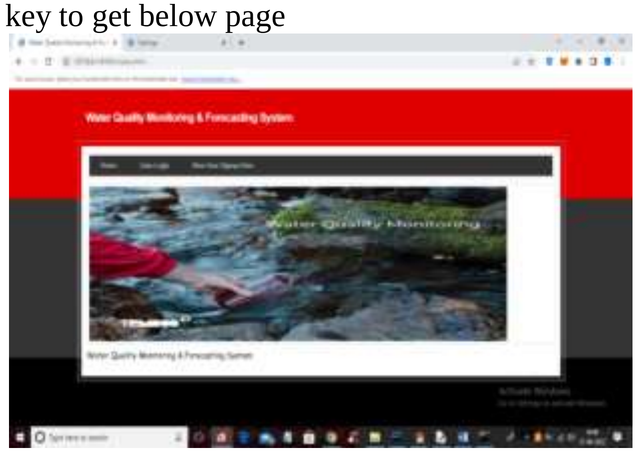


In above test data screen we have all water quality values but we don’t GOOD and POOR label so when we applied on algorithm trained model then it will forecast GOOD or Poor Quality.

SCREEN SHOTS

To run project first copy content from ‘DB.txt’ file and then paste in MYSQL database to create it and now double click on ‘run.bat’ file to start DJANGO server and then will get below output

In above screen DJANGO server started and now open browser and enter URL as ‘http://127.0.0.1:8000/index.html’ and press enter key to get below page



In above screen click on ‘New User Signup Here’ link to get below screen

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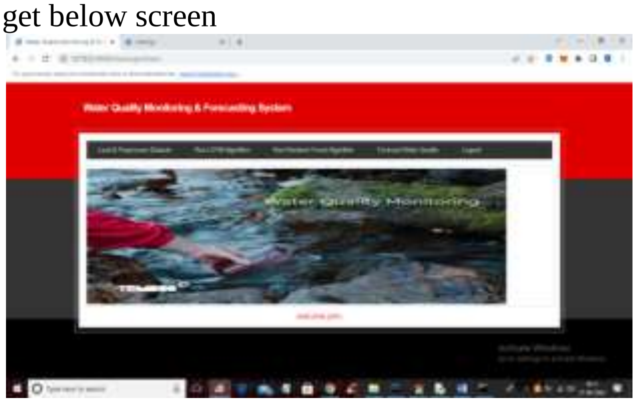
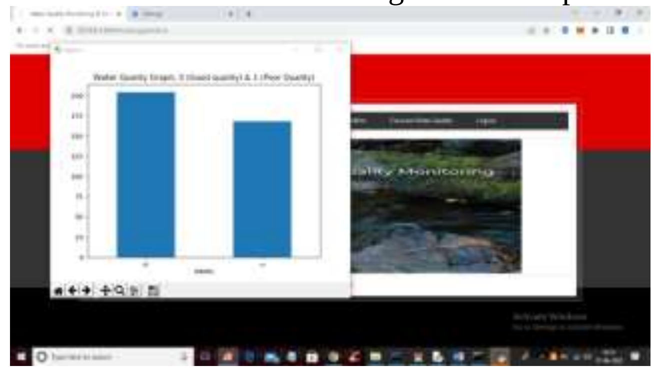
In above screen user is signing up and then press button to get below screen

In above screen signup process completed and now click on 'User Login' link to get below screen

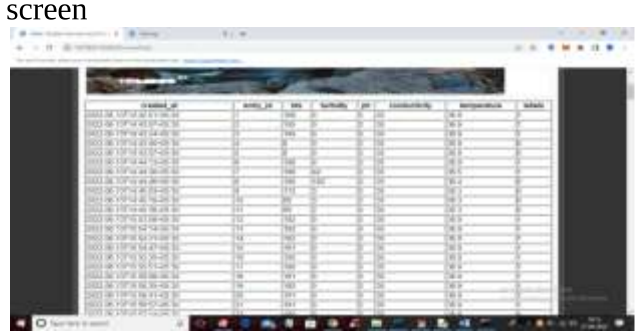
In above screen user is login and after login will get below screen



In above screen click on 'Load & Preprocess Dataset' link to load and process dataset such as replacing missing values with 0 and then split dataset into train and test and get below output



In above screen dataset is processed and in above graph x-axis contains water quality as 0 or 1 where 0 means GOOD quality and 1 means POOR quality and y-axis represents number of records and now close above graph to get below screen

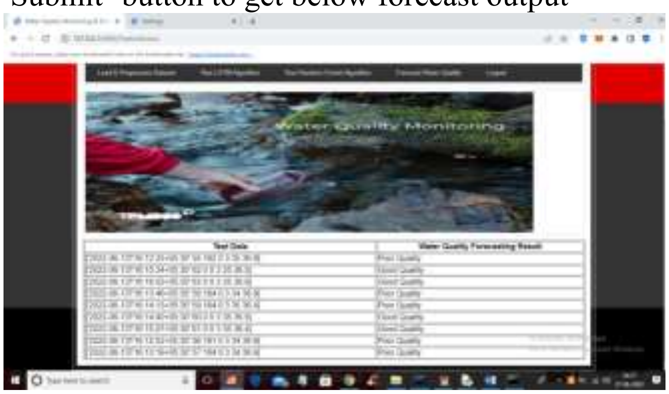


In above screen we can see dataset processed and loaded and now click on 'Train LSTM Algorithm' link to train LSTM and get below output

In above screen LSTM got trained and with LSTM we got 57% accuracy and now click on 'Train Random Forest Algorithm' link to train Random Forest and get below output

In above screen with Random Forest we got 94% accuracy and now click on 'Forecast Water Quality' link to upload test data and then forecast quality

In above screen selecting and uploading 'testData.csv' file and then click on 'Open' and 'Submit' button to get below forecast output



In above screen in tabular output first column contains water test values and second column contains forecast result as 'Poor' or "Good".

CONCLUSION

An attempt has been made to develop a Bluetooth operated agricultural robot which performs ploughing, seed sowing and mud levelling operations. The proposed system is battery operated and controlled by Bluetooth device. Using this robot, farmer can carry out other secondary activity along with operating the robot. By carrying out multiple activities at the same time, farmer can increase his income which results in development of Indian economy.

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