App Description Revised

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Background

Large buildings must be routinely inspected in order to ensure safety. Specifically, buildings such as sports arenas must have the ceiling trusses inspected. Each “joint/node” where the truss meets must be visually inspected for defects. Traditionally, this has been done by using scissor lifts and continually going up/down many times in order to cover the entire space. This obviously is very inefficient and slow. Due to the difficult nature of the task, it was not uncommon for these inspections to be skipped altogether. With the advent of modern drone technology, the task of inspecting large buildings has been streamlined.

With that being said, flying drones is a difficult task. It is very much subject to human error and crashes may occur frequently when flying in difficult or unfamiliar environments. Additionally, in indoor environments there is little or no GPS signal, and so flights must be manual. Given that flying in unfamiliar indoor environments is difficult, it would be beneficial to provide some medium for training and familiarizing novice pilots to fly in a particular space before making the flight on-site. That is, to familiarize and train people to repeat or perform a similar flight path to that of a path taken during an inspection by an expert drone pilot.

App Idea

This app seeks to provide a method of visualizing drone flights used in interior building inspections, or wherever autonomous GPS-driven flights are not feasible. This visualization will enable drone pilots to better understand the flight paths of professional pilots who have conducted simulated inspections within the space. Delivering this functionality is contingent on communicating spatial flight path data intuitively within a 3D space.

App Users

The primary users of the app will be drone pilots who have not conducted inspections within an indoor space.

The secondary users of the app may be construction managers, building inspectors, or experienced pilots explaining the current path data to the primary users. Generally, users that do not necessarily have experience with drones.

App Workflow - Novice Pilot (1)

1. (Upload View) User uploads and/or selects a building space (.glb) and inspection points (.txt) and provides a name for the space

2. (Upload View) User uploads drone flight paths (.txt) individually, providing a name for each
3. User switches to “Analyze View” using a tab or button
4. User orients scene to fit the path(s) (if needed)
5. User selects to visualize, up to several, loaded drone flight paths
6. User navigates the 3D environment and highlights individual paths
    a. User analyzes drone flight paths, position, and orientation (pitch only) data
    b. User analyzes inspection points
    c. User analyzes trouble areas
        i. Identified by different color/opacity on path,
    d. Cutaway camera views
    e. Preset orientations
7. Repeat steps 5-6 until comfortable with performing a drone inspection
8. Close App

App Workflow - Building Manager

1. (Upload View) User uploads and/or selects a building space (.glb) and inspection points (.txt) and provides a name for the space
2. (Upload View) User uploads drone flight paths (.txt) individually, providing a name for each
3. User switches to “Analyze View” using a tab or button
4. User orients scene to fit the path(s) (if needed)
5. User hands opened app to a Novice Pilot

App Workflow - Novice Pilot (2)

1. User is given the app in Analyze view, with a correctly oriented scene
2. User selects to visualize, up to several, loaded drone flight paths
3. User navigates the 3D environment and highlights individual paths
    a. User analyzes drone flight paths, position, and orientation (pitch only) data
    b. User analyzes inspection points
    c. User analyzes trouble areas
        i. Identified by different color/opacity on path,
    d. Cutaway camera views
    e. Preset orientations
4. Repeat steps 5-6 until comfortable with performing a drone inspection
5. Close App

Views/Widgets

- **Upload View**
    - Where the use may upload a space, path(s), and inspection points
    - Uploaded paths are named by the user

- **Analyze View**
    - The app loads the uploaded space and path into a 3d environment will tools for analyzing paths
    - **Scene Orientation Widget**
        - X, Y, Z, Pitch, Yaw, Roll coordinates to fine-tune the position of the scene compared to paths and points of interest
    - **Path Visualizer Widget**
        - Paths can have two states: rendered, or not rendered at all
        - A user may display multiple paths by selecting a checkbox next to the path name
        - Rendered paths will be listed and color-coded in this widget
        - Highlighted path appears bolder/bigger on hover/click, selected via radio button
    - **Highlighted Paths** (limited to one or fewer paths)
        - A highlighted path will appear thicker and brighter than an unhighlighted path
        - A highlighted path will display an orientation arrow for a point on the path when the mouse hovers over
        - A highlighted path may be oriented by the user to correct positions using a 3-axis arrow
        - **Flight Animation Widget** (Stretch Goal)
            - A highlighted path will have a timeline widget appear in which a user may watch a drone fly the path when pressing play or scrubbing.

App Data Types

Drone Flight - Collected from a VR drone simulation, and provided as txt files. These contain the position and orientation of the drone along with a timestamp. Velocity, angular velocity, acceleration, and angular acceleration may be derived from this data and packaged as a JavaScript object.

Space - A 3D model representing the intuition to be inspected. Will be provided as a .glb file.

Inspection points - A txt file containing the coordinates of all inspection points. These inspection points will be superimposed over the uploaded space model.

Visualization - The main data output of the app is an easy to digest visual representation of the drone flights uploaded. This visualization must communicate drone position, speed, orientation, and time at any given point of the drone flight.

Anticipated Challenges

- Ease of navigating the 3D space

- Paths/Space/Inspection point combinations that do not align
- Path clutter
- Incorrect space and paths being uploaded
- Communicating orientation of the drone in an intuitive way