

B1: FocusEd Final Presentation

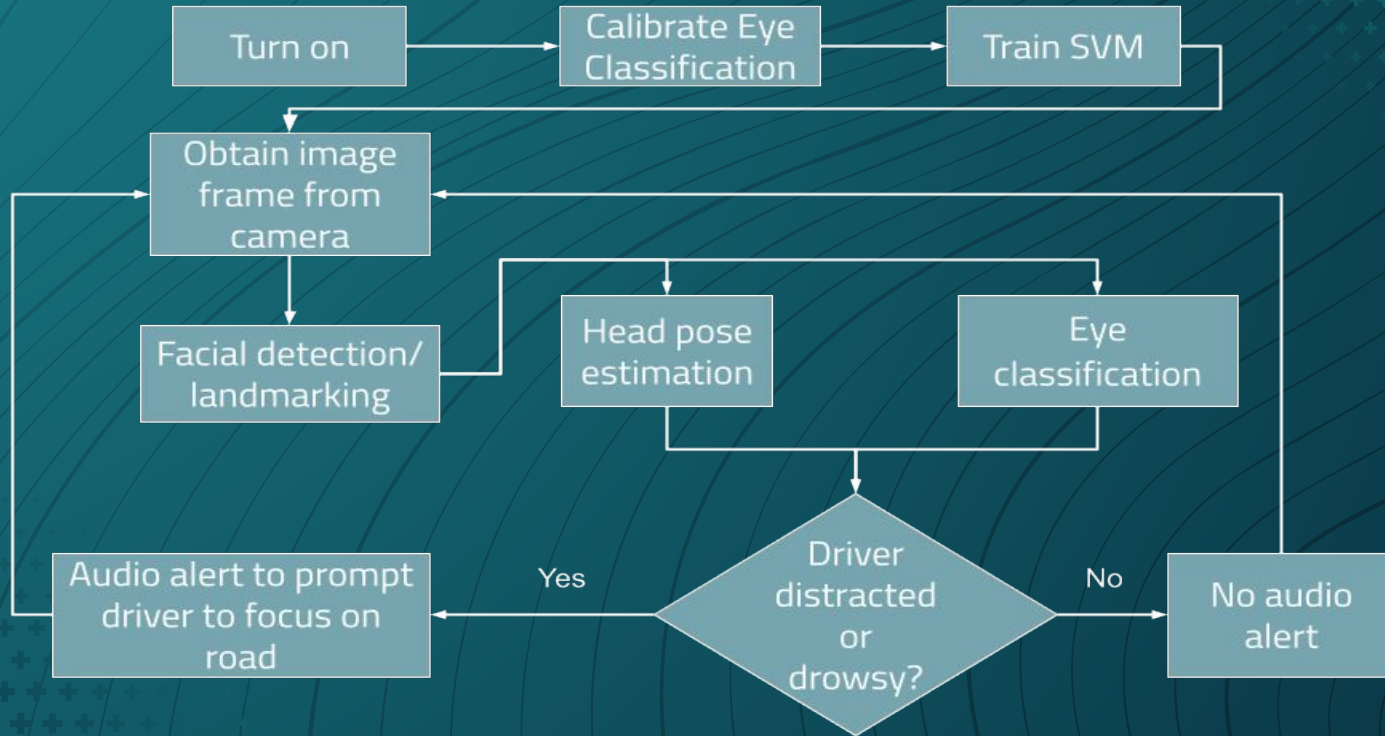
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Application Area

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



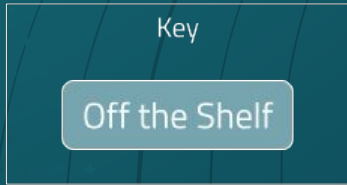
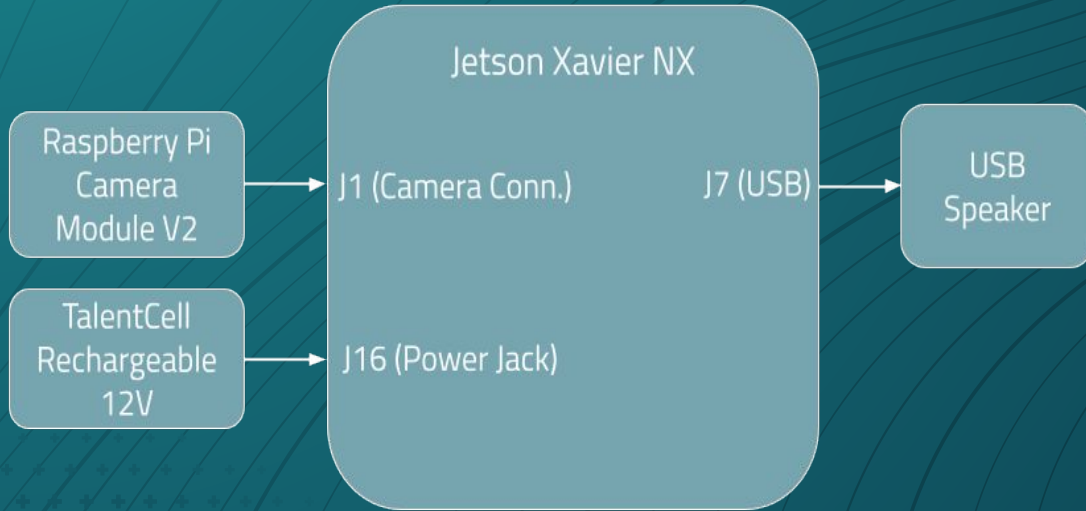
Solution Approach (User Flowchart)



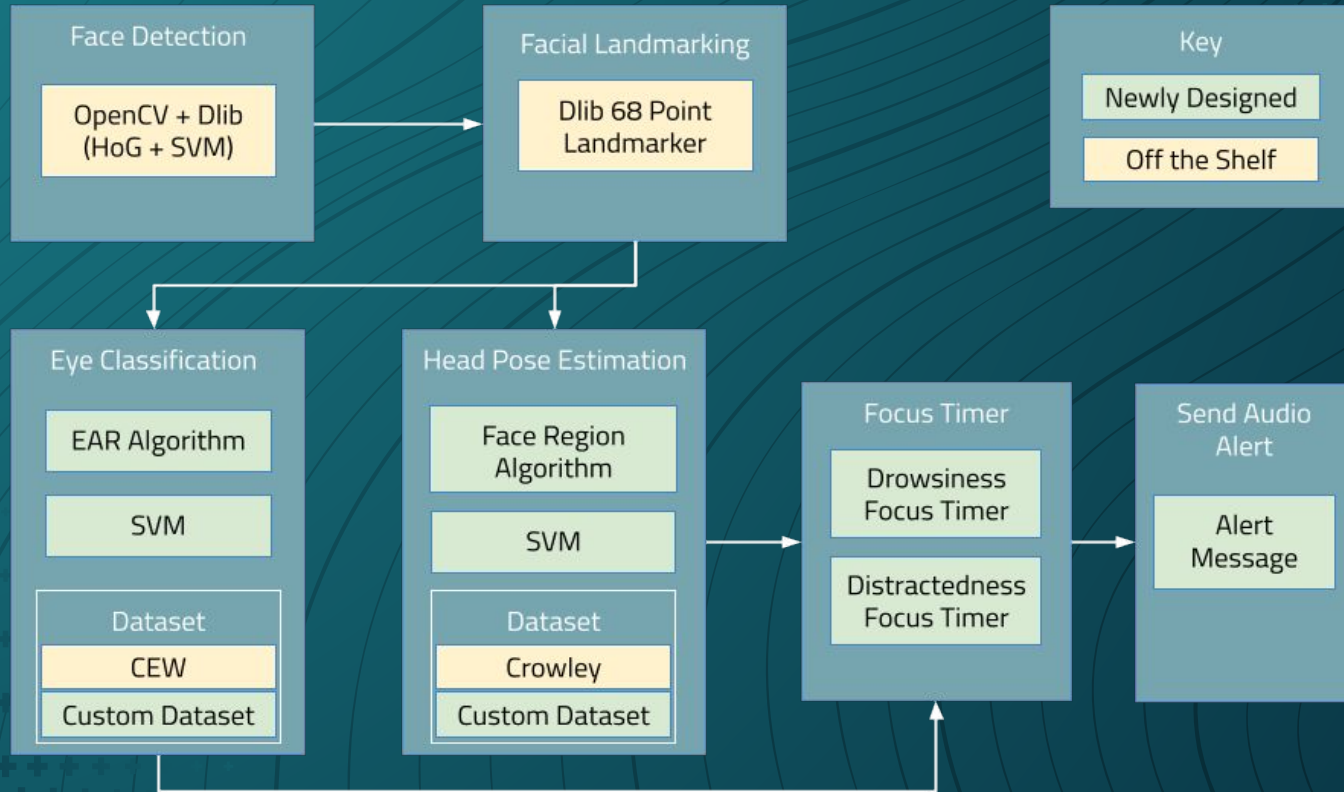
Solution Approach

1	Real-Time Facial Detection	<ul style="list-style-type: none">• Histogram of Oriented Gradients + Support Vector Machine (HOG + SVM) algorithm• OpenCV + Dlib
2	Real-Time Eye Classification	<ul style="list-style-type: none">• Calibrate/train SVM model to predict open/closed eyes based on Eye Aspect Ratio (EAR)
3	Real-Time Head Pose Estimation	<ul style="list-style-type: none">• Triangular areas of face used to calculate ratio for estimation• Pre-trained SVM model
4	Focus Timer	<ul style="list-style-type: none">• Alert driver if eyes closed for ≥ 1 s• Alert driver if head pose is classified as distracted for ≥ 2 s

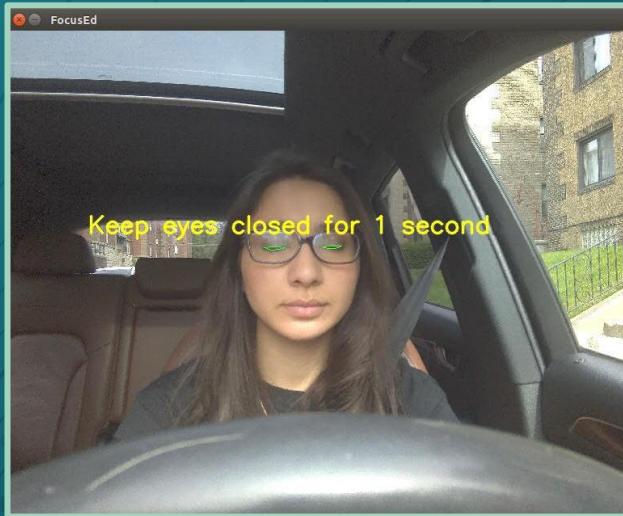
Hardware Block Diagram



Software Block Diagram

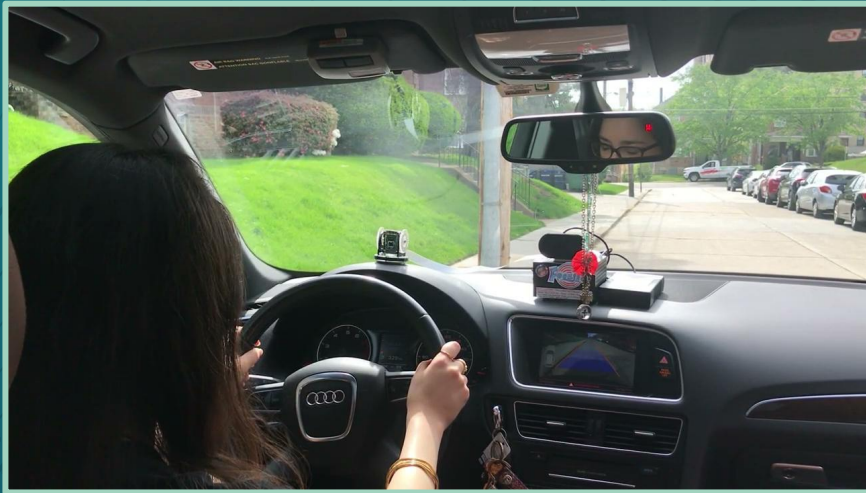


System Demo



Calibration for Drowsiness

System Demo



Falling Asleep



Looking Down at Phone

Metrics and Validation

Requirement	Test	Metric	Testing Result
Face Detection	Detect faces in various daytime light	Face is detected $\geq 90\%$ of the time in all light conditions	94% accuracy (5 datasets, 4355 photos)
Eye Classification	Compare open/closed classification to truth	Classification & truth match $\geq 90\%$ of the time	91% accuracy (4 datasets, 3403 photos)
Head Pose Estimation	Compare direction of head to estimation	Estimation & truth match $\geq 85\%$ of the time	93% accuracy (2 datasets, 1451 photos)
Focus Timer	Distracted vs normal based on 1s drowsy or 2s not focused	Distinguishes distracted vs normal $\geq 90\%$ of the time	87% accuracy (100 trials)

Metrics and Validation

Requirement	Test	Metric	Testing Result
Power Supply	Run Xavier until supply runs out	Xavier powered for 8 -10 hrs	8.5 hours of runtime (1 trial)
Audio Alert	Input distracted alert and ensure audio output	Audio output when alert is received $\geq 99\%$	Audio outputted 100% of the time (30 trials)
System Latency	Time the full system run through	System should detect and output audio alert within 3s	3.9s average (30 trials)
Driver Response	Test that audio alert does not send when driver refocuses	Check that alert no longer triggered within 3 iterations	Alert no longer triggered 100% of the time (100 trials)

Design Trade-Offs

- Used HoG + SVM instead of Haar Cascades
- Used pre-trained head pose estimation model instead of calibration
- Used facial areas to determine head pose rather than 2d to 3d landmark conversion
- Used EAR for eye classification
- Used Jetson Xavier NX

