CSCI 5551 Fall 2015 Term Project Proposal:
UAV Applications – Image Based Tracking of Mobile User

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I.   Abstract

The intent of this project is to develop an image based tracking application for a quadrotor UAV. Much work has been done in industry and academia in the field of hobbyist level quadcopter development, resulting in open source software and hardware that are readily available and affordable. This project will leverage COTS hardware and open source software libraries in order to develop a client based control application that enables a drone to track a mobile user. The drone will autonomously maintain a desired distance and orientation from the user as it moves through space. This is not a novel application, but rather a milestone on the way to building up an autonomous flying system with marketable capabilities. This project will address a small number of trade studies, including the development platform, software development environment and open source software support. The objective of these trades is early validation of the project concept. The majority of the work performed in this project will be in the domain of software development, specifically focusing on computer visualization and wireless communication. The outcome of this project will be twofold: an application potentially reusable by the development community, and a start on the development of a future robotic system.

II.   Project Description

A.   Definition of the Problem

The intent of this project is to develop an image based tracking application for a quadrotor UAV, more specifically, an application capable of allowing an autonomous flying system to track a mobile object using image recognition algorithms. The application must allow the user to command the drone to begin and end tracking, as well as indicate the desired distance and orientation the drone should maintain from the user. Initially a detector tag may be used for tracking; however, it is highly desirable to eventually migrate to tracking a user provided digital image.

In order to accomplish this goal, a system capable of autonomous flight control and real time feedback will be needed. At a minimum this system must possess the following: inertial measurement unit capable of reporting acceleration and attitude, altitude sensor, front facing camera, and wireless communication with client device. The following support is also highly desired: side and down facing cameras, magnetometer, user application processor resident on device, flight data and video stream recording capability. The tracking and controlling application may be hosted on either the drone itself or a client device (PC or Android based system).

B. Motivation

The motivation behind this project stems from a number of factors. One, to broaden experience working with autonomous flying vehicles from a control and communication perspective. Two, to develop an application potentially reusable by the community, academic or commercial. And three, to develop an application that may eventually be incorporated into a marketable product.

C. Related Work

Much work has been done in industry and academia in the field of hobbyist level quadcopter development, resulting in open source software and hardware that are readily available and affordable. From universities to start-ups to large corporations, time and money is being spent furthering the technology in the interest of utility, convenience, and profits. The concepts developed in this project are by no means novel; rather they are readily available in forms ranging from proprietary to open source. Companies like 3D Robotics, Parrot and EZ-Robot, among numerous others, have invested in software and hardware development, resulting in modular plug-and-play systems readily available to anyone with an interest in robotics.

D. Work Plan

The first tasks to be accomplished will be a series of trade studies, including: development platform, software development environment and open source software support. A number of development platforms will be traded, ranging from DIY to ready-to-fly systems. The development environment trade will assess the capabilities of available software development kits supporting the selected development platform. The open source trade will consider what existing open source libraries should be leveraged in the project.

After selection of the development platform has been completed, a proof-of-concept task will be conducted. The primary goal of this task is to quickly prove out the ability to accomplish the overall project goal of mobile image tracking on the development platform. A community developed and/or commercially available application will be used for this task.

The project specific application development will follow the proof-of-concept phase. The software development will be conducted in the selected development environment, utilizing selected open source libraries. The output of this project phase will be a custom application capable of tracking a mobile user. The validation of the final product will also be included in this phase.

Upon completion of the project, future work will be addressed and presented in the final report.

Configuration management of software developed for the project will be conducted via Git, and is available at https://github.com/Eric0870/CSCI_5551_Proj.

III.   References

ID	Reference
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3	D. Eggert. (2014, January). "Communicating with the Quadcopter." *objc.io*. [On-line]. 1(8). Available: https://www.objc.io/issues/8-quadcopter/communicating-with-the-quadcopter/ [Oct. 7, 2015].
4	D.J. Sures. "EZ-Robot." Internet: http://www.ez-robot.com, [10/10/2015].
5	D.J. Sures. "Color Following AR Parrot Drone." Internet: http://www.instructables.com/id/Color-Following-AR-Parrot-Drone/?ALLSTEPS, [10/10/2015].
6	O.H. Boyers. "An Evaluation Of Detection and Recognition Algorithms To Implement Autonomous Target Tracking With A Quadrotor." B.S. Thesis, Rhodes University, South Africa, 2013.

IV.   Resources

ID	Resource
A	AR.FreeFlight, Parrot, https://play.google.com/store/apps/details?id=com.parrot.freeflight&hl=en.
B	EZ-Builder, EZ-Robot, https://www.ez-robot.com/EZ-Builder/windows.
C	EZ-SDK, EZ-Robot, https://www.ez-robot.com/EZ-Builder/sdk.
D	AR.Drone SDK, Parrot, http://developer.parrot.com/ardrone.html.