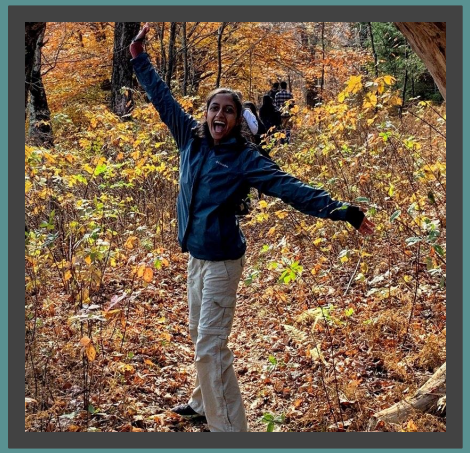
Team B7: Carma Design Review



Jananni Rathnagiri

Adriana Martinez

Evann Wu

Application Area

Drowsy and Distracted Driving

- Sleepy / Distracted Eyes
- Yawning

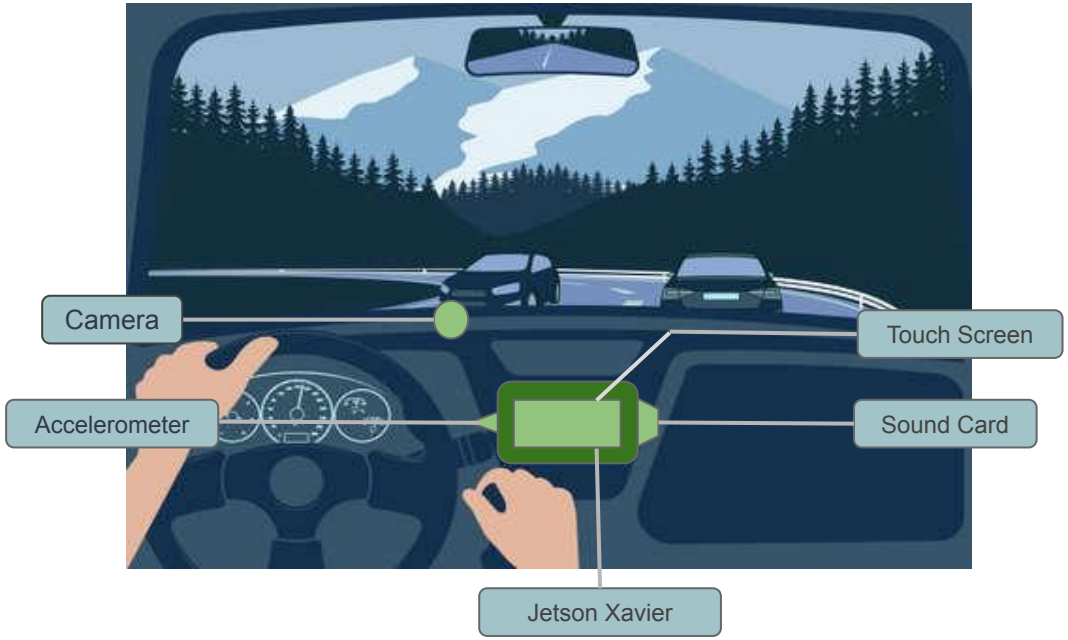
Applications

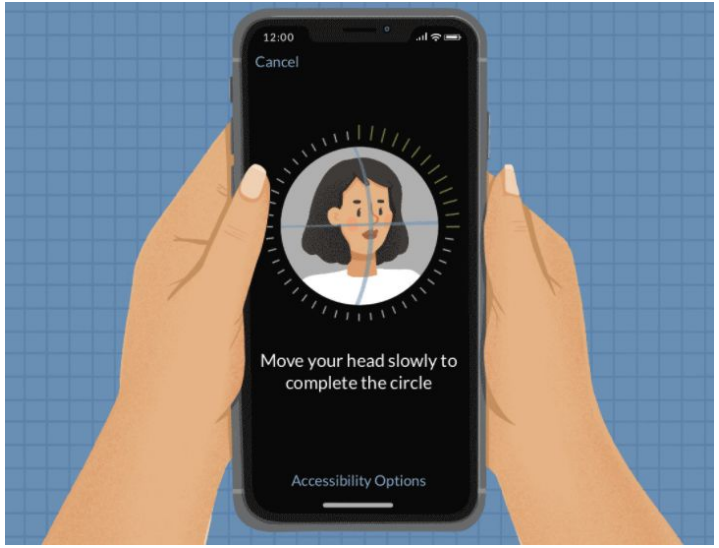
- Trucking industry
- Commercial use

ECE Areas:

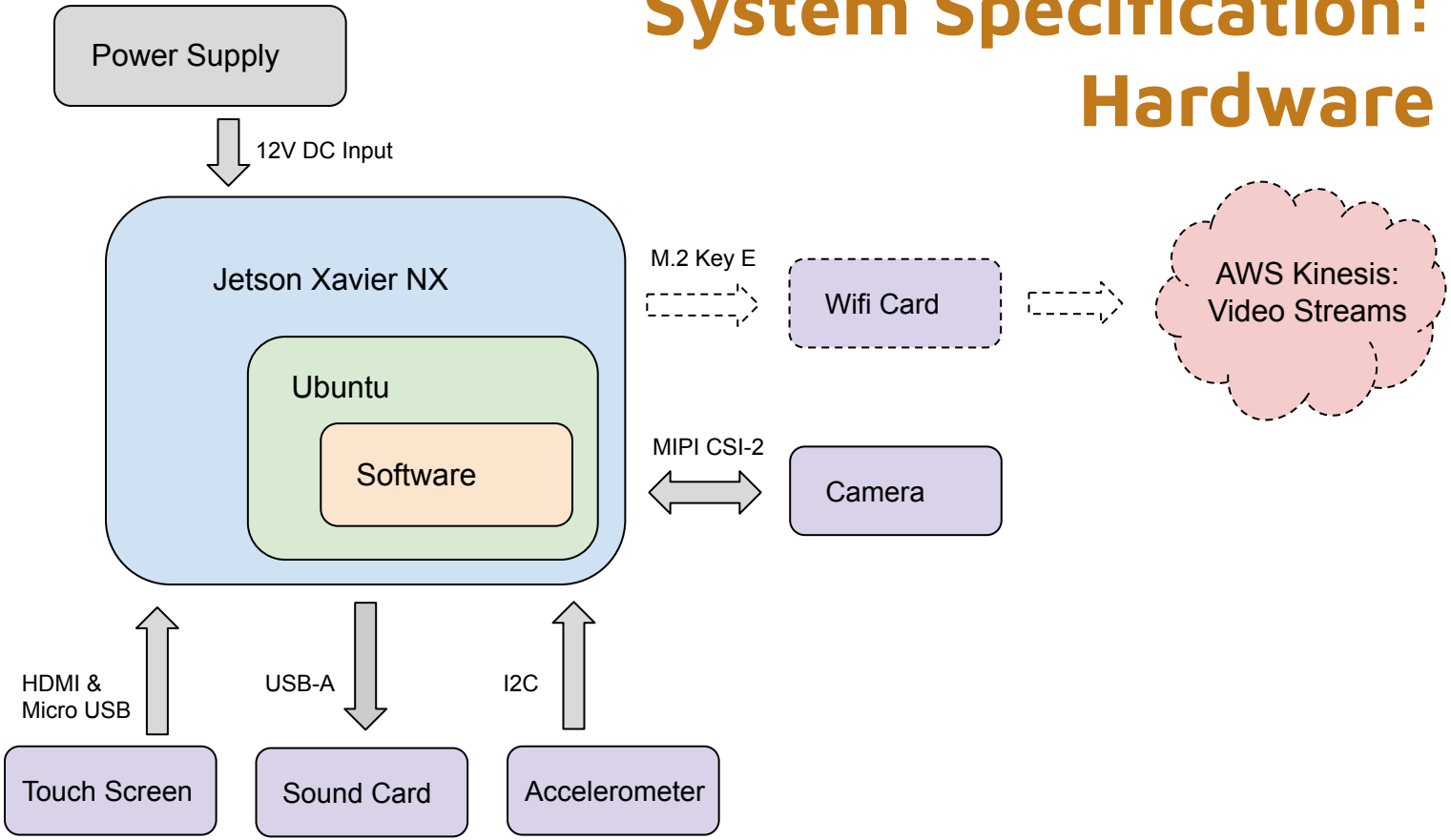
- Software
- Signals and Systems

Solution Approach

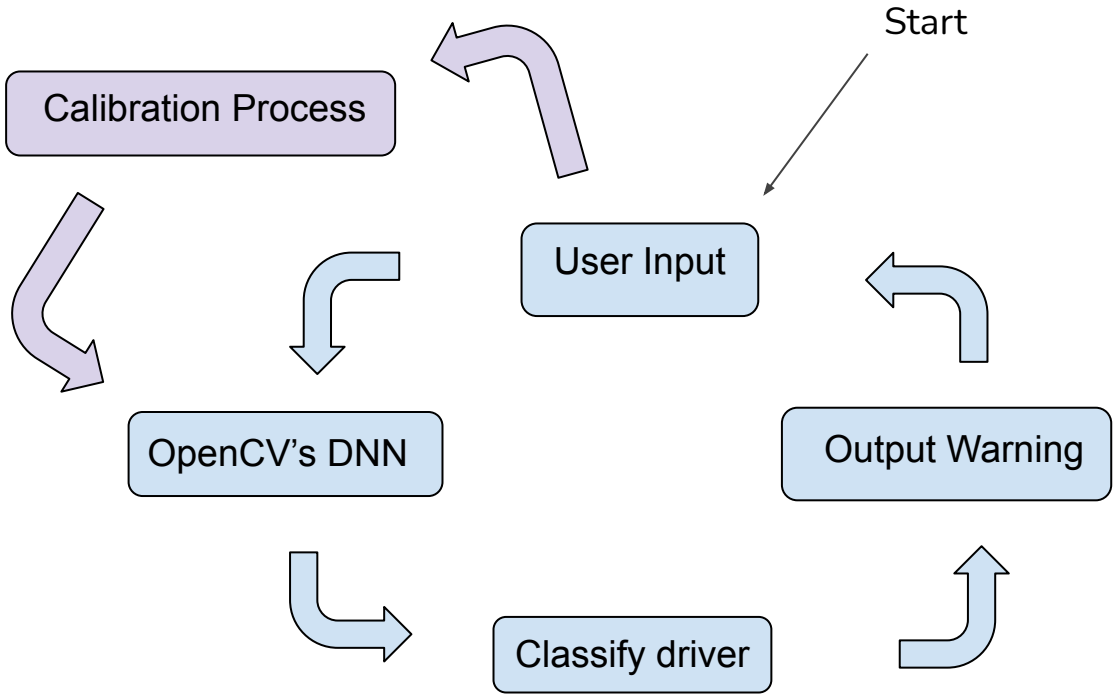




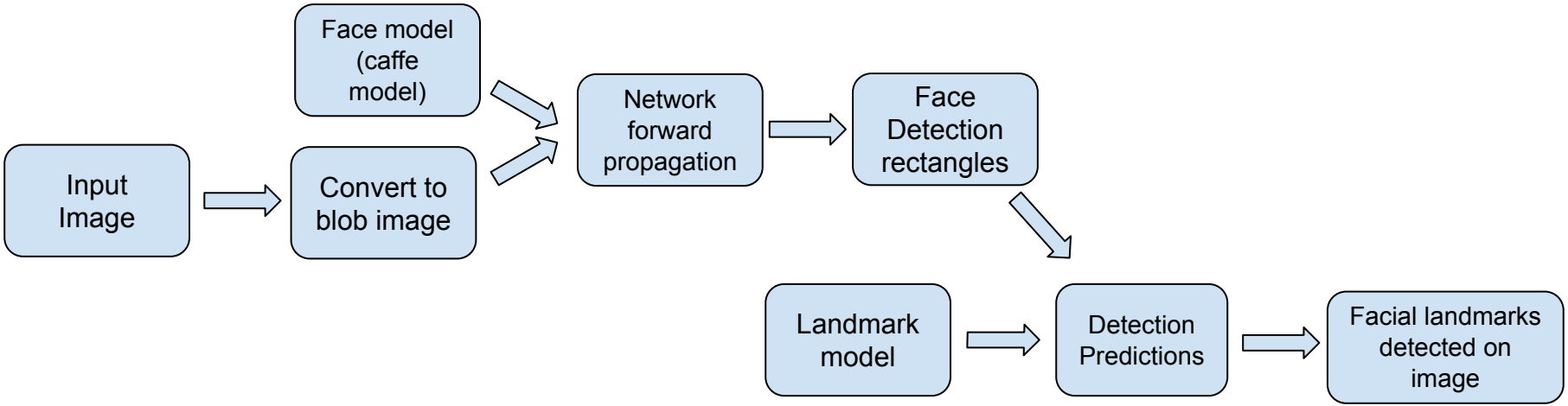
System Specification: Hardware



System Specification: General Software



System Specification: Deep Learning with OpenCV



Implementation Plan

Components to Download

- OpenCV
  - DNN Module
- TensorFlow

Components to Design/Implement

1. Following OpenCV deep learning tutorials from PyImageSearch
   a. How to utilize OpenCV library for facial detection and eye tracking
2. Parallel GPU Processing
   a. OpenCV's CUDA API in order to obtain desired frames per second

Components to Buy

- Jetson Xavier board (arrived)
- Jetson Kit includes Touch screen, camera and SD card (arrived)
- Car Power Adapter (for late stage testing)
- Wifi Card (back-up)
- Sound Card (back-up)
- Accelerometer (back-up)
- Total ~$540

Components to Borrow

- Sound Card (claimed)
- Accelerometer (claimed)

Metrics and Validation: Driver

Requirements	Metrics	Test Plan
Driver should never take eyes off the road for > 2 secs	Frontal view: Eyes looking away > 2 sec	Error rate <10% False + <9% False - <1%
Driver should not fall asleep at the wheel	Frontal view: Frequency of blinking and/or length of blink increases by 0.25x norm	Error rate <15% False + <13% False - <2%
Driver should not fall asleep at the wheel	Frontal view: detect yawning detect eyes closed	Error rate <15% False + <13% False - <2%
Most fatal accident happen over 55 mph	Side view: turned > 2 secs while driving > 55 mph	Error rate <35% False + <30% False - <5%

Metrics and Validation: Device

Requirements	Metrics	Test Plan
Driver should never take eyes off the road for > 2 secs so computation must be fast	Computation Time < 1000ms	Measure the time at start and end of computation
Driver should never take eyes off the road for > 2 secs so computation must be fast	>= 5 frame/sec (fps)	Run the program with a person looking at the camera for 60 seconds. Take the average frame rate
Total Device Accuracy	-	Accuracy of model against test suite >= 75%

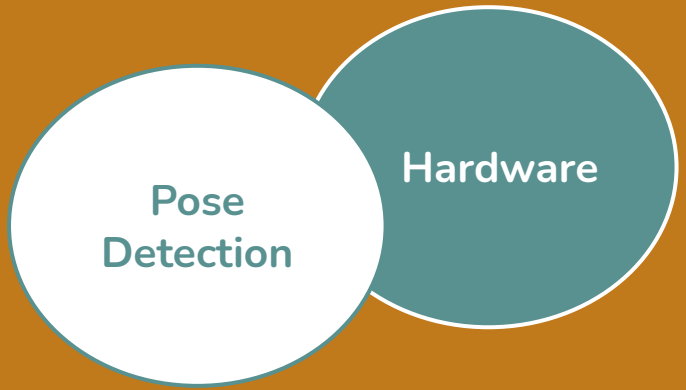
Risks and Mitigation

Risks	Mitigation
Inadequate Board Performance (Low FPS)	Using AWS Kinesis for Faster Computation
Poor Frontal Face Detection or DNN GPU parallelization incompatibility	Switch to Dlib Algorithm
Xavier NX Board Malfunction	Use Jetson Nano (~$100) + AWS
Accelerometer/Sound Card/Camera Failure	Purchase new parts using remaining budget
Unforeseen delays	10 days of slack

Division of Labor

Jananni Rathnagiri

Adriana Martinez

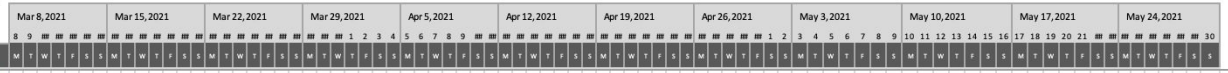


Evann Wu

Carma Project Schedule

Sun, 3/7/2021

1



TASK	PROGRESS	START	END
Adriana			
Implement Preliminary Computer Vision Algorithm	30%	3/7/21	3/1/21
Implement Eye Detection	60%	3/1/21	3/15/21
Implement Facial Pose Detection	0%	3/15/21	3/28/21
Parallelize CV Code for GPU	0%	3/29/21	4/8/21
Design Review Slides	100%	3/4/21	3/7/21
Testing and Verification for CV Algorithms	0%	3/25/21	4/8/21
Implement Stretch Goals	0%	4/8/21	4/21/21
Slack Time	0%	4/22/21	5/1/21
Evann			
Finalize Initial Bill of Material	100%	2/22/21	2/24/21
Order Materials	100%	2/24/21	2/25/21
Setup Hardware	50%	3/5/21	3/10/21
Verify that I/O works	0%	3/10/21	3/14/21
Integrate CV application to run on Xavier board	0%	3/15/21	3/26/21
Optimize CV code	0%	3/26/21	4/1/21
Implement Speaker Output	0%	3/22/21	3/26/21
Implement Accelerometer Input	0%	3/27/21	4/3/21
Implement Stretch Goals	0%	4/4/21	4/19/21
Slack Time	0%	4/20/21	4/30/21
Final Presentation Slides	0%	4/28/21	5/2/21
Jananni			
Research into Machine Learning Classifier	100%	2/21/21	3/1/21
Create Test Data Set	0%	3/11/21	3/20/21
Explore AWS Cloud Processing	80%	3/8/21	3/14/21
Implement Machine Learning Classifier	0%	3/15/21	3/24/21
Optimize ML	0%	3/25/21	4/4/21
Create interface for Calibration Using Speaker	0%	4/4/21	4/10/21
Implement Calibration Code for CV	0%	4/8/21	4/16/21
Implement Stretch Goals	0%	4/8/21	4/19/21
Slacks Time	0%	4/20/21	4/30/21