ISSN: 0974-5823 Vol. 6 No. 3 December, 2021

*International Journal of Mechanical Engineering*

# A novel method to predict air-pollutants using soft computing approach

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**Abstract**

The implementation of urbanization and industrial development can cause a very huge changes in air quality because of pollution. The air contamination can be limited viably by taking efforts to control the various atmospheric pollutants and by implementing various procedures. The models that are currently used for air pollutant findings are more complex and consumes more time. In this circumstances, a novel soft computing technique is suitable for this volatile type of data prediction. It is suitable for dynamic changes and it gives high range of accuracy. This papers describes a novel soft computing methodology for predicting the air quality.

Air pollutants measuring system provide early warnings to the population and by means of continuous involvement there are many chances to shut down the considerable number of measuring units. Also due to the presence of the dynamic time variable data and its unpredictable behaviour soft computing methods are considered to be best technique for prediction.

It has been noted that the prediction of air quality mostly follows technical methods rather than technological methods. The application of soft computing methods was not used to much extends in case of Air quality models. The research findings elaborated in this paper will put forth the various predictive techniques of air quality based on soft computing techniques.

## Introduction

Due to the vast increase in population and also due to the increment of urbanization and industrial development there is very huge contaminations in the atmospheric air quality [1].This uncontrollable population expansion and the development of severability with respect to the development of urbanization, industrialization and anthropogenic exercises have given a major change towards the countries climatic changes[2]. The quality of the air depends on the biotic and abiotic parts produced and hence the measures to predict the quality are very much essential. Further due to the changed vacillations in the piece of constituents of the atmospheric climate because of which air quality is contaminating in a very faster rate. The cause of air Pollution has many significant results, for example, unfavourable impact on human wellbeing and different creatures, an extraordinary change in the vegetation and furthermore to the development of the new products will lead to environmental and marks gigantic impact on environment changes. The above one is a very much worrying factor for the nation because it contributes unsafe impacts. In order to control the impact government had taken several steps such as deploying various observing stations, implementing plans to control the pollution and to avoid the deforestation to balance the ecological system. Many valid researches are executing in this air quality control and still it seems to be a tough task to maintain the air quality. The proposed soft computing method seems to be a convincing one and it greatly plays a vital role for predicting the air quality to ensure greater living. This paper is arranged as follows section 2 gives the survey analysis ,section 3 gives the proposed model and section 4 gives the conclusion and future improvement.

## Literature Survey

Predicting air quality and controlling it plays an important role in environmental system plan [3].For atmospheric and environmental research. The input data to analyse the air quality criteria is very complex. There are so many existing models and different types of techniques to predict the quality[4]. The various models are shown below.

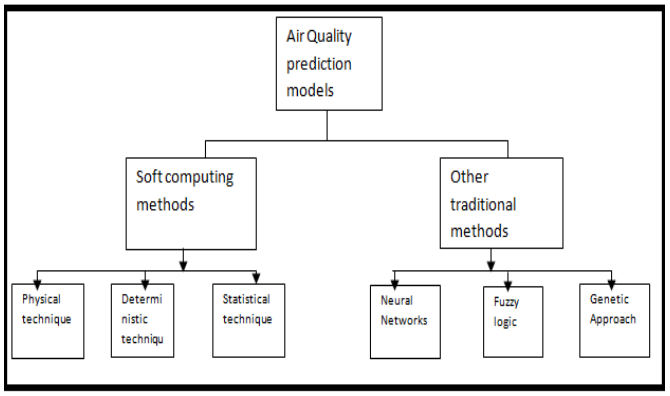


**Fig 1.0 Air quality prediction – a classification**

There are different kinds of soft computing models used for exploring air quality modeling. The increasing number of studies may create an ambiguous situation in the selection of appropriate soft computing models. However, there are few research proceedings that follows the soft computing approach in air quality prediction [11,12,13–15]. They are mostly limited to either artificial neural networks or deep learning techniques

## Limitations in traditional air quality prediction models

- Inadequate data sets of historical data and its attributes

- Lack of actual understanding.
- Under execution with non-direct frameworks.
- Lot of exorbitant calculation strategies are required
- Statistical models are site explicit.
- Semi-observational factual relations among accessible information and estimations.
- Complex to manage the non-direct connections of numerous factors

| S.No. | Air Quality Forecasting models using Soft-computing Techniques | References |
|---|---|---|
| 1. | Artificial Neural Network (ANN) | [8][9][10][11] |
| 2. | Support Vector Machines (SVM) | [12] |
| 3. | Fuzzy Logic | [13] |
| 4. | Evolutionary Algorithm | [14][15][11] |
| 5. | Particle-Swarm Optimization | [16] |

**Table1.0 shows sample of data quality prediction models based on soft computing approach**

**Limitations of existing models**

Though soft computing is a well-accepted approach it lags some notable information's as mentioned below[8][9]

- The air quality prediction using neural methods becomes complex when the air pollutants increases.
- In ANN there are no rules to fix the size of network and learning scenarios, which will improve the prediction procedure.
- ANN models lags accuracy for time variables and actually need to work on to accomplish great forecast execution as successfully and productively true to form.
- Using multilayer neuronal organisation to intrude but not extrapolate, the results are excellent. No specific standards exist for determining the data collecting process for the creation, testing, and approval of a neural network model.
- In Fuzzy Logic, the issue of discovering participation works and forming the membership function with suitable principles regularly a tiring interaction of endeavor and blunder.

SVM can do fantastic air quality forecast speculations, but its success depends on the kernel selection and implementation.Our research discovered that an air quality prediction model can be built using a mix of delicate registration methodologies previously employed in soft computing. Our Neuro-Hybrid Model for Air Quality Prediction is detailed in the segment that follows.

**Soft Neuro-hybrid model for air quality prediction**

The combination of delicate processing methods creates the Crossover Soft Computing model and these types of model share a strong foundation for demonstrating of genuine frameworks[5] .We recommend using a mix of Artificial Neural Networks (ANN)[6] and Fuzzy Logic to construct this study's theoretical framework[7] . Because of their ability to manage the complicated information frameworks that are the best method of handling model selection, these two solutions were chosen. ANNs enjoy an innate advantage in revealing complex frameworks without prior information.

Dynamic frameworks where multi-class information is found are formed using fuzzy logic.Our model consists of four layers: one of which handles the data factors, while the other contains the ANN model. The secret-hidden layer and the output layer associates the other two layers. A secret layer's loads and bias conditions are refreshed, and the ANN layer[13] outputs its contribution to the next layer, which generates fuzzy-logic-based if-then rules. The boundaries of the yield spectrum will be formed as either low or high, depending on yield levels. The following outline portrays the whole operation process.

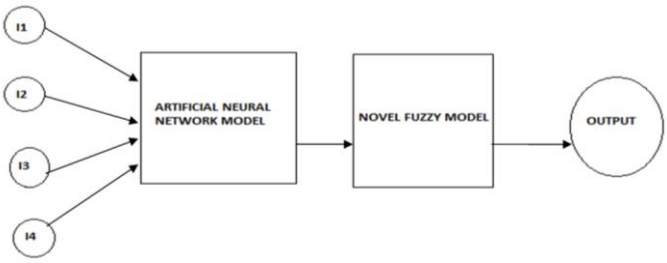


**Fig 2.0 soft-hybrid model for air pollutant prediction**

The model referenced above was developed using MATLAB to forecast RSPM concentrations (Respiratory Suspended Particular Matter). The various input parameters are relative humidity, temperature, wind speed and mean visibility. The various input and output referential data are shown in the tabular column. The above system can be modified for n number of input parameters .

| Inputs | | | Outputs |
|---|---|---|---|
| *Meteorological data* | *Air pollutant data* | *Geographical data* | API or AQI |
| General weather condition | AQI | Altitude | $CO_x$ |
| Temperatures | $CO_x$ | Longitude | $NO_x$ |
| Wind speed | $NH_3$ | Latitude | $O_3$ |
| Wind direction | $NO_x$ | *Sustainability and economic parameters* | Pb |
| Wind bearing | $O_3$ | Gross domestic product | $PM_{2.5}$ |
| Atmospheric pressure | Pb | Gross inland energy consumption | $PM_{10}$ (TSP/RSP) |
| Relative humidity | $PM_{2.5}$ | Production of primary coal and lignite | $SO_x$ |
| Solar radiation | $PM_{10}$ (TSP or RSP) | Paper and paperboard | TVOC |
| Sunshine duration | $SO_x$ | Round wood | |
| Precipitation/rain | TVOC | Sand wood | |
| Air mass origin | | Refined copper, aluminum, pig iron, crude steel, and fertilizers | |
| Moisture content | | Incineration of wood | |
| Dew point | | Motorization rate | |
| Urban heat island | | *Other data types* | |
| Visibility | | Direct industrial and thermal power plant data | |
| Cloud cover | *Traffic data* | Satellite data (aerosol optical depth) | |
| Stability class | Vehicle movement | Daily fire pixel observations | |
| Mixing height | Vehicle volume | Drilling diameter | |
| Planetary layer height | Vehicle emission | Moisture and slit content | |
| Solar elevation | Vehicle type (two- or three-wheelers, diesel- or gasoline-powered) | Rock mass density | |
| Friction velocity | | Rebound hardness number | |
| *Temporal data* | | | |
| Hour of the day | | | |
| Day of the week and month | | | |
| Month of the year | | | |
| Weekday or weekend day | | | |
| Sine and cosine of the hour | | | |
| Sine of the weekday | | | |

**Table 2.0 Inputs and outputs of the novel hybrid model**

**Conclusion**

The Air Quality Prediction framework has been constructed using the combination of Artificial Neural Networks (ANN) and Fuzzy logic. This approach hold good to anticipate the RSPM. This approach has a good accuracy, as it outperforms the real-time effect. It is found the above model can also be improved by adding the genetic features..

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