CSCI 5551 Fall 2015 Term Project
UAV Applications – Image Based Tracking of Mobile Object

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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 object. The drone will autonomously maintain a desired distance and orientation from the object 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 software library 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.

Contents

1. Introduction

1.1. Problem Description

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 object. 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 mobile system).

This paper provides an Introduction to the project, including the problem description, motivation, related work and the work plan. A Background section is included to provide the reader with an understanding of project requirements, trade studies performed and development tools used. The development activities performed in this project are provided in the Work section, including the proof of concept and Follow Me application implementation. Future work is also included in this section. Finally, the project Results and Conclusions are presented, followed by a Reference section. A Terminology section is included at the end to allow the paper to flow without inline definitions for acronyms and industry standard terms.

1.2. 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.

1.3. 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 profit. 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. A number of research projects and papers were evaluated to learn about the current state of the open source toolset, including J. Courbon's "Visual Navigation of a Quadrotor Aerial Vehicle" [9], M. Ryosuke's "Vision-Based Guidance Control of a Small-Scale Unmanned Helicopter" [11], O. Boyer's "An Evaluation of Detection and Recognition Algorithms to Implement Autonomous Target Tracking with a Quadrotor" [13], and P. Bristeau's "The Navigation and Control Technology Inside the AR.Drone Micro UAV" [15].

1.4. Work Plan

The first phase of the project will be a series of trade studies to identify the development platform, software development environment and software library support. A number of development platforms will be traded, ranging from DIY to ready-to-fly systems. The selected development platform must be able to meet all of the system requirements of the project. The development environment and software library trades will assess the capabilities of available software development kits and community libraries supporting the selected development platform.

After selection of the development platform is 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 SDK's and software libraries. The output of this project phase will be a custom image based "Follow Me" 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 artifacts developed for the project will be conducted using Git [E]. All artifacts are available on GitHub under the following projects:

- Design: https://github.com/eric0870/CSCI_5551_Proj
- Code: https://github.com/eric0870/ardrone_followme

2. Background

2.1. Requirements

The system requirements for the project are provided in Table 1 below. These requirements were derived in the interest of completing the project within a reasonable budget and an aggressive schedule. They were used to govern the procurement of development hardware and tools, as well as drive the system and software development effort of the project.

Table 1: Project Requirements

ID	Requirement	Threshold	Objective
1	Cost of development Hardware	< \$500	< \$300
2	Cost of development Software	< \$100	Free
3	Availability of development Hardware/Software	Now	
4	Project development schedule	2 months	
5	Development platform form factor	Quadcopter UAV	
6	Development toolchain support	Mature community/ commercial support	
7	Development platform sensor suite a. Inertial Measurement Unit b. Altitude sensor	 a. 6 DOF (accel, gyro) b. Ultrasound telemeter	 a. 9 DOF (accel, gyro, mag) b. Pressure sensor
8	Development platform video a. Camera(s) b. Video stream frame rate	 a. 1 (front facing) b. 15 FPS	 a. 2 (front, down facing) b. 30 FPS
9	Development platform support for user application software	Onboard	Remote
10	Development platform real-time communication with user application a. Communication type b. Data: user app to drone c. Data: drone to user app d. Rate	 a. Wired or WIFI b. Command / control c. Nav data, video d. 1 Hz updates	 a. -- b. -- c. -- d. 100 Hz updates
11	The system shall provide an application capable of image based tracking of a mobile object *Goal: the application should be agnostic to both the development platform and host device*	Tracking based on detector tag image supplied to application	Tracking based on generic digital image supplied to application

ID	Requirement	Threshold	Objective
12	The system shall provide a driver capable of routing images to the application, and control commands to the drone		
13	The image tracking software program shall be hosted on a user computer capable of wireless internet	PC running Linux based OS	Mobile phone running Android OS

2.2. Trade Studies

2.2.1. Development Platform Trade

A number of development platforms were traded, ranging from DIY to ready-to-fly systems. The outcome of the study was the selection of the AR.Drone 2.0 by Parrot. The AR.Drone is equipped with an onboard sensor suite and proprietary set of control algorithms that provide assistance to the user for all supported maneuvers [19]. Ergo, less time will be spent fine tuning vehicle stability, leaving more time to accomplish project specific goals. The AR.Drone is also widely used by the community, resulting in numerous user applications available for flight demos, proof-of-concept and open source examples. Table 2 provides a summary of each of the development platforms included in the trade study.

Table 2: Development Platforms

Platform	Cost	Pros	Cons
Ardupilot, by 3D Robotics [1][4]	$500	Open SW/HW	Does not meet project development schedule requirement
Phantom 3, by DJI [7]	$700	High quality camera and sensors	Does not meet project cost requirement
AR.Drone 2, by Parrot [16]	$300	Meets project requirements, Widely used by community	Closed onboard processor (but has well defined client interface)
Bebop, by Parrot [17]	$500	High quality camera and sensors, Open onboard processor	Does not meet project development toolchain requirement
Spiri, by Pleiades [18]	$1200	High quality camera and sensors, Open onboard processor	Does not meet project cost and availability requirements
Hummingbird, by AscTec [2]	$5000	High quality camera and sensors, Open onboard processor	Does not meet project cost requirement

2.2.2. Development Tools Trade

A number of free tools are available to support development activities related to robotics [12]. They range from the development environment to libraries associated with the development platform and project application to examples provided by the community. The tools targeted for this project include ROS (primary) and OpenCV (secondary). The development environment and software library trades were combined to ensure compatibility. The primary objective of this study was to select a development environment supporting the integration of the tools noted above, along with the AR.Drone SDK 2.0. Secondary objectives included community support, quick start and ease of use. Table 3 and Table 4 provide a summary of the development tools traded. The outcome of the study was the selection of the Eclipse development environment. Due to lack of ROS support in Windows, the software development for the project will be done in Linux. A number of software libraries and development kits were included in the trade, the majority of these will be leveraged during the development of the Follow Me application.

Table 3: Development Environments

IDE [9]	OS	Pros	Cons
Eclipse [K]	Linux, Windows	Cross platform support, Multi-language support, Well supported, mature toolchain	
EZ-Builder [A]	Windows	High level IDE for quick start, Well supported in community	No Linux support
Qt Creator [L]	Linux, Windows	Cross platform support, Multi-language support, Native support for CMake projects	
Visual Studio [F]	Windows	Well supported, mature toolchain	No Linux support, Limited capability in free version

Table 4: Development Libraries

Library / SDK	OS	Pros	Cons
AR.Drone Autonomy Lab [J]	Linux	Integrated with AR.Drone SDK, AR.Drone Examples	
AR.Drone SDK 2.0 [H]	Linux, Windows	High and low level support of AR.Drone specific features	
EZ-SDK [B]	Windows	High level IDE for quick start, Well supported in community	No Linux support
EZ-SDK Mono [C]	Linux	High level support for quick start	
OpenCV [D]	Linux, Windows	Rich set of CV libraries, Multi-language support, Well supported in community	
ROS [G]	Linux	Rich set of robotics libraries, Well supported in community	

2.3. Development Tools

2.3.1. AR.Drone 2.0

The AR.Drone 2.0, hereafter referred to as the AR.Drone, is a second generation quadrotor UAV developed by Parrot [16]. Parrot's intention for the drone is to provide a platform for academics and hobbyists that allows the developer to focus their effort on software application development, leveraging COTS OEM hardware and a small set of aftermarket accessories. The progression from first to second generation included sensor and camera upgrades, the addition of a pressure sensor, magnetometer, and USB port as well as software/firmware updates. A brief discussion of the AR.Drone hardware and software is included here to familiarize the reader with the drones components and capabilities.

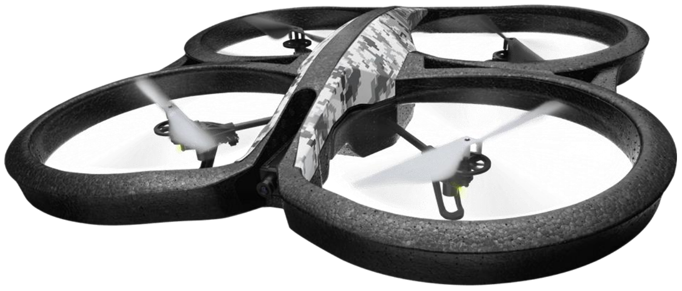


Figure 1: Parrot AR.Drone 2.0

The AR.Drone is an indoor/outdoor quadrotor powered with a rechargeable 12V 3-cell LiPo battery pack. The drone's movement is controlled by four 3-phase DC brushless motors, each connected to a propeller. The drone's sensor suite includes a 9DOF MEMS IMU (accelerometer, gyroscope, and magnetometer), an ultrasound telemeter, and pressure sensor. Data provided by this sensor suite allows the drone's onboard mission processor to resolve heading, pitch, roll, tilt and altitude. The drone also has two onboard cameras, one front facing, and the other downward facing. Both cameras are capable of up to 720p image resolution and 30 FPS. In addition to capturing photos and video, the downward facing camera is also used resolve ground speed measurements. Communication between the drone and a client device is facilitated by an onboard Wi-Fi controller. The drone generates its own wireless network, allowing a client to connect and interact with the drone [19].

The mission processor software is hosted on a TI OMAP 3 series processor containing an ARM Cortex A8 core running a Linux based real-time operating system. The application is responsible for managing multiple threads, including Wi-Fi communications, video data sampling, video compression (for wireless transmission), image processing, sensor acquisition, state estimation and closed-loop control [15].

The AR.Drone was developed with safety and convenience in mind. The drone ships from the factory with a detachable foam propeller guard for indoor flight. It has casualty modes capable of landing the UAV in cases where a propeller obstruction or low battery is detected. Parrot also built in a handful of high level commands for the most common maneuvers (take-off, trimming, hovering in place and landing), as well as configurable flight control limits on altitude, yaw speed, vertical speed and tilt angle.

2.3.2. AR.Drone Software Development Kit (SDK) 2.0

The AR.Drone SDK 2.0, hereafter referred to as the AR.Drone SDK, is an open source software development kit written for AR.Drone application development [19]. The SDK is a collection of libraries and examples written in C and compatible with Windows, Linux, Android and iOS operating systems. The library collection ranges from a hardware level Application Programming Interface (API) to application level routines. The API abstracts hardware management providing functions for Wi-Fi, Bluetooth, etc. The application level provides routines for memory allocation, thread management, communication, video stream processing, etc. The examples included with the SDK range from bare minimum communication modules to full up mobile applications. Figure 2 illustrates the software architecture for a user application built on the AR.Drone SDK.

The AR.Drone Library (and file structure) is grouped into modules as indicated in Table 5. Within the "Soft" component is a set of AR.Drone specific code, including: header files defining the drone's communication structures, an AR.Drone Tool kit, and a set of utilities. The AR.Drone Tool kit is a library providing functions for all Client / drone communication. A breakdown of the AR.Drone Tool is provided in Table 6. The communication services supported by the AR.Drone are grouped into four categories, each with its own communication port. A listing of these services is provided in Table 7. The AR.Drone Tool provides a means of assembling and parsing data over each of these communication ports, including codecs for video processing.

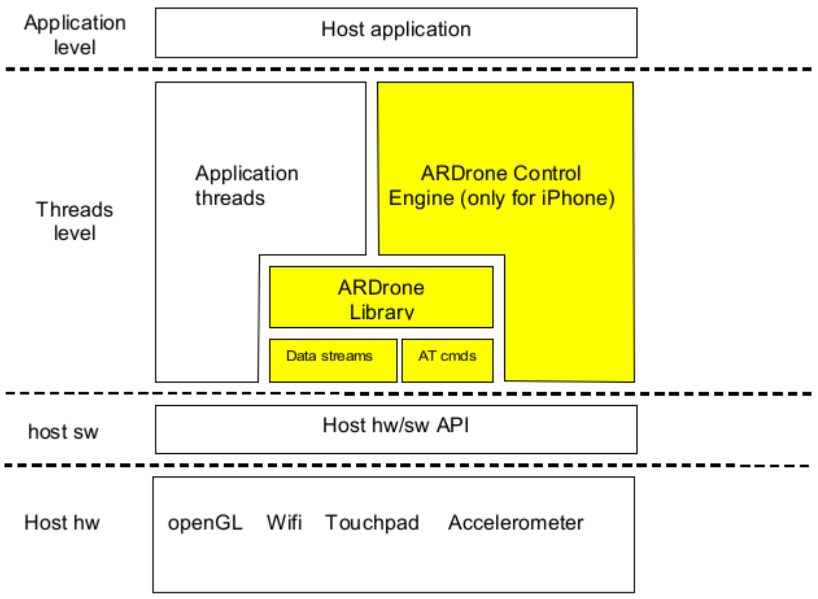


Figure 2: AR.Drone SDK 2.0 Layered Architecture

Table 5: AR.Drone SDK Components

Component	Sub-Component(s)	Description
Soft	Common	Header files describing the drones communication structures
	Lib/ardrone_tool	API to handle the client command and receive threads
	Lib/utils	Utilities to support application development
VLIB	--	Video processing library
VPSDK	VP Stages	API for video processing
	VP OS	API for system level support (memory allocation, thread mgmt., etc)
	VP COM	API for communication support (Wi-Fi, Bluetooth)
	VP API	API for video pipeline

Table 6: AR.Drone Tool Components

Tool	Description
AT	Contains functions for configuring and commanding the drone
Com	Contains functions for communication configuration for serial and Wi-Fi
Control	Contains functions for critical drone control over the Control Port (5559)
Navdata	Contains functions for Navdata parsing
Video	Contains functions for video parsing and recording

Table 7: AR.Drone Communication Ports

Port	Description
5554	UDP protocol for sending Navdata from drone to Client
5555	TCP protocol for sending video stream from drone to Client
5556	UDP protocol for sending configuration/control (AT) commands from Client to drone
5559	TCP protocol for sending critical mission data from Client to drone

2.3.3. Robot Operating System (ROS)

The ROS (Robot Operating System) provides libraries and tools to help software developers create robot applications. It provides hardware abstraction, device drivers, libraries, visualizers, message-passing, package management, and more. ROS is licensed under an open source, BSD license [G]. ROS is primarily Linux based, with unofficial support for OSX and Android. ROS distributions are managed and released through Github, the current LTS version is Indigo Igloo with lifespan 2014-2019. The Jade Turtle distribution is the latest and will be used for this project.

ROS may be hosted on a processor onboard the robot, or a remote PC. ROS can be executed with or without a robot in the loop, and even provides the ability to record traffic from the robot for playback to accommodate development and test activities. ROS is not a real-time operating system, but can [and has been] integrated with a number of RTOS's. As noted in the ROS Wiki, *the primary goal of ROS is to support code reuse in robotics research and development. ROS is a distributed framework of processes (aka Nodes) that enables executables to be individually designed and loosely coupled at runtime* [14]. The "Desktop" installation of ROS includes the ROS core along with a number of the most commonly used packages supporting features like robot-generic utilities, simulations, visualization, navigation, etc. ROS also provides a means for users to share their work by registering their package, stack, and/or metapackage at ros.org who then provides a link to the repository on Github. One such user contribution called the ardrone_autonomy package was used in this project.

2.3.4. AR.Drone Autonomy

The ardrone_autonomy package is an ROS driver for the Parrot AR.Drone quadcopter. This package is based on the official AR.Drone SDK [3]. It was originally developed by the Autonomy Lab at Simon Frasier University [20], though it is now maintained as an open source project on Github. The ardrone_autonomy package has been used and extended for numerous open source projects and tutorials including tum_ardrone by the TUM Computer Vision Group in Germany [21], arl_ardrone_examples by the Algorithmic Robotics Lab in Utah [22], and ardrone_tutorials by Robohub [10]. The Autonomy package is written primarily in C++ with some supporting python scripts and the AR.Drone SDK which is written in C. The primary benefit of the package is that it provides the user with many high level function calls to manage communication between a user client and the drone.

3. Work

3.1. Proof of Concept

The primary goal of this task was to quickly prove out the ability to accomplish the overall project goal of mobile image tracking on the development platform. The Windows based EZ-Builder [A] application was leveraged for this task due to its inherent support for the AR.Drone quadcopter. EZ-Builder is a high level development environment created by EZ-Robot [6]. The application is targeted to developers interested in programming and interacting with the EZ-Robot products, however it also contains libraries for third party robots and even supports low level libraries for DIY development. EZ-Robot has made a number of tutorials available to the developer who wishes to come up to speed quickly. One such tutorial [5] discusses using the application to control the AR.Drone to track an object based on its color. To conduct the proof-of-concept, the suggestions provided in this tutorial were used.

An EZ-Builder project was created that included an AR.Drone Movement Panel (third party add on) and a Camera controller. The Camera controller was configured to command the drone to track objects with the color red. During the test, the EZ-Builder application communicated with the drone over the PCs WIFI network connection. The drone was commanded to Take-Off and then commanded to track the red object. At a high level, the tracking was controlled by the application as follows: The drone telemetered camera image and vehicle state information to the EZ-Builder application over its WIFI network. The application used the camera image as input into its control algorithms to generate acceleration commands that would allow the drone to maintain a desired orientation with respect to the red object. These acceleration commands were then passed back to the drone via the WIFI network.

The proof-of-concept was successfully accomplished in a relatively short timeframe. The AR.Drone quadcopter demonstrated the ability to track a mobile object based on image processing performed real time on a remote device. A video of this test is available at the Github URL provided in section 1.4.

3.2. Follow Me Application

A "follow me" application was prototyped in this project to allow a quadrotor drone to track a mobile object based on vision. The AR.Drone was used for a test platform due to its onboard sensor suite, cameras, and WIFI network support. The ROS, AR.Drone SDK and ardrone_autonomy packages were used in this project due to their applicability to the Follow Me application. A set of requirements, provided in section 2.1, and design, provided below were developed to drive the implementation of the Follow Me application.

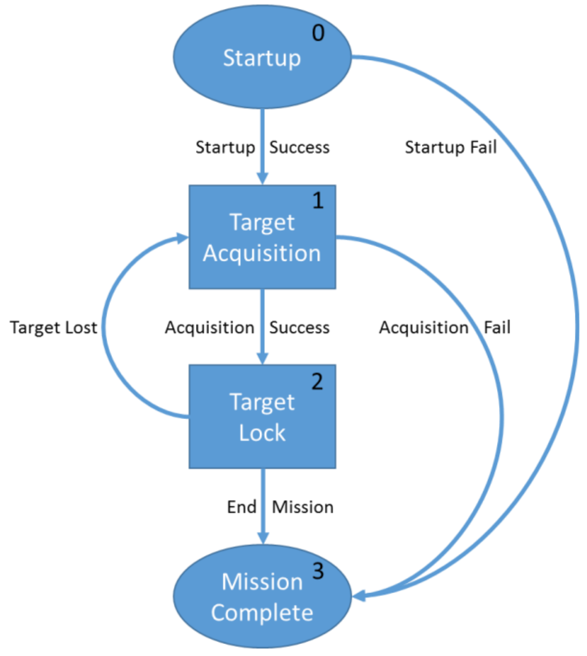
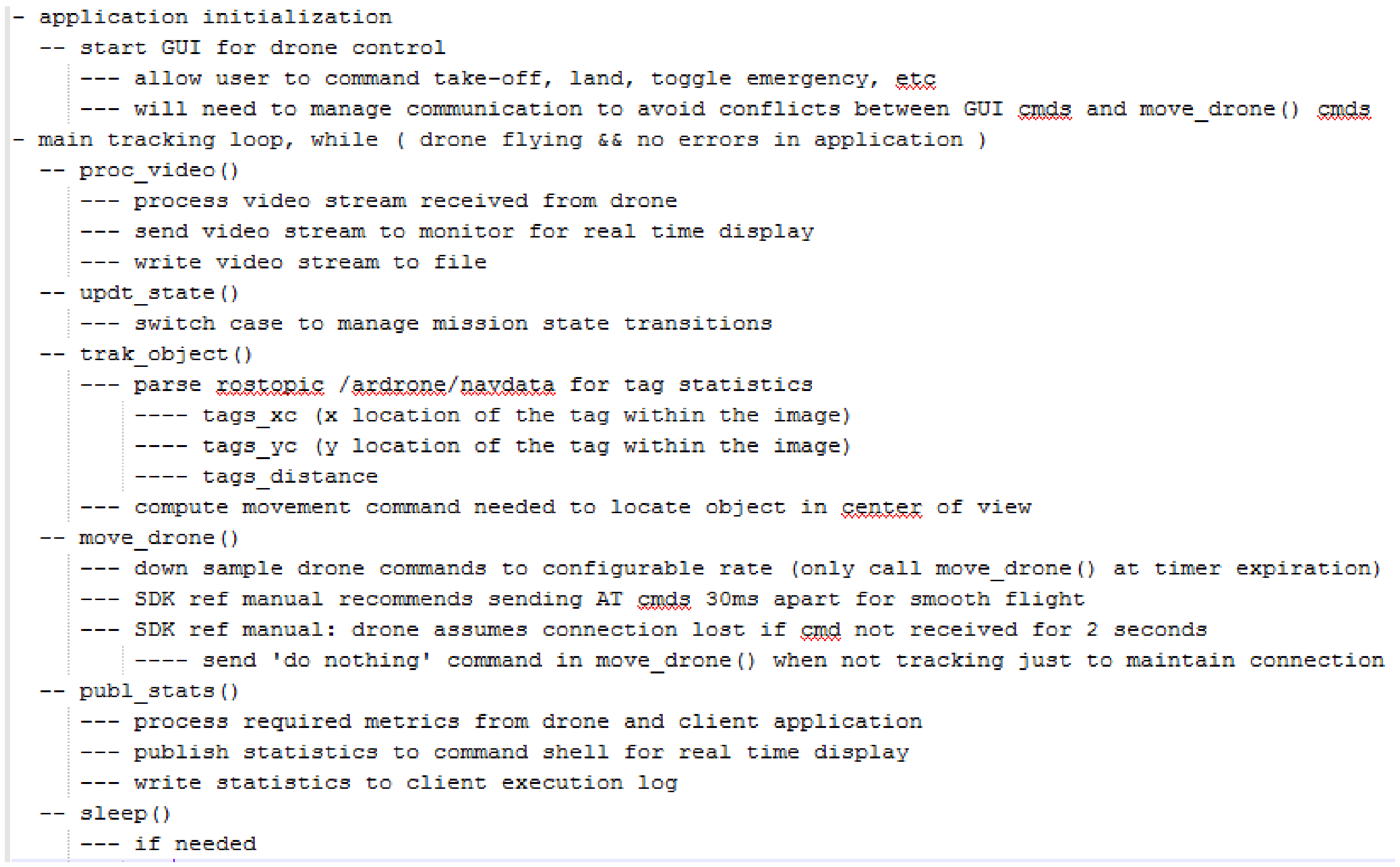


Figure 3: Follow Me State Transition Diagram

The complete Mission State Machine design is available in the Design repository noted in section 1.4. The state transition flow chart is provided here in Figure 3 for reference. A simple design was chosen in order to implement the minimum set of control needed to acquire and track an object during the execution of the Follow Me application. At startup, the application is initialized and then transitions to the Target Acquisition state if there are no startup failures. While in the Target Acquisition state, the application attempts to locate the object to track. As implemented in this project the object to track was a detection tag with distinct features that the AR.Drone could recognize and compute statistics for. The application uses the recognition statistics to determine when it is necessary to transition to the Target Lock state. Namely, the tag recognition count is used to indicate if at least one detection tag is recognized. After transitioning to the Target Lock state the application is able to compute and send movement commands to the drone. The movement commands are computed based on tag recognition statistics, namely the location of the tag within the field of view. The intent of the algorithm is to command the drone to move in order to position the object tracked in the center of the field of view, and to locate the drone at a required distance from the object. The algorithm runs periodically at a rate that allows the drone to react to a moving object. A loop rate of 5hz was chosen for the Follow Me algorithm to avoid over-commanding the drone resulting in jerky motion.

A design prototype of the functions needed to implement the Follow Me application is also provided in Design Github repository. This design is based on an assumption that C/C++ would be used. A snippet of the main routine is provided here for reference.



```
- application initialization
  -- start GUI for drone control
     --- allow user to command take-off, land, toggle emergency, etc
     --- will need to manage communication to avoid conflicts between GUI cmds and move_drone() cmds
- main tracking loop, while ( drone flying && no errors in application )
  -- proc_video()
     --- process video stream received from drone
     --- send video stream to monitor for real time display
     --- write video stream to file
  -- updt_state()
     --- switch case to manage mission state transitions
  -- trak_object()
     --- parse rostopic /ardrone/navdata for tag statistics
         ---- tags_xc (x location of the tag within the image)
         ---- tags_yc (y location of the tag within the image)
         ---- tags_distance
     --- compute movement command needed to locate object in center of view
  -- move_drone()
     --- down sample drone commands to configurable rate (only call move_drone() at timer expiration)
     --- SDK ref manual recommends sending AT cmds 30ms apart for smooth flight
     --- SDK ref manual: drone assumes connection lost if cmd not received for 2 seconds
         ---- send 'do nothing' command in move_drone() when not tracking just to maintain connection
  -- publ_stats()
     --- process required metrics from drone and client application
     --- publish statistics to command shell for real time display
     --- write statistics to client execution log
  -- sleep()
     --- if needed
```

In order to develop the Follow Me application in an amount of time agreeable with the project schedule, a simple prototype was implemented in Python. Although a C/C++ implementation was preferred from a performance standpoint, Python provided a shorter development cycle by leveraging the high level features inherent in the language. The prototype made use of the ROS framework, Autonomy ardrone_driver and tutorials provided by Robohub. Rather than developing the application from scratch, the drone_controller provided in the Robohub tutorial was extended to meet the needs of the project. Development of the design provided above in C/C++ is left for future work.

4. Results and Conclusions

4.1. Overview

The project goal was to create an application to allow a drone to autonomously follow an object through space. In order to meet schedule constraints of the project, open source tools and COTS hardware would need to be leveraged and integrated. The work completed and described in the previous section partially fulfilled the project objectives. Though the resulting application left much to be desired in performance and robustness. The application did not successfully track the mobile object, likely due to a number of factors:

- the control algorithm was not robust enough to handle challenges associated with outdoor flight (wind, obstacles, network outages)
- the control loop frequency needed to be optimized
- default camera calibration files were used instead of a custom calibration

The application was successful at managing the mission state transitions, generating motion commands and publishing flight test debug data. The ability to analyze the flight test data and improve the control algorithm was lacking due to the following factors:

- post-test analysis was difficult due to lack of experience with available tools (rosbag)
- real-time debugging was difficult due to the short duration of the flight

The project provided a great opportunity to learn about and gain hands on experience with the AR.Drone platform and ROS application. The exiting open source infrastructure makes it possible to pick an area of interest and implement a program to accomplish a desired task. This project would likely have been more successful if it were either approached by a team rather than an individual or spanned a greater life cycle.

4.2. Future Work

A number of interesting and challenging activities fell outside of the scope of this project. The first follow-on task is to implement the project design as a stand-alone ROS package in C/C++. The motivation for this is to address performance concerns inherent in the Python implementation as well to provide a package to share with the community. To build on this package, OpenCV should be integrated. OpenCV provides a vast framework for image processing, allowing the Follow Me application to go beyond tag recognition to user defined digital object recognition (eg: a building, truck, face, etc).

The next step in future work includes re-hosting of the client application. It is highly desirable to remove the dependence of a PC running Linux from the Follow Me application. There are two primary targets in mind for re-hosting, the Android OS and a processor onboard the drone itself. Re-hosting to an Android OS would allow for reuse of the AR.Drone platform. Moving to an onboard processor would require a new platform capable of hosting a user application, preferably running the ROS.

4.3. Acknowledgements

A special thanks goes out to the groups that made open source robotics code available to the community, including Parrot, the Open Source Robotics Foundation, and Simon Frasier University. Gratitude is also extended to those who provided online tutorials for the AR.Drone including Mike Hammer and D.J. Sures.

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5.3. Images

Figure	Image Title	Reference
Cover page	AR.Drone splash	http://www.augmentedplanet.com/2011/11/parrot-ar-drone-review
1	AR.Drone 2.0	http://ardrone2.parrot.com
2	AR.Drone SDK Layered Architecture	AR.Drone SDK 2.0 Reference Manual

5.4. Terminology

Term	Description
Client	Reference to remote application communicating with drone
COTS	Commercial Off-the-Shelf
DC	Direct Current
DIY	Do it yourself
DOF	Degrees of Freedom
Drone	Reference to UAV
FPS	Frames per second
Host	Reference to system containing client software (may be used in place of client)
HSL	Hue, saturation, lightness color model
HSV	Hue, saturation, value color model
LiPo	Lithium-ion Polymer [battery]
LTS	Long Term Support
MEMS	Micro-electro-mechanical System
Node	ROS term for an executable that is connected to the ROS network
Open CV	Open source Computer Visualization software library
OEM	Original Equipment Manufacturer
OMAP	Open Multimedia Application Platform
PC	Personal Computer
Publisher	ROS term for node that sends messages on a specific topic
Quadcopter	Quadrotor UAV
ROS	Robotics Operating System
RTOS	Real-time Operating System
SDK	Software Development Kit
Subscriber	ROS term for node that listens for messages on a specific topic
Target	Mobile object tracked by drone
TI	Texas Instruments
Topic	ROS term for communication channel
UAV	Unmanned aerial vehicle
Wi-Fi	Wireless Fidelity (wireless communication standard)