Brigham Young University

AUVSI Capstone Team (Team 45)

Capstone Project Contract

Andrew Torgesen, Team Member

Ryan Anderson, Team Member

Derek Knowles, Team Member

Jake Johnson, Team Member

Brady Moon, Team Member

Tyler Miller, Team Member

Andrew Ning, Team Coach

Tim McLain, Sponsor

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Tyler Critchfield, Team Member

Connor Olsen, Team Member

John Akagi, Team Member

Jacob Willis, Team Member

Brandon McBride, Team Member

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Revision History

ID	Rev.	Date	Description	Author	Checked By
PC-444	1.0	10-02-2018	Opportunity development initial stage	Andrew Torgesen	Kameron Eves & Ryan Anderson & Jacob Willis & Tyler Critchfield & John Akagi
PC-444	1.1	10-17-2018	Added Key Success Measure explanations	Andrew Torgesen	Jacob Willis

Introduction

Each year, the Association for Unmanned Vehicle Systems International (AUVSI) hosts a Student Unmanned Aerial Systems (SUAS) competition. While each year's competition has unique challenges, the general challenge is to build an Unmanned Aerial System (UAS) capable of autonomous flight, object detection, and payload delivery. This year's competition will be held June 12^{th} to 15^{th}, 2019 at the Naval Air Station in Patuxent River, Maryland.

The UASs entered into the competition are judged primarily on their mission success during the competition. Each team is also required to submit both a report and a flight readiness review presentation. The report should justify the UAS decision, explain design trade-offs, demonstrate the team's engineering process, and highlight the capabilities of the UAS. The flight readiness review presentation demonstrates that the UAS is capable of safely completing the competition. The overall score for a team is based on a combination of the points from the mission, report, and presentation.

For the last two years BYU has sponsored an AUVSI team to compete in the competition. The 2017 team was primarily volunteer based and placed 10^{th} overall while the 2018 team was a Capstone team and placed 9^{th} overall. This year's team is also a Capstone team consisting of BYU Mechanical, Electrical, and Computer Engineering students and looks to place as one of the top five teams.

Project Objective Statement

Improve upon last year's BYU AUVSI unmanned aerial system (UAS) by improving path planning, obstacle avoidance, visual object detection, and payload delivery by April 1, 2019 with a budget of $3,500 and 2,500 man hours.

Contact Information

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Project Approval Matrix

The Project Approval Matrix, as depicted in Table 1, lists the major stages of development for the project, as well as their due dates and constituent artifacts. A budget is also included for each stage.

Table 1: Project Approval Matrix for the UAS

Development Stage	**Expected Completion Date**	**Design Artifacts Required for Approval**	**Budget**
Opportunity Development	October 5, 2018	Project Contract System Requirement Matrix Last Year Results Scoring Breakdown	$100
Concept Development	November 2, 2018	Description of Vision Concept Description of Unmanned Ground Vehicle (UGV) Concept Description of Airframe Concept Test Procedures and Results Concept Selection Matrices Subsystem Interface Definitions	$500
Subsystem Engineering	January 18, 2019	Wiring Diagram Vision Logic Diagram Autopilot Logic Diagram Bill of Materials UGV CAD Model UGV Drop Model Subsystem Requirement Matrices Subsystem Test Procedures and Results	$2,000
System Refinement	March 22, 2019	Refined Integrated System Definition System Requirement Matrix UGV Engineering Drawings Refined Bill of Materials Integrated System Test Procedures and Results	$800
Final Reporting	April 1, 2019	Final Report Compilation Flight Readiness Video Technical Design Paper Safety Pilot Log Team Promotional Video	$100

Key Success Measures

We developed a system requirements matrix in conjunction with the AUVSI competition rules (see artifact RM-001). All system-wide performance measures were considered, and five measures listed in Table 2 were selected as key success measures. Over the course of the next two semesters, we will gauge the desirability of our product based on how well the product completes each of these performance measures. Each performance measure will be evaluated in an environment designed to mimic the competition.

Table 2: Key success measures for the UAS

Measures (units)	**Stretch Goal**	**Excellent (A)**	**Good (B)**	**Fair (C)**	**Lower Acceptable**	**Ideal**	**Upper Acceptable**
Obstacles Hit (#)	0	1	3	5	0	0	5
Average Waypoint Proximity (ft)*	5	20	25	30	0	0	100
Characteristics Identified (%)**	80	40	30	20	20	100	100
Airdrop Accuracy (ft)	5	25	50	75	0	0	75
Number of Manual Takeovers	0	1	2	3	0	0	3

* *Average Waypoint Proximity* refers to the norm of the distance between the UAS and the waypoint location at the point when the autopilot considers the waypoint to be captured.

** *Characteristics Identified* refers to the ability to classify the color, shape, and textual content of visual targets scattered on the ground using camera measurements.

Change Management Procedure

An Engineering Change Order (ECO) will be used to facilitate the proposal, approval, and implementation of any future changes to this contract. The ECO template is found on page

249 of the Product Development Reference (Mattson and Sorenson). A change is initiated by filling out the template and submitting it to all involved parties for approval. Upon unanimous approval, this contract will be edited, the version number will be changed, and the revision history section will be updated with the relevant information, including a reference to the ECO created.