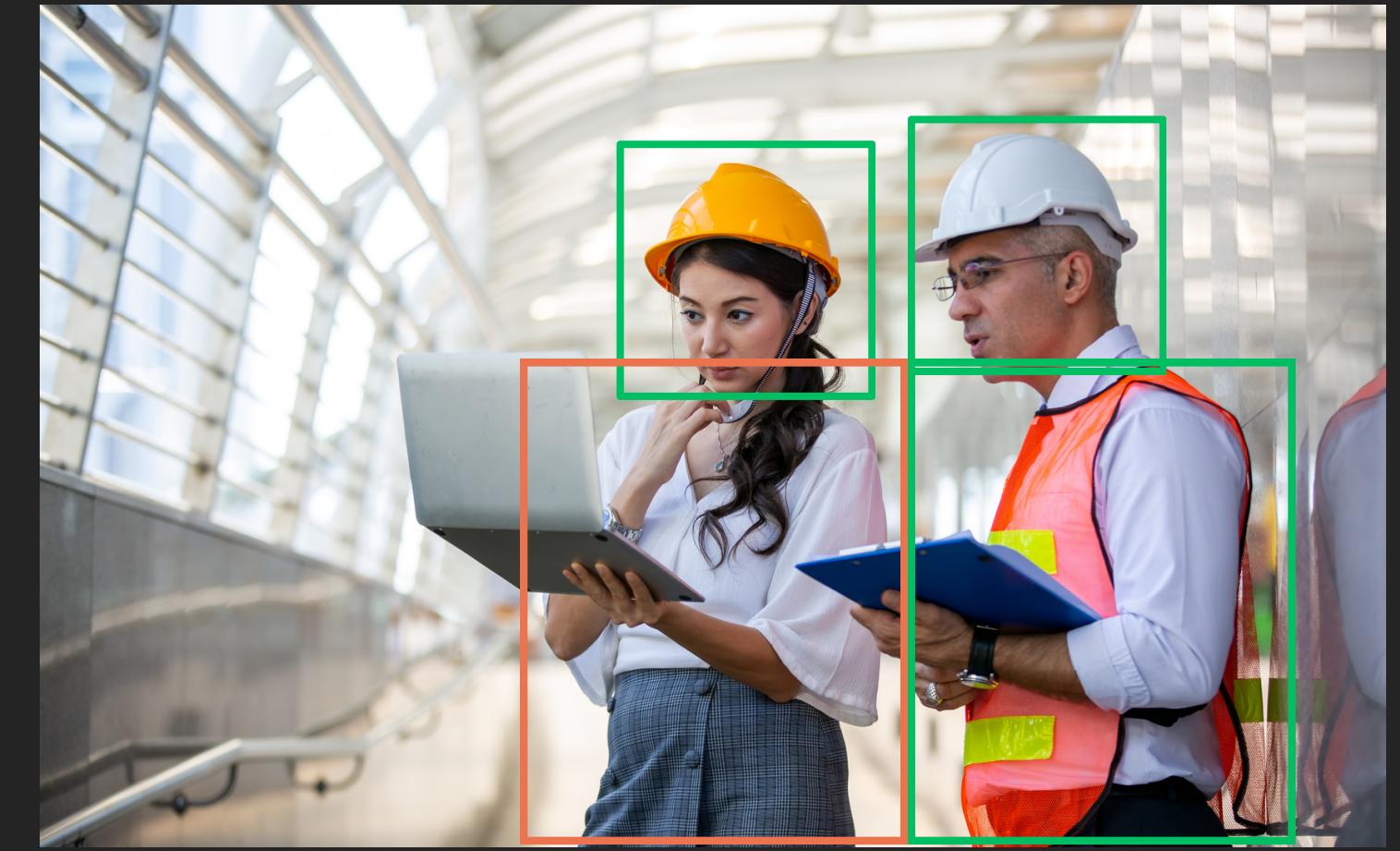




SMART GUARD

By:





PROJECT INTRODUCTION

PROJECT INTRODUCTION

Project Idea: **Entrance Counting System**

What it should do:

- Detect people within a video, image or a live camera
- Count number of people who enter the worksite

What it is for:

- Assist in emergency management by providing counts of people present
- Attendance Systems
- Prevent Overcrowding (*Covid-19*)

OUR PROJECT

- **Face Recognition Model** to provide accurate count of people who enter worksite, aiding in efficient emergency management
- **Automated PPE Verification** to detect if individuals entering the worksite are wearing required PPE, such as helmets, vests, gloves and boots.
- **Face Recognition Model** only detects **registered** and **authorised** personnel who are trained and aware of the safety protocols are able to enter worksite, minimizing accidents

WHY WE DECIDED TO MAKE THIS?

PPE > HAND PROTECTION

Workers Are Risking Injury By Not Wearing Safety Equipment

Aug. 17, 2010 

A new survey of safety professionals has found a high incidence of employee noncompliance with corporate and federal mandates to wear appropriate personal protective equipment (PPE).

Sandy Smith



In fact, nearly all of the safety professionals in a survey released Aug. 12 said that workers in their organizations had at some point failed to wear the necessary safety equipment while on the job. Ninety-eight percent of respondents who attended the recent American Society of Safety Engineers (ASSE) conference in Baltimore answered "yes" when asked if they had observed workers not wearing safety equipment when they should have been, according to the survey, which was conducted by Kimberly-Clark Professional.

To make matters worse, 30 percent of these respondents said this had happened on numerous occasions. Given this, it's not surprising that worker compliance with PPE protocols was cited as the top workplace safety issue by all survey respondents.

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Unauthorized Jobsite Access Could Be The Safety Risk You've Forgotten

 June 7, 2018



Safety managers have several important responsibilities that are integral to the success of a construction project. Chief among these professional duties is overseeing jobsite access. Safeguarding restricted areas, and effectively ensuring jobsite safety and security, is no small task.

In the day-to-day operation of any given construction site, the last thing you want is to inadvertently permit unauthorized entry to a potentially dangerous area. A mistake of this nature almost always has legal and safety repercussions. Whether due to confusion or criminal activity (fingers crossed it isn't the latter), unauthorized jobsite access is an all-too-common mistake that your construction company simply can't afford.



PROJECT FEATURES

Main Project Features



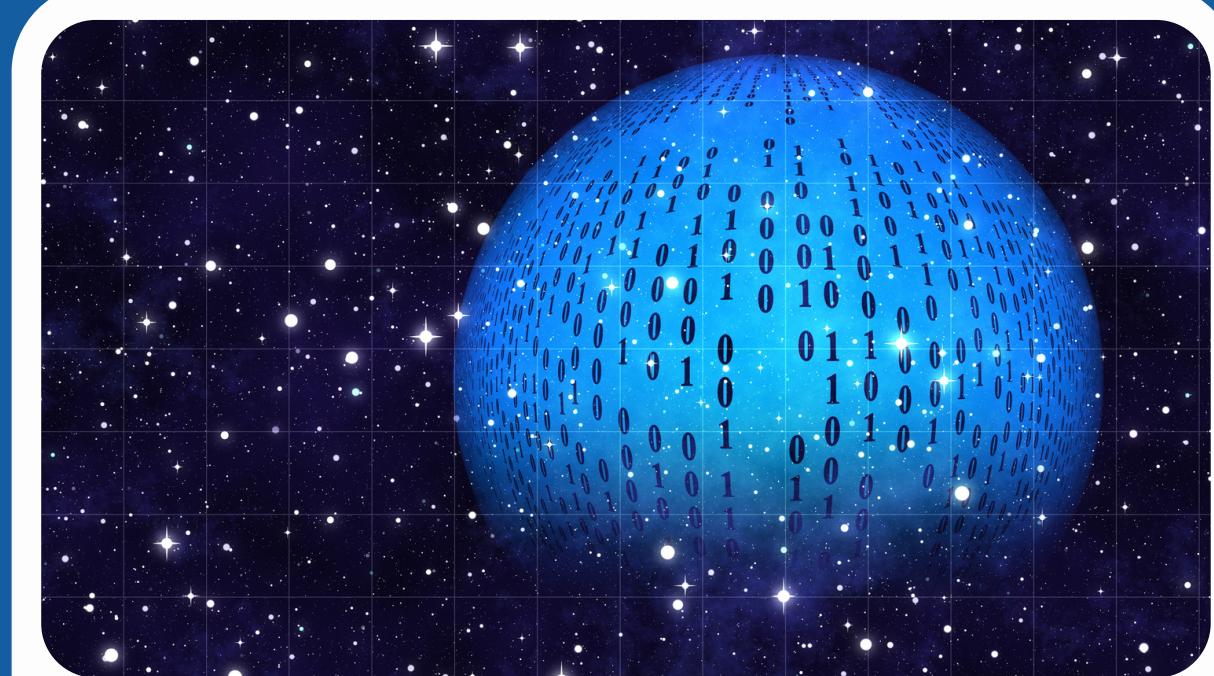
Person/PPE Detection

Ability detect both people and PPE on the person through object detection



Face Recognition

Face Recognition allows for live identification of workers during entry, allowing only authorised personnel to enter as well as providing accurate count



Access Controls

Access control system that allows or denies entry based on PPE compliance and facial verification

HOW ITS DONE

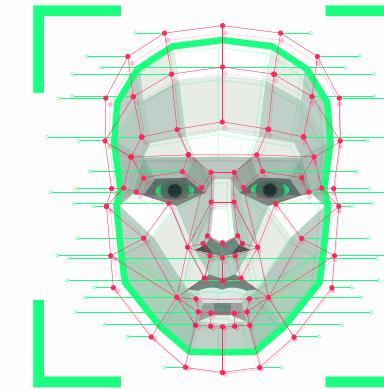
PPE (OBJECT DETECTION)



Compiled and self annotate images from Roboflow for a tailored dataset

Train a YOLOv8 model using the custom dataset and optimized for real-time detection accuracy

FACIAL DETECTION



Facial Detection algorithms to identify human faces in images/video frames

CNN is used to distinguish faces from backgrounds and other objects, enabling accurate detection

FACIAL RECOGNITION



Facial recognition technology maps detected face to create digital representation

General facial representation then compared to database of known faces to find match

PROJECT FEATURES

Base Feature: Detect a person

Advanced AI Feature: Face Detection & Recognition, PPE Detection

Extra Features:

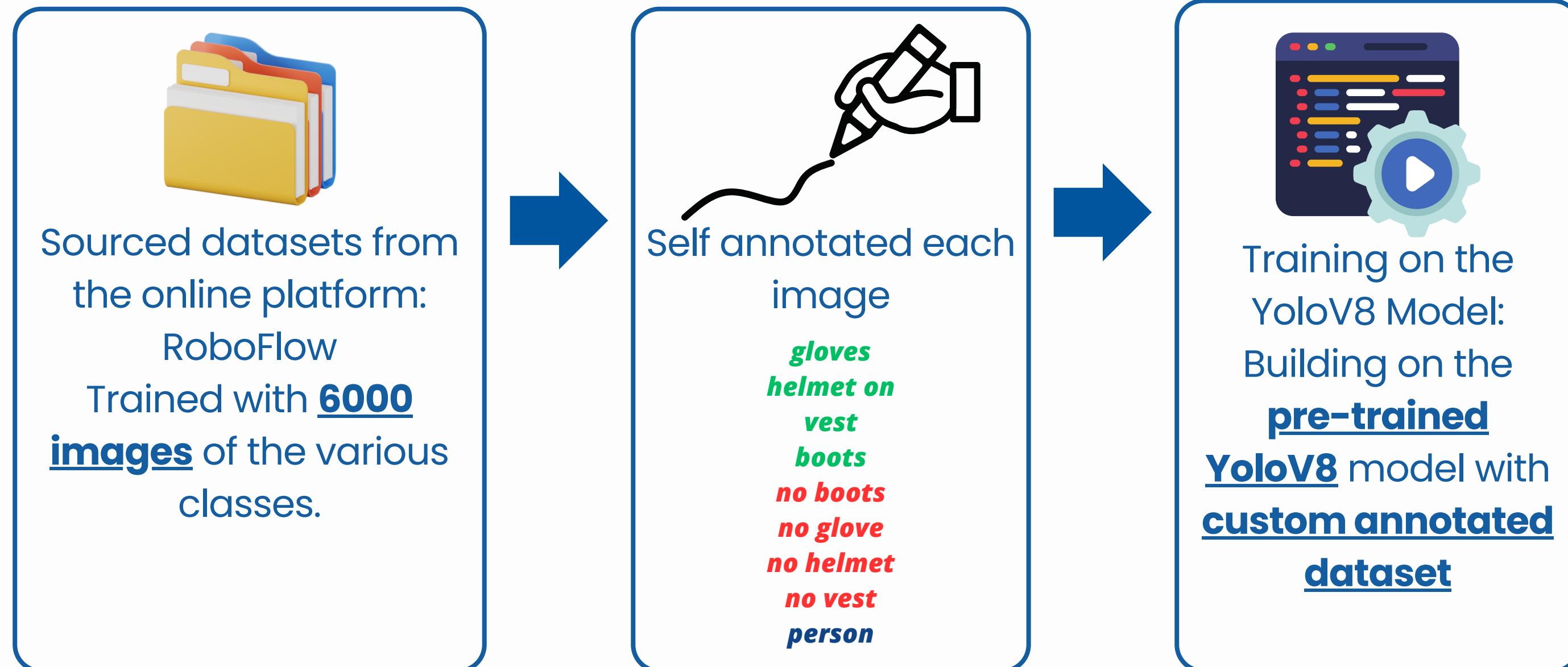
- Voice Assisted Program
- Bounding Boxes
- PPE Classification with different colors
- Unique Entry Tracking
- Detecting different operational personnel
- Firebase Cloud Storage to store/retrieve personnel information
- Automatic Updating System
- Interactive UI



PROCESS

Dataset Creation

COMPUTER VISION PIPELINE



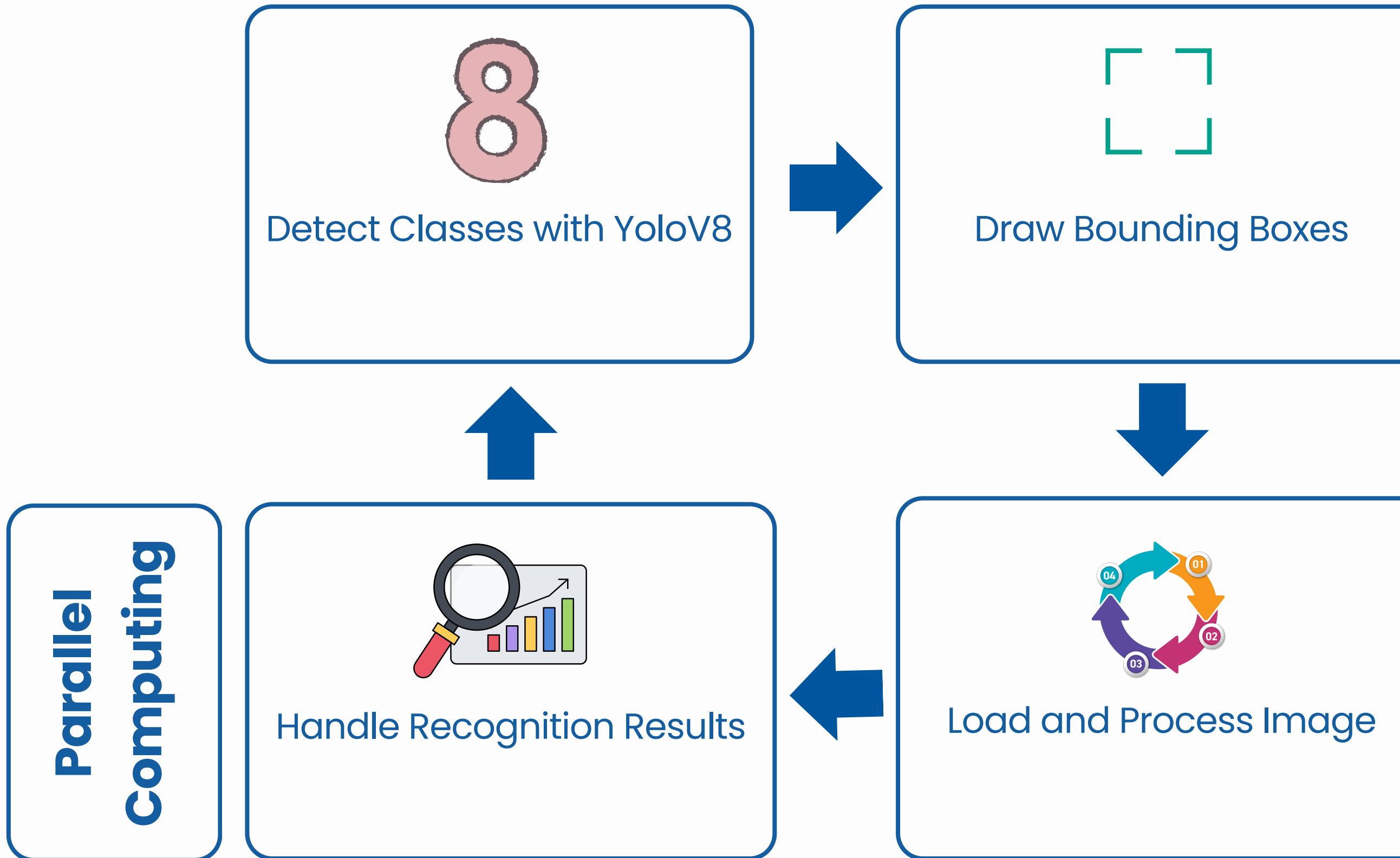
START OPERATION

COMPUTER VISION PIPELINE



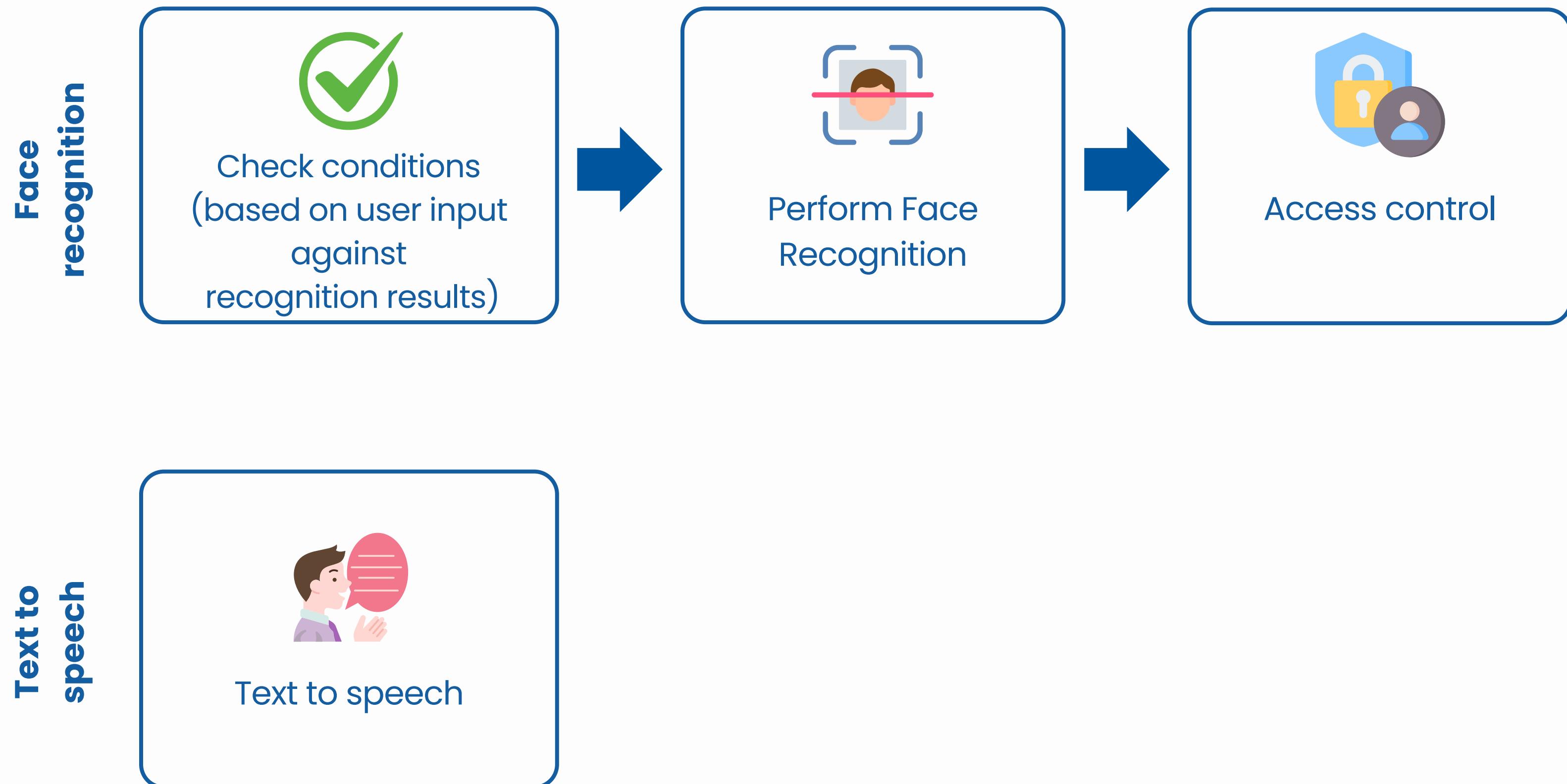
MAIN PROCESS

COMPUTER VISION PIPELINE



PARALLEL COMPUTING

COMPUTER VISION PIPELINE





PROS/CONS

PROS

Safety

In order to ensure the safety of workers, they are required to wear all required PPE before being able to enter.

Identification

With Face Recognition/Identification, it allows for a second layer of safety check, ensuring that only authorized users are allowed to enter.

Customization

Customizable PPE options to facilitate versatile project usage across the various factory scenarios.



CONS

Inference

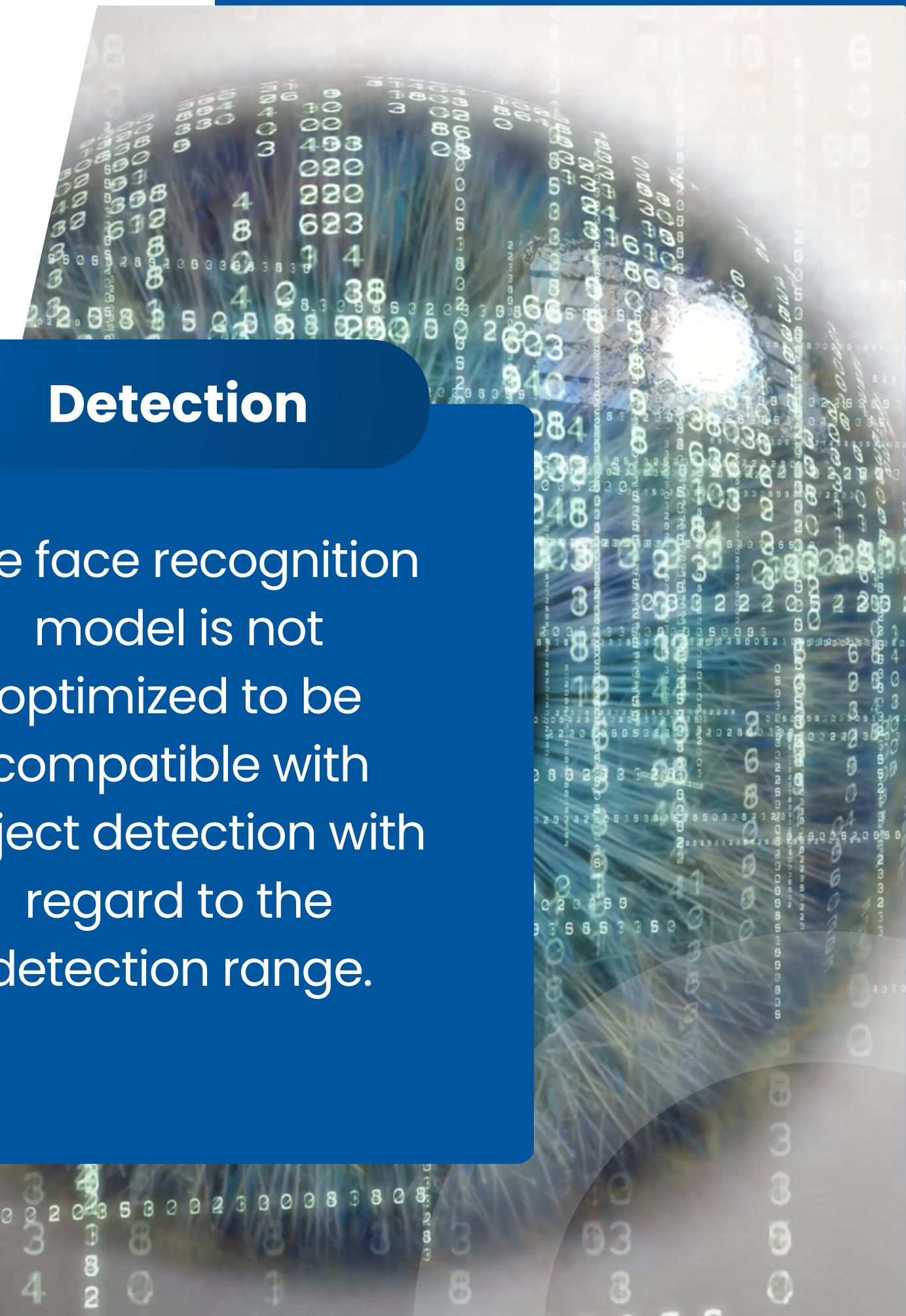
Inference speed is reasonably slow to the point where it affects detection/printing

Hardware Limitations

Requires GPU to process efficiently, instead of it being able to run on CPU like most projects as we access 2 models with 1 input to produce the visual output

Detection

The face recognition model is not optimized to be compatible with object detection with regard to the detection range.





PROBLEMS AND WORKAROUND

Problems Experienced

Roboflow Code

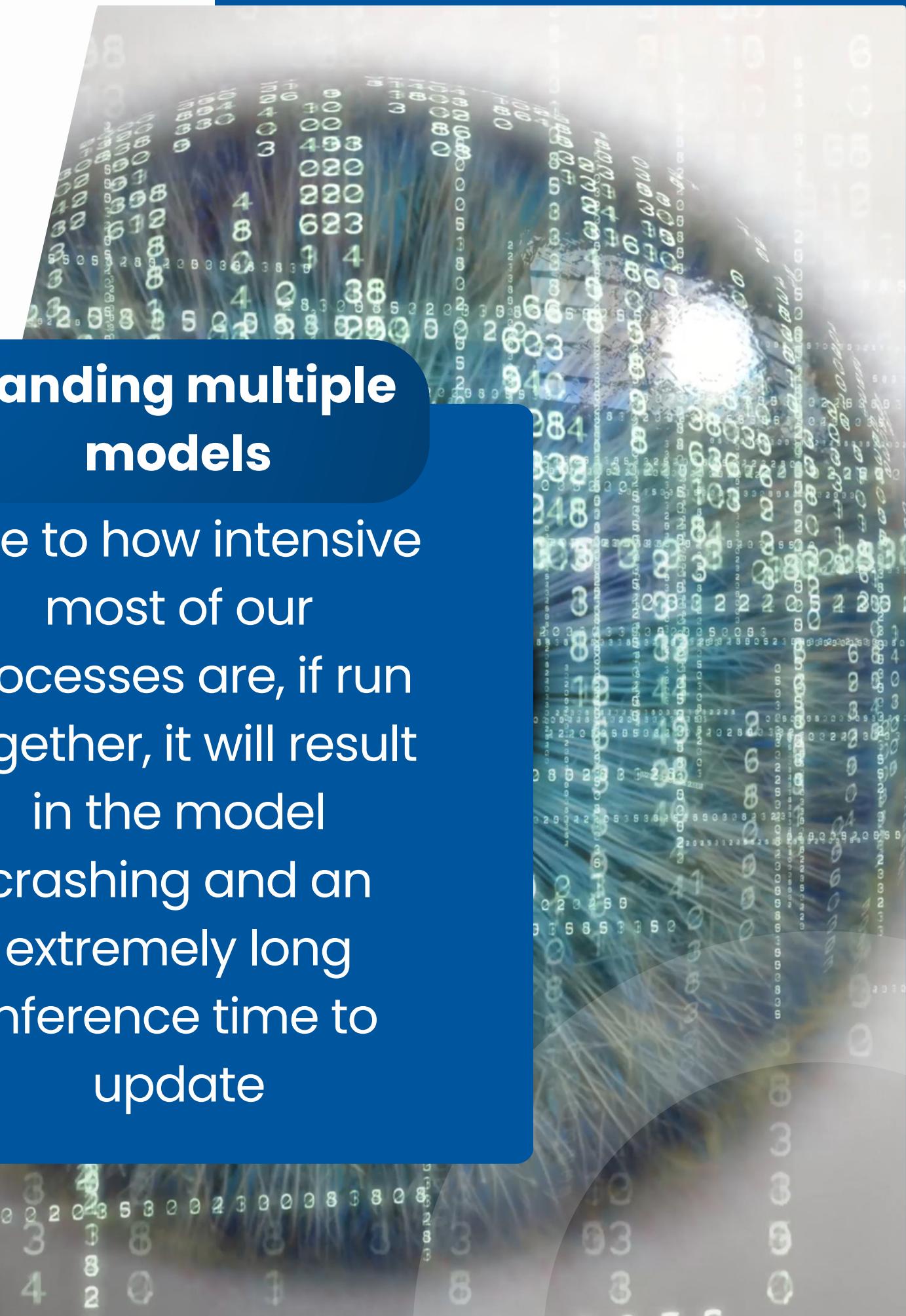
Roboflow Inference Pipeline was a different code, resulting in us being unable to use their pretrained models

Face Recognition

Face Recognition is capable of detecting multiple faces within an image, leading to some errors when multiple people are detected

Handling multiple models

Due to how intensive most of our processes are, if run together, it will result in the model crashing and an extremely long inference time to update



How we fixed

Self-Training v8

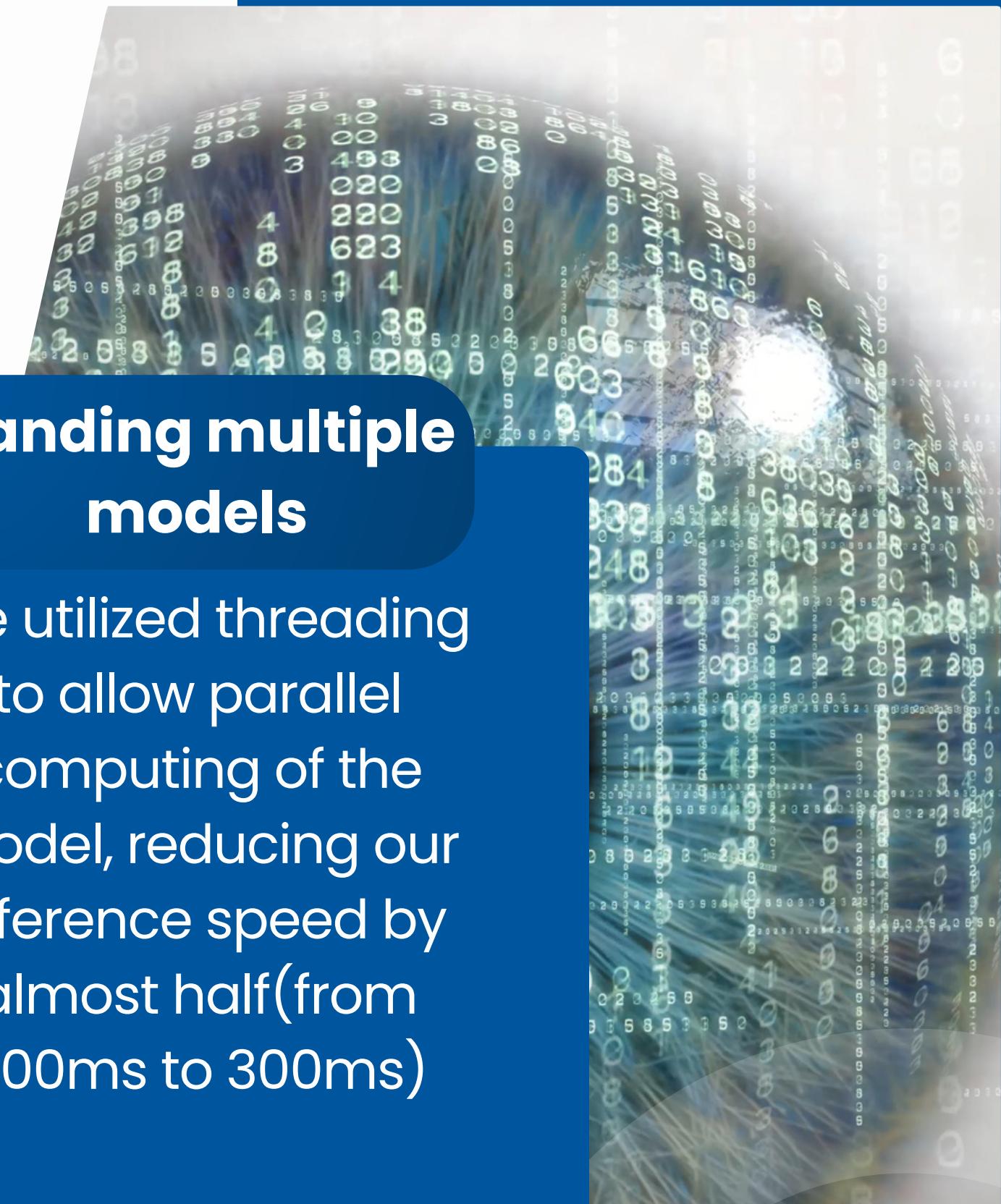
Self Trained the model to be able to adapt with the cv2 library, to keep the code simple and customizable with our current knowledge

Event Handling

Using simple if-else conditionals, it ensures that only one person is detected in order to prevent multiple faces

Handling multiple models

We utilized threading to allow parallel computing of the model, reducing our inference speed by almost half (from 600ms to 300ms)



THANK YOU!



PROJECT DEMO



Q&A



Why YoloV8 for ?

YOLOv8 offers several key improvements and features compared to YOLOv7. Some of the advancements in YOLOv8 include faster detection speed and improved accuracy in detecting small objects. YOLOv8 has an anchor-free architecture, multi-scale prediction, and an improved backbone network.

15 Dec 2023



Keylabs

<https://keylabs.ai> › blog › comparing-yolov8-and-yolov...

⋮

[Comparing YOLOv8 and YOLOv7: What's New? - Keylabs](#)

Why we used dlib ?

Dlib is a modern C++ toolkit containing machine learning algorithms and tools for creating complex software in C++ to solve real world problems. It is used in both industry and academia in a wide range of domains including robotics, embedded devices, mobile phones, and large high performance computing environments.



Dlib
<http://dlib.net> :

[dlib C++ Library](#)

Face Recognition: Facial Detection using deep learning models - Histogram Oriented Gradient + Support Vector Machines and Convolutional Neural Network

Face Recognition

Recognize and manipulate faces from Python or from the command line with the world's simplest face recognition library.

Built using [dlib](#)'s state-of-the-art face recognition built with deep learning. The model has an accuracy of 99.38% on the [Labeled Faces in the Wild](#) benchmark.

Why the model could not detect certain features properly

The model is trained on real-life scenario where lighting and other conditions affects the quality of the model. The images are sourced from datasets found in Roboflow, where it is extracted and the dataset is very tailored to real-life application and its hard to replicate the conditions of the image as they have different attire and they are usually at a distance and our model can be hard to detect due to the close proximity of the detections

