Novel Multipurpose Air-Handling Robot With AI-Based Anomaly Detection

Saravanan, Mikul (School: Cranbrook Kingswood School)

Maintaining optimal indoor air quality (IAQ), humidity, and household safety is a critical aspect of improving overall health. Poor IAQ and improper humidity have adverse health effects. To a limited extent, stationary air purifiers and humidifiers address these issues. I experimented with multiple humidity and air quality sensors placed throughout a room, which showed that a standalone air purifier or humidifier could not distribute improved air evenly within the space. I solved the uneven distribution and household safety issue with an innovative robot containing an air purifier, humidifier/ dehumidifier, Ultraviolet C (UVC) lamp (disinfects air by killing most bacteria as well as viruses such as COVID-19), cameras, and microphones. My custom-built robot uses a Jetson Nano, LiDAR, cameras, microphones, and air quality and humidity sensors. The robot and the air handling system were modeled in Computer-Aided Design (CAD), analyzed with Computational Fluid Dynamics (CFD) to find the various components' optimal design, and built with 3D printed parts. AI-based environmental anomaly detection uses the microphone to detect unusual events, such as a glass breaking, smoke alarm going off, etc., and camera for human fall detection The robot was programmed using the Robot Operating System (ROS) to navigate a mapped room to avoid obstacles or until it detects poor air conditions or household safety anomalies. Navigation and obstacle detection is accomplished by a LiDAR sensor, visual odometry, and an AI-based object detection algorithm. My experiment shows that the robot could humidify a room more evenly than standalone devices and detect environmental anomalies.

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