



Automatic Fire: The Creation of the Doom Slayer's Shoulder Cannon

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Structure Rundown

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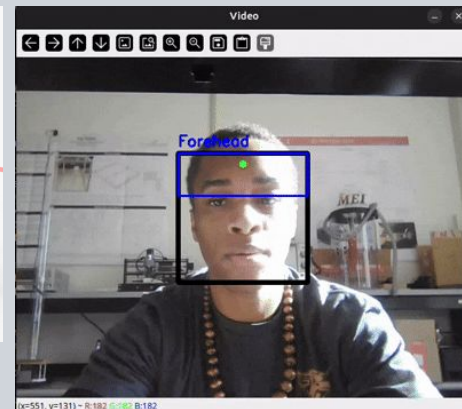
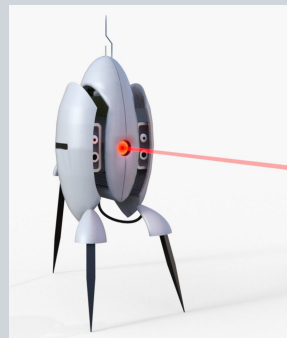
Background Introduction (What the Heck, Alyssa)

- The shoulder turret cannon comes from the Doom Eternal game
 - Called the Equipment Launcher; used by the Doom Slayer (i.e. you, the main character)
 - Shoots grenades, fire (like a flamethrower), and ice bombs
- This is not my first time/attempt in building this project
 - Work began after taking computer vision with Professor Bestie
 - Intended to make this for a halloween costume



What is it Meant to Do?

- The physical “turret” should detect any tracked faces from the camera and point a laser at them
 - The laser should ideally only point the last detected face in the camera
 - Minimize errors (false positives, false negatives, etc.) and point the laser “in between the eyes” (center of the forehead)
- The turret should be able to take face information and use it to track and point at the face
 - Must be fast enough to be real time, and reliable enough to always point towards the head





Building the War Machine

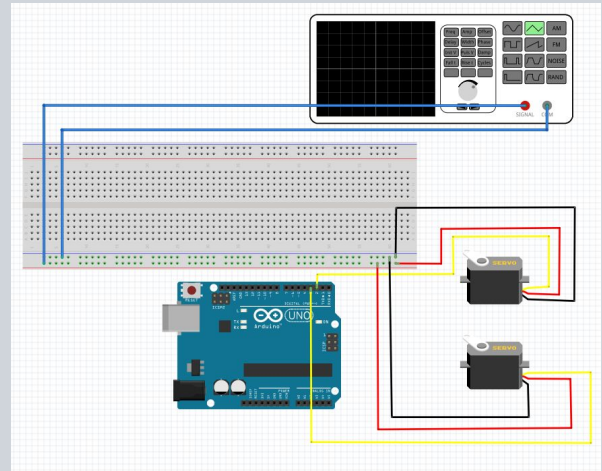


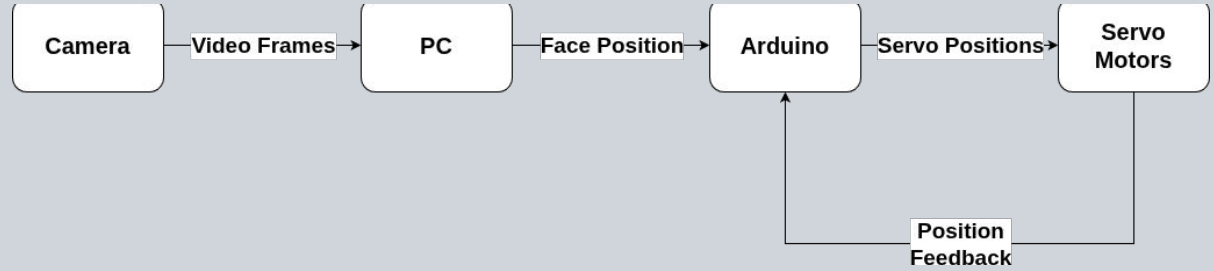
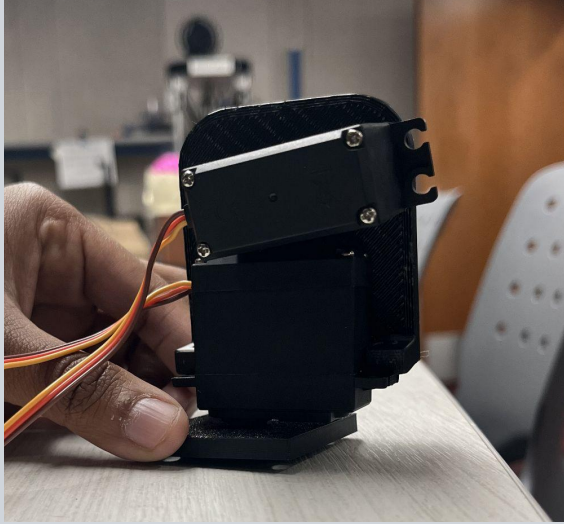
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Parts and Layout of the Turret

- The turret consists of:
 - Laser pointer
 - HITEKK Green Laser Pointer
 - 2 Servo motors
 - MG996R servos
 - One controls the x-axis and y-axis
 - 2 Machine Screws and Nuts
 - Stands
 - 3d printed stands for the servo motors
 - 2 Additional Spaces were also needed
 - Power supply
 - Computer
 - My laptop
 - Main Brains of the face detection
 - Camera
 - Webcam of the laptop
 - Arduino
 - The brains that move the servos with the information gathered from the computer
 - Breadboard
 - Not a board made of bread unfortunately...
 - Wires
 - Obviously





Model and Diagram of the Turret



- The python script (laptop/pc side) uses openCV to open the webcam and stream the video to be analyzed and altered
- Each frame is treated like an individual image and processed
 - Converted to grayscale and “scanned” for faces
- Once a face (or faces) is detected, then the approximate location of the forehead is calculated and sent to the Arduino
 - If multiple faces are detected at once, then the last face detected will be the target
- Using the coordinates, the Arduino then moves the servo motors to the point the laser at the target

Coding the War Machine

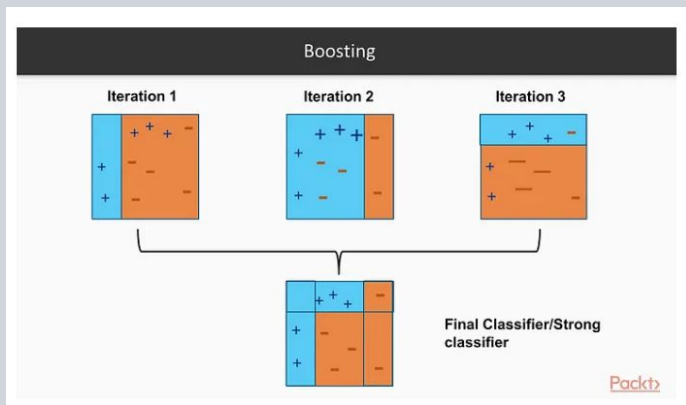
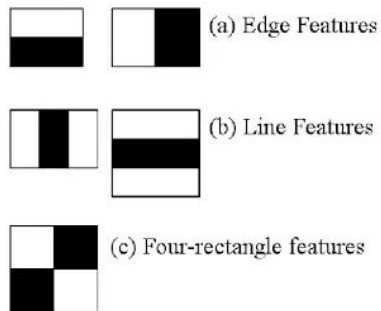
Basically How the
Brains Work



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How the Face Detection Works - Haar Cascades



- Haar Cascades are a machine learning algorithm for object detection
 - Created by Paul Viola and Michael Jones, but concept introduced by Alfred Haar
 - Used in real-time object detection and can only identify WHAT an object is, not WHO it is
- The idea behind it is to create Haar Features that are common within the object, using integral images, and use Adaboost Training
 - Not every feature is important and most get ignored
 - For the important features, now classifiers, they take the weak classifiers and combine them into strong classifiers
 - Strong classifiers are found and identified through cascading classifiers
 - The algorithm is so fast because most of the features get ignored
- The gif shows the entire process from start to finish





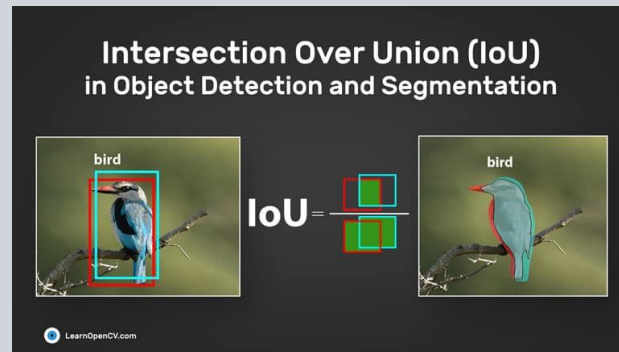
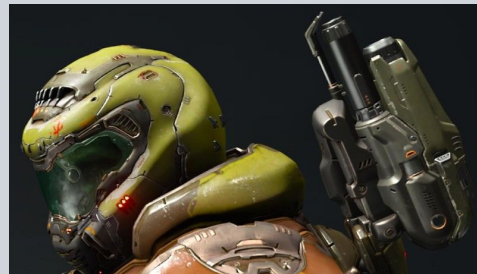
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Results/Live Demonstration



Progress Past the Project

- Restart on the costume
 - 3d model the equipment launcher body for the servos
 - Step 1. Learn 3d modeling
 - Get a raspberry pi (or something similar), look into mini cameras and portable power sources
 - Maybe make a PCB for it...
 - Implement a button-activated ball launcher
 - More mechanical than electrical, but could be fun (have fun sound effects, lights, etc.)
- Play around with the Parameters of the Haar Cascade face detection
- Look into reintroducing the Intersection of Union (IoU)
 - Area of Intersection/Area of Union
 - Basically combining the frontal and profile haar cascade models for higher tracking accuracy
 - More computationally taxing and more power required
- Look into Face Recognition
 - Requires a dataset of multiple pictures of one person and a LLM
 - More computationally taxing and more power required





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Conclusion

- I'm a Genius
 - Obviously
- Object detection is a very powerful tool that can be used to implement security measures
 - Do something when a person/animal/object is detected
- This project can have seemingly endless ways of working, personality, and customization
- Math is truly in every aspect of computer science
 - And in engineering as well...
- 3d Modeling is hard



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Thank You!

Any Questions?

