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# Deliverable F
## Prototype I and Customer Feedback

## IlluminEye

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# 1. Prototype 1

The foundation of the final product is the camera's ability to detect obstacles. Ensuring that the software can detect obstacles is a crucial step before proceeding. This is the purpose behind our group's first prototype.
Prototype 1 is a focused prototype on the object detection capabilities of the software. Three distinct rounds of testing were conducted to test the capacities.

**Methodology:**
The first test consists of the camera set up in a stationary position with people moving towards the computer.
The second round of testing consists of an individual holding the computer and moving towards stationary obstacles to simulate the glasses user navigating an environment.
The third and most rigorous set of testing that the prototype undergoes consists of an individual holding the computer and moving towards people who are also walking to simulate the glasses user navigating in a more realistic environment.

Each of these tests do not require much time, allowing for each test to be repeated for increased accuracy of data. Each test can be completed in under a minute.

The observations desired within each test are that the software is able to detect these obstacles. Said observations will be measured in the percent of obstacles registered by the software compared to obstacles presented to the camera.

**Testing metrics:**
It is desired to have 100% of obstacles presented to the camera be registered by the software. The stopping criteria for the testing is 100% detection of obstacles for each test.

# 2. Critical Components

## - Web Camera

To determine the actual distance of an object from the camera and the focal length.

**- Visual Studios Code**

Use it as a streamlined code editor for software development with available extension and pip install packages.

**- Python**

High-level coding language used for project development.

**- NumPy**

Python library that is short form for Numerical Python, it allows multidimensional array structures, such as linear algebra, fourier transform, and matrices.

**- Open CV**

It is an open-source real-time computer vision machine learning library, allowing video analysis and image processing, such as face detection and object tracking.

## 3. Testing Method

Each prototype would last around a minute, with each of the 3 trials done in multiple routes. A person walking, navigating through a set distance with other team members serving as obstacles (also walking or stationary). If the camera can detect all 3 obstacles: prototype is deemed effective.

Three trials:

1. Glasses user is stationary with “obstacles” moving in direction of user
2. Glasses user is in motion with “obstacles” stationary
3. Both the glasses user and the “obstacles” in motion

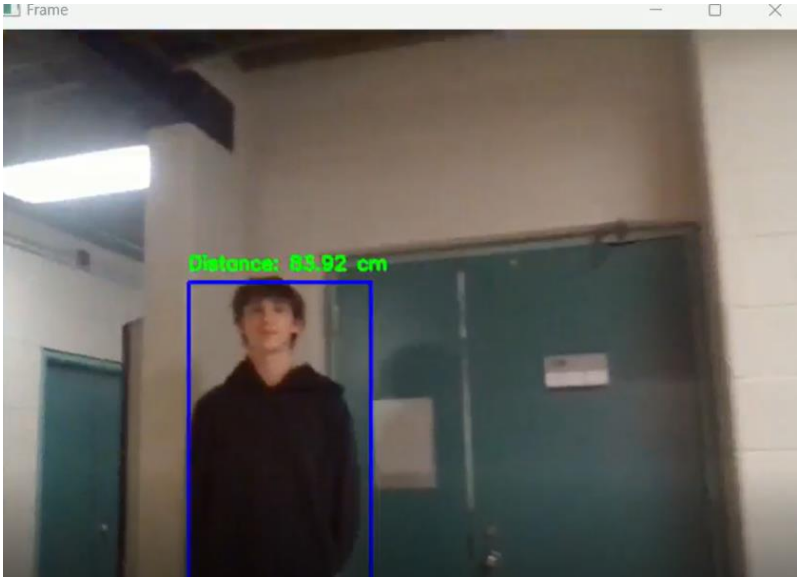
## 4. Observations and Measurements

**Observations:** Obstacles are detected with a high degree of accuracy.

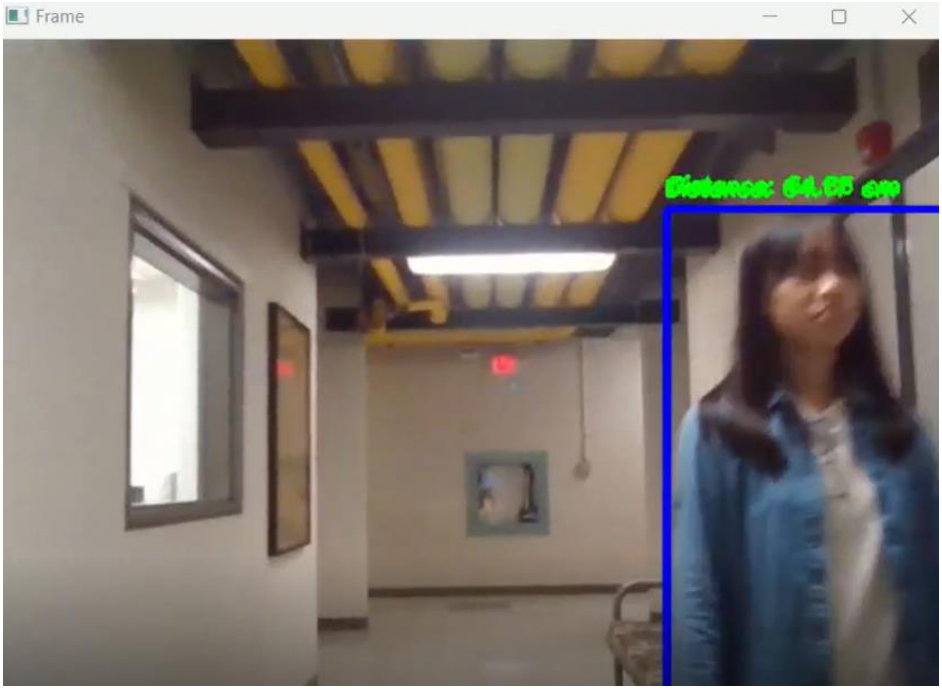
**Measurements:** Metric of 100% of obstacles detected was reached in all three rounds of testing. Further calibration of the distance detection is required for a more precise measurement.

**Results:** The distance of the obstacles from the camera is calculated and shown on screen, with the distance varying as both camera and obstacles move. However, sometimes when the obstacle is closer to the camera, their distance increases instead of decreasing, vice versa, sometimes when the obstacle moves away from the camera, the distance decreases. Furthermore, once tested with a ruler and estimation, the distance shown on the detection boxes were inaccurate. However, all humans, obstacles are detected clearly.


Trial 1. Where the camera is stationery and obstacles are walking in the direction of the camera.




Trial 2. Where the obstacle is stationary, and the camera is the one moving.



Trial 3. Where the obstacle is moving with the camera.

**Changing the Parameters:** As we move towards additional round of testing, we want to have the software's distance detection capabilities enhanced to increase the products fidelity to our desired final product.

We seek to have these capabilities incorporated into our model to be tested on alongside our prototype 2 testing.

New metrics of the accuracy of the camera's distance detection capabilities to be applied where the model should fall below a 10% percent error at for a trial of distances.

## 5. Questions for clients

- Do you think this prototype is up to par or going in the right direction?
- Which user feedback mode do you prefer / would like to see implemented?
    - Light
    - Sound
    - Vibration
- What would you like to see implemented into our final product?

## 6. Bill of Materials

| Part | Unit Cost $ | Quantity | Total Cost $ |
|---|---|---|---|
| Arduino UNO | 15.25 | 1 | $ 15.25 |
| LED lights(5mm) | 0.70 | 1 | $ 0.70 |
| Mini metal speaker | 5.00 | 1 | $ 5.00 |
| Vibration motor | 5.30 | 1 | $ 5.30 |

## 7. Prototype 2

### Prototype Plan

- Prototype type: Focused, Analytical
- Duration
  The camera takes under a minute to detect the obstacle and display the estimated distance.
- Timing
  The test starts when the object enters the camera's field of view and stops when the object is successfully recognized and an accurate distance is measured.

### Execution

During the test, an object will be placed in front of the computer's camera then we observe and record the distance produced from the software and if there was a response from the Arduino.

### Interpret

If the distance displayed is accurate and we received a response from the Arduino, we consider the test successful.

**Stopping Criteria**

The test can be stopped when 100% of detections produce a response from the Arduino.

**Fidelity of our prototype**: High

We are trying to measure the software's ability to measure the distance between the object and the user accurately, if we get a response from the Arduino and the accuracy of the response from the Arduino (how long does it take to react).