# B1: FocusEd Design Presentation

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

#### 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**

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Proposal Presentation	All	2/15/2021	2/21/2021																		
Research design specifications	All	2/22/2021	3/1/2021																		
Research face detection, landmarking, he	Heidi	2/22/2021	2/24/2021																		
Research eye classification examples	Vaheeshta	2/22/2021	2/25/2021																		
Write eye classification algorithm (on lapt	Vaheeshta	2/26/2021	3/9/2021																		
Order hardware components	All	3/1/2021	3/1/2021																		
Write simple face detection (on laptop)	Heidi	3/2/2021	3/4/2021																		
Design Presentation	All	3/2/2021	3/7/2021																		
Write simple face landmarking (on laptop	Heidi	3/3/2021	3/5/2021																		
Write face detection algorithm (on Xavier	Heidi	3/7/2021	3/10/2021																		
Write simple head pose (on laptop)	Heidi	3/9/2021	3/12/2021																		
Design Report	All	3/10/2021	3/17/2021																		
Test eye classification algorithm (on lapto	Vaheeshta	3/10/2021	3/16/2021																		
Test face detection algorithm (on laptop)	Heidi	3/12/2021	3/16/2021																		
Label face landmarks for pixel radius accu	Danielle	3/13/2021	3/17/2021																		
Write face landmarking algorithm (on Xav	Heidi	3/16/2021	3/19/2021																		
Find and download training set for open/o	Vaheeshta	3/17/2021	3/20/2021																		
Create custom dataset for face detection	Danielle	3/19/2021	3/21/2021						and a second												
Write focus timer (1) classification based	Danielle	03/20/2021	03/29/2021																		
Test eye classification on training set	Vaheeshta	3/20/2021	3/22/2021																		
Test face landmarking algorithm	Heidi	3/21/2021	3/24/2021																		
Integrate and testeye classification on Xav	Vaheeshta	3/22/2021	3/25/2021																		
Integrate custom data set with LFW datas	Danielle	3/23/2021	3/24/2021										1								
Write focus timer (2) classification based (	Danielle	03/23/2021	04/01/2021												1						
Create audio alert and integrate with spea	Danielle	3/24/2021	3/27/2021																		
Write head pose estimation algorithm	Heidi	3/24/2021	3/26/2021																		
Test with Xavier with power bank	Vaheeshta	3/26/2021	3/28/2021																		
Test head pose estimation with different d	Heidi	3/27/2021	3/31/2021																		
Test audio alert on Xavier	Danielle	3/28/2021	3/28/2021									1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1									
Integrate face detection with landmarking	Heidi	3/28/2021	3/30/2021																		
Integrate head pose estimation with lands	Heidi	4/1/2021	4/2/2021										1								
Integrate with face dectection + head pos	Heidi	04/03/2021	04/04/2021																		
Integrate eye classification with face deter	Vaheeshta	4/3/2021	4/7/2021																		
Integrate with detection algorithms	All	04/04/2021	4/9/2021												4						
Integrate with eye detection + classification	Danielle	04/07/2021	04/11/2021																		
Interim Demo	All	4/9/2021	4/12/2021																		
Distraction Classification (integrating all al	All	4/13/2021	4/16/2021																		
Integrate Focus Timer (1) and (2)	All	04/15/2021	04/20/2021																		
Integrate all parts	All	4/19/2021	4/23/2021																		
Slack	All	4/20/2021	4/27/2021																		
Test in controlled environment	All	4/24/2021	4/25/2021																		
Test in car	All	4/25/2021	4/26/2021																		
Final Presentation	All	4/27/2021	5/2/2021																		
Final Report	All	4/27/2021	5/2/2021																		
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Danielle

Heidi

Vaheeshta

All