Autonomous Flight & Aquatic Systems Laboratory

Encased Safety Inspection Drone for COVID 19 and Underground Mines

NEW MEXICO TECH
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Background

The COVID 19 pandemic has presented many new challenges to health care workers; an autonomous drone with the ability to screen patients for fevers could help limit the exposure professional health care workers must face. With the conclusion of the pandemic, the drone can also be slightly modified for surveillance within underground mines.

Objective

Design and manufacture an autonomous drone with thermal imaging capabilities, collision resilience, and both live and recorded video feedback capabilities for later conversion into an underground mine inspection drone.

Product Requirements

- Protective shock-resistant cage.
- Autonomous flight with payload capabilities.
- Lightweight drone-to-cage connection.
- User-friendly lighting system.
- Easily replaceable modular sensors.
- Simple thermal image processing feedback.
- Abnormal temperature-detecting capability.
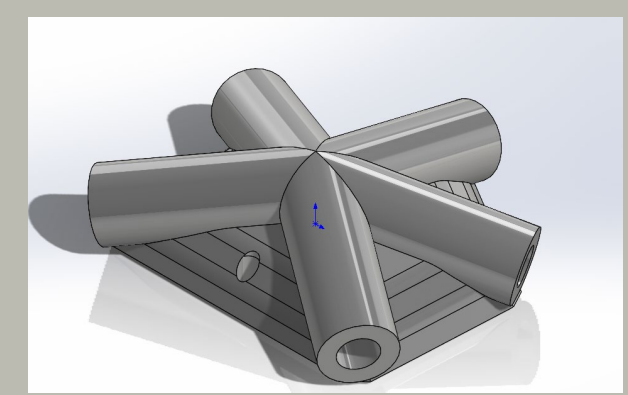
Final Joint Design

Figure 1. TPU Joint

Figure 2, TPU Joint with Spring connection Point

A new TPU joint was designed to allow for direct connection of springs from the joint to the drone baseplate. The design is more stiff to allow for the added force of the springs suspending the drone.

Completed Design

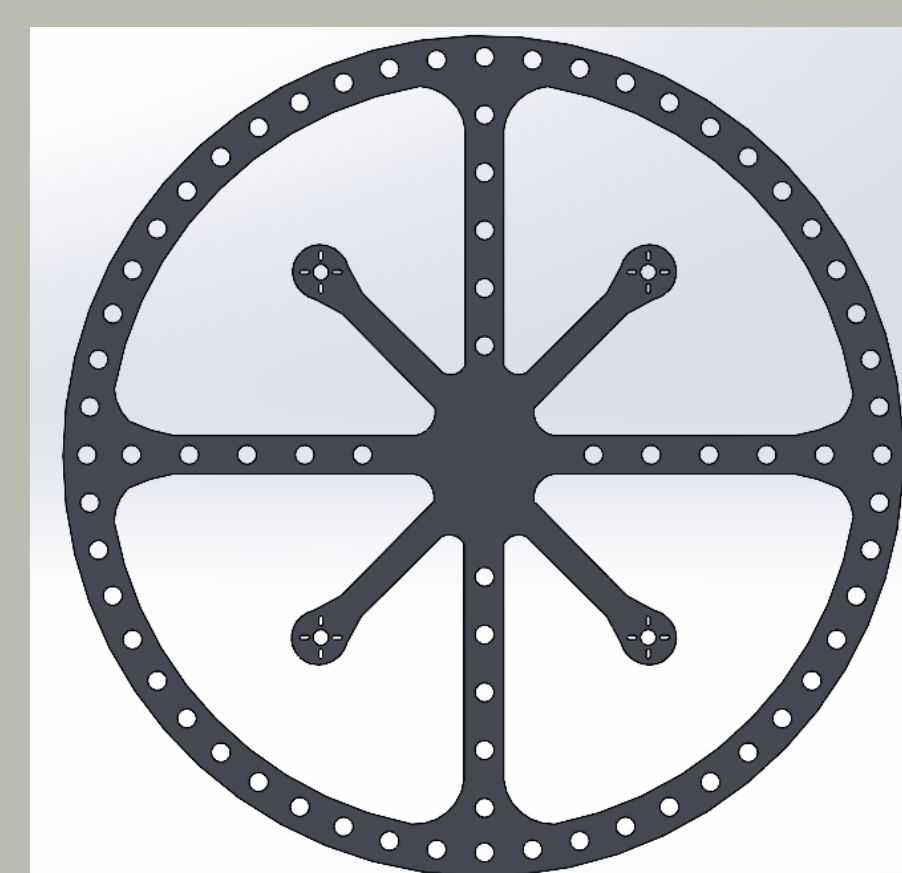Figure 3. Drone with Protective Cage

Drone Connection

Figure 4. Base plate ring design

The drone body is secured to a modular ring that connects to the cage joints with springs. After testing and improving the design, we will order a light-weight and strong carbon fiber baseplate. The planned design is shown to the left.

The drone is mounted to the cage using a spring system. The system is made of a mounting ring and special joints that allow direct mounting of the springs. The preloaded springs support the weight of the drone, absorb impacts, and mitigate vibrations felt by the flight controller.

Figure 5. Ring-Cage Connection

Thermal imaging

The raspberry Pi works with a FLIR Lepton 3.5 thermal camera module to estimate surrounding temperatures to a +/- 1 °F accuracy. These temperature readings help determine individuals with higher temperatures and help determine potential hazards in underground mines.

Figure 6. Thermal Image

Flight Tests

- Flight Test #1 - The drone had plenty of power for flight but suffered from sporadic movement and lack of control.
- Flight Test #2 - With new batteries, the drone failed to have enough power for successful flight.
- Flight Test #3 - With new motors designed for the lower voltage batteries, the drone achieved stable flight and good control without the cage.

Future Work

- Design sensor and thermal camera connection to the drone
- Fabricate carbon fiber connection ring
- Program image processing and autopilot
- Design live video feedback
- Conduct further test flights

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REFERENCES
[a]Dozolme, P. (2019, January 25). Specific and Non-Specific Hazards in Underground Mines. Retrieved from https://www.thebalancesmb.com/specific-and-non-specific-hazards-in-underground-mines-2367338.