Influent And Effluent Parameters Prediction In A Wastewater Treatment Plant

Supervisors:

Dr. Parul Yadav

Mr. Sandeep Yadav

Submitted By:

Aditya Chaudhary 1805210004

Nitish Kr. Chaudhary 1805210031

Priyanshu Sharma 1805210039

Anand Keshari 1900520109002

Content

- Introduction
- Motivation
- Methodology
- Technology/Library Requirements
- Proposed Model
- Conclusion

Introduction

The more the population increases, the more water is consumed, and the constant increase in the usage of water results in an increase in the wastewater generated by the region. This increase requires the wastewater treatment plants to operate efficiently to process the demand for sewage disposal.

The project proposal is based upon designing and implementing a machine learning-based model for analyzing and predicting flow and quality parameters like COD, BOD, TSS, DO, pH, Temperature, Ammonia, Phosphorous and oil content, etc. in influent, and also predicting parameters like COD, BOD, DO, pH, temperature, etc. of effluent in a wastewater treatment plant. The proposed model shall provide support to centrally monitor processes and operations of wastewater treatment plants. This project shall improve operational efficiency and provide cost-effective utilization of various resources at wastewater treatment plants by knowing the influent and effluent parameters in advance.

More specifically, we shall collect the water parameters from Bharwara WasteWater Treatment Plant situated in Lucknow district which is the largest UASB based wastewater treatment plant in Asia as it can operate and process an average flow rate of 345 MLD with the ability to handle a peak load of 517 MLD of sewage daily. However, the implemented model shall be applicable for any UASB based wastewater treatment plant or any wastewater treatment plant after a specific training part or maybe after minor model refinements.

To provide for a quick and efficient method to process influent and effluent particles in sewage we are proposing a combination of Artificial Intelligence and IoT devices/ Online analyzers to automate the prediction of the various influent and effluent parameters which will result in the efficient working of the various reactors without manually checking and adjusting for the systems in place. Many other Models were made in the past based on IoT and Machine learning algorithms

Motivation

As of now many researchers have contributed in proposing machine learning models for wastewater treatment plants. However, the available monitoring technologies used for analyzing and predicting parameters of wastewater quality have a number of limitations or drawbacks e.g. models are suited for plants of outside India. In India, such smart systems for monitoring, analyzing, predicting quantity and quality parameters of wastewater are at a very preliminary stage. Smart, advanced and/ or automated systems are required not only for efficient utilization of resources but also for smooth functioning of the wastewater treatment plants which can directly affect the health of humans/ living beings. In India, no existing standard smart monitoring tool is currently available/ used that predicts flow of influent and parameters of influent and effluent in wastewater parameters in advance for effective resource utilization at plant.

The automation of wastewater systems is still not as developed as other process industries. The proposed project is based upon implementation of such a model/ infrastructure/ framework for Wastewater Treatment Plant where data analysis shall be performed on real time data collected from Bharwara Wastewater Treatment Plant, Lucknow.

Methodology

The proposed project is based upon analyzing and predicting influent flow and quality parameters of influent and effluent using machine learning techniques to provide efficient utilization of chemical resources during treatment process ensuring the desired level of quality indicators in effluent. We shall collect real dataset of Bharwara Wastewater Treatment Plant, Lucknow for data analysis. The methodology of the proposed project is briefed using the following steps:

1. Data Collection.
2. Preprocessing of collected raw data

   Firstly, we treated the outlier datapoints using Quartile range. Then we imputed the missing values using KNN imputer in order to smooth out the dataset. Lastly we had used feature scaling to normalize the data.
3. Analyse the Effluent and Influent parameters
4. Designing a Machine Learning model to predict Effluent parameters
5. Designing a Machine Learning model to predict Influent parameters
6. Improving Performance of the model

Proposed Model

Proposed models for influent prediction: We shall design and implement a machine learning-based model to analyze and predict the flow and parameters of influent in wastewater treatment Plant. With the available data set, we analyzed the flow rate of influent which is graphically represented in the figure on the right.

Figure 1 shows the per day flow of influent water and Figure 2 shows the monthly flow of influent in Bharwara WWTP. As we can clearly observe that there is inconsistency in influent quantity. So the future prediction is necessary to maintain the efficiency of WWTP.

In order to make such predictions, time series analysis algorithms like LSTM and ARIMA would perform better than normal machine learning algorithms.

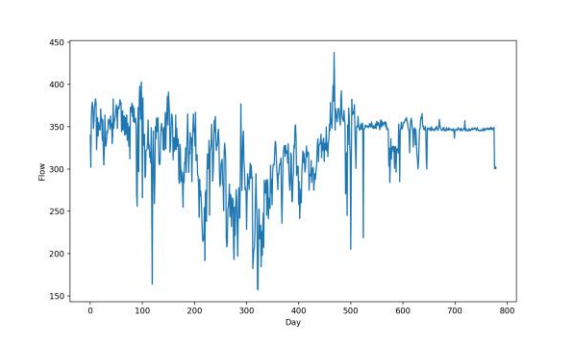

Fig 1: Flow Rate of Influent

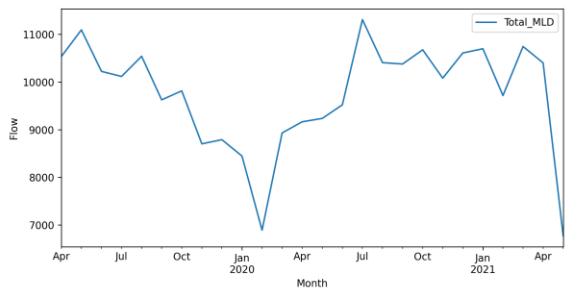

Fig 2: Monthly Flow of Influent

Proposed models for effluent prediction:

We shall design and implement a machine learning-based model for analyzing and predicting the concentration of effluent quality indicators in a wastewater treatment Plant. In this project, we propose to use Linear Regression, Support Vector Regression, and Artificial Neural Network to predict parameters of effluent.

Conclusion

Wastewater Treatment Plants(WWTPs) have a vital role in shaping the urban environments of our cities as they are used for processing sewage water and removal of various particles and chemicals which are harmful for the water hydrosphere and the organisms which are dependent on it. Wastewater treatment thus allows us to implement reuse and recycling of water as nature is able to adapt and thus return the treated water into the water cycle much more easily .

The goal of this project is to increase the efficiency of such WWTPs by deploying an automated system to retrieve and process data required by the plant administrators in order to ensure smooth and efficient working of the multiple wastewater treatment processes employed within a WWTP. We are using real time analyzers to collect data containing the influent and effluent parameters of the input water at the treatment plant. This data will then be processed by using various machine learning techniques in order to provide us with inferences about the input water quality and thus will be used to predict the parameters of output water from the plant.

THANK YOU