Firefighting Remote Probe

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Project Description

Our team, Team FIRES, aims to create a remote sensing probe for firefighters. The probe aims to deliver atmospheric composition (O2 and CO levels) and temperature data as well as a live video stream. The stream is capable of seeing in both the visible and infrared spectrums. The purpose of the probe is to limit the number of firefighters that are needed to search a structure fire. Current methods require two teams of two firefighters to enter a structure; one team to conduct the primary search and the other to tackle fire suppression. Our system replaces the primary search team with the deployable probe that can be monitored by the pump operator outside the building, therefore reducing the number of lives put into immediate danger.

Wireless Capabilities

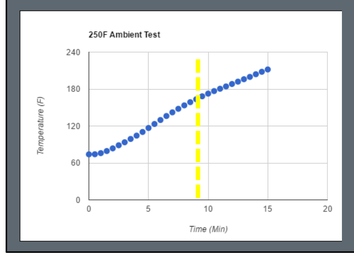
- The goal of the project was to provide wireless, continuous data to firefighters outside of the fire. This wealth of data being provided to them without having to risk firefighter lives would have the opportunity to save lives. Utilizing a WiFi connection, our probe can send visual / IR video feed, temperature data, and atmospheric data to a firefighter's laptop outside the blaze.

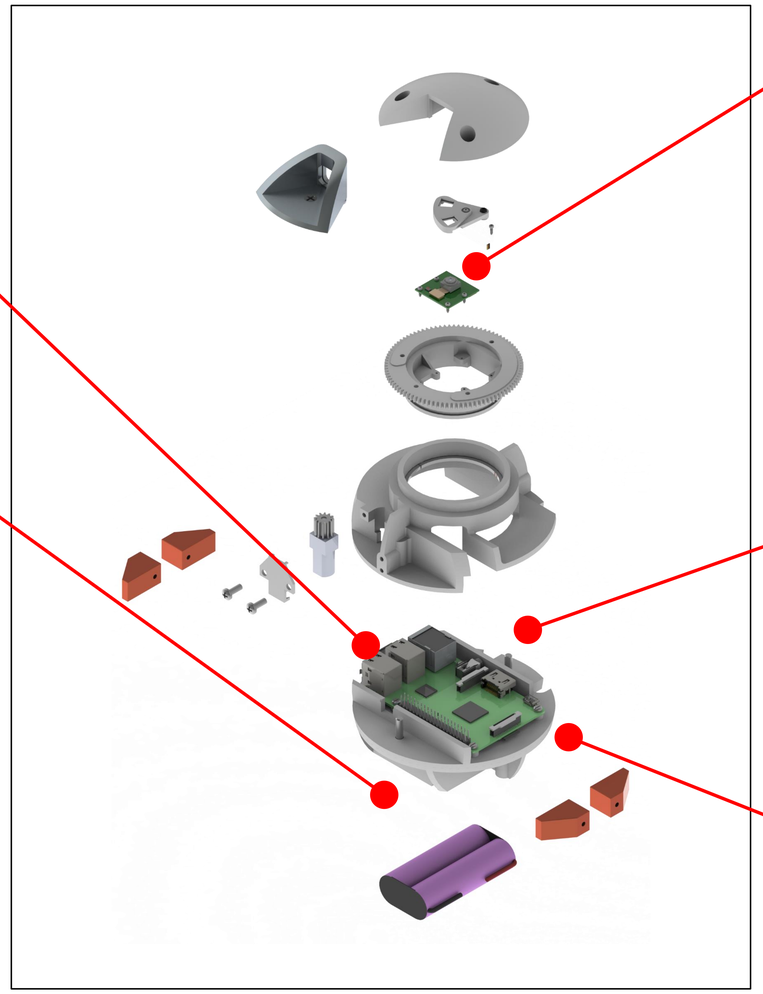
Automatically Orientating

- The probe has four copper weights at the bottom that bring the center of gravity very low to the base of the shell. This allows for the probe to always be in the correct orientation and "roll" into the upright position when tossed by a firefighter into a room.

Thermal Testing

- Our probe aims to be able to last as long as possible in a fire situation and to also be reusable. Through initial thermal testing, it was shown that our probe's electronics will shut down around 170F and will fail around 370F. Below are two plots showing the internal temperature of the probe with two different ambient temperatures. Yellow vertical lines represent when the electronics would shut down in self preservation and the red vertical line represents system failure.





Camera Design

- The camera setup is centered around a Raspberry Pi camera positioned on the central axis of the shell to point directly up at the cap.
- To see directly out the front of the probe, a mirror is placed at 45^{o} in the specially designed cap insert; thus, rotating the image 90^{o} downward.
- To switch the camera feed between regular imaging and infrared, a filter tray is attached to an HS-5035HD Digital Ultra Nano Servo that rotates between the two options directly over the camera lens.
- A 50 rpm DC motor with an attached gear box assumes the role of rotating the entire camera pod capsule (shell cap included).

Sensor Design

- Sensors (air quality and temperature) are placed inside two hollow cylindrical tube which consists of an insulated door between them.
- The insulated door provides protection from high heat outside and controls air flow to the sensor.

Insulation / Shock Absorption

- Steel outer shell to provide a strong and rigid container for probe's electronics.
- Aerogel (space age insulation) is then lined inside the outer steel shell. Aerogel has insanely high resistance to conduction and convection and will keep probe safe from high temperatures.
- The aerogel being used in this project is very similar to a foam cushion and also serves as a shock absorbing pad for the internal electronics.