B1: FocusEd Design Presentation

Heidi Batres, Vaheeshta Mehrshahi, Danielle Kakish

Problem Statement

- **Increased number of accidents due to distracted driving**
  - Increased reliance on smartphones

- **Lane detection**
  - Focuses on the vehicle itself and not the driver
  - Want to correct behavior before driver begins to pose a danger

Application Area

FocusEd serves as a way for drivers to curb their distracted day driving while simultaneously improving road safety and their own driver education.

Solution Approach (User Flowchart)
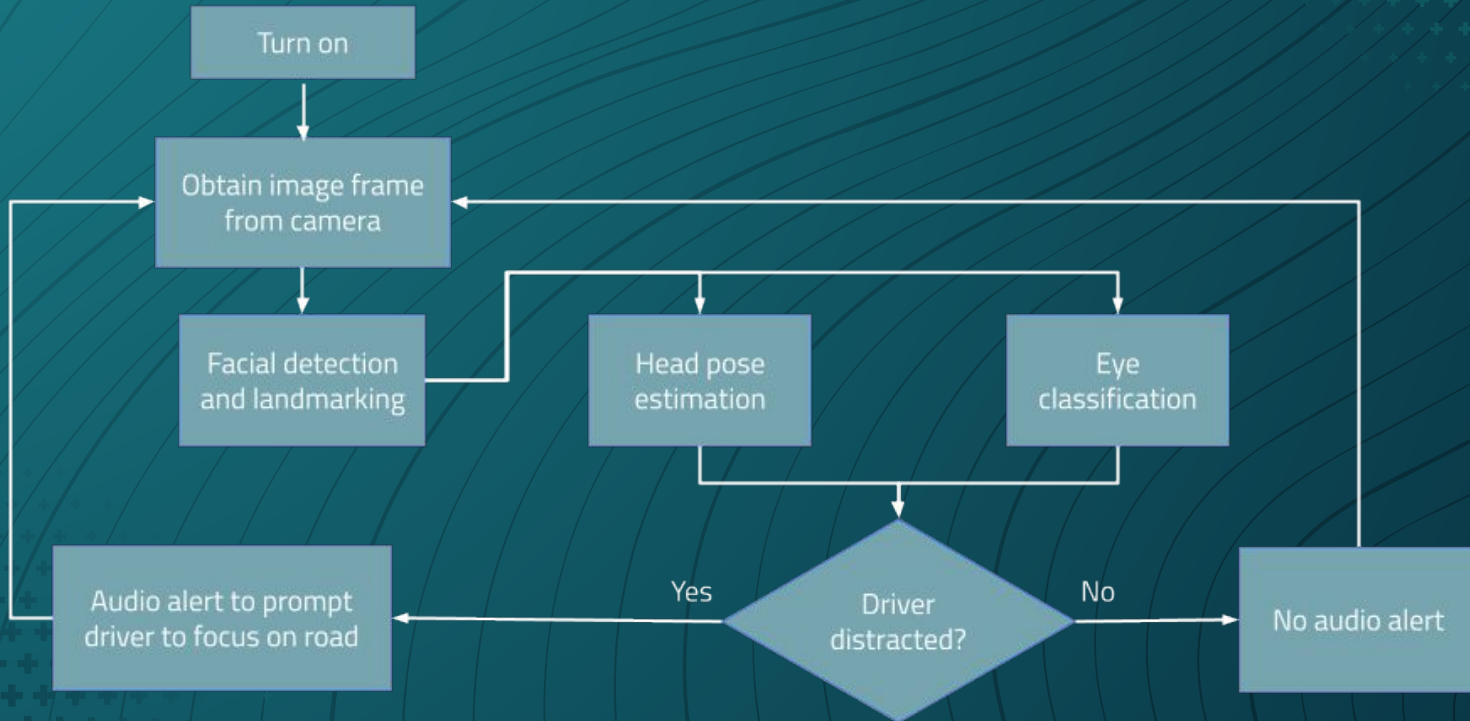
Solution Approach

1	Real-Time Facial Detection	• Histogram of Oriented Gradients + Support Vector Machine (HOG + SVM) algorithm • OpenCV + Dlib
2	Real-Time Eye Classification	• HOG + SVM • Eye Aspect Ratio (EAR) algorithm • OpenCV + Dlib + NumPy + SciPy
3	Real-Time Head Pose Estimation	• Classify head pose as possibly distracted if axis is negative • OpenCV + Dlib + TensorFlow
4	Focus Timer	• Alert driver if eyes closed for >=1 s • Alert driver if head pose is classified as distracted for >= 2 s

System Specification/Block Diagram
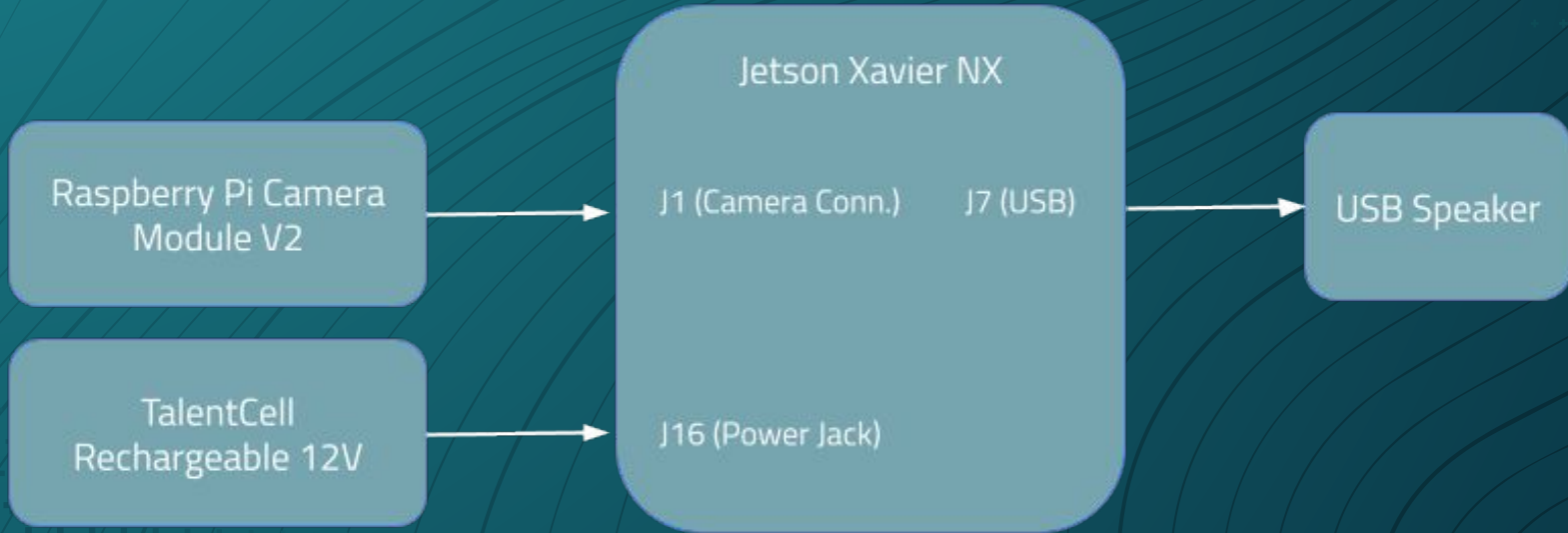
System Specification/Block Diagram
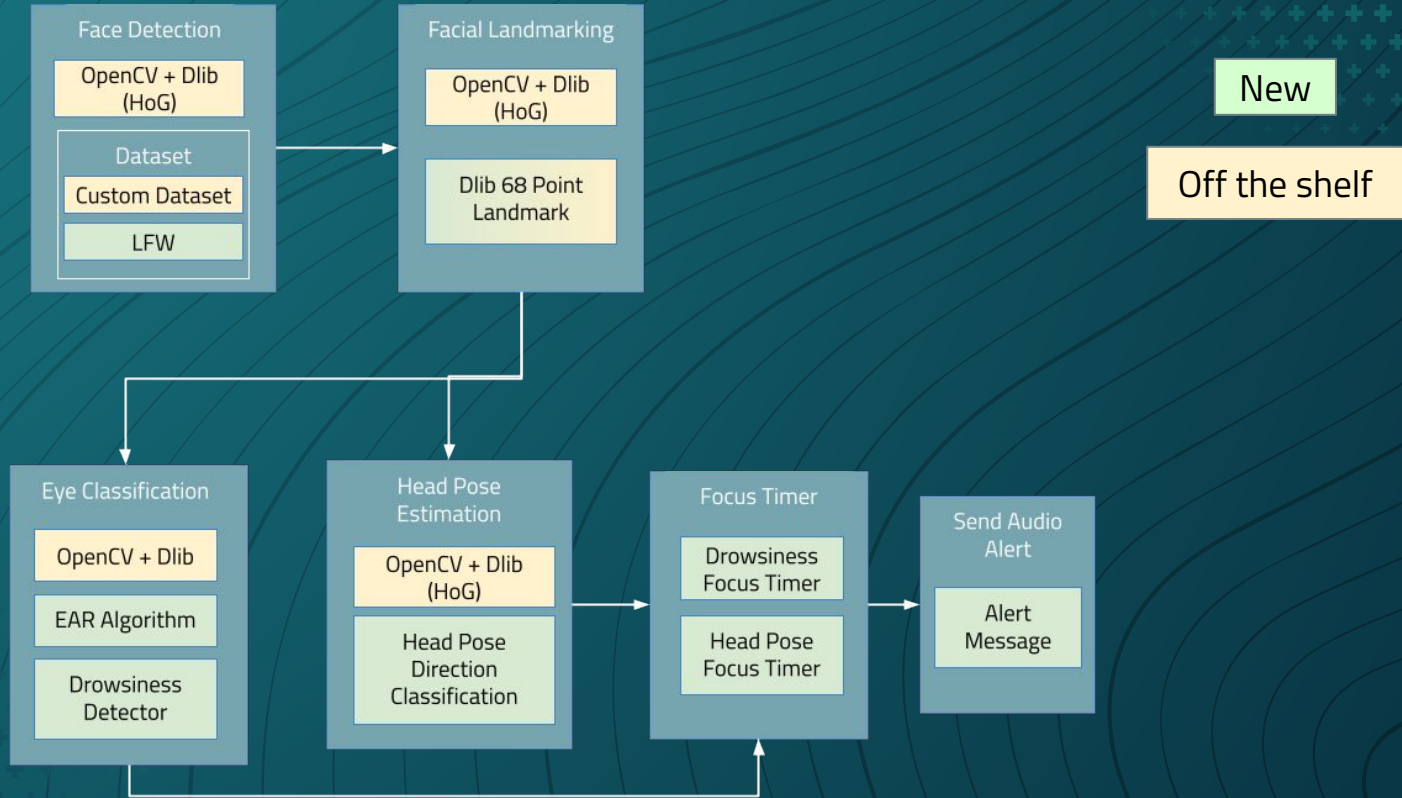
Implementation Plan

- **Detection**
  - Ordered the Jetson Xavier NX Developer Kit, Raspberry Pi 3 Camera Module, and other necessary supplies, such as the TalentCell Rechargeable power supply
  - Downloaded OpenCV and dlib
  - Designing and training algorithms for face detection, facial landmarking, eye classification, and head pose estimation
  - Integrating algorithms with focus timer algorithm

- **Alert**
  - Ordered USB-speaker
  - Adding audio alert to be played when distraction is detected

Metrics and Validation

Requirements	Test	Metric
Face Detection	Detect face in various daytime light	Face is detected >=90% of the time in all light conditions
Facial Landmark	Compare true landmark to output landmark	Output landmark within 10px radius (front facing and other poses)
Head Pose Estimation	Compare direction of head to head pose estimation output	Estimation and truth match >=85% of the time
Eye Classification	Compare open/closed classification matches to truth	Classification matches truth >=90% of the time

Metrics and Validation

Requirement	Test	Metric
Focus Timer	Distracted vs Normal based on 1s drowsy or not focused 2s	Distinguishes distracted vs normal >=90% of the time
Power Supply	Run Xavier until power bank runs out	Xavier powered for 8 -10 hrs
Audio Alert	Input distracted alert and ensure audio output	Audio output when alert is received >=99%
System Latency	Time full system run through	System should detect and output audio alert within 3s
Driver Response	Test that audio alert does not send when driver refocuses	Check that audio alert no longer triggered within 3 iterations

Risks

- Detection and alert are not within specified time frame

- Don't detected all distracted instances

- Power bank is not able to power Xavier

- Detection and Alert time differ depending on lighting conditions

Project Management