

# JANUARY DRONE PRODUCT DESCRIPTION AND SPECIFICATION

*2/2/16*

*REVISION 3.0*

## PRODUCT DESCRIPTION

Our smart drone will be able to track any object in an open field autonomously. It could be your best friend when you want to do outdoor activities. It will capture your moment when you go down a ski slope, or when you make a fancy move while dirt biking. Show off your skills and our smart drone will record it.

## MUST

- Implement GPS and WiFi onboard
  - The WiFi capability is built into the Edison and Intel has documentation on connecting to devices via WiFi with the Edison. WiFi capability is necessary to transmit image from user to Edison on drone\*. Our GPS breakout will transmit GPS data to the Edison. GPS information is necessary for telemetry for the drone.
- Autonomously follow an object in an open field with image processing software on board
  - Autonomous flight control will be handled using Multiwii. Our Flip MWC 1.5 flight controller is designed to be used with Multiwii as its multi-rotor controller. Autonomous flight has been achieved by others using Multiwii in conjunction with an altitude sensor of some kind. ArduCopter is a possible option if Multiwii is not sufficient for our purposes.
  - Flip MVC 1.5 flight controller has I/O pins for all flight controls. So, it will be possible to transmit commands to flight controller from Edison through software.
- Upload an image of an object for the drone to follow
  - Image uploading will be done when the drone is within wifi proximity. A device capable of connecting and transmitting information to a wifi device is required. The connected wifi device onboard the drone will be the Edison. \*
  - Alternately, a USB stick could be used to transfer images to the Edison.
- Keep it as simple as possible
  - The complexity of this project can definitely exceed our capabilities within a 20 week timeframe if we get too ambitious. We should strive to achieve the minimum requirements as simply as possible and look to develop additional features after completing the baseline project requirements.
- Ability to follow an object on clear and slightly cloudy days
  - As it stands, the electrical components and circuitry are exposed to the elements. Protective casing is not a prerequisite for us and will be handled if time allows.

## SHOULD

- Following parameters:
  - The parameters set are set because we believe those parameters are reasonable for the components that we have and we believe that they give enough of a buffer for failsafes to activate and reacquire the target, or fly back to a safe position, in the event that the

object begins to behave erratically relative to the behavior that the drone is expecting to see.

- Image tracking and processing will be done in OpenCV. SURF (Speeded Up Robust Features) is an image processing technique that should be sufficient for our tasks. The key features differentiation in SURF should allow us to differentiate between objects and track the correct object that we wish to track.
- Distances from point of image capture to object can be measured with triangle similarity and knowing the intrinsic parameters of the camera (focal length, sensor height, etc.). The approximate true height of the object may be needed as well.
- Fly at maximum altitude of 50 ft above the object being tracked
  - Barometer sensor information will read pressure data to determine altitude of drone
- Able to follow an object with maximum speed of 25 mph
  - The drone should be able to track an object engaging in, say, dirt biking. Dirt Biking enthusiasts estimate that their average mph is ~20 mph.
  - Drone velocity will be determined based off of sampling images and calculating the time between sample images and the distance of the tracked object in each sampled image.
- Keep an appropriate distance within 100 ft of the object being tracked
  - Distance from object will attempt to remain constant as often as possible (fluctuations are bound to occur with sudden acceleration of tracked object).
- Able to stop and change direction with respects to the object stopping and/or changing direction
  - A user engaging in an active sport may change direction suddenly.
- Minimum flight time of 30 minutes
  - This will be tested by measuring the power draw of the 4 motors running at full throttle and all electrical components actively computing. (Worse case scenario)
- Track the object from behind
  - Tracking from behind the object reduces the degree of freedom that the processor needs to work with and should simplify the process and make it easier for the drone to properly track the object. An image from behind should still capture the behavior that the average user would want to capture. "Behind" does not account for orientation of the object, for example, behind does not necessarily mean a person's back, rather, the drone will trail the object's direction of motion.
- Track and differentiate unique, specific object among a collection of possible similar objects
  - SURF algorithm can differentiate objects based off of key feature markers and identifiers.
- If the drone loses track of an object, go back to initial starting position
  - Many flight controllers have built in "Back to Base" failsafes as long as initial calibration is performed correctly by the user.

## MAY

- Application to connect to the drone
  - an application with a rudimentary gui may be developed to assist the user in interfacing between their image uploading device and the drone. The application may also assist in storing and/or retrieving saved video/image captures.
- Store video feed on SD card
  - This is essential to the long term idea behind the project, but it is not essential to the goals assigned to our team. Streaming the video is probably not feasible due to the limited range of wifi and the relative distance between the drone and the device that the information would be streamed to. A 4GB SD Card would be capable of storing 1080p video for the maximum duration of a single flight (previously mentioned to be at least 30 minutes).
- Have camera in a protective cover to protect from dust, moisture
  - The base level requirement is to have the drone fly under “ideal” weather conditions (defined in the Must section of this document). Protective casing for flight controller and other electronic components is available for purchase or may be constructed if time allows.
- Add servos for the freedom of camera movement
  - Servos for freedom of camera movement would allow for more dynamic, “cinematic” shots. This, however, would complicate things a great deal in terms of how the drone would track the object. Therefore, this degree of freedom would be nice to have, but is not essential to the requirements set forth for our team.
- Scan an object via drone
  - A scan of the object would give a more complete and comprehensive detail on the object that is being tracked but it may be too much for our processor to handle and the added complexity of comparing and sifting through several images rather than just a single image from a single angle is most likely beyond the scope of our project.
- Status LEDs
  - Status LEDs displaying the status of the drone (battery levels, successful calibrations, etc.) would be useful information for the user.
- Throw drone up in the air for launch
  - Most flight controllers and rotor control software for drones have takeoff and landing protocols built in. According to user experience from enthusiasts that have used the FLIP MWC 1.5 flight controller, the stability mechanics are excellent for the FLIP MWC 1.5 flight controller. This could make it possible to achieve takeoff and landing in a more dynamic fashion than a launching pad or station. If time allows, it may be beneficial for users of this device to launch and land the drone in a less strict environment.