Chapter 9

Application of Predictive Intelligence in Water Quality Forecasting of the River Ganga Using Support Vector Machines

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ABSTRACT

Predicting the water quality of rivers has attracted a lot of researchers all around the globe. A precise prediction of river water quality may benefit the water management bodies. However, due to the complex relationship existing among various factors, the prediction is a challenging job. Here, the authors attempted to develop a model for forecasting or predicting the water quality of the river Ganga using application of predictive intelligence based on machine learning approach called support vector machine (SVM). The monthly data sets of five water quality parameters from 2001 to 2015 were taken from five sampling stations from Devprayag to Roorkee in the Uttarakhand state of India. The experiments are conducted in Python 2.7.13 language (Anaconda2 4.3.1) using the radial basis function (RBF) as a kernel for developing the non-linear SVM-based classifier as a model for water quality prediction. The results indicated a prediction performance of 96.66% for best parameter combination which proved the significance of predictive intelligence in water quality forecasting.
INTRODUCTION

For sustainable development of the environment it is crucial for the human being to protect the key water resource i.e. rivers. Predicting the water quality of rivers has been considered as one of critical and challenging application of time series based predictive intelligence. The reason behind is that the determination of water quality of rivers is itself a nonlinear and complex phenomenon in nature. Basically the water quality is characterized by three important components i.e. physical, biological and chemical with reverence to their proposed use and set of corresponding standards (Gazzaz, 2012). Recently, there have been a tremendous increase in the number of research in the field of ecological and environmental modelling. Researchers have made remarkable efforts in the field of water quality. (Maier, 2010) discussed their research in detail and conducted a detailed survey of 210 journal papers and indicated that artificial neural networks (ANNs) have been used progressively for modelling problems in water and ecological domain. They concluded that majority of studies more than 90% of the papers focused on water quantity with only few focused on to water quality.

This research work will address the problem associated with present water related challenge in India i.e. of ‘water quality’. The major motivational factor behind the present study is: “water pollution” in rivers which is attracting a lot of attention in all around especially in India. The second motivating factor which inspired the most is the orders of the Supreme Court of India to the Government of India for finding out technical solutions to the water related challenges (Union Ministry of Science and Technology Govt. of India, 2009). Finally the most striking motivational factor to carry out this research is the fact that only a limited efforts and little research has been carried out to date for the Indian rivers and as far as to the best knowledge of authors concern no efforts have been made till date for assessment, prediction and modelling the water quality of GANGA river in India using technical approaches based on machine learning.

The objectives of this chapter is to contribute to the development of various prediction models for forecasting or predicting the quality of the river Ganga in prospective of India based on collection of the previous historical times-series authentic data and then selecting the best one on the basis of their forecasting performance. In this paper authors, first of all emphasis is on one of the modern approach of machine learning named Support Vector Machines (SVM). Secondly, the research will determine an efficient predictive model among the developed models by comparing their performances via several experiments. Finally, try to propose an optimal model that can be used as a decision support system for proactive planning and performing actions in order to maintain the water quality of rivers.

BACKGROUND

During the past years the quality of water is deteriorating day-by-day that resulted in serious problem of water pollution. Therefore this issue of water security attracted a lot of attention of the researchers and academicians all around the world. A variety of research work in this fields has been going on using different techniques. Because of much difficult and highly non-linear nature of environmental systems the deterministic models which have been constructed so far are not up to the mark (Sarkar & Pandey, 2015). In addition to this, limited availability of water data and high cost in monitoring are main drawbacks associated with the process based modelling methodologies (Palani, 2008). Now-a-days various machine learning techniques are common in practice which use the given data in order to derive a solution for
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