The Air We Breathe- Reducing Health Risks by Improving IAQ: An Innovative, Smart, and Responsive Ductless System Optimized by Stochastic Simulation and Machine Learning

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Indoor air pollution is the world's biggest environmental killer; every year over four million people die prematurely from poor indoor air quality (IAQ). Exposure to poor IAQ can result in multiple health problems: neurocognitive defects, pulmonary diseases, asthma, lung cancer, premature death etc. Poor IAQ has been shown to cause decreased productivity and impaired cognitive skills. the estimated productivity cost from poor IAQ ranges from $40-168 billion annually in USA. Despite this, partially due to the invisibility of the pollutants and symptoms that often do not manifest for years after exposure, IAQ is among the world's most ignored problems. This research presents a much-needed solution in a market where the existing options are expensive and largely ineffective. The author has developed an affordable, innovative, ductless, modular, and smart IAQ improvement system. This cost-effective, sensor driven innovative solution overcomes physiological limitations and reduces the burden of conscious decision-making from the inhabitants and responds to changes in IAQ and weather conditions automatically. A data analyzing algorithm using black-box Monte Carlo simulation and LSTM RNN (Long Short-Term Memory Recurrent Neural Network) was created by the author to determine the run-time for reducing the exposure risk and minimizing the operating costs. The experimental results show significant exposure reduction (15% or more). This prototype is affordable and installation does not require any new skills and expensive remodeling. Given the enormity of the problem, the improvements achieved in IAQ suggest significant potential benefits that can improve the health of millions and yield significant economic benefits.

Awards Won:

Second Award of $2,000