Needs Assessment and Project Scope

EML 4551C – Senior Design – Fall 2012 Deliverable

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Needs Assessment

An unmanned aerial vehicle (UAV) is an aircraft that does not have a human pilot on board. The flight of the vehicle can be controlled autonomously by computers in the vehicle or under the remote control of a navigator. The navigator can either be a pilot on the ground or in another vehicle. The military has focused heavily over the past decade on the research and technological advancement of the UAV for purposes of reconnaissance and rescue. There is a need to promote the advancement of these vehicles primarily for the operational standards and importance of military missions throughout the world. The mainconditionsare when human lives are at risk or cost is too great for manned flight. For our assignment, we are to configure a vehicle by autonomous means to complete a list of tasks for a Naval reconnaissance mission. Contingent upon the successful completion of these tasks, team six will be entering our vehicle in the Association for Unmanned Vehicle Systems International (AUVSI) Competition held in June of 2013.

Competition Needs

Takeoff/landing will occur on a designated 100ft wide paved surface with no height obstacles. Vehicles that do not perform wheeled a landing can use the grass immediately adjacent to the runway. After takeoff all vehicles shall maintain steady flight at altitudes between 100ft-750ft. Takeoff under manual control with transition to autonomous flight is permitted. Extra credit and a cash award will be provided for autonomous takeoff.

GPS coordinates (ddd.mm.ssss.) and altitudes will be announced prior to the competition. However, it is possible that in-flight adjustments or additional waypoints may be given. All vehicles shall autonomously overfly selected waypoints, remain inside assigned airspace, and avoid no-fly zones. Teams will fly a predetermined course that includes changes in altitude and heading to and from the search area.

Air vehicles will be required to fly specific altitudes (± 50 ft.) while identifying several targets along the predefined entry/exit route. UAVs shall not vary from the flight paths (± 100 ft. tolerance) briefed during the mission planning in order to obtain an image of the target. Enroute waypoints shall be achieved in order. Once in the predefined search area, the aerial vehicle shall autonomously search for specific targets of interest. Vehicles can search at any altitude between

100ft-750ft. Competitors shall record the characteristics of the targets (location, shape, color, orientation, alpha, alpha color) on a target data sheet (and/or electronic form) and provide this data sheet to the judges. While searching for targets, the team will be provided with a new search area located within the no fly zone boundary, to locate "pop-up" targets

Landing will occur in the designated takeoff/landing area. Manual control for landing is permitted, however extra points and a cash award will be given for autonomous landings. The mission is over when the air vehicle motion ceases, engine is shut down, and the mission data sheet and imagery have been provided to the judges.

Each team will be given 40 minutes to set up equipment prior to their mission. Once the mission has started, each team has 40 minutes to complete all tasks including turning in imagery and data sheet to the judges. If mission time exceeds 40 minutes points will be deducted from final score. If time exceeds 60 minutes, the team will be required to terminate the mission and turn in results as is. Extra points will be awarded to teams that finish in less than 40 minutes.

Extra points will also be awarded for actionable intelligence. A.I. is all six target characteristics (shape, background color, alphanumeric, alphanumeric color, orientation, and location) provided at that time and recorded on the target data sheet. Credit for actionable intelligence will only be given for up to one target.

For Complete guidelines please refer to: http://www.auvsi-seafarer.org/news-events/2012-competition.aspx. Contingent upon the successful completion of these tasks, team six will be entering our vehicle in the Association for Unmanned Vehicle Systems International (AUVSI) Competition held in June of 2013.

Problem Statement

The use of unmanned air vehicles for both military and civilian applications has increased dramatically within recent years. As such, the Association for Unmanned Vehicle Systems International (AUVSI) has created an undergraduate, objective-based competition in order to stimulate interest in the field of unmanned air vehicles and automation. Our group is tasked with designing and building an automated air vehicle to successfully complete the objectives outlined in the 2013 AUVSI competition.

Background/Justification

The birth ofUAVs began in 1959 when the United States Air Force officers, concerned about losing pilots over hostile territory, began planning for the use of unmanned flights. Many of these missions were classified and it wasn't until the mid-1980 to 1990's when the developing and miniaturization of applicable technologies caught interests within the higher levels of the U.S. military. Since then the UAV has been utilized in conflicts such as Kosovo, Iraq, Afghanistan, and humanitarian relief operations such as Haiti.Long demoted to the sidelines in military operations, UAVs are now making national headlines as they are used in ways normally reserved for manned aircraft. UAV's are thought to offer two main advantages over manned aircraft: they eliminate the risk to a pilot's life, and their aeronautical capabilities, such as durability, are not bound by human limitations.However, the current UAV accident rate (the rate at which the aircraft are lost or damaged) is 100 times that of manned aircraft. This fact coupled with the growing concern of terrorism and global unrest has sparked a more recent interest in the advancement of UAV technologies.

The increase in autonomous technology is capable of producing benefits in the private sector as well. Scenarios for data tracking, weather crafts and first responder missions have all utilized the UAV.The government and private sector have increased UAV exploration and have been allocating extra funding for university level research as well. Projects such as this will provide a pathway for developing technologies in this growing field, help expand and cultivate an emerging market, and to better understand the uses and benefits of an evolving technology.

Objective

This is a performance based competition where the objective is to design an aircraft that will autonomously follow a previously specified route and therefore avoiding no-fly zones. The aircraft will also be required to locate specific targets based on certain criteria such as location, size, shape, color, orientation, the alphanumeric located on the target, and the color of the alphanumeric. The aircraft must be designed to move quickly and precisely, while following the guidelines given by the SAE Aero Design East committee. Bonus points will be awarded for completely autonomous flight, including take-off and landing, as well as, completing the mission

successfully in a designated time frame. Safety will be a major component of the project, as the aircraft must be designed with certain safety features to avoid any possible dangers. The project will be structured around three phases: a technical report, a pre-flight presentation and inspection, and the execution of the mission itself.