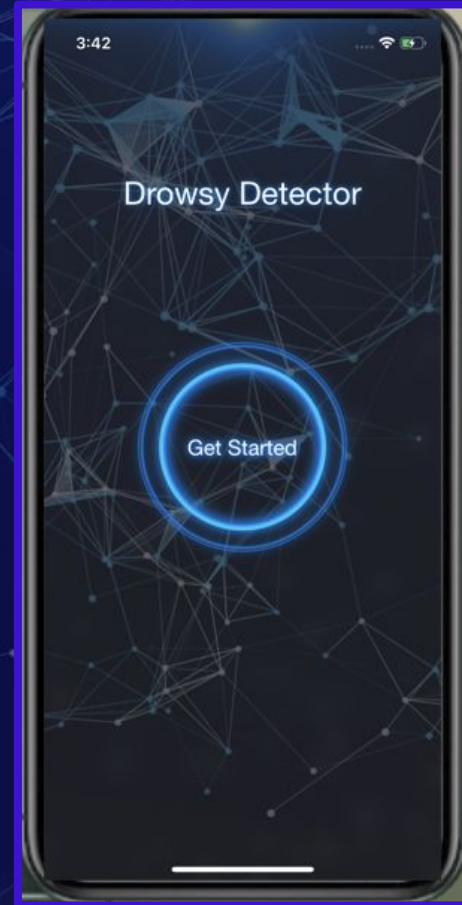


Driver Drowsiness Detector

An Artificial Intelligence based iOS application for detecting drowsy and distracted state of driving



Application features:

- ❖ Detects a driver's drowsy state i.e.
 - a) Driver has sleepy eyes
 - b) Driver is yawning
- ❖ Detects a driver's distracted state i.e.
 - a) Looking too far left or right
 - b) Looking too far up or down
- ❖ Alerts are generated via sound or voice notifications and visually on the phone screen.



General Application Usage:

- ❖ The user places the iphone into his/her car phone holder.
- ❖ User starts the application on phone and follows instructions on screen to calibrate system for the specific user.
- ❖ System tracks the user's eyelid movements, lip movements and head vertical deviations continuously through the drive.
- ❖ Application alerts the user through sound alerts and on screen alert display when cases of either drowsy eyes, yawning and/or distracted driving are encountered.
- ❖ Specialized drive statistics are provided for each user based on his/her total recorded drives. This includes a **drive quality rating** which provides insight into how distracted free and drowsy free a person has driven until now.

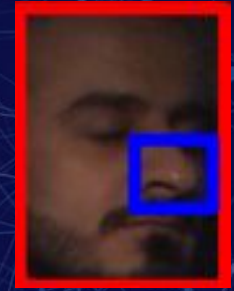


Drowsiness Detection System Overview

1] Driver Face and Nose Detection

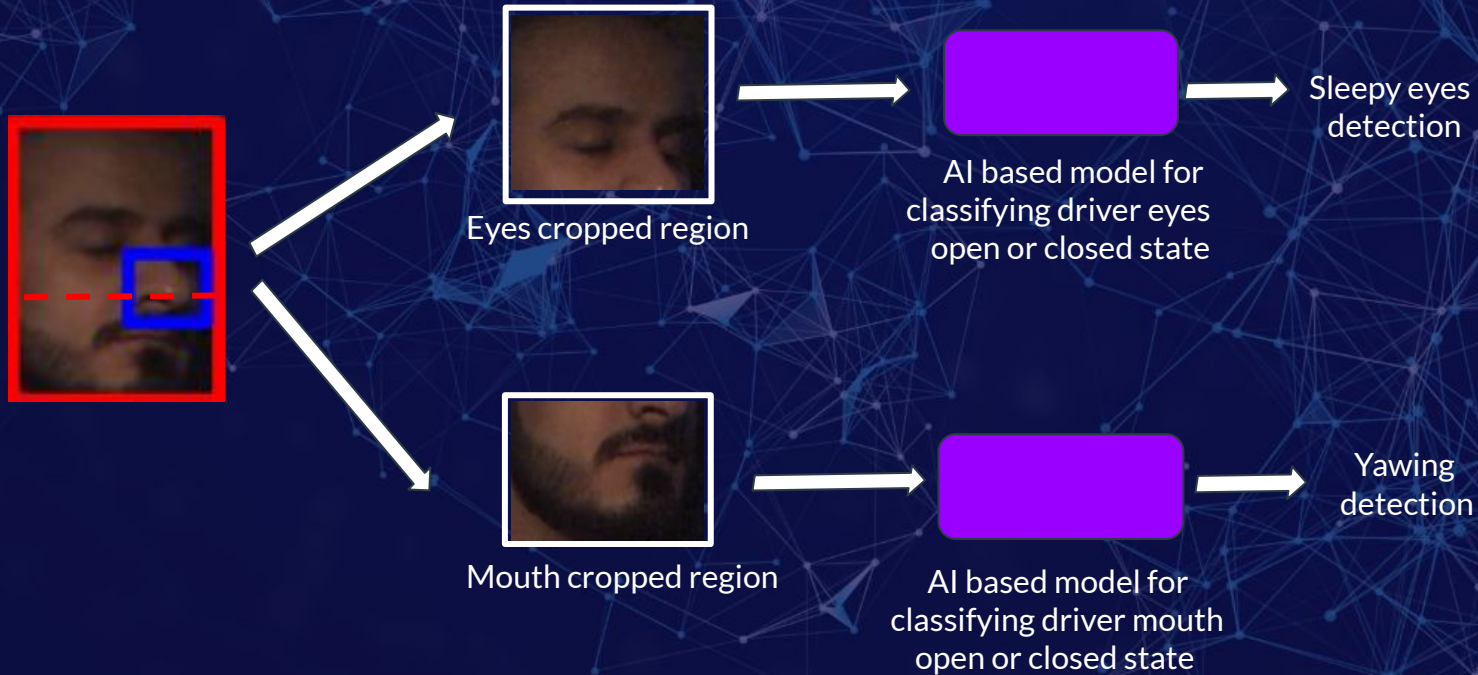


→
AI based model
trained for
face and nose detection



Drowsiness Detection System Overview

2] Eyes closure and Mouth open Detection



Distractedness Detection System Overview

❖ Cases used for detecting distracted driving:

- 1] Driver Face and/or Nose is not detected owing to the driver looking too left or right.
- 2] Nose Box location is way above or way below the general nose box location calculated during an initial calibration phase.

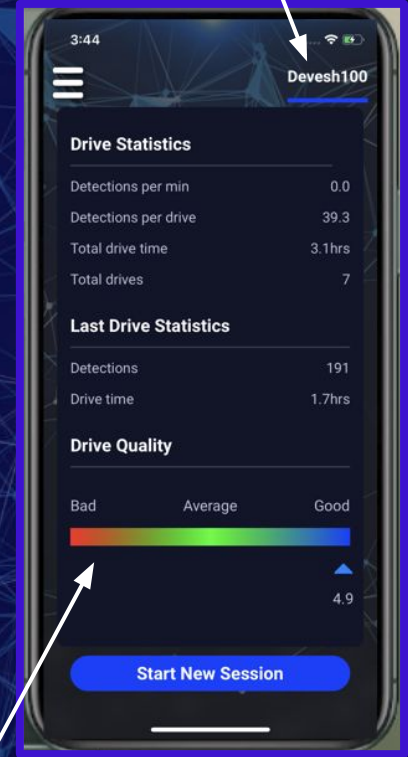
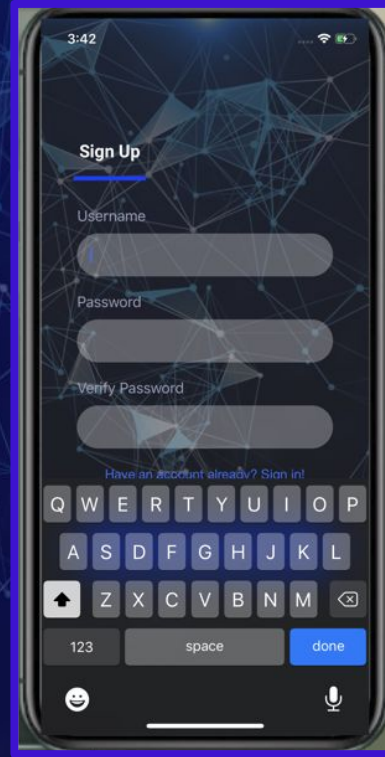


Detection System Logic

- ❖ A detection buffer is maintained which stores drowsiness and/or distractedness positive frames.
- ❖ This buffer's length is scaled according to the system speed (FPS) it is able to achieve on a specific phone. This makes the system logic **hardware agnostic**.
- ❖ The buffer acts as a sliding window across the detected frames removing positive frames which are older than certain amount of seconds. (This value is kept as user setting)
- ❖ An alert is processed when the buffer is filled up to 95% of its capacity.
- ❖ This helps system to distinguish between **eye blinking and sleepy eyes**. Also helps distinguish between **talking and yawning**.

User Profile and Database Management

- ❖ User profiles are maintained to store user preferred system settings.
- ❖ User drive history is also stored, from which drive quality statistics are computed.
- ❖ Based on total drowsiness detections encountered per minute of a user's drive, a drive quality number is computed in the range of 0.0 to 5.0



Drive Quality Scale

Driver Sobriety Test

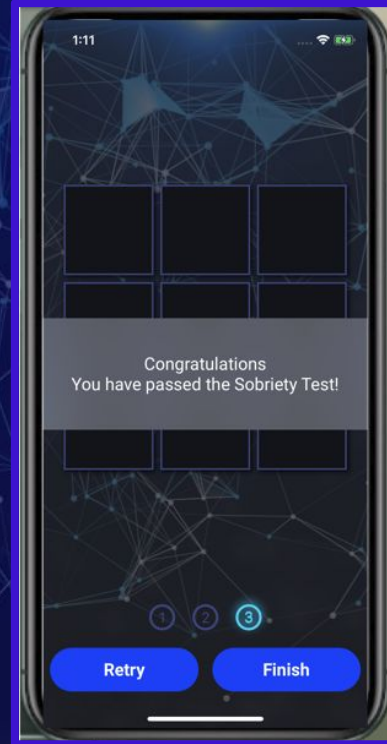
- ❖ This test focuses on driver's cognitive and memory recollection skills. A driver under influence would have these skills slightly compromised.
- ❖ The driver is instructed to memorize an image, specifically a traffic sign and is later asked to pick it from a grid of 9 randomly chosen traffic signs.
- ❖ The driver is asked to perform this task three times so as to remove any probability of luckily getting the right choices.
- ❖ This test is required to be taken prior to every new drive session.
- ❖ An advisory warning is displayed on screen in case of test failure in any of the three attempts. The driver can retake the test if he/she feels there was any mistake made during the test.



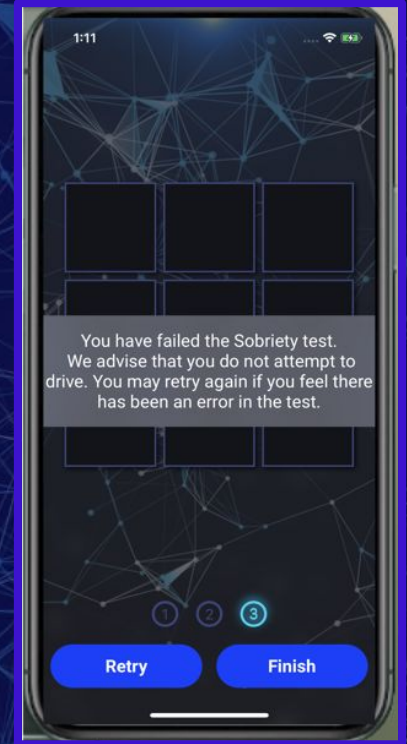
Driver Sobriety Test

- ❖ This test is required to be taken prior to every new drive session.
- ❖ An advisory warning is displayed on screen in case of test failure in any of the three attempts. The driver can retake the test if he/she feels there was any mistake made during the test.

Successful Attempt

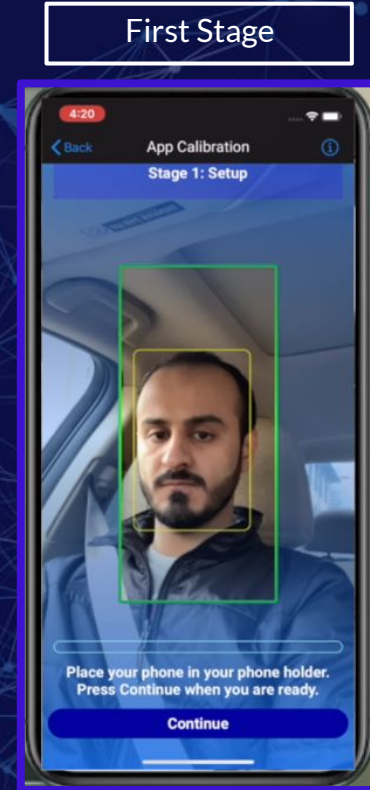
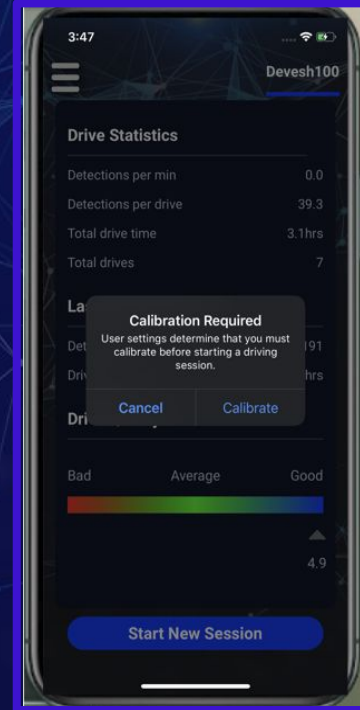


Failed Attempt



Driver and System Calibration

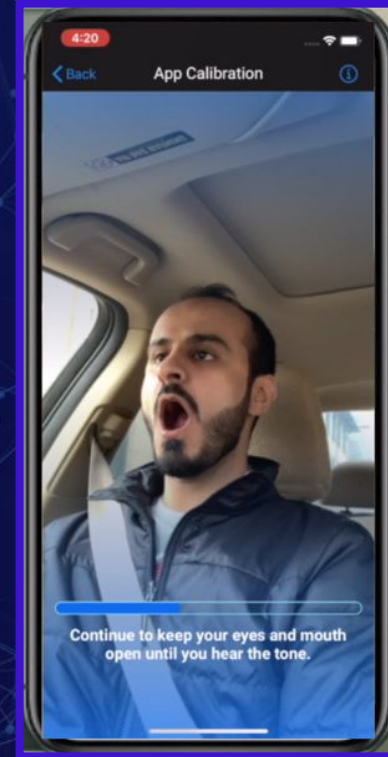
- ❖ A calibration phase follows the sobriety test which helps tune the system for the current driver, drive lighting conditions and car seating adjustments.
- ❖ The calibration consists of **three major stages**, the detailed information about which is provided to the user through an info dialog box linked to a help icon on top right corner of screen.
- ❖ The **first stage** ensures that the phone is adjusted in the phone holder such that the driver's face appears in center of the captured frames.



Driver and System Calibration

- ❖ The **second stage** tunes the AI models for driver's state of having his eyes and mouth both open.
- ❖ Two tones are played by the application which signal the start and end of capture interval.

Second Stage



Driver and System Calibration

- ❖ The **third stage** tunes the AI models for driver's state of having his eyes and mouth both closed.
- ❖ A three second countdown timer precedes the frame capture interval which allows the user to get ready.
- ❖ Two tones are played by the application which signal the start and end of capture interval.

Third Stage



Driver and System Calibration

- ❖ During the second and third stages, thirty frames are captured respectively through the iPhone's front-facing camera.
- ❖ Driver's average face detection box coordinates and nose box heights are computed using both stage statistics.
- ❖ Model Confidence thresholds customized for specific user are set using the outputs generated from the drowsiness-trained AI models.
- ❖ The entire calibration phase is designed keeping the user usability and ease into consideration.

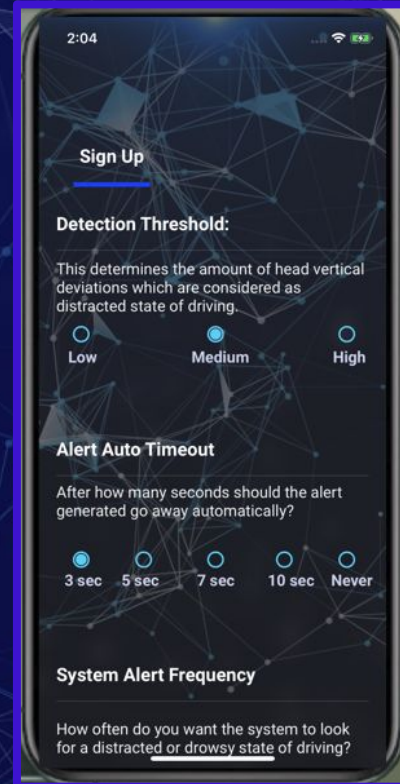
Calibration info button



User System Settings

❖ System Detection Threshold

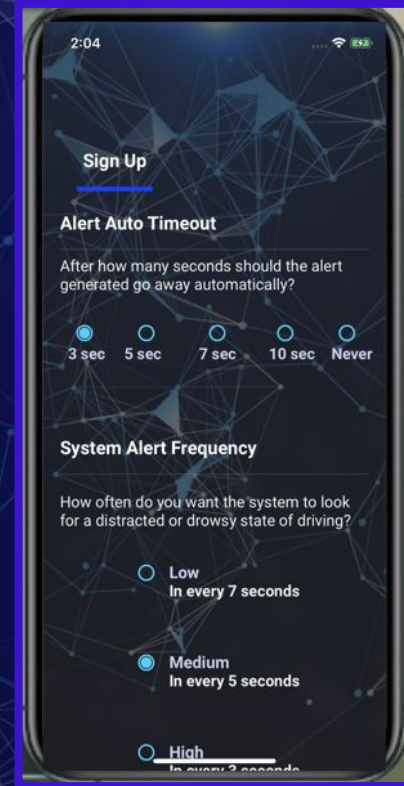
This setting helps the user control how strict the "UP Looking" and "Down Looking" thresholds are set for the drive. The option of High would mean looking up or down by slight margins could trigger the distracted case. Similarly, the option of Low would give the most leeway for looking up or down during the drive. The default is set at Medium.



User System Settings

❖ Auto Alert Timeout

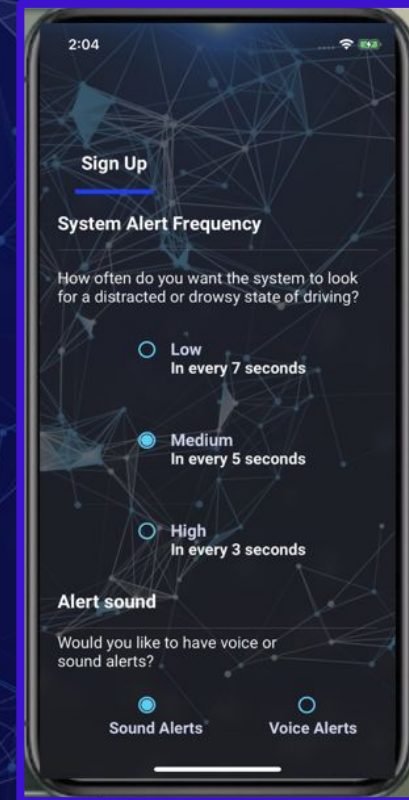
This setting helps the user choose between timing out the displayed alert after a certain amount of time or keep it going until the user presses the play button on screen. The user can select between auto timeout options of 3 secs, 5 secs, 7 secs, 10 secs or Never (which would then need the user to stop it manually).



User System Settings

❖ System Alert Frequency

This setting helps user set the time interval over which the detection is calculated. The longer this interval the more robust the system is against false positive cases. The options of **Low** (in every 7 seconds), **Medium** (in every 5 seconds) and **High** (in every 3 seconds) are provided. There is tradeoff between the robustness of system and promptness of alerts processed by the system. Thus a default option of Medium is recommended.



User System Settings

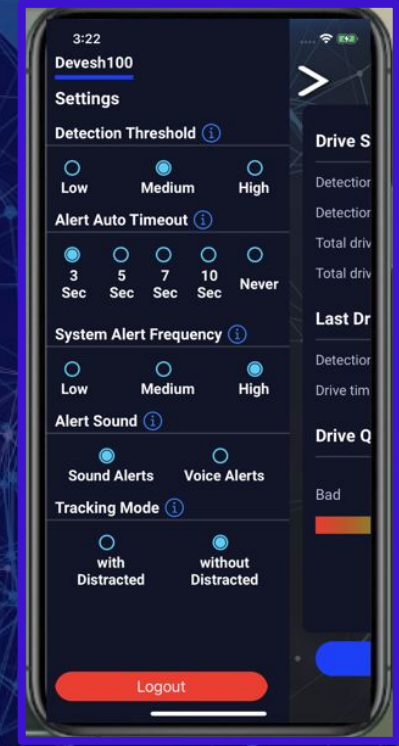
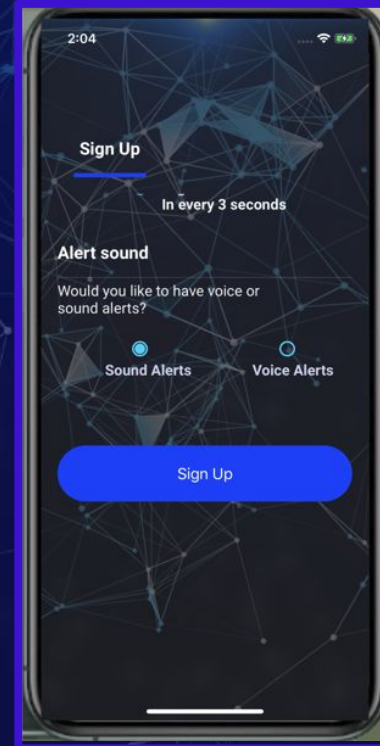
❖ Alert Sound

This setting helps the user select between sound alerts and voice alerts wherein the sentence "Alert. Please pay attention" is played for the latter option. The user can select according to his liking. The default is sound alerts.

❖ Tracking Mode

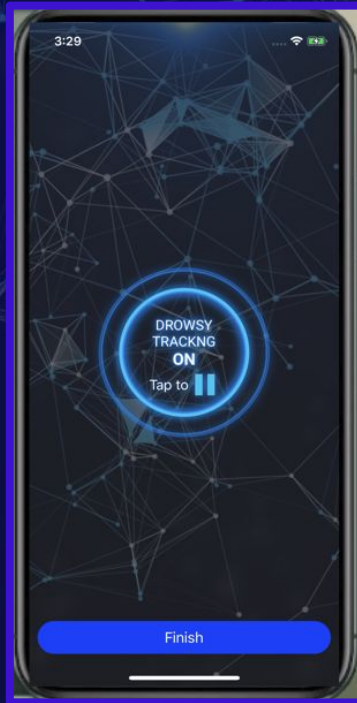
This setting allows the user to turn on/off distracted driving detection in addition to drowsiness detection if he/she wants to.

Side Panel Settings

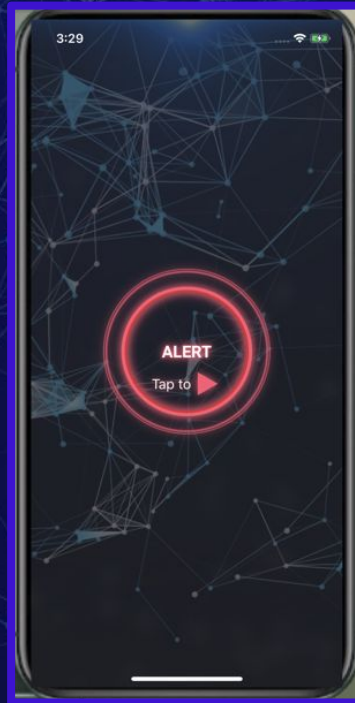


Drive View UI

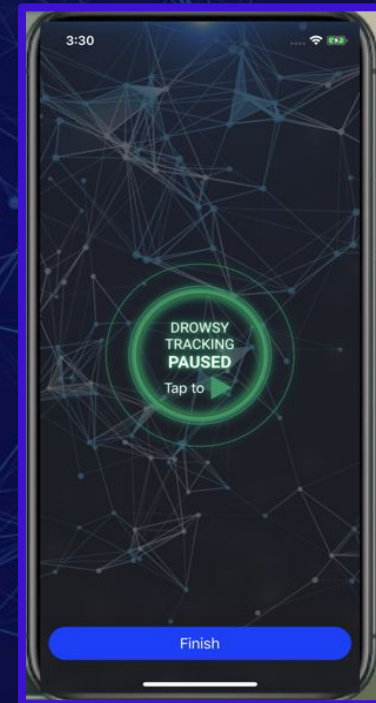
Tracking View UI



Alert View UI



Paused View UI



Optimal Performance Notifications

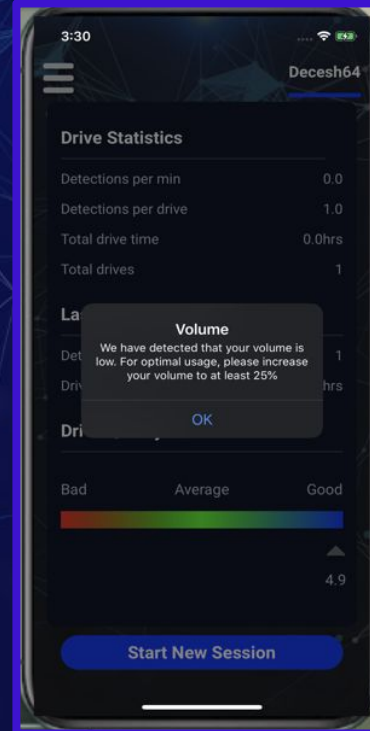
❖ Minimum phone volume check

Before start of every drive session, the system checks if the phone volume is atleast 25%, which is required to ensure adequate alert sound effect. The user is notified to increase the volume in cases of too low volume.

❖ Recalibration Suggestion

In cases of lighting conditions turning too dark during current drive session or major change in seating arrangement or phone holder location, the user is advised to recalibrate system for optimal performance. This appears on top of drive view.

Volume Check



Recalibrate Suggestion

