

## **Fire Sensor Project Abstract**

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### **Abstract**

The Fire Sensor project team has designed and built a device capable of detecting people during fires using RF and optical sensors. This dual sensor system aims to assist first responders by providing real-time data on the location and number of individuals trapped in burning buildings, particularly in dense urban environments. Emergency services will benefit from enhanced situational awareness and improved efficiency of rescue operations. The ability to quickly and accurately identify the position of individuals in hazardous environments can be critical in minimizing casualties.

The Fire Sensor system utilizes Texas Instruments mmWave cascading imaging radar and the Intel RealSense camera. Radars, which transmit electromagnetic waves and read the associated reflection, generate a point cloud that maps the presence and position of individuals in a room. The RealSense camera, when activated, scans the room and offers a real time view of the situation. Combining the radar and the RealSense modules allow for the system to generate a more precise image of a given room. Upon the integration of machine learning modules, trained by the team to specifically identify human figures, the final product can report to emergency services the number of individuals still in an area along with their location. This component eliminates the potential of false identifications or the potential for excluding human figures in the sheer amount of data produced.

A key goal of this project was to create an efficient fire detection and response system. Aimed to assist urban environments where high-rise buildings and complex layouts can make search and rescue operations challenging. Recent events in big American cities, such as Los Angeles, have especially demonstrated the need for smarter solutions to disaster in aging cities. High-rise buildings often feature multiple floors and enclosed areas, hindering traditional rescue operations. The Fire Sensor system aims to decrease these challenges by offering rescuers accurate real-time information over the location of residents. The project's portal, designed with an easy-to-use UI, facilitates this goal further.

To test and validate project efficacy, the team developed a fully operational prototype, outfitted with the previously mentioned sensors. Testing was conducted by simulating the hazy environment. The prototype was enclosed in a secure acrylic case. One side was replaced with a fiberboard partition, allowing for a stopgap and smoke funnel to be cut into the side. An HVAC pipe slowly pumped fog from a fog machine until a realistic degree of opacity was achieved. Team members were posed in front of the sensors as it gathered data, in a variety of poses and distances with several props. Consistently, sensors supplied data through the smoke while the ML models reported the existence of humans in the room.

Through and through, the Fire Sensor system is clearly capable of identifying people and their locations in low visibility environments. While it could stand to benefit from a more comprehensive training data set and more efficient radar, the project produced a novel solution that stands to better the lives of many. As this system continues to be developed and improved it will become a reliable and helpful tool for first responders to improve safety and efficiency during fires.