

How Artificial Intelligence Helps Air Pollution

Stephen Cobb

Old dominion University

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## How Artificial Intelligence Helps Air Pollution

### Introduction

Air pollution is a major problem that we have been facing for decades now matter of fact less than 1% of the world is safe from the high air pollution levels. It also helped the spread of covid. Artificial intelligence is a type of computer science that creates computers and programs and trains it to think like a human. Some AI doesn't even need human training to think like a human, it just learns from their past data analyzes to help better their performance. Today we will be looking at how artificial intelligence helps fight air pollution. There is no doubt air pollution and artificial intelligence are two scary things separately but when put together it can help fight the greater cause and keep people healthy. Artificial intelligence can help fight air pollution by using sensors to help find where gas leaks, using drones piloted by AI to monitor real time air pollution levels, and I can pinpoint where air pollution is above the legal limits. Sensors are normally hard to gauge and expensive to operate, but with the help of artificial intelligence and innovation air quality sensors are now lower in cost and easily accessible to air quality data. People themselves in society can now wear sensors to see what type of levels they are experiencing on a day-to-day basis. This is huge for local climate campaigns and environmental justice people. Wearable air sensors help people collect and visualize data and is a very important first step for reaching air quality control. AI pinpoints where legal limits of air pollution have been passed. There are scientists from Barcelona that created an AI model that can predict the areas that are approaching the legal limits of air pollution, specifically nitrogen dioxide. They combined multiple things like "the CALLIOPE-Urban model that predicts air pollution at high resolutions, at varying heights, and at any location in the city," (Clean Air Fund). They also made

air quality stations using sensors, maps on building density, and information on meteorology. They hope to persuade decision makers to better manage air quality in cities.

### **Overview of the Research/Required Information<sup>1</sup>**

The use of artificial intelligence to treat air pollution has been seen in two models so far. There has been a developed computational model that evaluates toxic compounds that are bad for people in densely populated areas. This looks at the air quality over time to see what the negative damage was already. Fuzzy logic that will classify air quality into an index, “an air quality index describing the pollution levels in five stages: excellent, good, regular, bad and danger, respectively,” (Hernandez). The second model predicts air quality using an autoregressive model. This can predict air quality using fuzzy logic that was used in the model before. “We perform a comparison among air quality indices developed for environmental agencies and similar models. Our results show that our models are an appropriate tool for assessing site pollution and for providing guidance to improve contingency actions in urban areas,” (Hernandez). Air pollutants are anything in the air that can harm humans and the environment. They can be seen as anything ranging from gases to solid particles. They need to be monitored all the time so that people’s health does not decline. “There are six common air pollutants that have been studied for defining air quality levels: ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide and particulate matter,” (Hernandez). The air quality levels overview are as follows, Excellent: safe to be outside and doing activities. Good: activities outside can be done but children might be in a little discomfort. Old people might be sick. Regular: activities outside should be avoided, more health effects are noticed in the population, and children and older adults can have respiratory problems like asthma. Bad: activities outside should be avoided; children and older people might have

asthma or other respiratory conditions. The last one is dangerous: everyone could have health effects; a lot of serious complications are seen in children and older adults.

**Frameworks/Processes to Follow/Methodology.** Basing an index off of fuzzy logic is important because there is no limit on traditional methods that were designed to help develop environmental quality indices. There are 15 parameters for air pollutant criteria, bioaerosols, and volatile organic compounds. This is included because their effects on health are very important to look at. Fuzzy-Based Indoor Air Quality Index factor was assigned to the 15 parameters because the medical evidence showed important health effects. Data was generated to cover a lot of different quality levels and a sensitivity analysis was done to make sure everything was true. “Fuzzy logic has been increasingly applied mainly due to its particular capability in efficiently handling the environmental complex issues. By applying fuzzy logic, qualitative elements such as expert’s knowledge and experience can be added to the quantitative part of a problem. The traditional methods used to develop indices are not capable of handling the environmental problems,” (Hamedian). Traditional logic has limitations because some things remain unclear; this is why most do not let traditional logic handle environmental problems like air pollution. Fuzzy logic helps compute values that are not just numbers because things can come in words or phrases nowadays. Fuzzy logic can take care of computing issues and its techniques have been used in multiple different things these days, not just environmental air pollution. Through the use of fuzzy logic it helps determine the state of air quality to decide where things fall on the index. The Air quality index ranges from 0 to 500 and there are 5 levels that change every 50. “Good, 0–50; moderate, 51–100; unhealthy for sensitive groups, 101–150; unhealthy, 151–200; very unhealthy, 201–300; and hazardous, 301–500,” (Katushabe). The lower the AQI value is the better the air quality is in real life. To define air pollutants there are a couple of compounds and

those are nitrogen dioxide, particulate matter, and Sulphur dioxide. Those are detected by the fuzzy logic and then put into the form of linguistic variables to determine the output and levels of air quality. Fuzzy logic plays an important role in helping determine air pollution. It determines inputs and outputs that come in handy later. Outputs are then generated into an if-then form to determine the levels of quality. Fuzzy logic then categorizes the outputs into six categories, Good, moderate, sensitive, unhealthy, very unhealthy, and hazardous. Once the outputs are in the right category then the table will be used by the Environmental Protection Agency to determine the correct response.

***Tools/Resources/Results.*** The results of a fuzzy logic-based air quality index model rely on an input/ output system and it shows how different air pollutants will affect the Air quality index. “The fuzzy associative memory method is used to map input fuzzy values to corresponding output fuzzy sets in order to generate the inference rules. In this, the three variables represented by the three fuzzy sets, a total of twenty-seven rules, are generated in the following rule base: for 3 inputs (M) classified into 3 linguistic variables (N). M to the power N rules ( $M^N=3^3=27$ ) are generated. Rules are formed based on the highest values of NO<sub>2</sub>, SO<sub>2</sub> and PM<sub>2.5</sub>. To generate the rule base, we take into consideration all the pollutant concentrations, that is, if one of the pollutants is high, then the resultant KAQI will be Unhealthy, as clearly indicated in the rule base,” (Katushabe). For example about 38% of all homes had moderate air quality. Upwards of 60% had unhealthy air quality. This result was found in indoor living because most homes have gas stoves on top of all the air pollution outside. There are two main indexes: the Air Quality index (IAQ) and the Fuzzy-based Indoor Air Quality Index (FIQI). The IRAQI most of the time is higher because there are more pollutant factors that go into it. So basically when the air quality is good in both indoor and outdoor categories the AQI will indicate

lower levels because fuzzy logic will pick up the presence of different air pollutants like bioaerosols. The only question that remains is the different criteria of air pollutants. For example the AQI pollutants that are high are labeled responsible pollutants while all the others do not impact it at all. But in the FIJI all pollutants are considered so when one pollutant has high concentration it does not raise the index value significantly. Therefore the Fuzzy-based Indoor Air Quality Index is a better pick.

*Conclusions.*

We looked at fuzzy logic and its contribution to helping air pollution. Fuzzy logic is a type of artificial intelligence that is a set of rules that makes logical conclusions from data that is fuzzy. It is clear that fuzzy logic helps air pollution because it takes all data into account. When sensors and other tools gauge air pollution levels it might not be as clear as to where the levels stand but when those tools are paired with artificial intelligence and available to the public that is when we will start to see changes in climate. When people are aware of air pollution and what damages it causes to one's body that is when change will come. Artificial intelligence is everywhere now whether we like it or not, so it is best that we use it to our advantage to make the world a better place. When it comes to densely populated areas air pollution monitors should be placed everywhere or else people will start to see complications later on in life. Fuzzy logic can pick up every type of pollutant from nitrogen oxide to the ones found indoors like bioaerosols. It all contributes to air pollution so when the government decides to trust researchers like me to tell them they need to push artificial intelligence they should listen. Fuzzy logic only helps.

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