Indoor Drone Navigation System Risk Analysis (I.D.N.S)

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Distribution Statement: This document is intended for use by the University at Buffalo CSE453 drone navigation team, Dr. Kris Schindler, and Lockheed Martin employees only.

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1. Introduction:

1.1. Document Overview

This document discusses the possible risks associated with the production and deployment of the indoor drone navigation system in relation to avoiding, mitigating, transferring and accepting possible issues.

2. Risks:

2.1 Accuracy of Navigation

The expected tolerance for the navigation system is stated to be within a couple of inches. Localizing the drone will be done using visualization of QR codes. With a single QR code in the field of view (FOV), the drone may not be able to find the following QR code due to accuracy. To mitigate this problem, the drone will always have at least two QR codes within its FOV. Under any unforeseen circumstances, the drone will be able to see at least two codes and therefore will be able to retain its pathfinding algorithm.

2.2 Object Avoidance

The current object avoidance system is dependent on an array of ultrasonic sensors. This system is redundancy for loss of LOS of QR codes as described in 2.3. This system is currently only implemented for static obstacles as the system assumes a dedicated fly zone (2.4.3). Testing will be done to determine if the latency of the ultrasonic sensors is fast enough to avoid moving objects.

2.3 Alternative Path Design

In the case where an object is detected on the planned path of the drone, the system will need to find an alternative path. If there is an object in the path, that will indicate that not only will the ultrasonic system be reading, but the LOS of QR code is unavailable. In this case, the system will rely on the ultrasonic vector field histogram algorithm for pathfinding until LOS is regained.

2.4 Mitigate Damage

2.4.1 Testing Phase

During testing the drone will be operating at a low altitude at a controlled speed in order to reduce damages upon system failure. Additionally, a manual override will be available for flight controls in the case of failed software testing.

2.4.2 Software Watch Dog

In the case of a software timeout, the system will stop and reset as opposed to continuing to fly in its current direction.

2.4.3 Dedicated Fly Zone

The risk of failure will be greatly reduced with the application of a dedicated fly zone within the environment.

2.4.4 Drone Crash

In the case of a crash, the system will shut down completely to avoid further damage to the drone and the environment.

2.4.5 Drone Damage

The most probable component of failure is the propellers as they are the most exposed. In the case that a propeller fails, we will have additional propellers on hand. If the body of the drone is damaged, assuming beyond repair a new drone will need to be purchased.