deti universidade de aveiro
departamento de electrónica, telecomunicações e informática

Tracking

Elaboration Phase

Supervisors:

Professor Osvaldo Pacheco

Professor Gonçalo Carnaz

Tracking

OUR TEAM

DAVID AMORIM

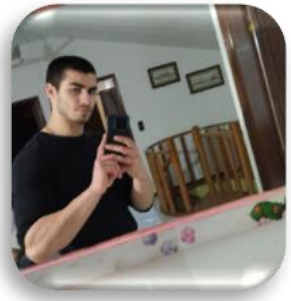
DevOps

FRANCISCO ALBERGARIA

Product Owner

FRANCISCA SILVA

Project Manager



GABRIEL SANTOS

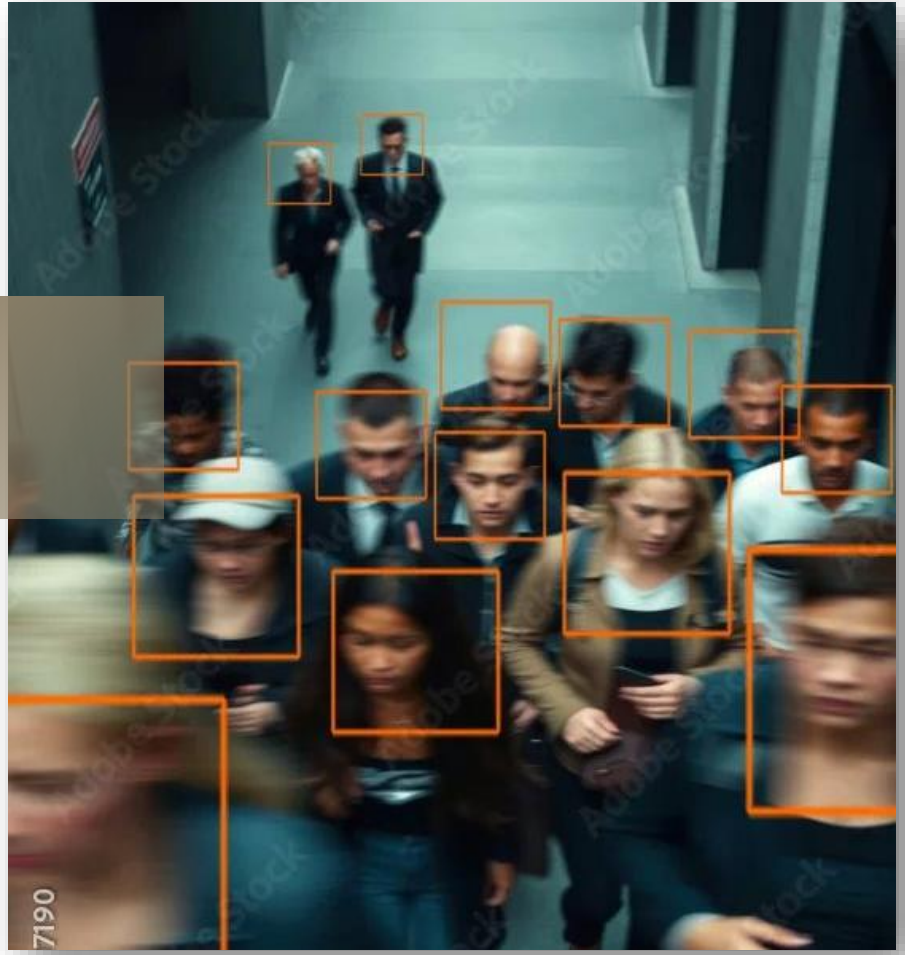
Quality Assurance
(Product Tester)

GUILHERME AMARAL

DBA

JOÃO GASPAR

Architect



ABOUT TRACKING

Software designed to assist police agents in investigations. Using AI, the system can analyze multiple cameras in real time, detecting individuals based on specific characteristics, such as carrying a weapon, and logging their movements. The goal is to significantly reduce the time required to locate suspects, enabling a faster and more effective response in critical situations.

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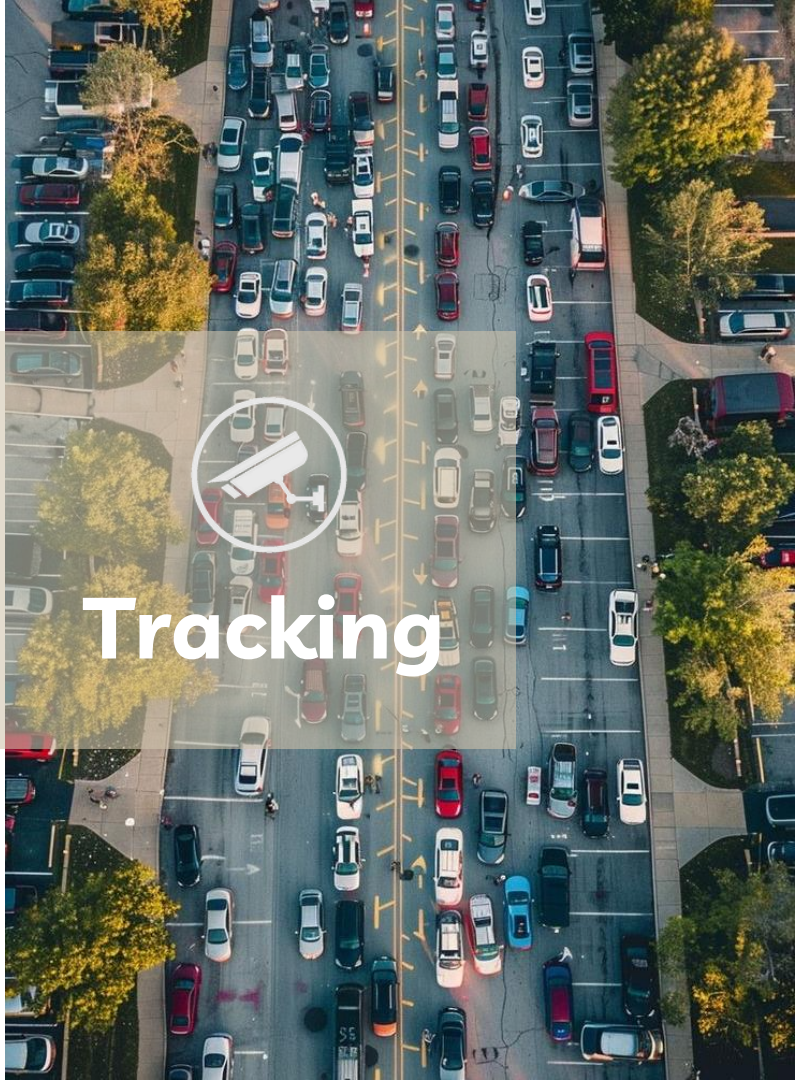
REQUIREMENTS GATHERING

01

REQUIREMENTS GATHERING

Discussing between the team and with help from our supervisors, the group managed to gather the necessary functionalities without whom our system would not work as expected.



FUNCTIONAL REQUIREMENTS

02

FUNCTIONAL REQUIREMENTS

LOGIN

The system should be able to authenticate users upon login

REGISTRATION

The system should allow an administrator to register new users

ADD/REMOVE CAMERA

The system should allow to register and unregister a camera

MARK SUSPECTS

The system should mark people using weapons as suspects as well as allow a user to choose a person in a video frame to mark as suspect

TRACK SUSPECTS

The system should be able to follow and keep track (logs) of suspects movement along several cameras

WEAPON DETECTION

The system should be able to automatically detect weapons in several video vigilance videos originated from cameras

FUNCTIONAL REQUIREMENTS

CAPTURE & SAVE

The system should capture and save any video vigilance where a suspect appears

ALERT

The system should give alert messages when it identifies a suspect

HIGHLIGHT

The system should highlight both identified suspects and weapons

MAP

The system should print the suspects movement onto a map after tracking it

UPLOAD AND DOWNLOAD VIDEO

The system should allow a user to upload a video from a certain timestamp to a camera as well as download all vídeo frames where a suspect appears

CONTEXT
STATE OF ART

03

PREVIOUS RESEARCH

This project draws inspiration from the master's thesis by **Pedro Monteiro**:

"***Real-Time Weapon Detection in Surveillance Video Footages***"
(Universidade de Aveiro, 2024).

His research developed SafeGuard, a system that detects weapons in real-time using YOLOv5.

HOW OUR PROJECT EXPANDS THIS WORK

Beyond Weapon Detection: Instead of only identifying weapons, our system tracks suspects across multiple cameras.

Improved Investigation Process: We **log suspect movements** and allow users to **mark and follow individuals** in video footage.

Enhanced Security and Control: The system includes user authentication and access control.

Our project builds upon existing research in computer vision and object detection. A key reference is **Pedro Monteiro's MSc thesis, *"Real-Time Weapon Detection in Surveillance Video Footages"***, where he successfully trained a YOLOv5-based model to detect weapons and knives with high accuracy.

YOU ONLY LOOK ONCE (YOLO)

Real Time Object Detection System

- Since YOLOv5 (used in Monteiro thesis), newer versions such as YOLOv8 and YOLO11 have introduced improvements, including instance segmentation, pose estimation, and object tracking.
- Such advancements allow us to not only detect weapons but also track and segment the individuals holding them.
- Although object tracking, like ByteTrack, still faces challenges when a subject leaves and re-enters the camera's field of view, fine-tuning model parameters could help mitigate this issue.

ACTORS

04

CHIEF OF POLICE DEPARTMENT

STUART LITTLE

Age: 53
Gender: Male

Background: Works at a PSP station based in Coimbra, where is responsible for supervising, coordinating and leading police teams for whose results he is responsible.

Problem: Stuart's department is overwhelmed with investigations that require extensive surveillance footage review. This extremely time-consuming process leads to delays in solving cases.

Needs: A software that helps to keep track of suspects and their movements more efficiently, as well as to control software access.

POLICE AGENT

LARA CROFT

Age: 35
Gender: Female

Background: Works at a PSP station in Coimbra. She is married and has two children with whom she cherishes spending quality time.

Problem: Working in investigations, Lara has to check surveillance cameras videos to track criminals and their movements. Due to the high number of city cameras and possible escape routes, this ends up being very time-consuming and Lara ends up doing extra hours, missing her so-regarded family time.

Needs: A tool that automates the suspect-tracking process, allowing her to follow a suspect's movement with the click of a button, making her job easier and faster.

USE CASES

05

USE CASES

REGISTER AND UNREGISTER USER

Priority: 4

Difficulty: 2

Priority: 3

Difficulty: 2

DETECTION OF WEAPONS & SUSPECTS IN LIVE CAMERAS

Priority: 5

Difficulty: 5

5 - High

1 - Low

UPLOADING VIDEO

Priority: 5

Difficulty: 3

REGISTER AND UNREGISTER CAMERA

Priority: 4

Difficulty: 3

USE CASES

VIDEO SUSPECT SELECTION FOR TRACKING

Priority: 5

Difficulty: 5

DETECTION OF WEAPONS & SUSPECTS UPLOADED VIDEOS

Priority: 4

Difficulty: 4

DOWNLOAD VIDEO CLIPS

Priority: 3

Difficulty: 3

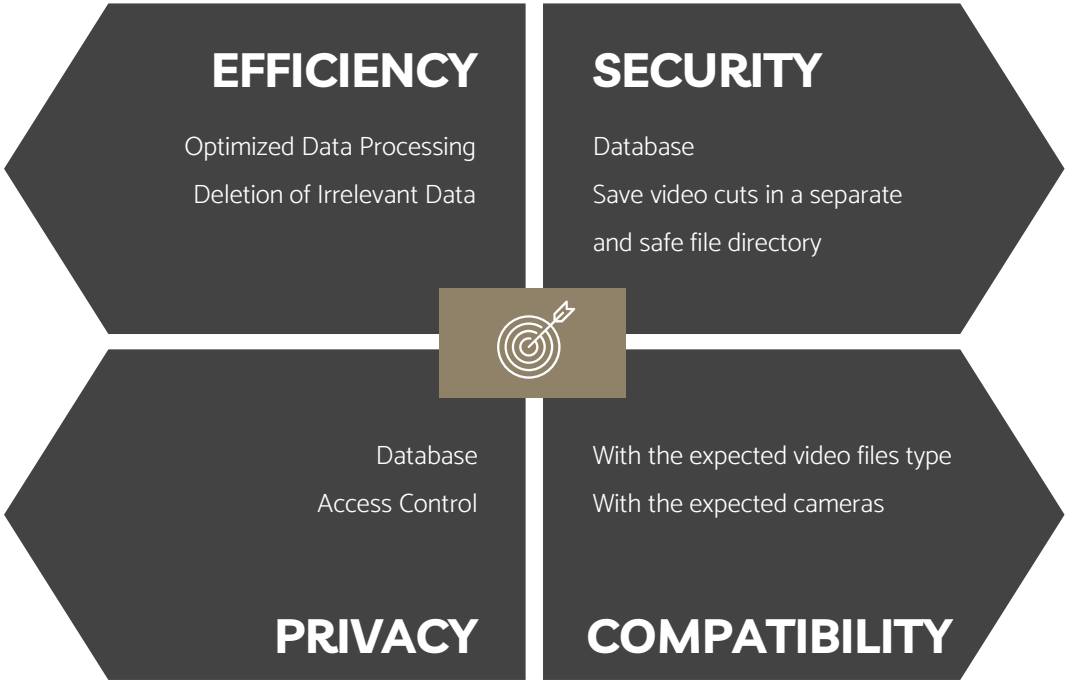
RETRIEVING TRACKING LOGS FOR A SPECIFIC SUSPECTS

Priority: 4

Difficulty: 3

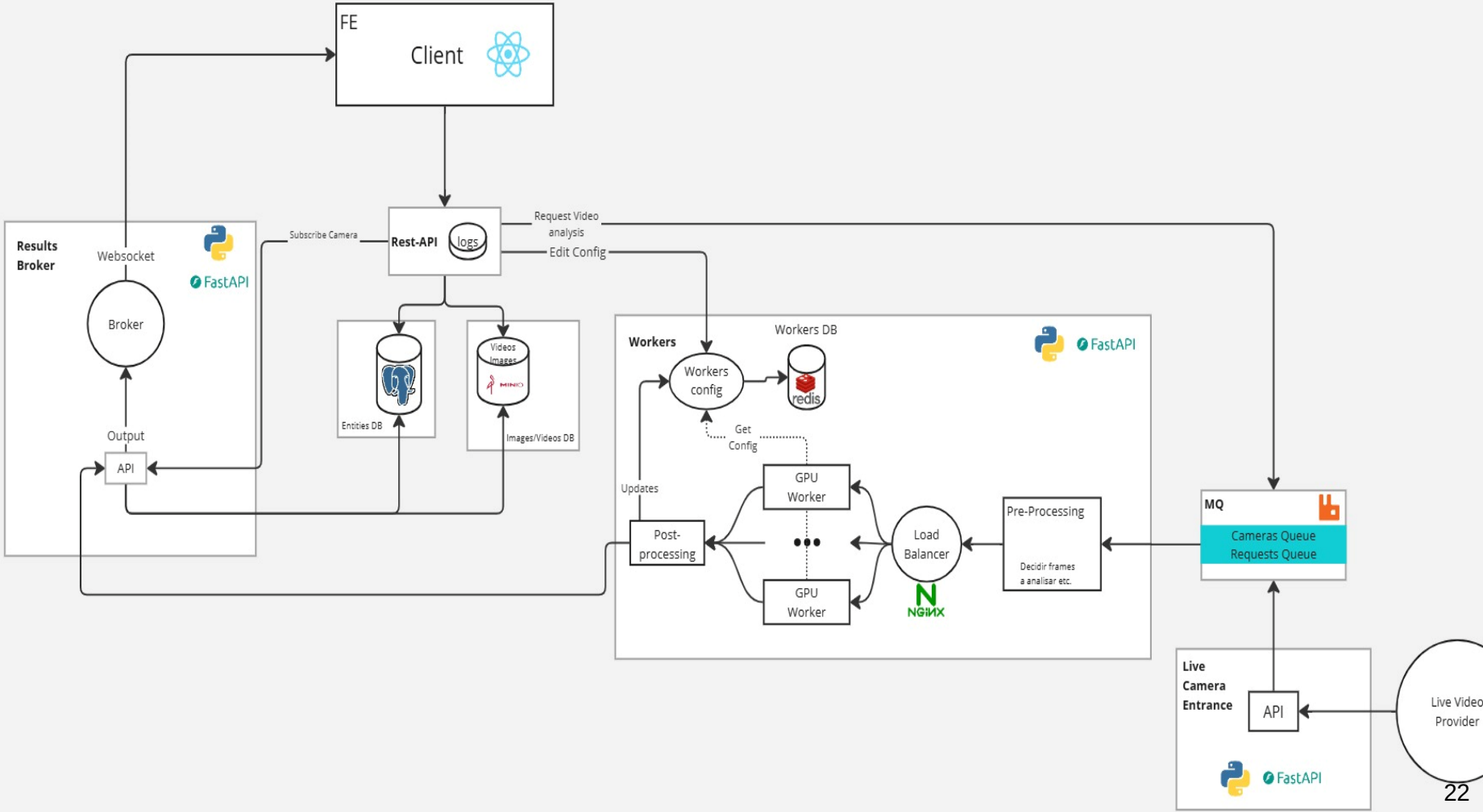
NON-FUNCTIONAL REQUIREMENTS

NON-FUNCTIONAL REQUIREMENTS



SYSTEM ARCHITECTURE

07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Websocket
FastAPI
Broker
Output
API
Subscribe Camera
Rest-API
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Request Video analysis
Edit Config
Entities DB
Videos Images
Images/Videos DB
Workers
Workers DB
Workers config
redis
Get Config
Updates
GPU Worker
Post-processing
Load Balancer
NGINX
Pre-Processing
Decidir frames a analisar etc.
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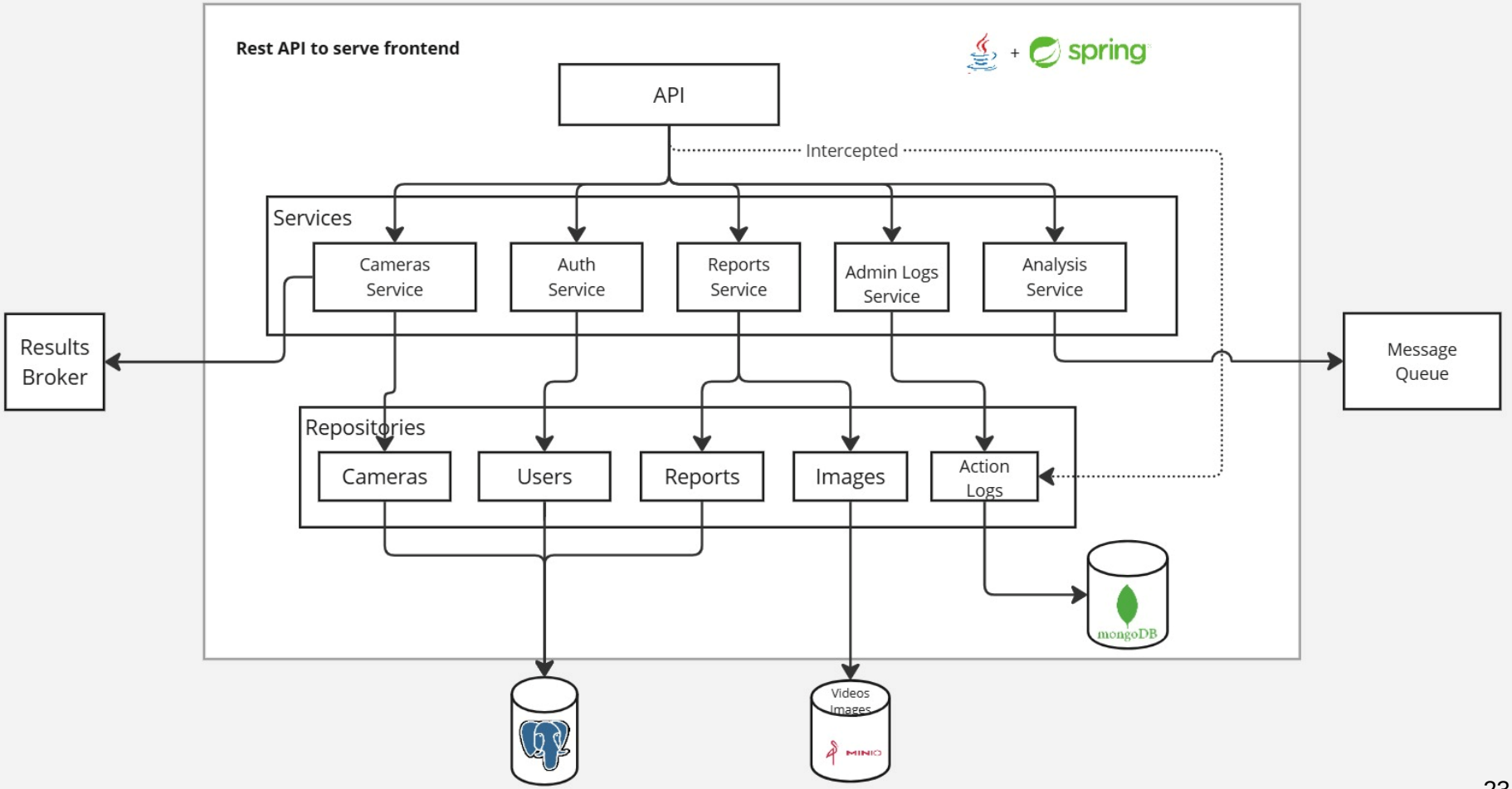
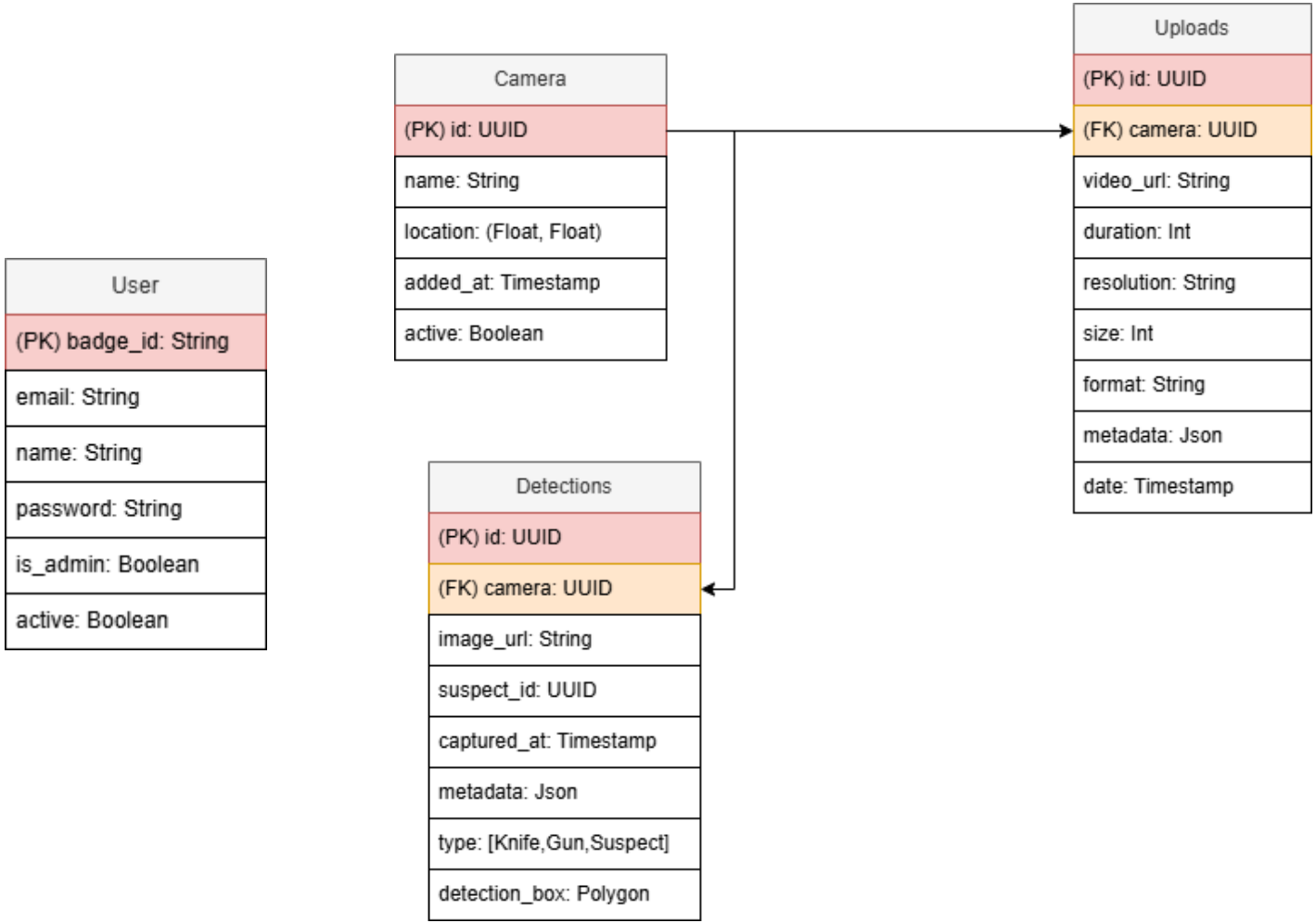
Requests Queue
Live Camera Entrance
API
FastAPI
Live Video Provider


Rest API to serve frontend
API
Intercepted
Services
Cameras Service
Auth Service
Reports Service
Admin Logs Service
Analysis Service
Results Broker
Message Queue
Repositories
Cameras
Users
Reports
Images
Action Logs
mongoDB
Videos
Images
MINIO

Databases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email: String
name: String
password: String
is_admin: Boolean
active: Boolean
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name: String
location: (Float, Float)
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active: Boolean
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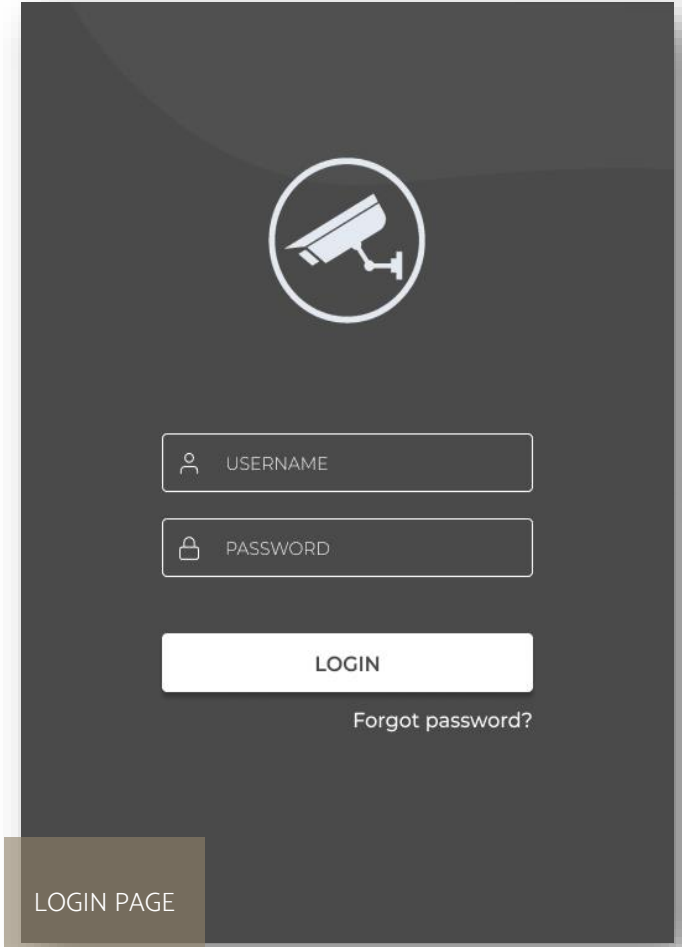
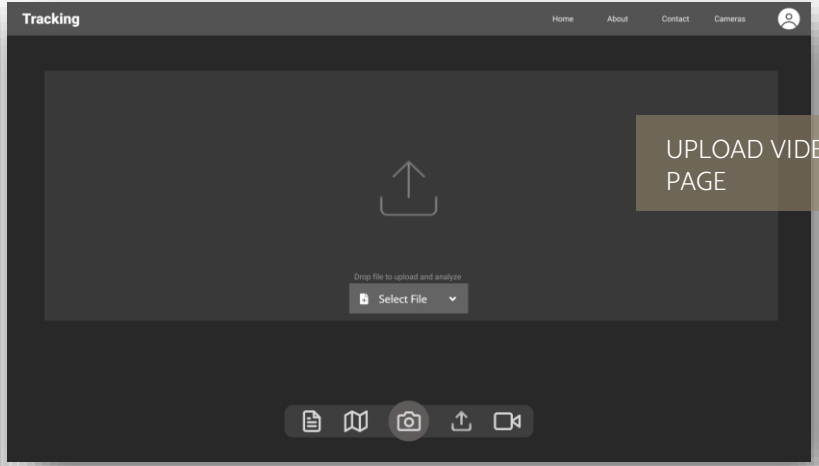
format: String
metadata: Json
date: Timestamp

MOCK-UP

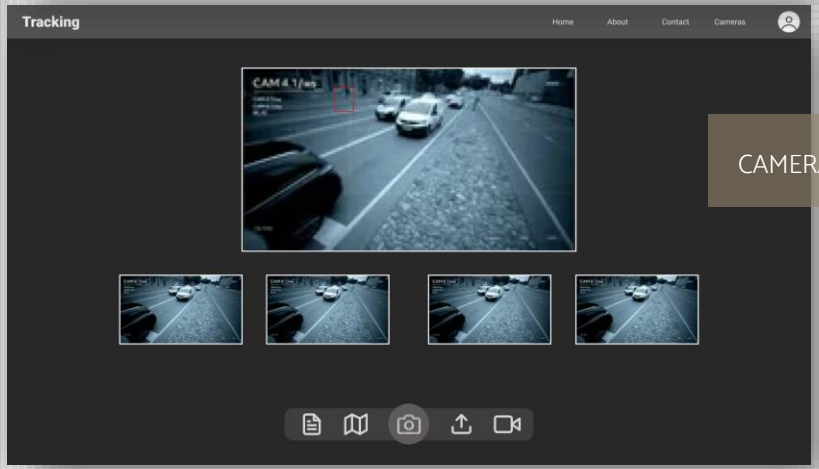
MOCK-UP



LOGIN PAGE



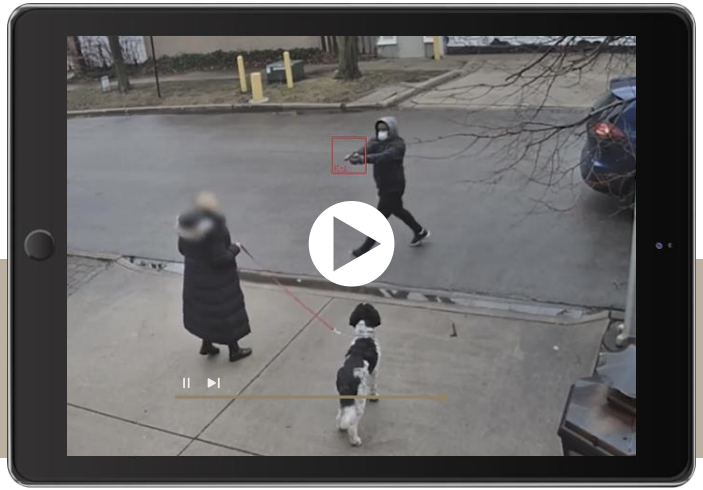
UPLOAD VIDEO PAGE



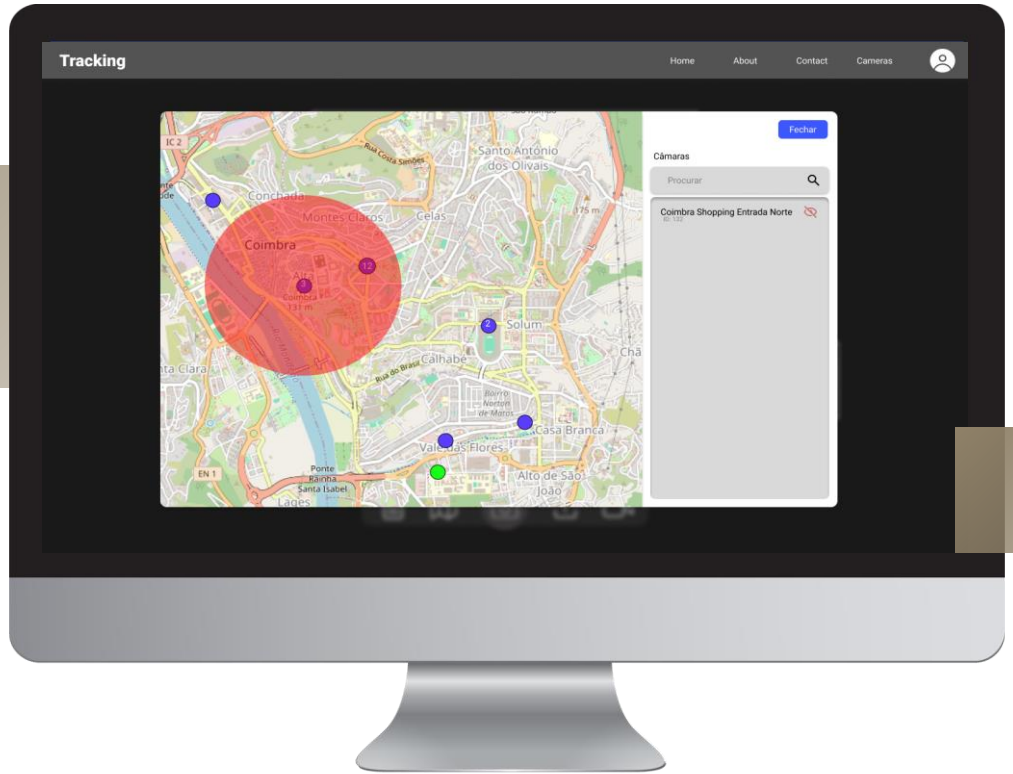
CAMERAS PAGE

MOCK UP

ANALYSING
UPLDOADED VIDEOS
PAGE



MOCK UP


Tracking
Home
About
Contact
Cameras
Fechar
Câmaras
Procurar
Coimbra Shopping Entrada Norte
Coimbra
Montes Claros
Santo António dos Olivais
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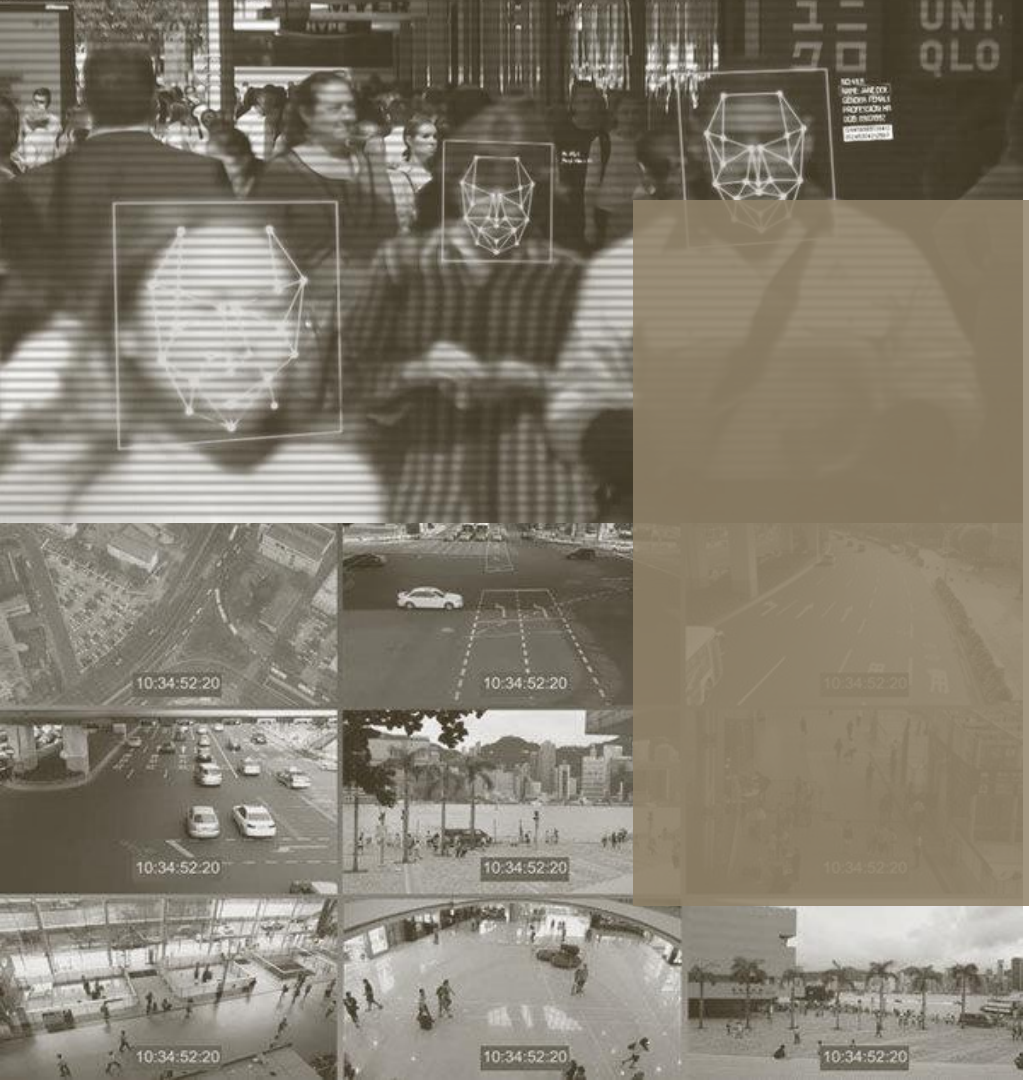

THANK YOU!

Does anyone have any questions?