Autonomous Encased Safety Inspection Drone for Underground Mines

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Background

Underground mines are highly dangerous working environments in which employees are exposed to fires, floods, explosions, falling rocks, and deadly gasses[1]. The introduction of an autonomous inspection drone into the mining industry will save hundred of lives every year.

Objective

Design and manufacture an autonomous drone with collision resilience and video recording capability, for underground mine inspection.

Product Specifications

- Protective shock-resistant cage.
- Autonomous drone with payload capabilities.
- Connection of drone to the protective cage.
- Lights and obstacle avoidance sensors.
- Ability to add additional modular sensors.
- Rotational recording and live feed camera.

Final Joint Design

Figure 1. TPU Joint

The joints use a pressure lock system combined with the elastic material of TPU to hold the carbon fiber rods together in the spherical cage.

Completed Design

Drone Connection

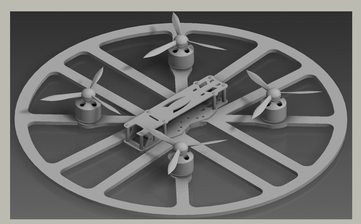

Figure 3. Modular Drone-Ring

The drone body is secured onto the modular ring. The drone arms were recreated as a part of the connection ring to increase the overal stability and cohesiveness of the design.

The image to the right shows our proposed ring-to-cage connection types. The fixed length arms (right) offer strength & rigidity while the adjustable length arms (left) offer better impact resistance & could potentially act as a vibration dampener.

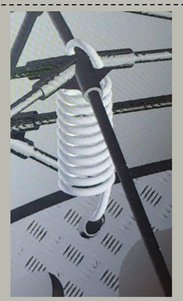

Figure 4. Ring-Cage Connection

Drone Sensors

The drone is planned to be able to work fully autonomous, in order to do this the team will employ sensors which will give close to a 360 degree reading around the drone. To achieve this, Lidar sensors will be placed around the cage. The flight controller that is being used is compatible with Lidar sensors so no special equipment is needed.

Flight Tests

There have been numerous flight tests of the drone. So far the tests have shown that the drone can lift the weight of the cage. There are a few stability issues that are stemming from the motors or the flight controller.

Future Work

- Implement remaining sensors on cage frame
- Conduct test flight
- Program autopilot
- Design live video feedback process for GPS-denied areas

Figure 6. Team Photo: (left to right) Micaela Olivas, Joseph Martinez-Ponce, Richard Cross, Christopher Mooty, Brian Pando, Alexander Malburg, and Riley Willingham

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REFERENCES
[1]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.