SENIOR DESIGN PROJECT: LOW COST FILTRATION 1 ABSTRACT

This design project was undertaken to investigate affordable, do-it-yourself air purification systems which could offer an improvement over the basic single-filter, single-fan design. With the advent of COVID-19 and recent wildfires, there has been a growing demand for clean air. Although portable air purifiers exist in the market, they can be quite expensive. A common do-it-yourself alternative is to attach a 20-inch air filter to a 20-inch box fan. Multiple design configurations were studied for increased air flow and filtration rate, with an emphasis on the positioning of the fan and filters. Additionally, the possibility of an ultraviolet (UV) light option was investigated.

Three goals for the design were to 1) filter particles down to 0.5 microns in size, 2) demonstrate an appreciable improvement in air change effectiveness and flow rate, and 3) cost under $50. Five unique conceptual designs were simulated inside a bedroom model using ANSYS Fluent. Fan airspeed and volume flow rate were evaluated for each, and air change effectiveness was calculated at the breathing height (3.5 ft above floor) for select configurations. It was concluded that the first conceptual design, a triangular prism with two filters, offered the best balance of performance, cost-effectiveness, and flexibility of arrangement. The triangular prism located in the middle of the room resulted in a fan volume flow rate increase of 38% and an air exchange efficiency increase of 26% over the baseline case. The cost was roughly $74 using a Lasko box fan and low-budget, Minimum Efficiency Reporting Values (MERV) 13 filters. Regarding the UV light option, further research indicated that the limitations of a homemade system would prevent the incubation time required for sterilization from being met.

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