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 onboard
    - 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
    - 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
    - A USB stick will be used to transfer images of the object to track to the Edison.
- Track an object based off of image processing techniques rather than tracking a device located on the object
    - Image processing and tracking will most likely be done using OpenCV's library for image processing and tracking. There are a variety of image processing and tracking techniques in the OpenCV library that we can utilize to accomplish our goal.
        - SURF (Speeded Up Robust Features) is an image processing technique that uses key feature identifiers for object recognition.
        - 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.
        - OpenCV can differentiate objects based off of color differences
        - There are more tutorials on using OpenCV's various image processing and tracking functions
    - Objects will be followed from directly behind in the direction of travel at greater than 10 feet distance from the object with the object traveling only in a straight line. The object must not accelerate or decelerate faster than approximately 3 mph (average walking speed of a person). The drone will fly at a height just greater than the height of the object (approximately 7 ft from the ground) to ensure optimal view of the object.
- 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

- Objects will be followed directly behind in the direction of travel at greater than 10 feet distance from the object with the object traveling in straight lines and turns no greater than 45 degrees. The object must not turn in the same direction twice. Thus, the drone can follow the object primarily by strafing. The object must not accelerate or decelerate faster than a rate of approximately 20 mph.
- 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. (Worst case scenario)
- Track and differentiate unique, specific object among a collection of possible similar objects
    - Our Must requires us to track an object in an open field. If time allows, our drone would be able to differentiate a specific object from a collection of like objects (i.e distinguish one person from another).
- 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

- Objects will be followed directly behind in the direction of travel at greater than 10 feet distance from the object with the object traveling in any direction at anytime. The object must not accelerate or decelerate faster than a rate of approximately 20 mph
- Implement 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 may be used to transmit image from user to Edison on drone.
        - 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.
- 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. Currently, take off requires a level surface. If time allows, it may be beneficial for users of this device to launch and land the drone in a less strict environment.
- Autonomously follow an object in an open field with image processing software on board
    - Instead of motor control directly from the Edison to the I/O pins on the Flip MWC 1.5, we may do autonomous flight control 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. This is only if we’re unable to sufficiently control the motors with the Edison.