UAV Outback Challenge 2016
Deliverable #1

Matt De Bono, Alex Daraio, Wesley Lim, Shanon Loveridge

September 1, 2015

1 Aircraft Design

1.1 Flight

In order to achieve the required flight range and maneuverability to coincide with the objectives, the UAV will be a hybrid aircraft. It will be both a traditional fixed-wing aircraft and a Vertical TakeOff and Landing (VTOL) multi-rotor aircraft. A Skywalker X8 frame is being used, with 3 motors extruding it. These motors will act as a tri-copter when in VTOL mode, and the front motors will rotate forwards when in fixed wing flight mode.

Section 3.1.1.

- Will be autonomous
- Maximum weight of 10kg

1.2 Sensing

Figure 1 outlines the on-board sensing capabilities that will be available to the aircraft. Each sensor is detailed below.

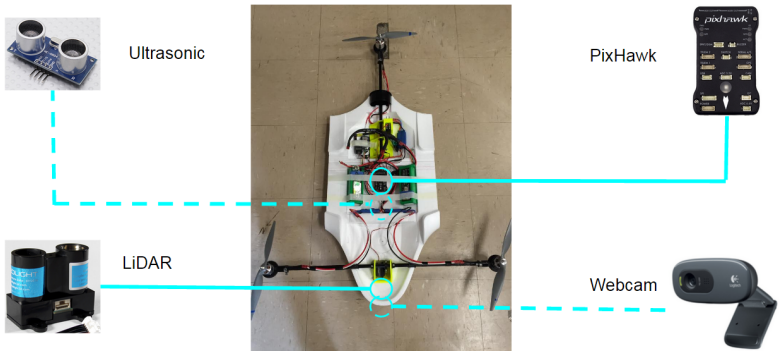

Figure 1: Onboard sensing capabilities

PixHawk Flight Controller

The PixHawk has several in-built or plug-and-play sensors, including a 3-axis accelerometer, altimeter, compass, and GPS. The PixHawk will provide the aircraft's telemetry to the main processor, which will be augmented by the additional sensors below.

Ultrasonic Module

The ultrasonic module will be mounted underneath the aircraft. It will provide a more reliable and controllable height measurement than the PixHawk's inbuilt altimeter, and will assist in the aircraft's autonomous landing.

Webcam

The webcam will mounted beneath the nose of the aircraft. It will provide vision for the aircraft's obstacle avoidance maneuvers, and will form the basis for identifying Joe's blue jeans.

LiDAR

The LiDAR will be mounted in the nose of the aircraft. The LiDAR can only measure the range of objects directly in front of it, so it will be mounted on a dual servo system that allows it to sweep a hemisphere in front of the aircraft (see Figure). It will provide a 3D map of the environment in front of the aircraft, and will assist in path planning and obstacle avoidance.

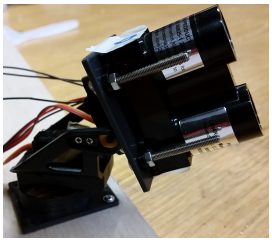

Figure 2: LiDAR mounting

1.3 Geofence System

As per 3.1.3. although the Pixhawk will be able to detect if the geofence is crossed automatically, the UAV will use the Raspberry Pi to avoid the geofences. This is because the Pi will be acting as an onboard path planner. It will have capabilites that will keep it within. If it fails to do this however, either the Pi or Pixhawk will be able to terminate the craft.

1.4 Flight Termination System

As per 3.1.4. there will be two options for flight termination on the completed craft. The higher level Raspberry Pi will be able to send temrination signals to the Pixhawk directly if termination is required. This will comply with either fixed wing or multi rotor termination requirements, depending which mode it is currently in. On a lower level, the Pixhawk will be able to automatically comply with termination requirements through a failsafe if necessary (such as crossing a geofence or losing signal).

In the event that the aircraft must terminate its flight, ... as per 3.1.5.

As per 3.1.6. Flight termination will be automatically activated if the aircraft crosses a Geofence boundary, if the Geofence detection system fails, or if the autopilot has failed. Manual termination can also be activated by the controller at the request of judges/range personnel, for example, if the aircraft appears out of control.

1.5 Miscellaneous

1.5.1 Communications

Will make use of INSERT HERE to maintain telemetry radio communications during flight, as per item 6 of the *General Requirements*.

1.5.2 Safety Systems

The aircraft will be equipped with an external emergency stop button to disengage power, as per item 7 of the *General Requirements*.

It will also be equipped with a visual state indicator to indicate armed and disarmed states, as per item 8 of the *General Requirements*.

1.5.3 Storage Compartment

Section 1.4.1.

2 Use of UAVs

UAV: How it will complete the mision... How do systems work together?

"Arming switch" "Retrieval aircraft" No more than 1500ft AGL Section 1.2.1. +-100m position of Joe Transit corridor Section 1.3.1. Landing site assessment 30m-80m from Joe.

Mission completion

- Does not cross Geofence boundary
- Autonomous landing between 30m-80m from Joe
- Autonomous take off from landing zone
- Lands at base with sample
- Lands within mission time

3 Risk Assessment

See attached "Risk Assessment" document.

4 Risk Management

See attached "Risk Management" document.

Arming switch E-stop button