Development of a Fire Analysis Drone for Smoke Toxicity Measurement for Fire Prediction and Management

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Abstract : This research presents the design and creation of a drone gas analyser, aimed at addressing the need for independent data collection and analysis of gas emissions during large-scale fires, particularly wasteland fires. The analyser drone, comprising a lightweight gas analysis system attached to a remote-controlled drone, enables the real-time assessment of smoke toxicity and the monitoring of gases released into the atmosphere during such incidents. The key components of the analyser unit included two gas line inlets connected to glass wool filters, a pump with regulated flow controlled by a mass flow controller, and electrochemical cells for detecting nitrogen oxides, hydrogen cyanide, and oxygen levels. Additionally, a non-dispersive infrared (NDIR) analyser is employed to monitor carbon monoxide (CO), carbon dioxide (CO_2), and hydrocarbon concentrations. Thermocouples can be attached to the analyser to monitor temperature, as well as McCaffrey probes combined with pressure transducers to monitor air velocity and wind direction. These additions allow for monitoring of the large fire and can be used for predictions of fire spread. The innovative system not only provides crucial data for assessing smoke toxicity but also contributes to fire prediction and management. The remote-controlled drone's mobility allows for safe and efficient data collection in proximity to the fire source, reducing the need for human exposure to hazardous conditions. The data obtained from the gas analyser unit facilitates informed decision-making by emergency responders, aiding in the protection of both human health and the environment. This abstract highlights the successful development of a drone gas analyser, illustrating its potential for enhancing smoke toxicity analysis and fire prediction capabilities. The integration of this technology into fire management strategies offers a promising solution for addressing the challenges associated with wildfires and other large-scale fire incidents. The project's methodology and results contribute to the growing body of knowledge in the field of environmental monitoring and safety, emphasizing the practical utility of drones for critical applications.