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SPONSOR: SIGHTLINE APPLICATIONS

UAV Landing Aid - Design Report

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Abstract

SightLine Applications has developed a precision visual landing aid for UAV's. The Landing Aid supports autonomous landing operations by automatically finding and tracking an easy to place landing pattern. Integration of the SightLine Landing Aid for end users is problematic for two main reasons:

1. Connectivity issues with a wide range of cameras.
2. Communication issues with a wide range of filght controller hardware and software.

Currently the end user selects a camera to be used with the SightLine processing hardware. A wide range of cameras must be supported, and custom A/B boards must be designed for each one to interface with the SightLine hardware. Each of these A/B boards can have cable, power, and electrical connectivity issues that are problematic for the end user. There is also a wide range of flight controller hardware and software, each with a myriad of different communication protocols. Installing software components to facillitate this communication is fine for the end user, but if any programming needs to be done this is usually a complete show stopper. The proposed solution to these problems is to develop an all in one unit with plug and play capabilities that can be directly connected to a consumer level flight controller. By doing so camera connectivity and selection problems are eliminated, and communication and software deployment are made much easier for the end user.
The project is divided into three sections:

1. Choosing and building an "off the shelf" quadcopter that uses a Pixhawk 4 flight controller that can be used for testing
2. Designing a camera based on the On-Semi AR0134CS optical sensor that connects directly to the SightLine hardware, distributes power, and facilitates communication between the flight controller and SightLine hardware
3. Research and development of documentation and software installers to meet plug and play expectations using QGroundControl flight control and mission planning software

We quickly found that none of these tasks are easy or simple. The selection, build, and testing of a custom quadcopter is a complicated task with many variables. GPS signal degradation made indoor flight tests impossible, and safe outdoor testing locations were hard to find. We did succseffully autonomously fly the built drone using QGroundcontrol mission planning. A camera board, The SLA1500CAM was designed and tested.

Insert Hardware Test Results Here

Insert Software Results Here

What are the limitations?

Future implications of project?

Contents

List of Figures

1 Project Overview

1.1 Background

SightLine Applications has developed a precision visual landing algorithm that provides an excellent set of benefits:

- Works in degraded and denied GPS environments – Safety and reliability
- Reduces operator training and landing phase complexity.
- Provides detection functions for landing zone safety - detect people, animals, or objects from entering the landing zone
- Provides a rich set of telemetry for flight controllers. 30 Hz data with range, XY offsets, relative azimuth, etc.
- Supports landing on moving platforms - ground vehicles, marine.
- Is not impacted by bright sun or low light conditions.
- Can be used with Thermal (IR) cameras as well as visible (EO) cameras
- Effective range of operation (distance to target) only limited by the size of the landing pattern used

1.2 Problem Definition

Integration of the SightLine Landing Aid for end users is problematic. Often drone operators want to just "plug in" a component and fly their mission. Installing software components is acceptable, but any requirement for programming is a barrier to entry or a complete show stopper. Various cables, power, and other electrical connectivity issues are also difficult for vehicle integrators. Rugged or at least robust mechanical enclosures, easy mounting, and environmental reliability are equally important. Lastly, choice of optical system (camera) for the greatest range has cause adoption delays in that it has been a decision left to the integrator. Recognizing the needs from the end-users and the current developed benefits, Sightline wants to develop a plug and play precision landing aid for UAVs and expect that this new project will be highly valuable to a wide range of multi-copter integrators.

1.3 Solution(10,000ft view)

The project is divided into three sections:

1. Choosing and building an "off the shelf" quadcopter that uses a Pixhawk 4 flight controller that can be used for testing
2. Designing a camera based on the On-Semi AR0134CS optical sensor that connects directly to the SightLine hardware, distributes power, and facilitates communication between the flight controller and SightLine hardware

3. Research and development of documentation and software installers to meet plug and play expectations using QGroundControl flight control and mission planning software

Figure 1: *This is a caption for a blank figure*

2 Results(Technical Detail)

2.1 Quadcopter

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2.2 Hardware

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2.3 Software

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3 Conclusion/What's Left to do

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4 Appendix

4.1 I

4.2 II

4.3 II

4.4 IV

4.5 V

5 References

1. Mali, P. (1960). *Magnetic Amplifiers*. New York, NY: John F. Rider.

2. Figure 1. Simple saturable reactor. Reprinted from *Magnetic Amplifiers*(pg. 27), by Paul Mali, 1960, New York, NY, John F. Rider Publisher, Inc.

3. Figure 2. Full-wave self-saturating magnetic amplifier. Reprinted from *Magnetic Amplifiers*(pg. 35), by Paul Mali, 1960, New York, NY, John F. Rider Publisher, Inc.