UAV Outback Challenge 2016
Deliverable #1

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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. The fully assembled prototype is shown in Figure 1.

Section 3.1.1.

- Will be autonomous
- Maximum weight of 10kg

Figure 1: Outback Challenge aircraft - Prototype #1

1.2 Sensing

Figure 2 outlines the on-board sensing capabilities that will be available to the aircraft. Each sensor is detailed below.

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.

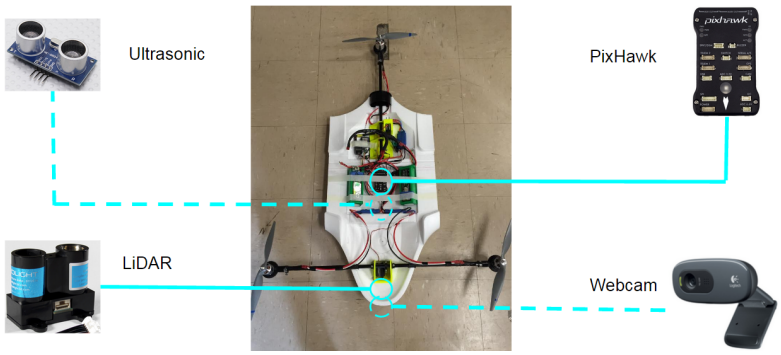

Figure 2: Onboard sensing capabilities for Prototype #1

Ultrasonic Module

The ultrasonic module will be mounted underneath the aircraft. The GPS and altimeter will provided altitude measurements in flight; the ultrasonic will provide a more reliable and controllable height measurement to augment these measurement to 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.

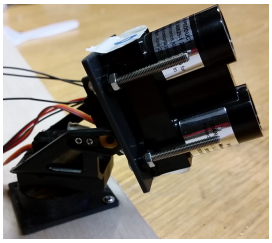

Figure 3: LiDAR mounting

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. 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). The Raspberry Pi will act as a last resort if the Pixhawk fails to terminate, as it relies on a seperate power supply.

In the event that the aircraft must terminate its flight, either by the Pixhawk or Pi, controls will be completely overridden to ensure servo positions are in termination positon for fixed-wing flight, or the throttle is closed during multirotor flight (VTOL) 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 sending a signal to the Pi at the request of judges/range personnel, for example, if the aircraft appears out of control.

1.5 Miscellaneous

Communications

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

Need to conform with Class Licences: Radiocommunications (Low Interference Potential Devices) Class Licence 2000 and Radiocommunications (Radio-Controlled Models) Class Licence 2002.

Safety Systems

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

It will also be equipped with an external arming switch, and a visual state indicator to indicate armed (red) and disarmed (green) states, as per item 8 of the *General Requirements*.

Storage Compartment

Section 1.4.1.

Mission Display

The ground station will make use of Ardupilot Mission Planner will be used to provide a graphical display and data feed of the aircraft's mission, per 3.2.2.

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