Team B1: FocusEd Project Proposal

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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

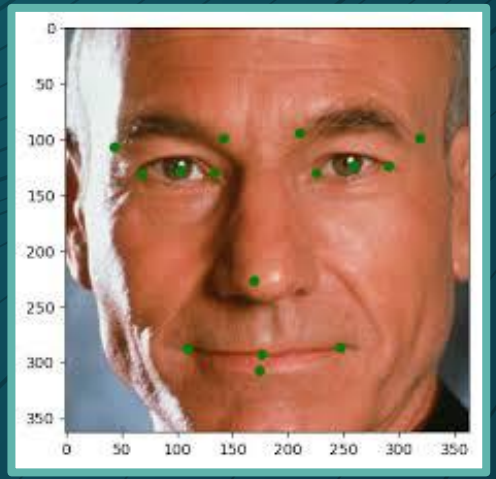
Use Case

- **Distracted Day Driving without eye obstruction**
  - Drowsiness
  - Texting
- **Improved Road Safety**
  - Corrects driver behavior to prevent accidents
- **Improved Driver Education**
  - Serves as a deterrent by alerting driver to refocus on road

Requirements (software)

- **Facial Detection**
  - **90% accuracy**
- **Facial Landmarking**
  - **90% points of interest accuracy**
- **Head Pose Estimator**
  - **85% estimation accuracy**
- **Eye Detection**
  - **90% accuracy**
- **Eye Classification (Open or closed)**
  - **90% accuracy**

- **Focus Timer (Eyes & Face Pose)**
  - Distraction vs normal driver movement
  - **80% accuracy**



Requirements (hardware)

- **Vibration Device**
  - Alert driver
    - **99% accuracy of vibration when alert received**
- **Power Supply**
  - On/off
  - Limit cables
  - Powered for 8-10 hours, charges overnight
- **Wireless Communication Capabilities**
  - Bluetooth
    - **90% alerts received**

Solution Approach

Facial Detection + Landmarking + Estimation

- Microprocessor
- Camera
- OpenCV + DLib

Eye Detection + Classification

- Microprocessor
- Camera
- OpenCV + DLib

Rechargeable Power Source

- For microprocessor and microcontroller

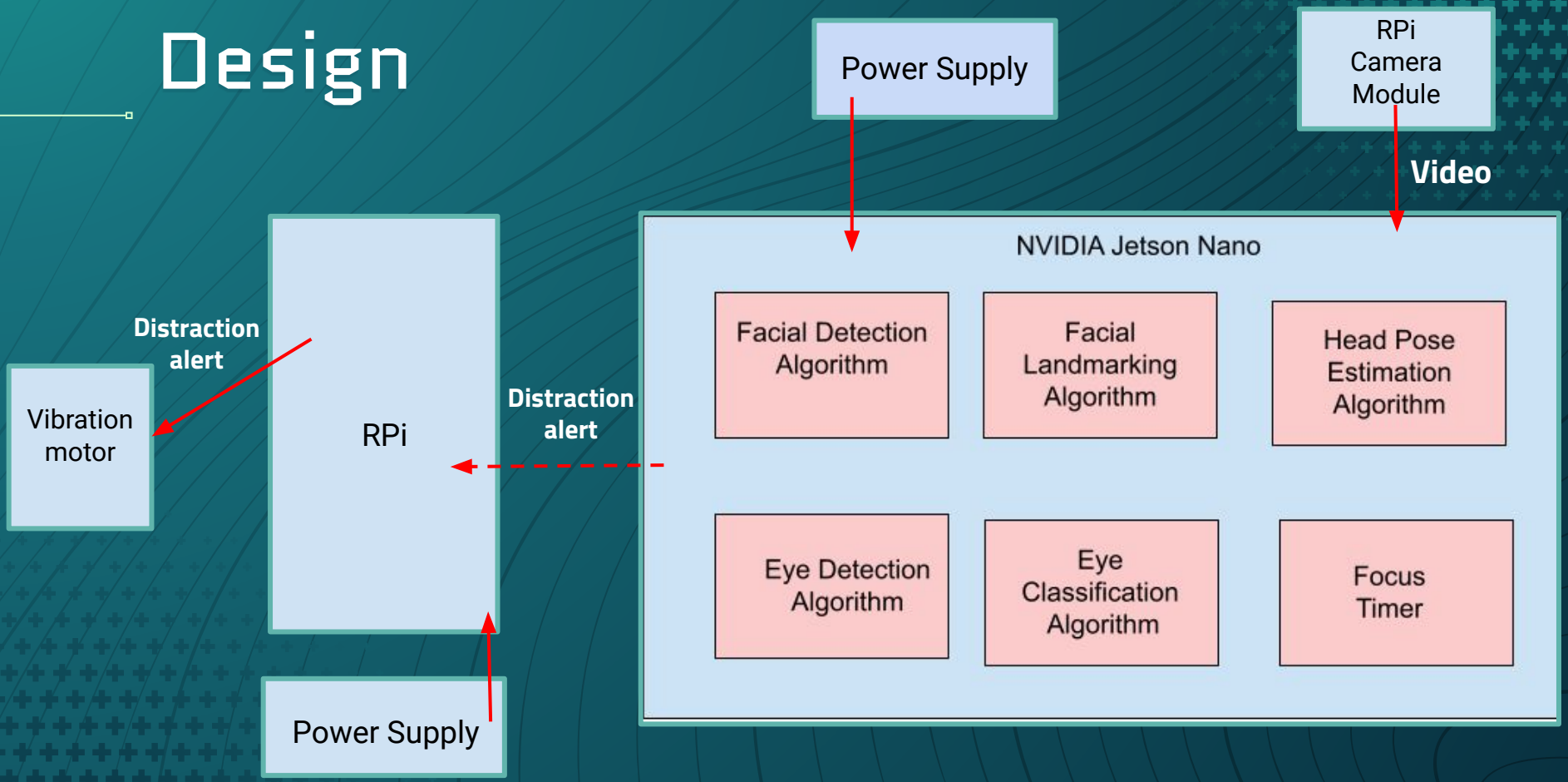
Vibration Device

- Microcontroller
- Vibration Motor

Wireless Communication

- Bluetooth

Design


Power Supply
RPi Camera Module
Video
NVIDIA Jetson Nano
Facial Detection Algorithm
Facial Landmarking Algorithm
Head Pose Estimation Algorithm
Eye Detection Algorithm
Eye Classification Algorithm
Focus Timer
Distraction alert
Distraction alert
Vibration motor
RPi
Power Supply

Technical Challenges

- Differentiating distracted driving from normal driving responses
- Communication between vibration device and microprocessor
- Efficient algorithm and image processing for as close to real-time

Testing, Verification, & Metrics

Requirement	Validation Method	Metric
Facial Detection	Verify face in various daytime lighting	90% facial detection accuracy
Facial Landmarking	Verify in various daytime lighting	90% points of interest detection accuracy
Head Pose Estimator	Verify in various daytime lighting	85% estimation accuracy
Eye Detection	Verify eyes in various daytime lighting	90% eye detection accuracy

Testing, Verification, & Metrics [cont]

Requirement	Validation Method	Metric
Eye Classification	Verify whether open/closed classification matches	90% eye classification accuracy
Focus Timer	Verify time interval classifies distraction vs normal	80% classification accuracy of distraction or normal
Vibration Device	Verify vibrates when detects distracted driver	99% accuracy of vibration when alert received
Power Supply	Verify hardware powered for day time and software runs automatically when turned on	RPi & Nano powered for 8-10 hrs Software starts/stops when on/off
Wireless Communication	Verify alert message received by RPi from Nano	90% alerts received

Division of Labor

Heidi

- Facial detection
- Facial landmarking
- Head pose estimation

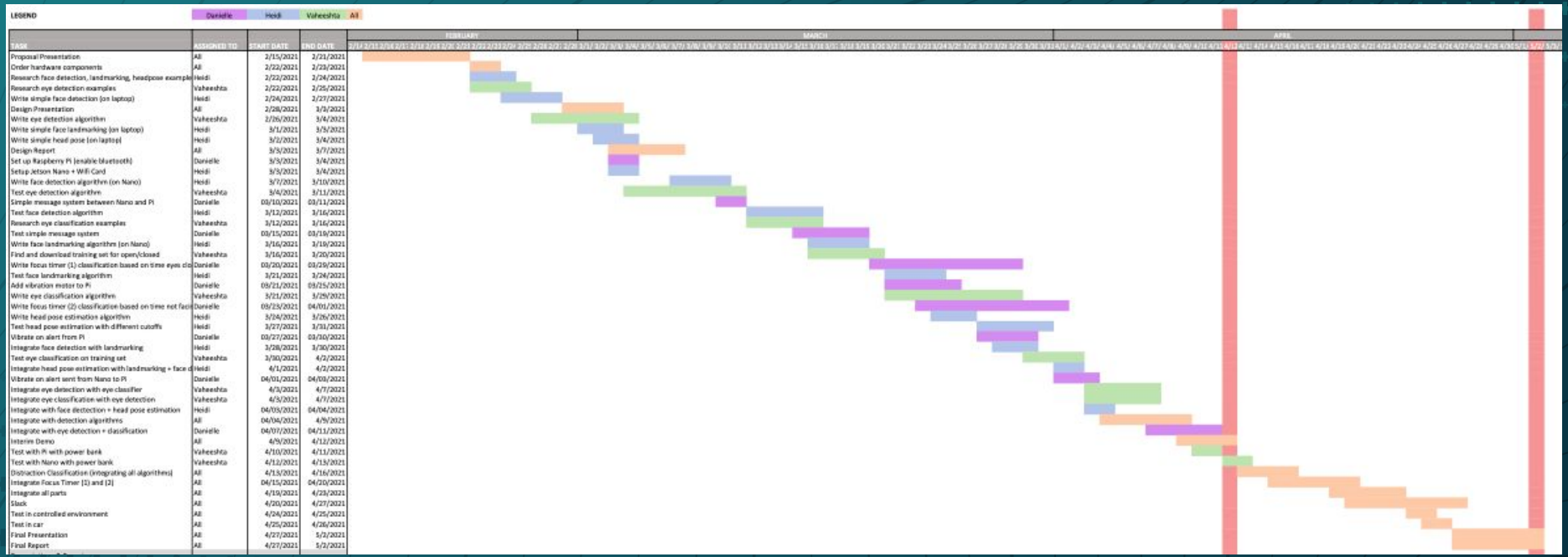
Vaheeshta

- Eye detection
- Eye classification
- Battery (RPi & Nano)

Danielle

- Focus Timer
- Vibration Device
- Wireless Communication

Gantt Chart



LEGEND: Danielle, Heidi, Vaheeshta, All

TASK	ASSIGNED TO	START DATE	END DATE
Proposal Presentation	All	2/15/2021	2/21/2021
Order hardware components	All	2/22/2021	2/23/2021
Research face detection, landmarking, headpose example	Heidi	2/22/2021	2/24/2021
Research eye detection examples	Vaheeshta	2/22/2021	2/25/2021
Write simple face detection (on laptop)	Heidi	2/24/2021	2/27/2021
Design Presentation	All	2/28/2021	3/3/2021
Write eye detection algorithm	Vaheeshta	2/26/2021	3/4/2021
Write simple face landmarking (on laptop)	Heidi	3/1/2021	3/5/2021
Write simple head pose (on laptop)	Heidi	3/2/2021	3/4/2021
Design Report	All	3/3/2021	3/7/2021
Set up Raspberry Pi (enable bluetooth)	Danielle	3/3/2021	3/4/2021
Setup Jetson Nano + Wifi Card	Heidi	3/3/2021	3/4/2021
Write face detection algorithm (on Nano)	Heidi	3/7/2021	3/10/2021
Test eye detection algorithm	Vaheeshta	3/4/2021	3/11/2021
Simple message system between Nano and Pi	Danielle	03/10/2021	03/11/2021
Test face detection algorithm	Heidi	3/12/2021	3/16/2021
Research eye classification examples	Vaheeshta	3/12/2021	3/16/2021
Test simple message system	Danielle	03/15/2021	03/19/2021
Write face landmarking algorithm (on Nano)	Heidi	3/16/2021	3/19/2021
Find and download training set for open/closed	Vaheeshta	3/16/2021	3/20/2021
Write focus timer (1) classification based on time eyes cl	Danielle	03/20/2021	03/29/2021
Test face landmarking algorithm	Heidi	3/21/2021	3/24/2021
Add vibration motor to Pi	Danielle	03/21/2021	03/15/2021
Write eye classification algorithm	Vaheeshta	3/21/2021	3/29/2021
Write focus timer (2) classification based on time not faci	Danielle	03/23/2021	04/01/2021
Write head pose estimation algorithm	Heidi	3/24/2021	3/26/2021
Test head pose estimation with different cutoffs	Heidi	3/27/2021	3/31/2021
Vibrate on alert from Pi	Danielle	03/27/2021	03/30/2021
Integrate face detection with landmarking	Heidi	3/28/2021	3/30/2021
Test eye classification on training set	Vaheeshta	3/30/2021	4/2/2021
Integrate head pose estimation with landmarking + face d	Heidi	4/1/2021	4/2/2021
Vibrate on alert sent from Nano to Pi	Danielle	04/01/2021	04/03/2021
Integrate eye detection with eye classifier	Vaheeshta	4/3/2021	4/7/2021
Integrate eye classification with eye detection	Vaheeshta	4/5/2021	4/7/2021
Integrate with face dectection + head pose estimation	Heidi	04/03/2021	04/04/2021
Integrate with detection algorithms	All	04/04/2021	4/9/2021
Integrate with eye detection + classification	Danielle	04/07/2021	04/11/2021
Interim Demo	All	4/9/2021	4/12/2021
Test with Pi with power bank	Vaheeshta	4/10/2021	4/11/2021
Test with Nano with power bank	Vaheeshta	4/12/2021	4/13/2021
Distraction Classification (integrating all algorithms)	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