Checkoff Checklist

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1. Commitment

Our commitment goal is to demonstrate the functionality of each module separately by using a test bench. These modules are described below:

a. Location Finder Module (Ertem)
- It estimates the Cartesian coordinates of an object with respect to its initial position in real time by using its acceleration data coming from the accelerometer.
- It uses techniques such as error correction and low pass filtering to reduce errors introduced during the calculations of the integral for velocity and position.

b. Angle Calculator Module (Faysal and Ertem)
- It calculates the angle between the positive x axis and the ray from the camera to the tracked object. If the object moves in three dimensions, it would then estimate the following two angles:
  - Θ: the angle between the xy plane and the ray from the camera at the center of the coordinate system to the object
  - Φ: the angle between the positive x-axis and the projection of the aforementioned ray onto the xy plane.
- It goes through a look-up table of 90 tangent values, thus, being able to estimate the angle with a precision of 0.5 degrees.

c. Image Module (Faysal and Ertem)
- This module consists of two parts:
  - It displays the location of the tracked object with respect to the fixed position axis centered on the camera. It will also display the ray from the camera at the origin to the object in order to visualize how camera turns to face the object.
  - It would also be able to display the camera image transmitted to the FPGA, the choice of which will be input by the user through a switch.

d. ADC Module (Faysal)
- This module controls and displays the data arriving from the external ADCs which convert the analog signals from the accelerometer to the digital signals, ready to be used in the Location Finder module.

2. Goals

Our main goal is to track the positon of an object in the xy plane and display its graphic and real image as it moves around the camera (Camera will be rotating to face the object). Besides the modules described above, realization of this goal depends on the correct operation of the following components:

- The flexible mini-camera (Faysal and Ertem): Attached to the servos, it will record the object's image and send it to the FPGA, which will then display it through the Image module.
- The servo system (Faysal and Ertem): It will rotate the camera so that the camera always faces the image as it moves on the xy plane. It will also have

the functionality to move the camera axis in the z direction. Its inputs will be provided by the Angle Calculator module.

- The Accelerometer-ADC system (Faysal and Ertem): Being the most complicated and hardest external component to implement, this extremely sensitive ADC would be able to produce up to 400 acceleration data samples per second by converting analog signals from the accelerometer to digital signals. These samples for acceleration in x and y directions would, then, be input to the Location Finder module.

Working together with the modules described in part 1, these components will play a crucial role in our demonstration of the project.

3. Stretch Goals

There are multiple stretch goals:

a. Extending the Tracking System into 3 Dimensions

Having enough time, we would like to track the object in xyz space by using the acceleration data for the z axis and by utilizing the capability of the servos to move in z direction. Although the Location Finder and Angle Calculator modules will be implemented with the ability to track the object's z location and estimate its Θ angles, these functionalities will not be demonstrated as a part of our main goals. They will be left as our stretch goals.

b. Wireless Tracking and Battery Powered FPGA

Unfortunately, the movement of the tracked object is constrained by the cables that transmit image data from the camera to the FPGA and angle data from the FPGA to the servos. Moreover, FPGA itself is constrained by the power cords. Hence, having enough time, we will implement wireless communication between the camera, servos and the FPGA. If we do not have enough time for this, we will use batteries to power the FPGA, thus, at least, getting rid of the power cords.