Mitigating Motion Sickness in FPV Drones: Proposal

by Eli Wu (eliwu)

Department of Electrical Engineering
Stanford University
Stanford, CA

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1 Introduction

A common problem in the drone racing and drone piloting space is motion sickness - although some pilots can overcome this problem and fly very well, a vast majority of people get motion sickness due to vestibular and nonvestibular disconnect - the conflict between being physically stationary while perceiving self motion; and the detectable lags between head movement and recomputation and presentation of the virtual display (Hettinger et. al.).

In this project, we attempt to mitigate this problem - we propose a novel new system to 1) transmit live stereo video feed from a drone to the viewer with minimal lag as well as 2) presenting this video feed to the viewer with minimal motion sickness.

2 Related Work

This problem is not unique; as this is an up and coming field, however; the general public does not usually use a VR headset or AR headset to visualize what the drone is seeing. Furthermore, since the footage is of the real world, motion sickness is not as pronounced as it is in a virtual world (Jerome et al.)

There have been several papers on mitigating motion sickness in virtual reality - a paper form Iowa University in 2014 researched several techniques to mitigate motion sickness, testing several subjects for motion sickness in four conditions.

Interestingly however, there have been very minimal studies on FPV drone racing and drone cinematography and motion sickness - we attribute this to the fact that these two things are relatively new and have a user base that widely does not have this problem. However, a quick search on forums pertaining to these topics reveals several instances where it has been a problem worth solving.

In conclusion, not enough has been written about mitigating motion sickness in FPV drone racing as well as drone cinemtography, a problem that has seemingly been ignored by academia. Current methods of motion sickness mitigation are cumbersome to implement and may not work as well as the methods we propose.

3 Implementation

3.1 Live video feed with minimal delay

First, we propose using a video stream system widely used in FPV racing due to its low latency - analog video transmission over 5.8ghz. Two analog cameras will be used, feeding to two different analog video transmitters over to two analog video receivers. These have an estimated range of 1km in clear line of sight, with a latency of sub-50ms. Current methods of digital video transmission, used in commercial drones such as the DJI Phantom or the Parrot AR drone, cannot reach this latency without either very expensive, proprietary hardware. These analog video feeds will be connected to a computer using an Easycap, with the resulting video feed sent to Three.js for warping for headset.

3.2 Mimicking user head motions

We propose using a 3-axis gimbal system in order to mitigate motion sickness resulting in the disconnect between the video motions and the user motions - using the VRduino to capture the head rotations, we will be controlling a 3-axis gimbal (yaw, pitch, roll) in the physical space in order to manipute the camera rotations to mimic the head rotations. This 3-axis gimbal will be made using 3 ultra-fast micro servos (rather than the now-popular brushless gimbals) due to the speed needed to mimic human head movement. Although head-tracking solutions do exist, these are usually made poorly or not tuned well.

4 Timeline

1. 5/27: Proposal submitted
2. 5/27: Parts ordered
3. 5/30: Three.js webcam feed started
4. 6/1: Three.js double webcam feed finished
5. 6/5: FPV and video feed to computer completed
6. 6/8: Project completed

Bibliography

Hettinger, L. J., Riccio, G. E. (1992). Visually Induced Motion Sickness in Virtual Environments. Presence: Teleoperators and Virtual Environments, 1(3), 306-310. doi:10.1162/pres.1992.1.3.306

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