Proposing

Alertawy

AI-Powered
Driver Monitoring System

ALERTAWY
YOUR ACTUAL SAVIOR

Graduation Project Dissertation

Outline

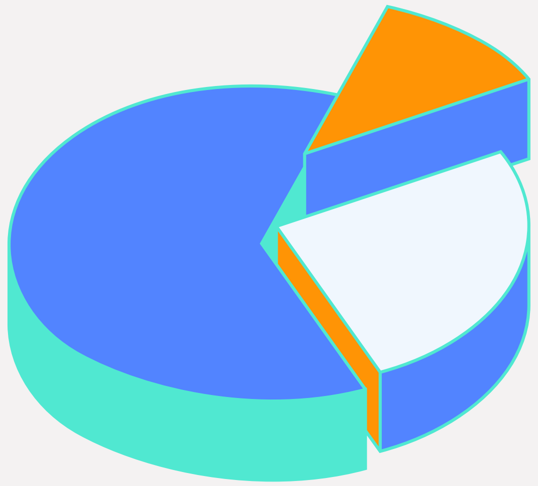
01 - Motivation

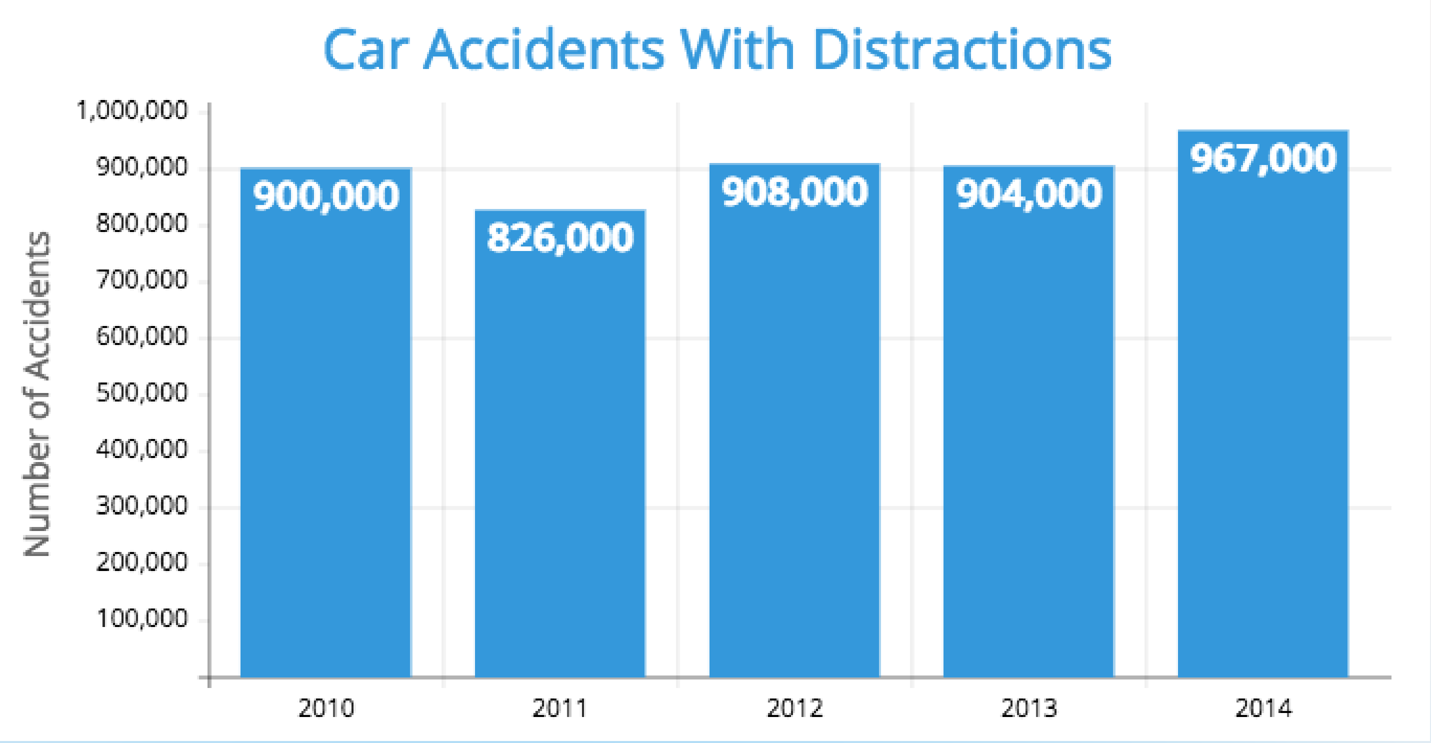
How many lives are lost each year as a result of road accidents stemming from distracted and drowsy driving, as well as non-compliance with the speed limits enforced by radar cameras?

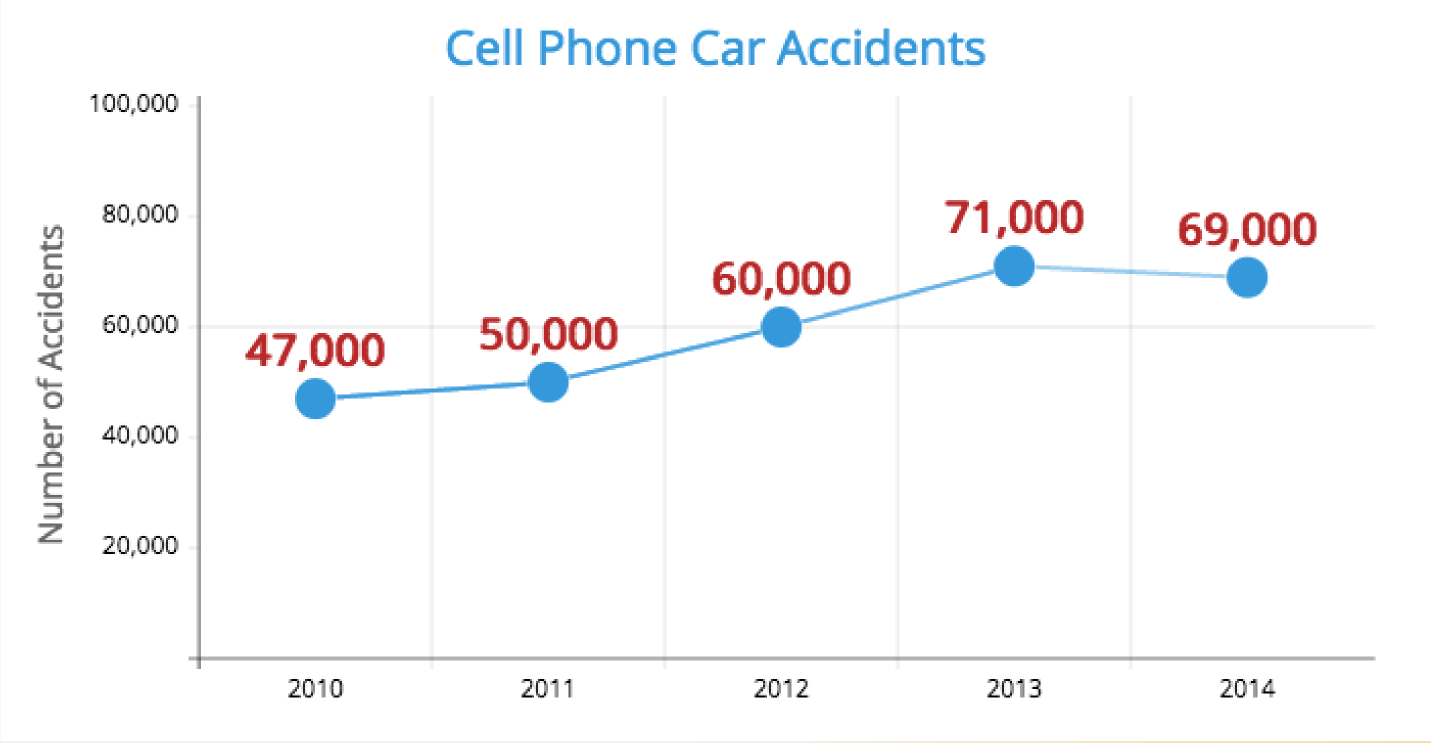
01 - Motivation

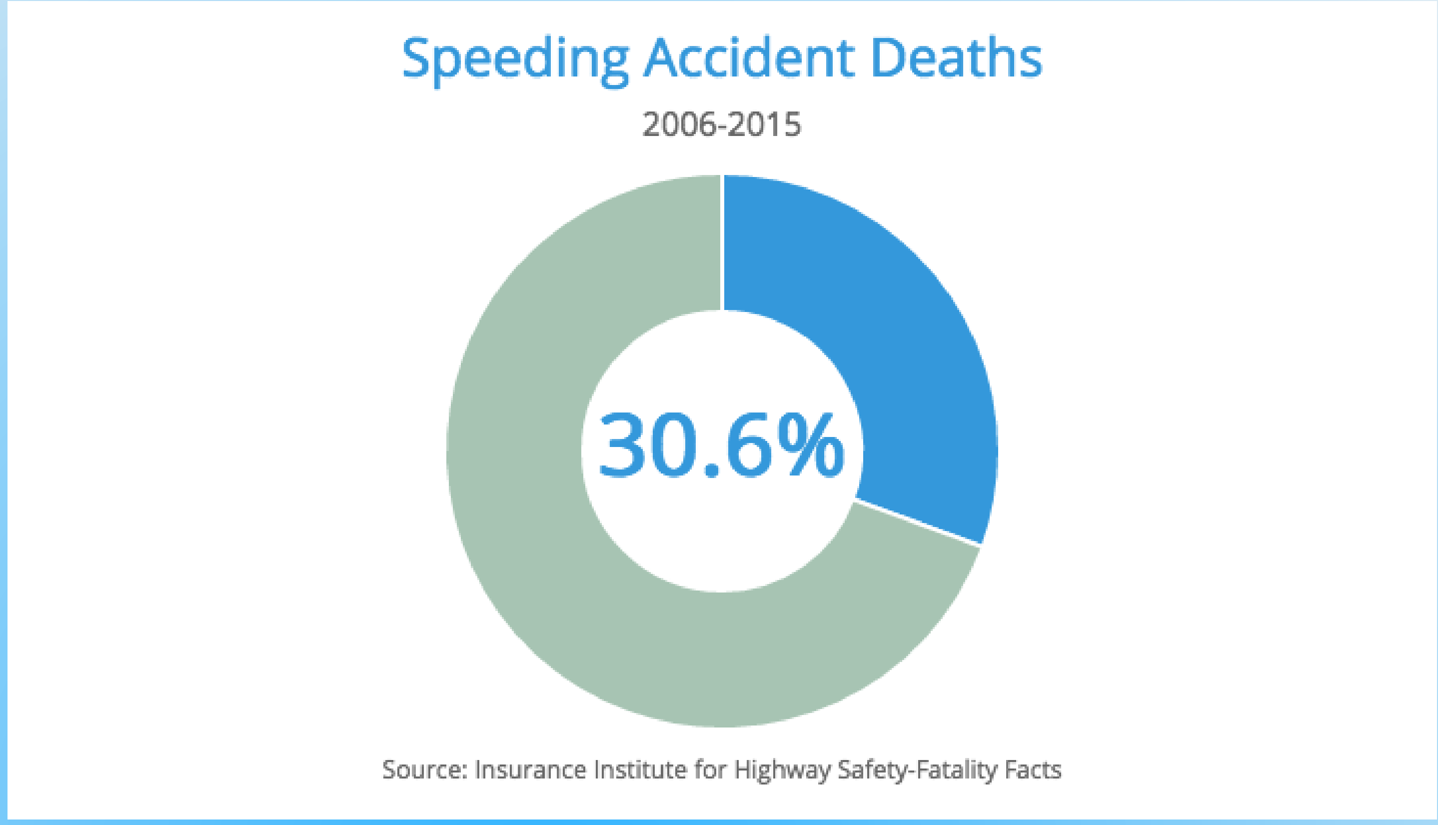
Actually, the numbers are large, Recent statistics show that distractions, drowsiness, cell phone use, and speeding are among the top seven causes of car accidents due to their significant impact.

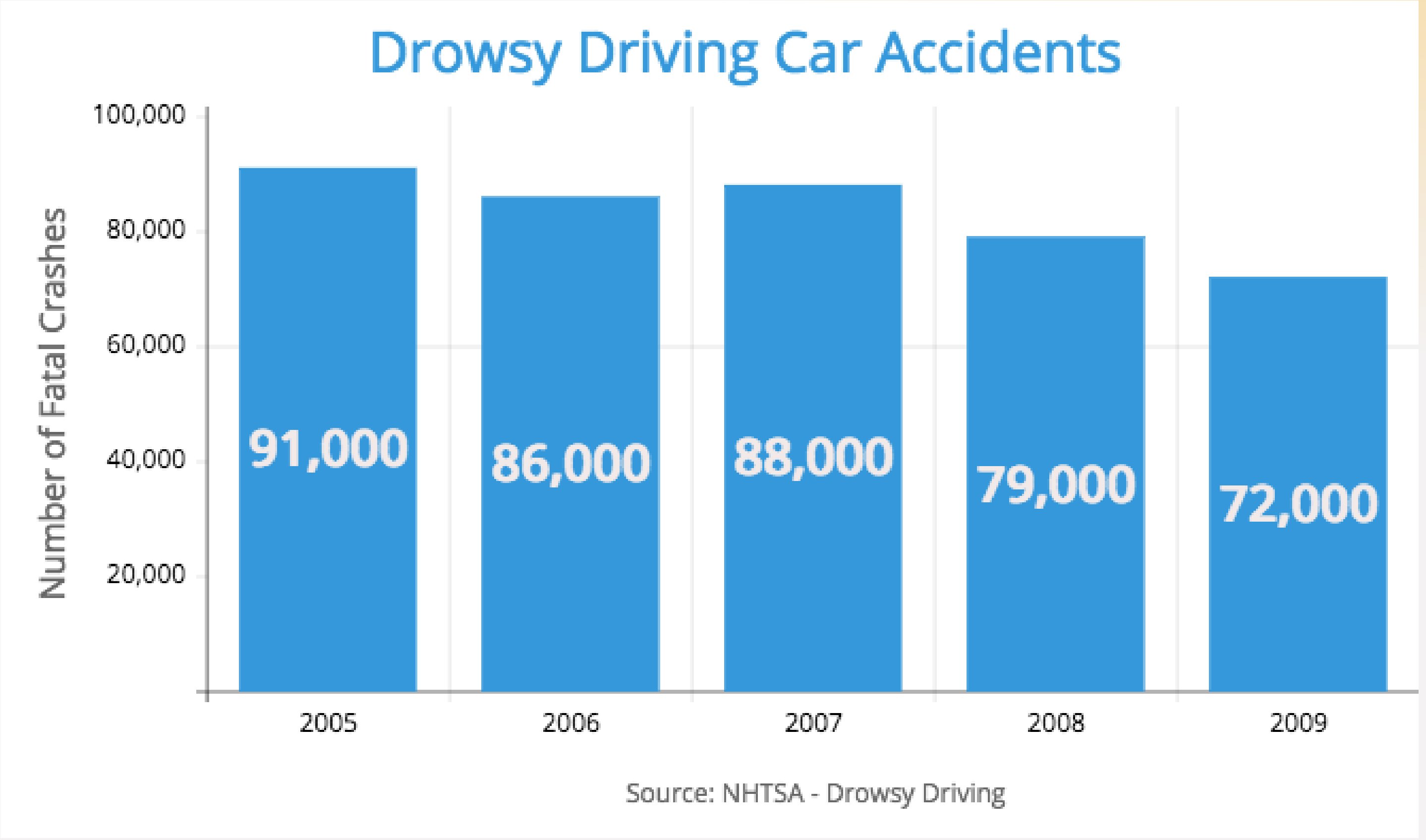
01 - Motivation







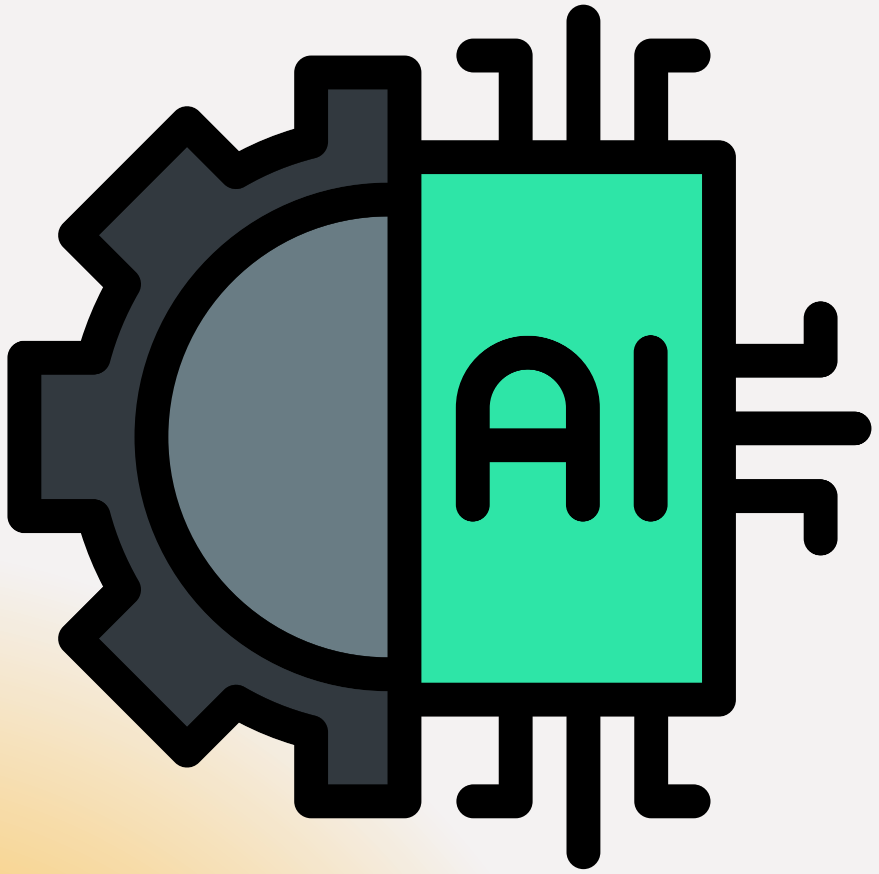


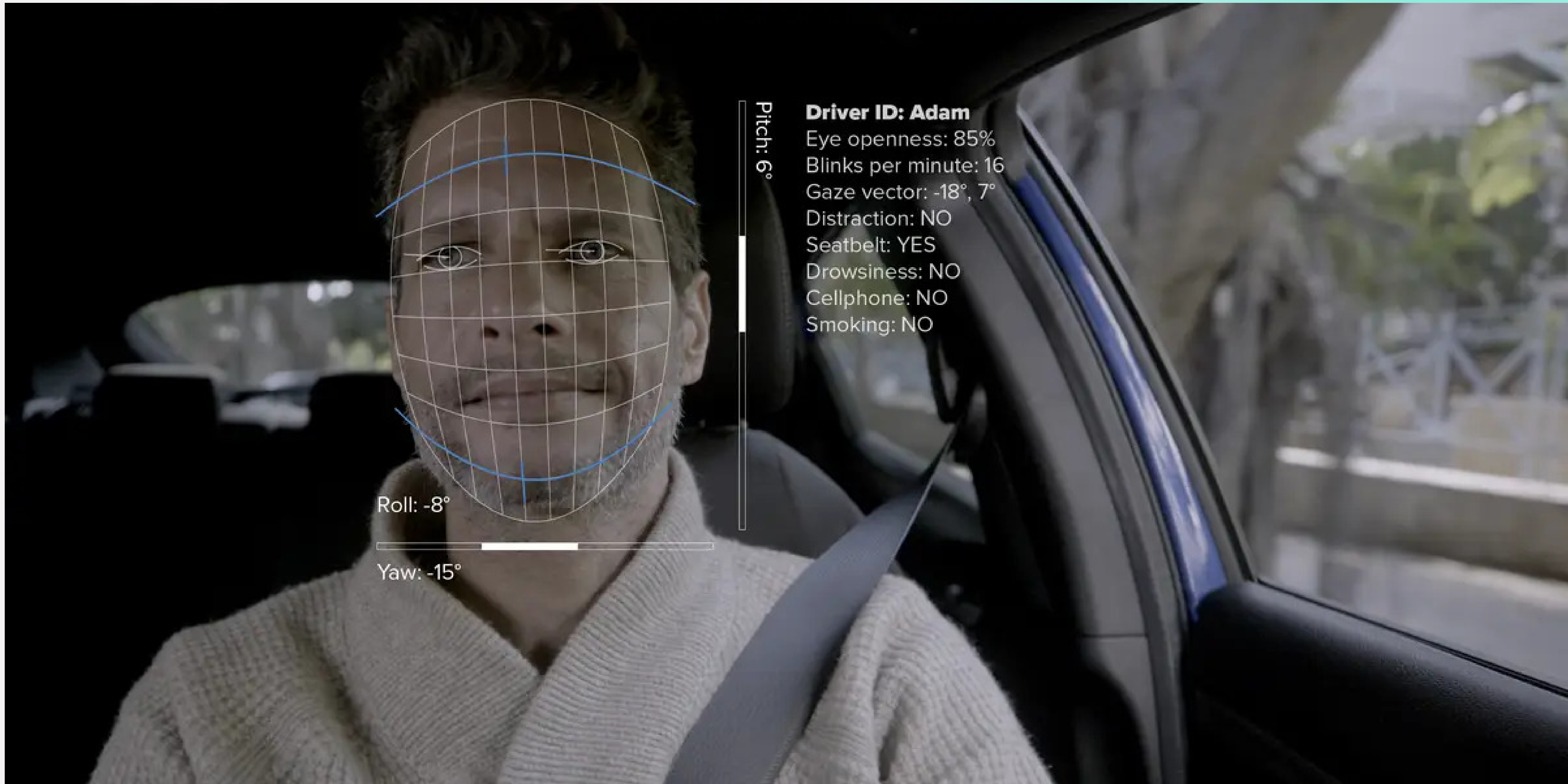


02 Objectives

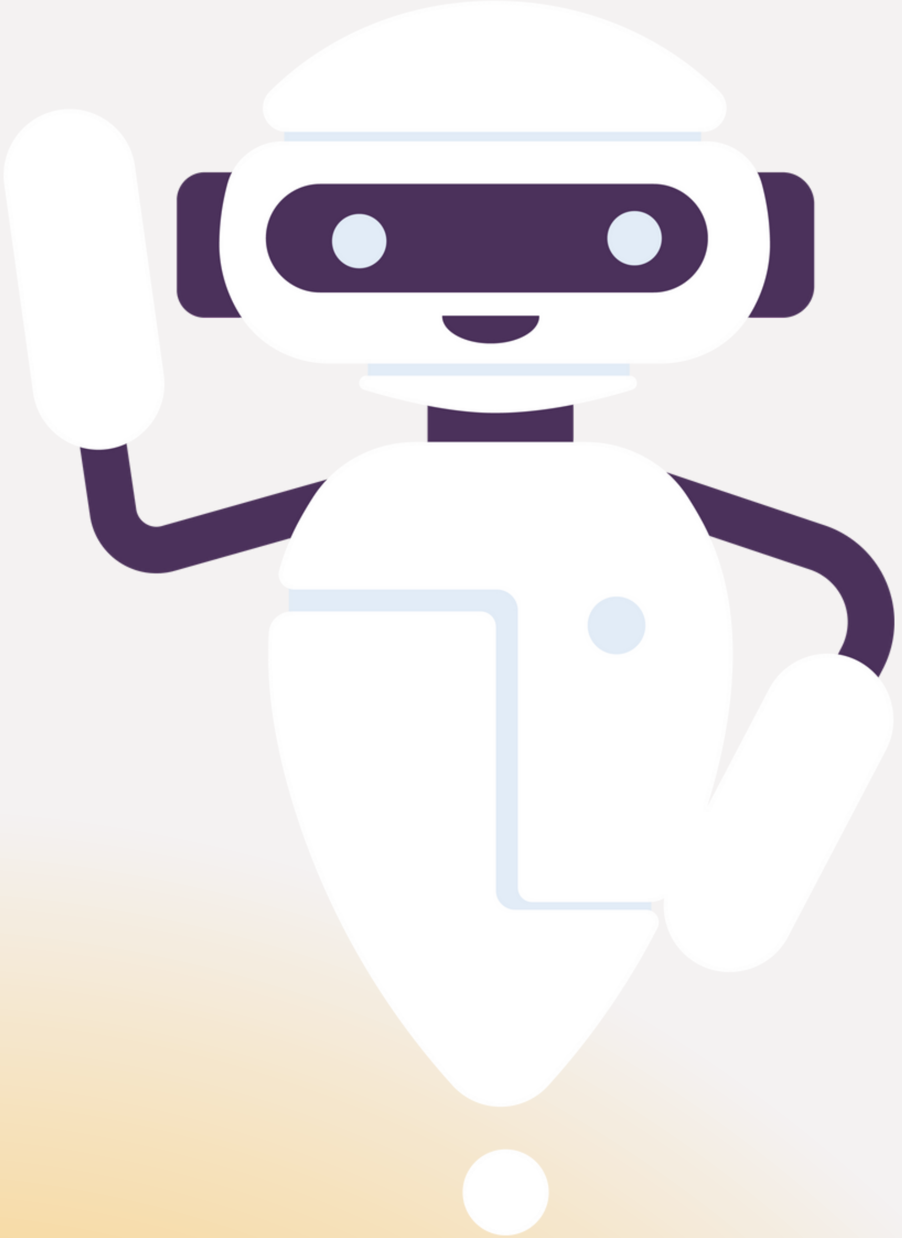
Enhancing Driver Safety through AI-Powered Monitoring System for All Users.

- The scope of our project is to address the critical issue of accidents caused by driver distractions, drowsiness, and lack of attention to the road.





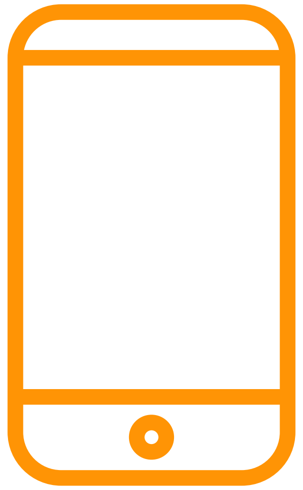
02 Objectives



- Our aim is to develop and present a solid **proof of concept** illustrating how AI-powered driver monitoring effectively reduces the risks of drowsy or distracted driving.

Alertawy Integrated System

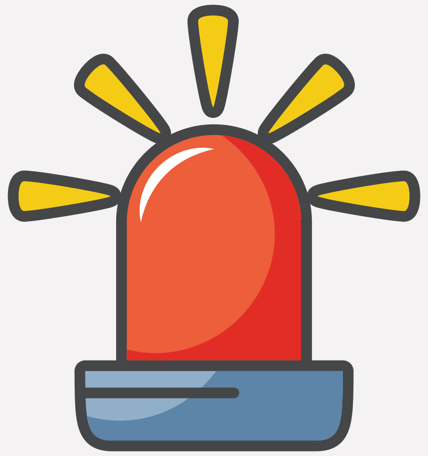
Mobile application for drivers



Web application for administration

02 Objectives

Key features of our Driver Monitoring System, "Alertawy"



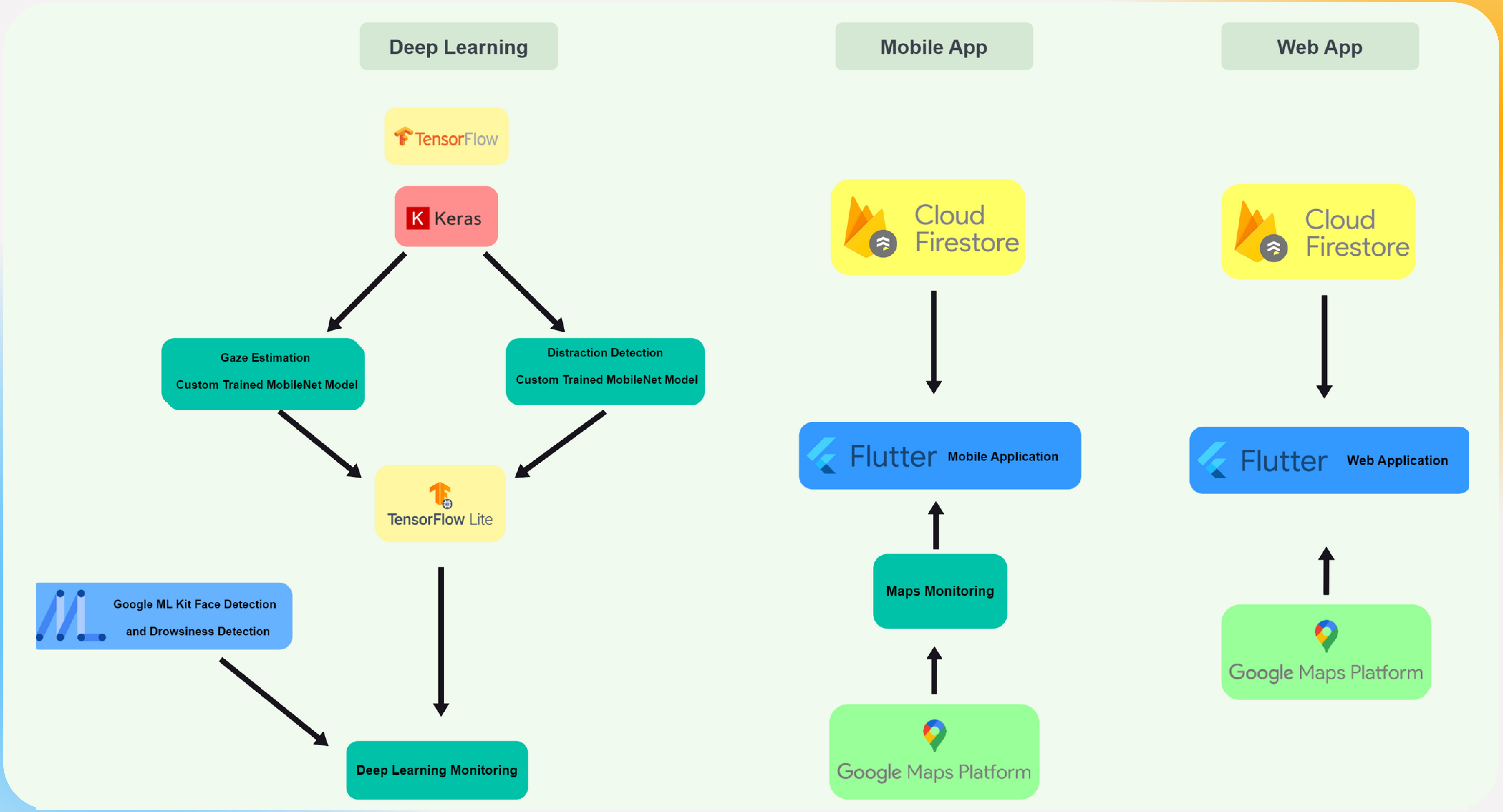
Real-Time Alerts: Utilizes **advanced Deep Learning Computer Vision Techniques** to detect and alert drivers of risky behaviors like phone use, drowsiness, and distractions.

Radar Avoidance Assistance: Helps drivers avoid radar detection by providing alerts for **unsafe driving practices and speeding**.

The web application: is an admin platform that provides a broader view **of driver rides and reports**. It facilitates evaluation, analysis, and proactive measures to enhance driver safety.

03 - Methodology

DMS Overview



03 - DL Methodology

Combined Distraction Dataset

Distraction Detection

- **Combined** three different datasets:
  - State Farm Distraction Kaggle competition Dataset
  - AUC Distracted Driver Dataset
  - Rabat University Distracted Driver Dataset

- **Total** of 80,000 images

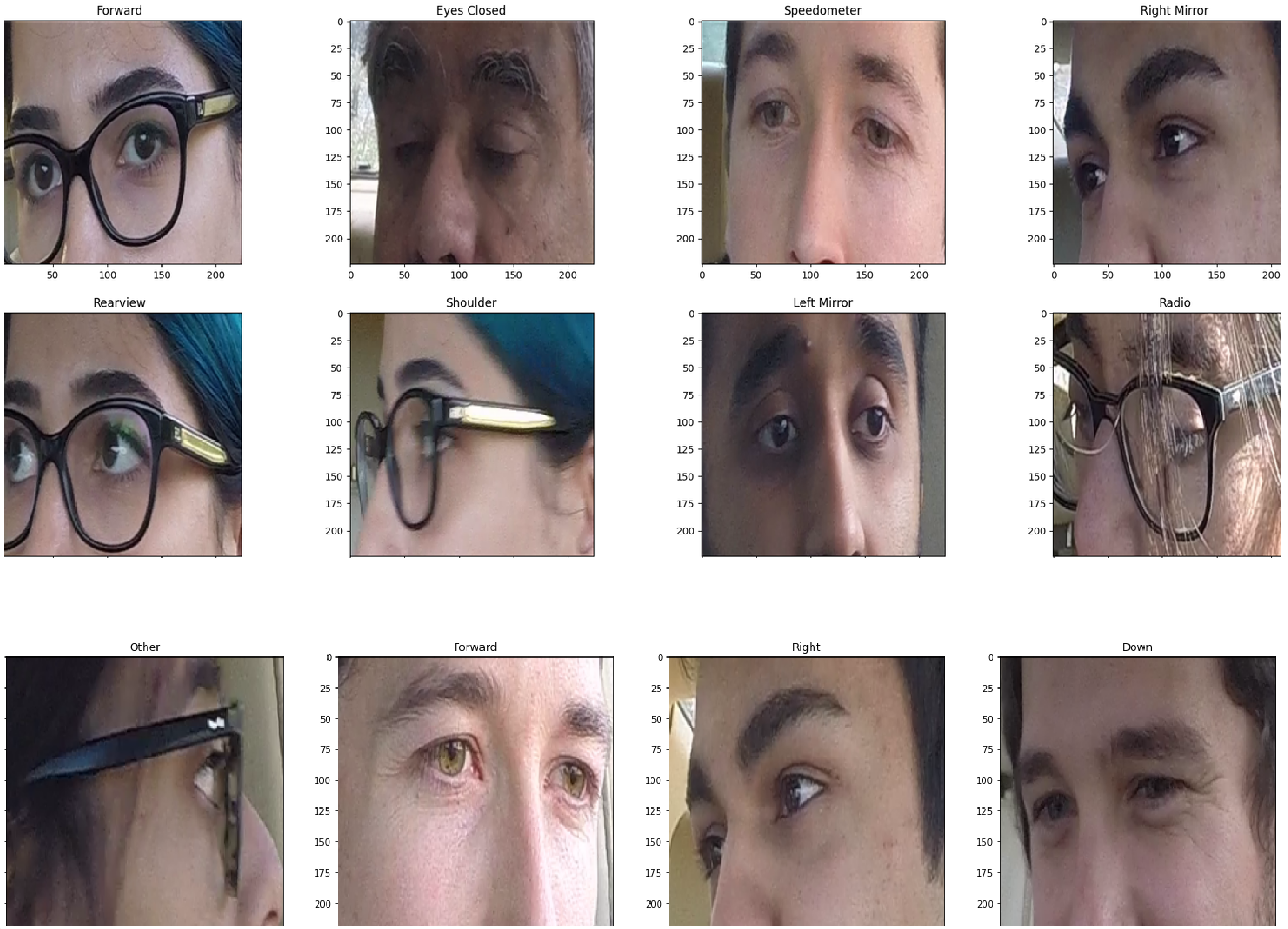
- **Utilized** 40,000 images after removing unwanted classes.

03 - DL Methodology

Gaze Estimation LISA Dataset

Gaze Estimation

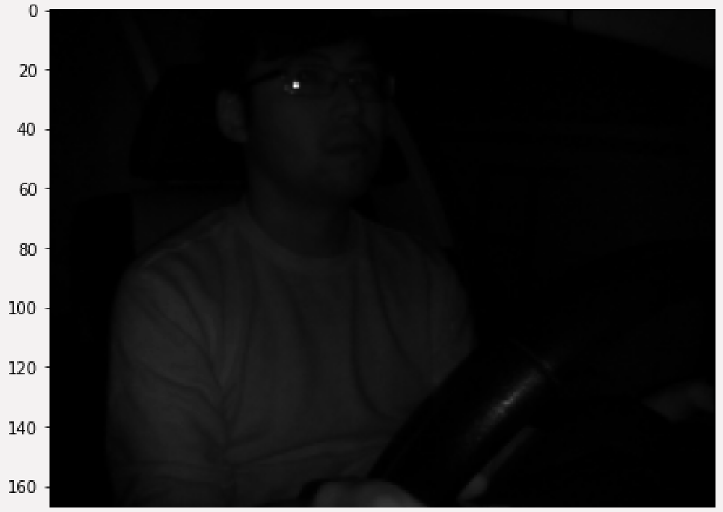
- **Total** of 30,000 images
- Consist of 8 **Classes** called driver gaze zones.
- We **Combined** Some of the Classes to Focus only on the **driver-eye direction**.

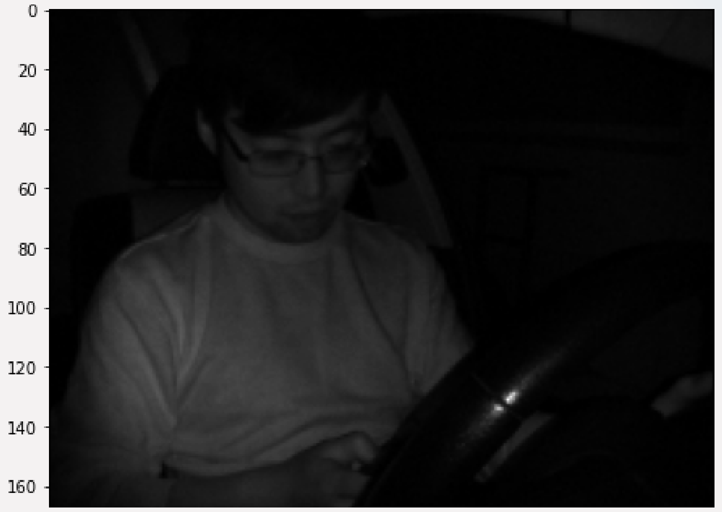


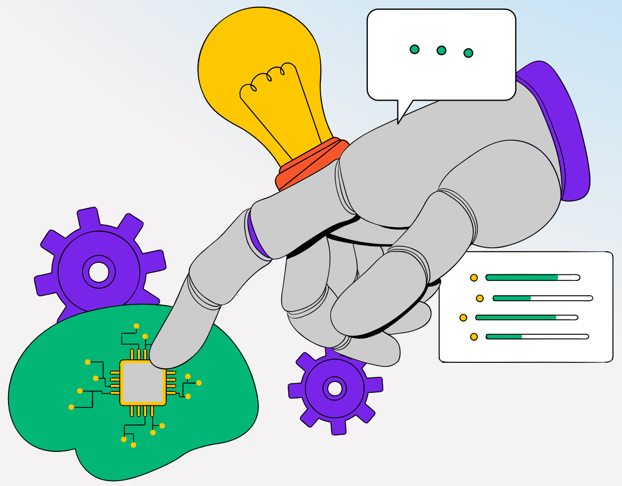
03 - DL Constraints

Limited Distraction Datasets: Overcoming the challenge of limited datasets containing the required shooting angles was crucial in training the distraction model, calling for innovative approaches to address this gap effectively.

Despite utilizing the DAD dataset: specifically captured from the desired camera angle, the model's performance was hindered due to the dimmed infra-red images, resulting in a limited accuracy of only 70%.







We attempted to develop a custom-trained **object detection** model for **Drowsiness Detection**, but encountered **challenges** regarding **deployment** and experienced **suboptimal performance** on **mobile** phones, necessitating further optimization efforts.

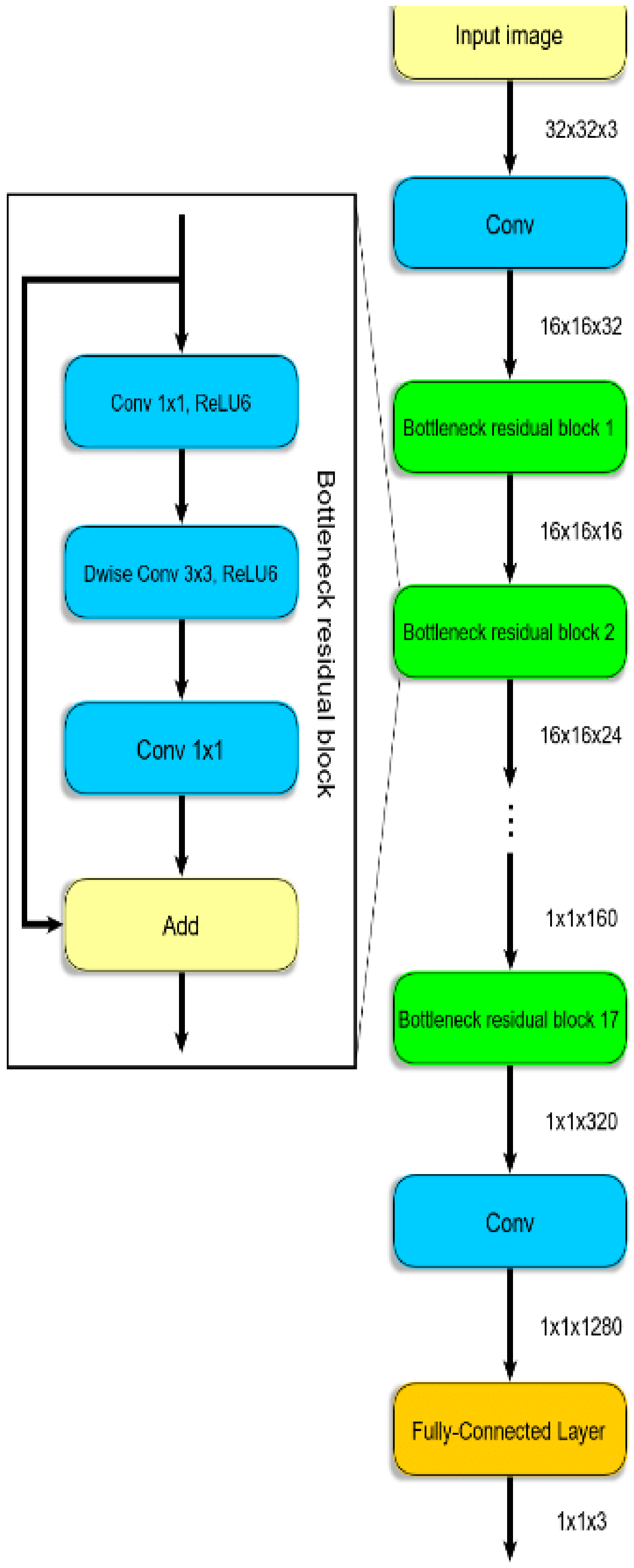
Exploring **fatigue detection** involved working with **video datasets**, which posed **challenges** for **mobile deployment**, emphasizing the need for tailored solutions to adapt and optimize such models for **real-time inference** on **mobile devices**.

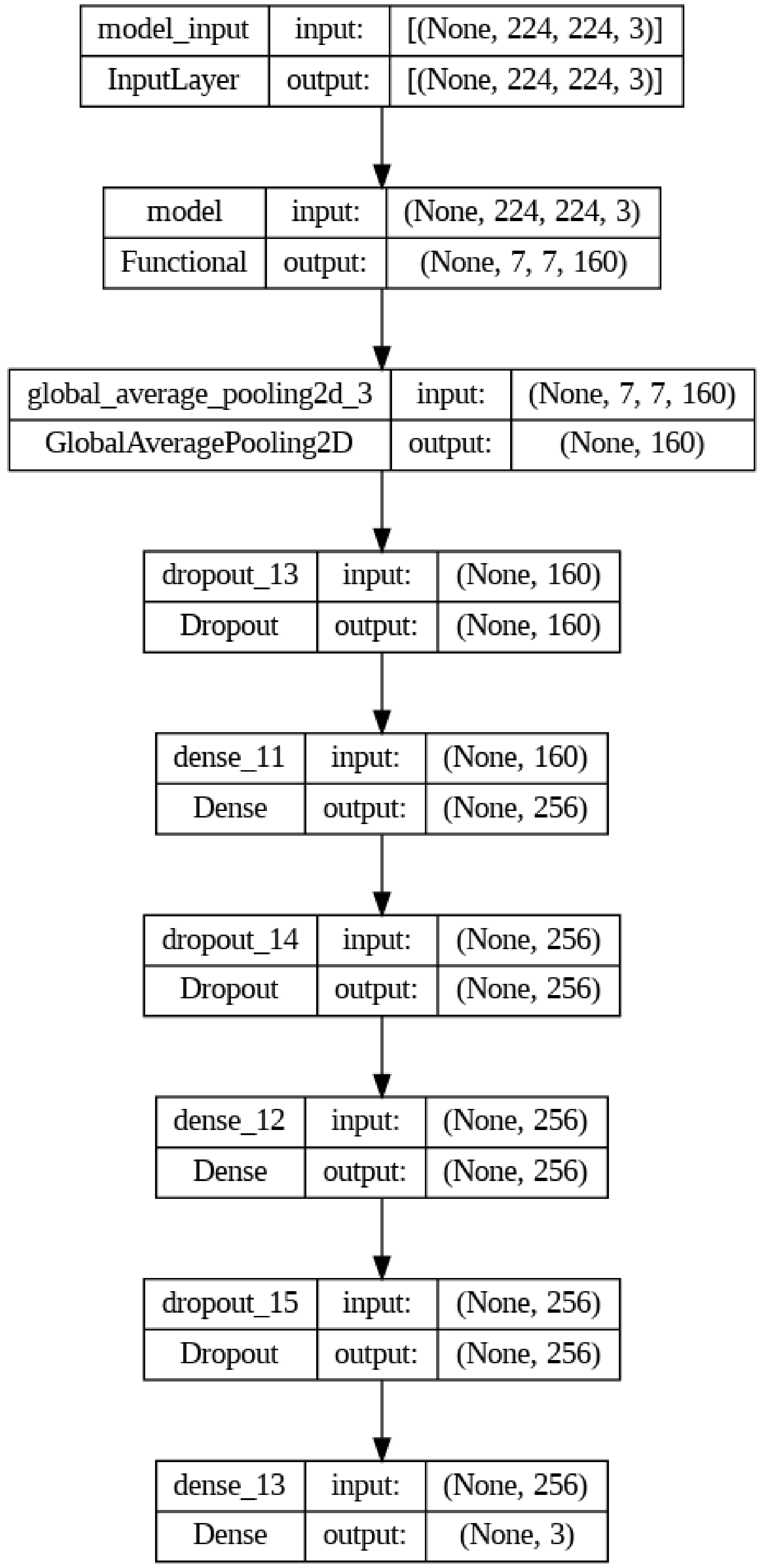
03 - Methodology

Model Architecture

MobileNet

- **Lightweight Design**: designed to be compact and efficient, making it suitable for resource-constrained environments like mobile devices. Using depthwise separable convolutions reduces the number of parameters and computations required, resulting in a smaller model size.
- **Fast Inference:** optimized for speedy inference, allowing it to process data quickly. Its streamlined architecture and reduced computational complexity enable real-time or near-real-time predictions, making it ideal for applications with low-latency requirements.
- **Mobile-Friendly:** tailored to the constraints of mobile devices, striking a balance between model size, accuracy, and inference speed.





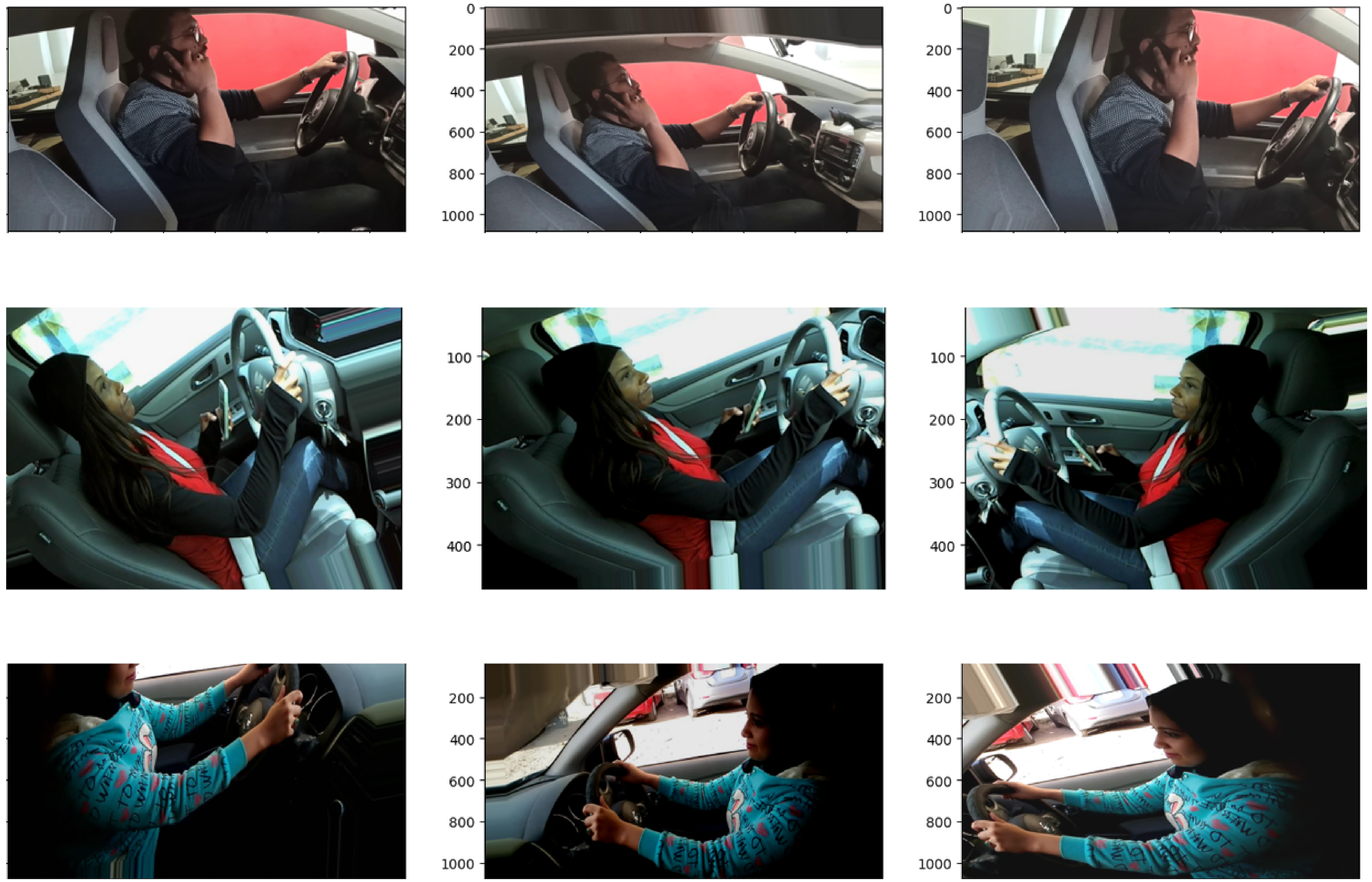
03 - DL Methodology

Deep Learning Training

- **Data splitting** was performed based on different drivers to prevent data leakage and ensure independence between the training and testing sets.

- **Data augmentation** techniques were applied to match desired camera angle and improve model generalization.

- **Balancing Classes**, certain classes were removed or combined to achieve a balanced representation of the different distraction categories



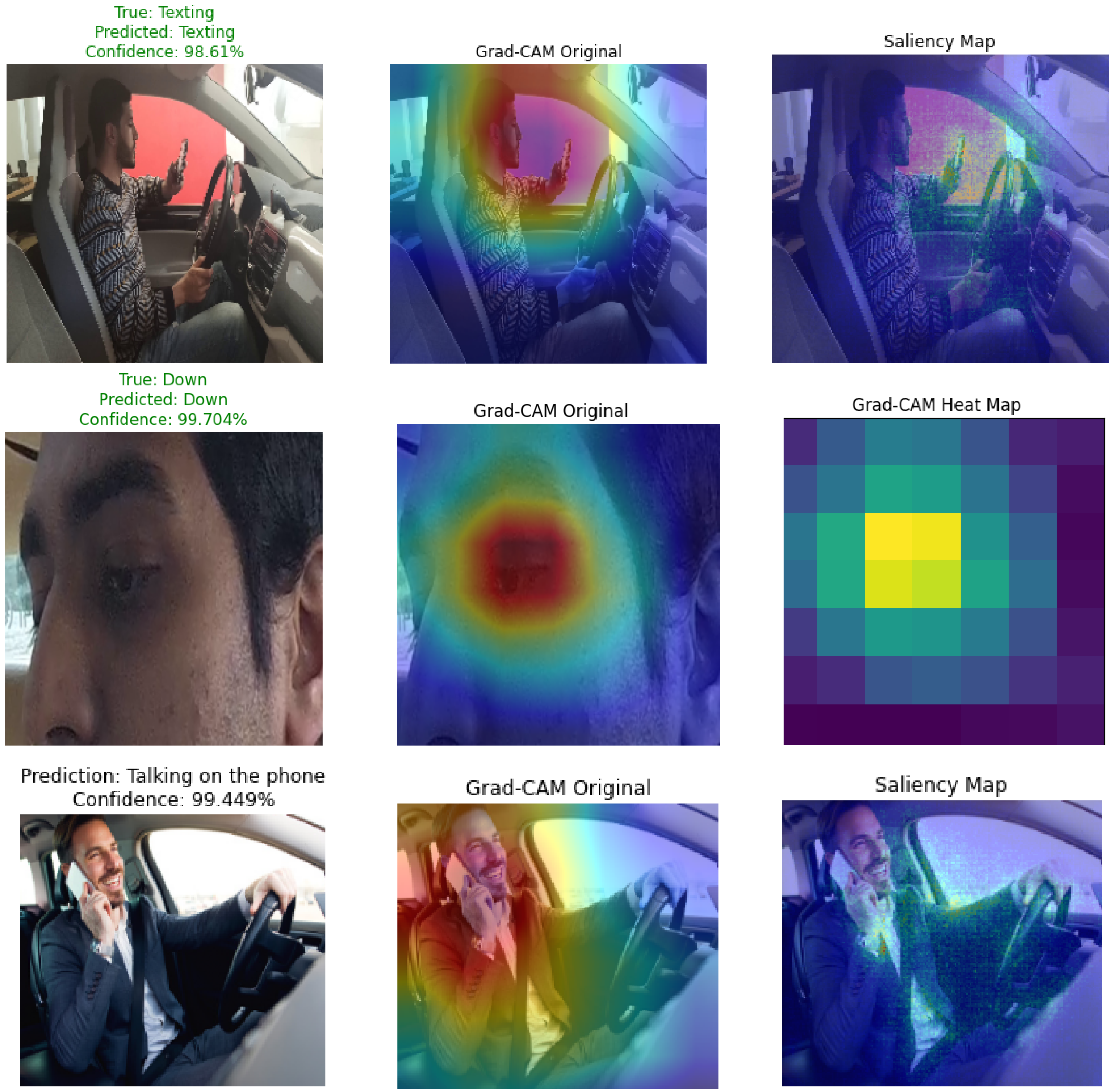
03 - DL Methodology

Deep Learning Results

- Both DL models achieved a high accuracy of approximately **98% on the validation set** and **97% on the testing set**, showcasing their outstanding performance.

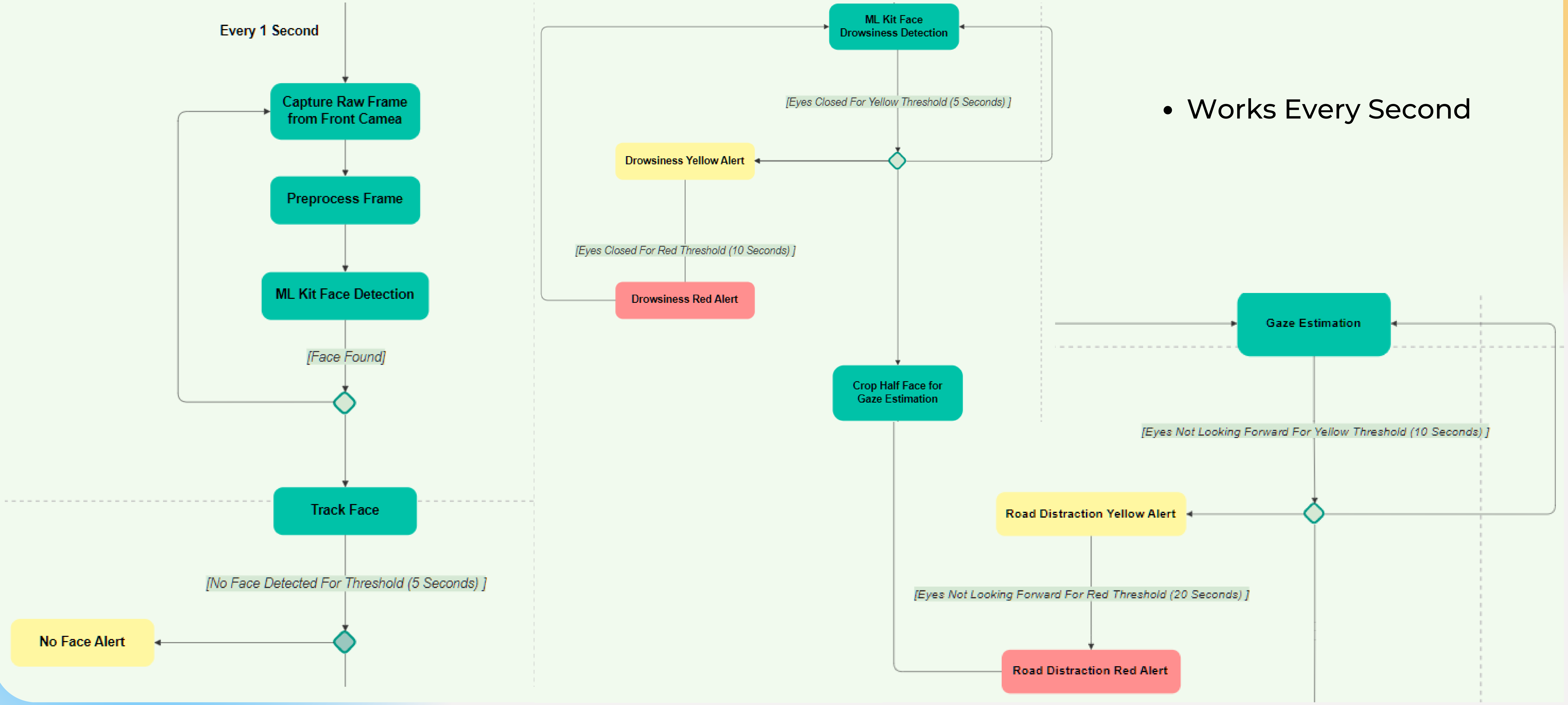
- In order to gain deeper insights into the models' inner workings, we explored their **black-box** nature by **interpreting** model **errors**, identifying confusing classes, and utilizing techniques like GRAD-CAM and Saliency Map to **explain predictions**, revealing the decision-making process and providing valuable insights into the models' inference mechanisms.

- To ensure the model's robustness and applicability in real-world scenarios, we incorporated **new images representative of the deployment environment**, allowing us to **evaluate** the model's **performance under realistic conditions** and validate its effectiveness in practical use cases.



03 - Methodology

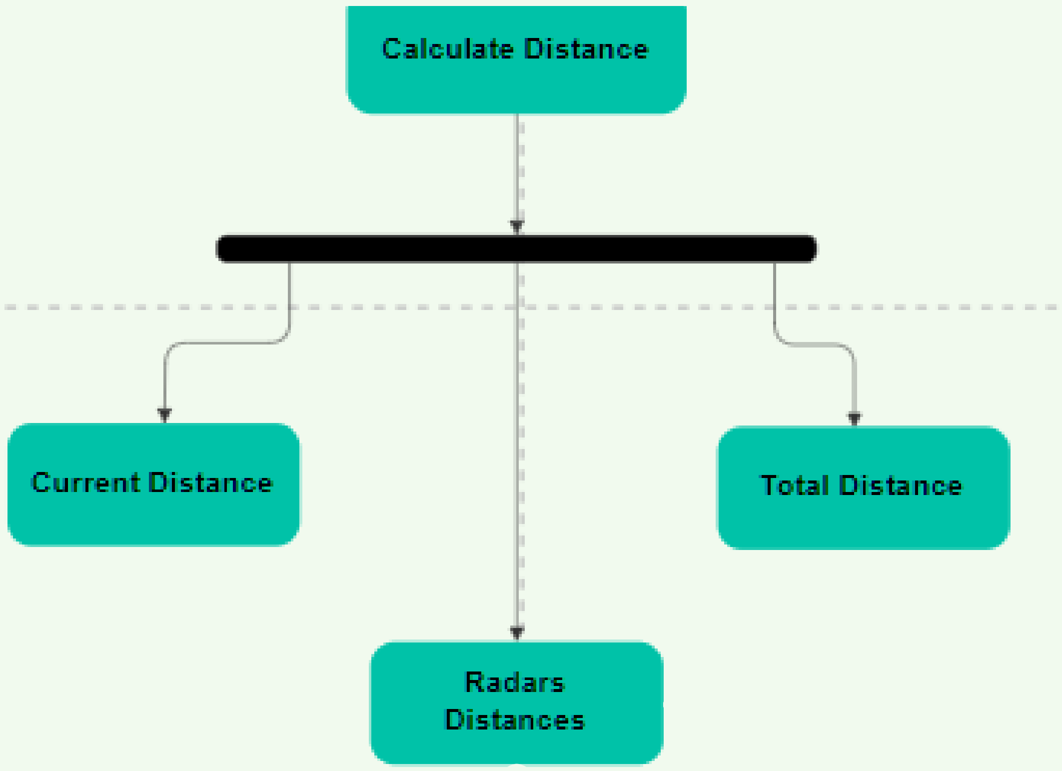
Deep Learning Monitoring



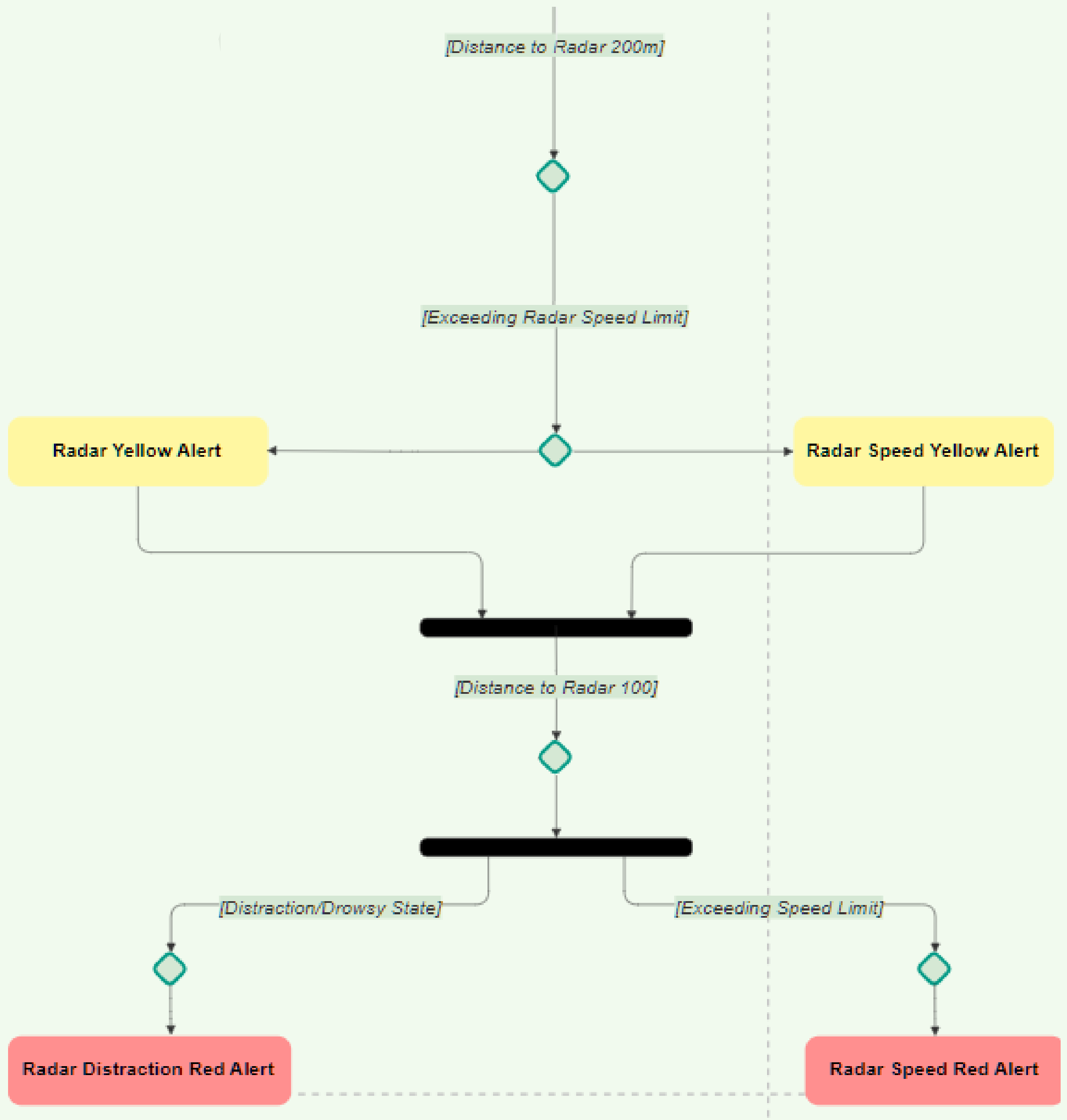
- Works Every Second

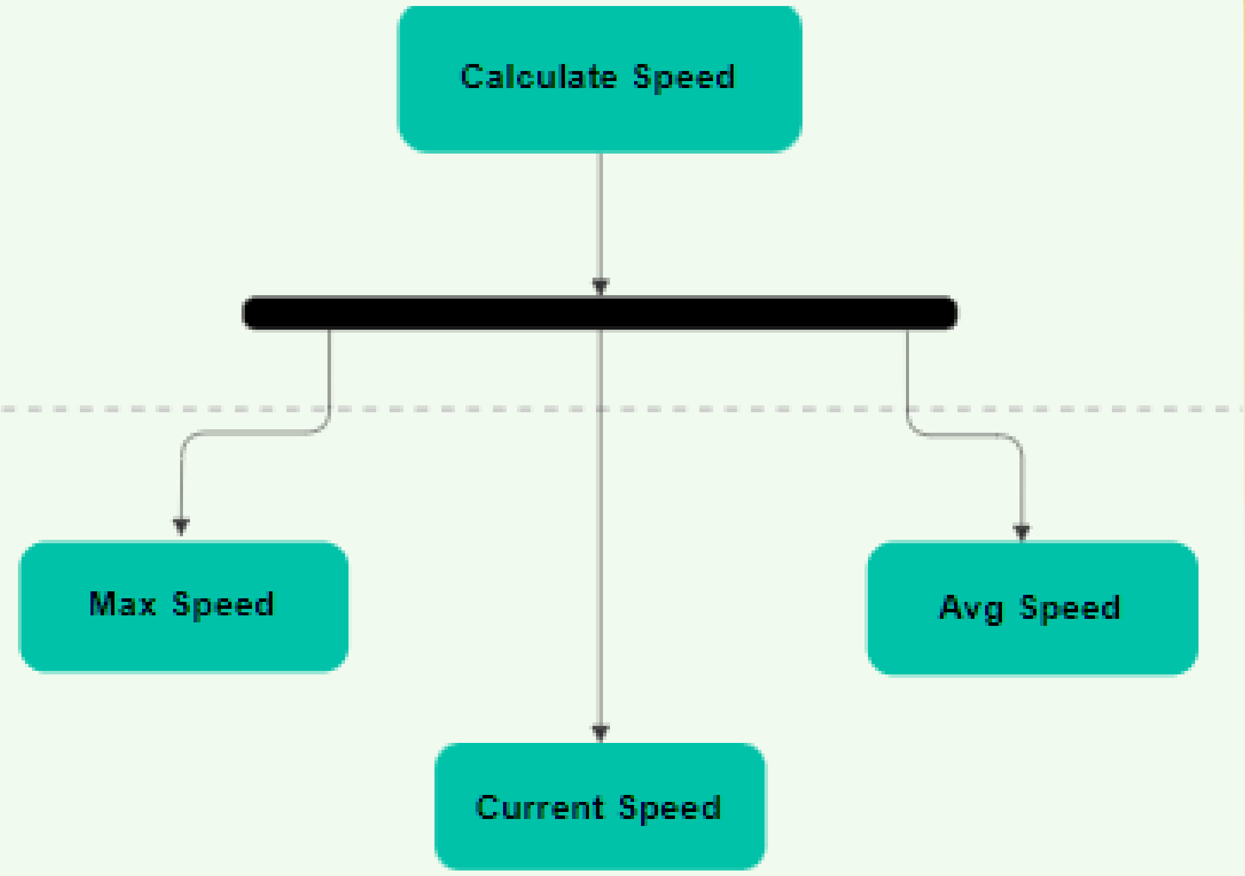
03 - Methodology

Maps Monitoring



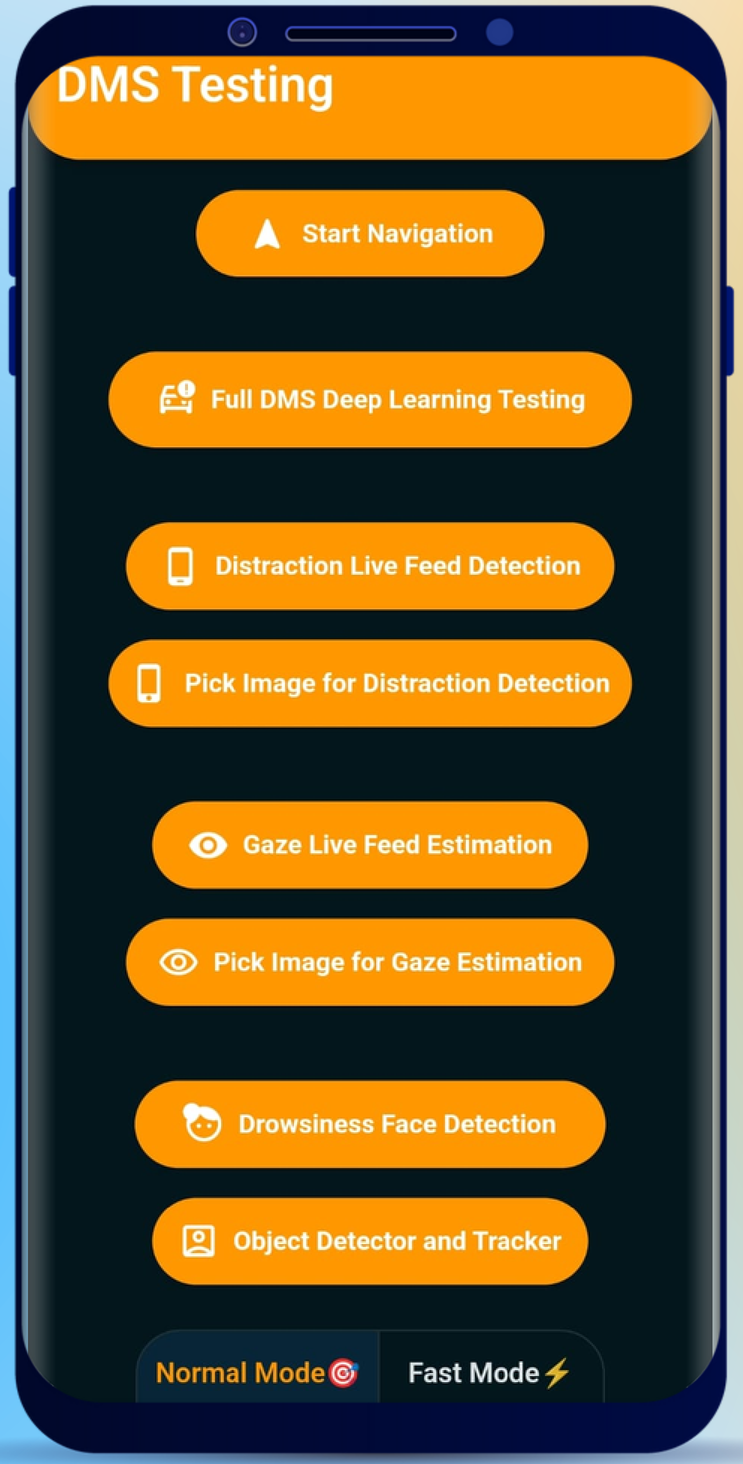
- Works Every five Seconds

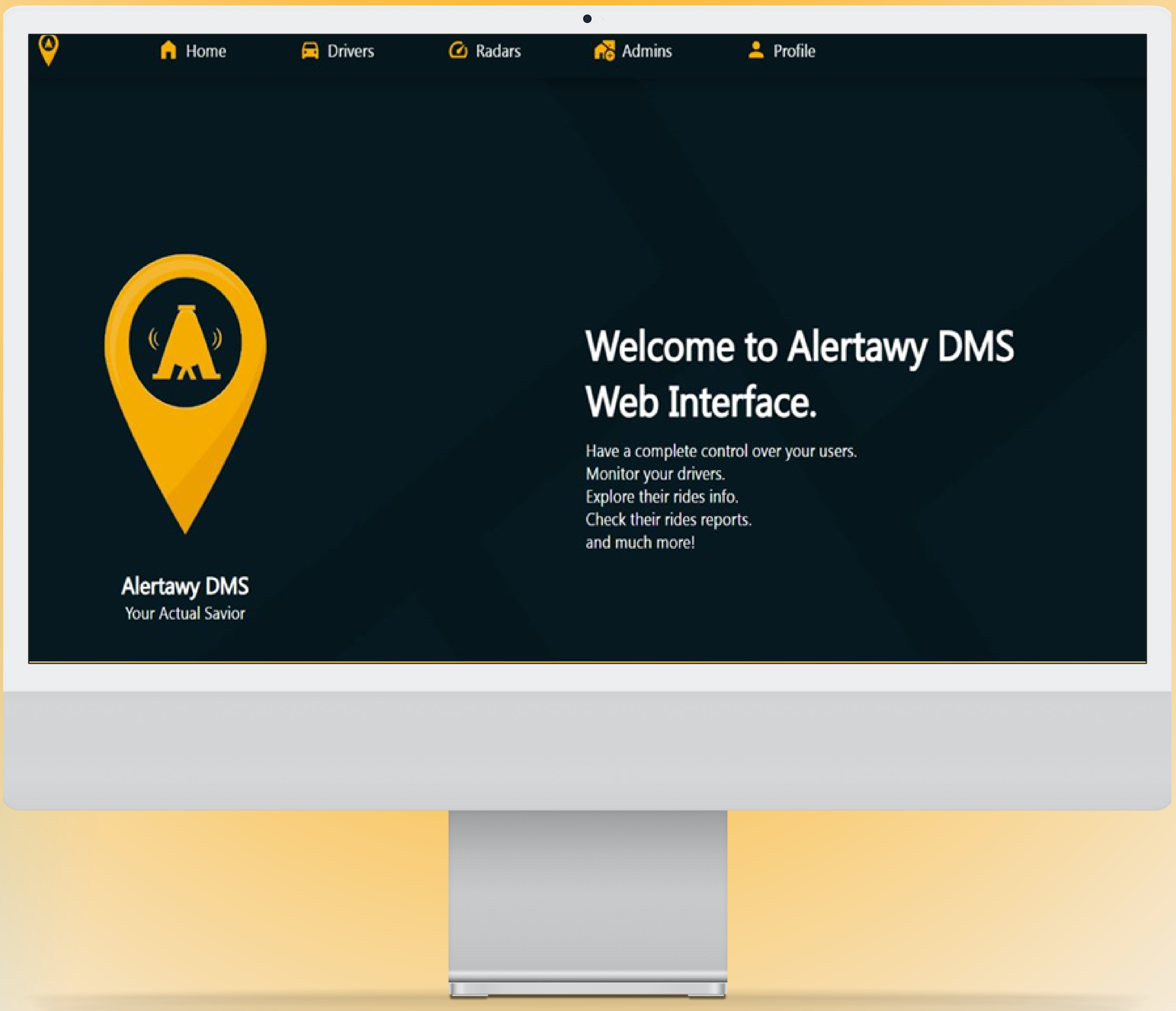




05 - Demo


ALERTAWY
YOUR ACTUAL SAVIOR
Sign Up
Sign In
Introduction


DMS Testing
Start Navigation
Full DMS Deep Learning Testing
Distraction Live Feed Detection
Pick Image for Distraction Detection
Gaze Live Feed Estimation
Pick Image for Gaze Estimation
Drowsiness Face Detection
Object Detector and Tracker
Normal Mode
Fast Mode

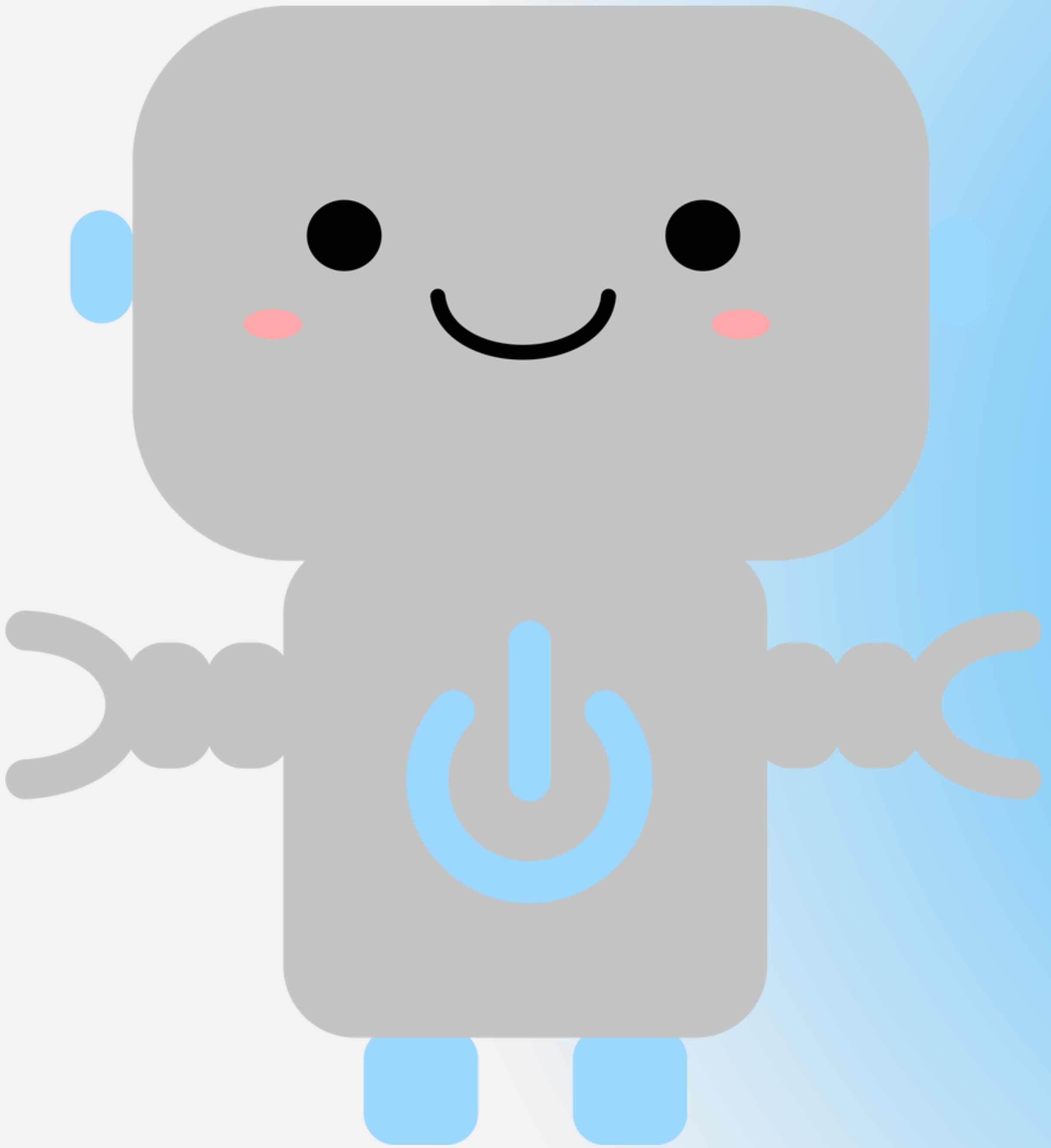

Home
Drivers
Radars
Admins
Profile
Welcome to Alertawy DMS Web Interface.
Have a complete control over your users.
Monitor your drivers.
Explore their rides info.
Check their rides reports.
and much more!
Alertawy DMS
Your Actual Savior

07 - Conclusion

At present, Our driving monitor system, Alertawy, includes features such as:

- **Distraction detection.**
- **Gaze estimation.**
- **Drowsiness detection.**
- **Radar alerting.**

Through the development of our **mobile application**, Our goal was to **protect drivers, save lives**, and **reduce road accidents**. Focusing on **refining** these **features for improved accuracy and performance** while keeping the application **updated to meet user needs**.



08 - Future Work

Cloud Services Constraints

Cloud Firestore

if we expect each user to read 10 documents per day, write 5 documents per day, and delete 5 documents per day, then we can have up to 100 users before reaching the free tier limits per day.

Google Maps Platform

If the Driver uses 10 requests to the Google Maps API with every ride, then we can handle up to 20,000 rides per month on the Maps API free tier.

08 - Future Work

- **Improve** our **deep learning models** by **retraining** them with **new datasets.**
- **Distraction with Object Detection.**
- **Fatigue** Detection Model.
- **Seat Belt** Detection Model.
- **Radar** Camera **Database.**
- Release **Beta Version** for Testing.
- **Web** Application Server **Hosting.**

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Thanks

Questions...