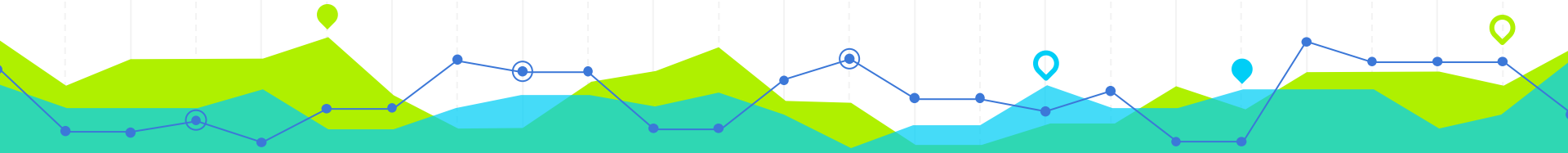
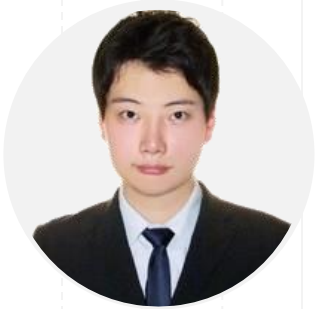


PRS First Project Presentation

Group 7

TEAM PRESENTATION



Hwang Sion

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Santi

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Agenda

- Project Objective
- Project Scope
- Data Required/Available
- Technical Approach
- Progress Update

Project Background

Year	Total Motor Vehicle Population	Accidents resulting in Casualties	Fatal Accidents	Fatality Rate per 100,000 persons
2010	945,829	8,808	188	3.80
2011	956,704	8,597	192	3.76
2012	969,910	8,184	162	3.16
2013	974,170	7,748	150	2.96
2014	972,037	7,959	150	2.83
2015	957,246	8,206	148	2.75
2016	956,430	8,417	140	2.51
2017	961,842	7,843	117	2.16
2018	957,006	7,810	120	2.20
2019	973,101	7,822	117	2.07

Figure 1. Year by Year motor vehicle casualties/fatal accident rate (EvlanovaAnastassia, 2021)

1. Chances of getting car accident have been drastically heightened.
2. Since 2020, cases of car accidents which cause injuries has been increased by 8.9%.
3. Between 2020 and 2021, annual increase of number of fatal accidents increased from 80 to 100.

Project Background

1. One of the biggest causes of the car accident in Singapore is 'Failing to keep proper lookout'.

2. There can be multiple external causes of distraction like phone, people sitting next to you, other cars passing by, and failure to lookout for slippery road etc.

3. Internal causes also exist, like fatigue due to prolonged driving.

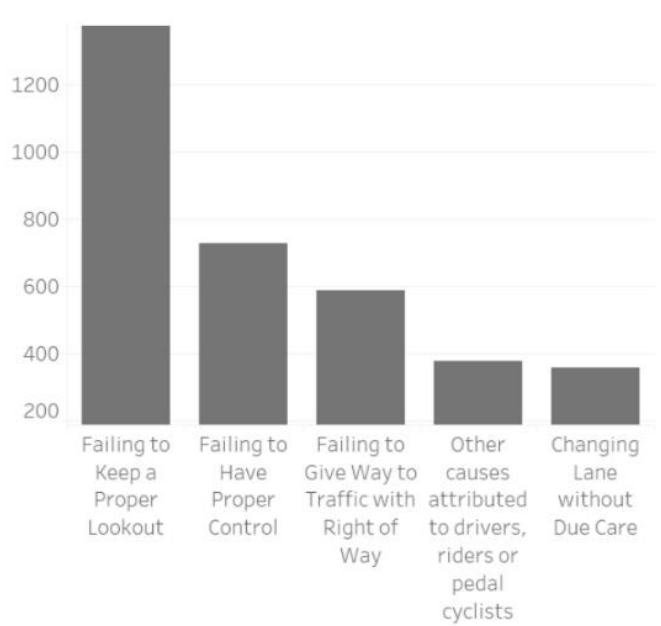


Figure 2. Top 5 Reasons for Car Accidents in Singapore (ShayedAmeer, 2020)

Project Objective

1. Create an MVP solution to detect driver alertness and provide an alert mechanism if there are some distraction or drowsiness detected that can be implemented in a lightweight device.

2. The alert can serve as reminder for driver to avoid accident due to drowsiness/distraction

Project Scope

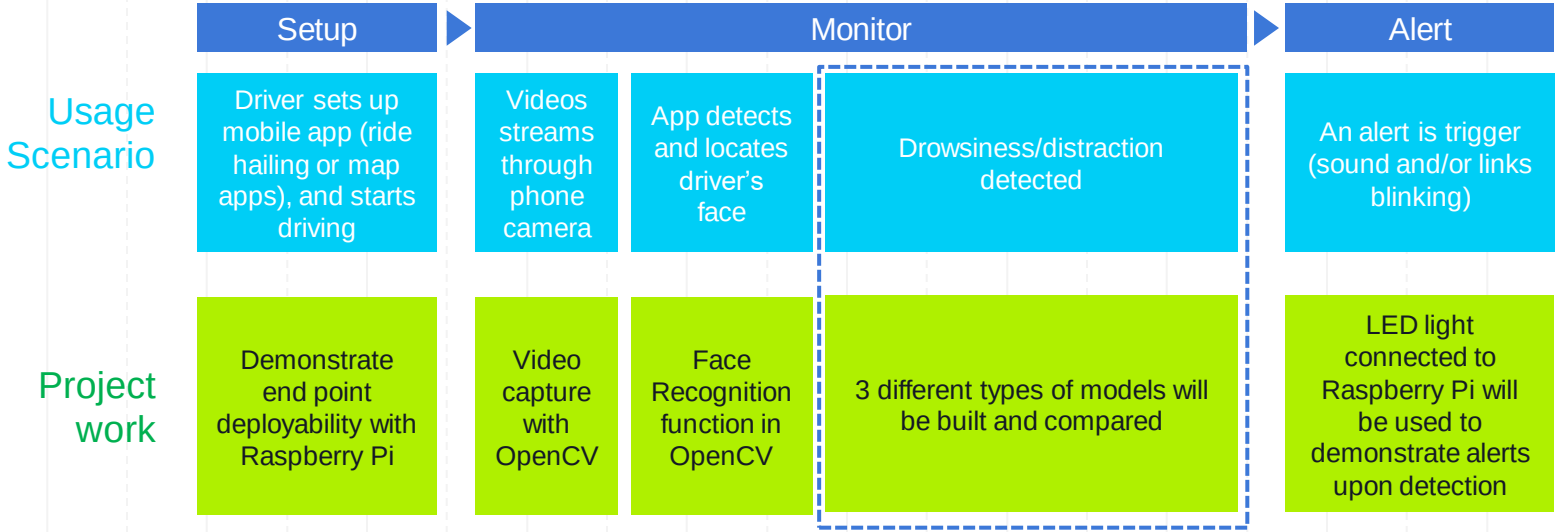
A driver alertness detection system that is deployed on end points.

The safety system should monitor the driver's video live-feed and issue alerts in real-time.

The safety system should not violate any privacy concerns arising from the continuous monitoring of the driver's video live-feed.

Only the driver's face should be considered by the computer vision model to detect signs of drowsiness and/or distraction.

System Design



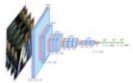
Data

Data Source	Description	Type	Data Size (No. of Samples)	Data Size
Nanjing University of Aeronautics and Astronautics – Closed Eyes In The Wild (CEW)	Dataset for eye closeness detection, consisting of subjects with both eyes open and closed. The dataset contains raw face images with background, cleaned face images, and images of eye patches only.	Images	2,423 subjects 1,192 subjects with eyes closed 1,231 subjects with eyes open	± 31.2MB
Kaggle.com	Fatigue face detection. The data consist of 3 classes – *Alert*, *Non-vigilant* and *Tired*	Images	3,124 (train) 393 (validation) 396 (testing)	± 1GB
Kaggle.com – State Farm Distracted Driver Detection Dataset	State-farm distraction dataset. The data consist of 10 classes such as normal driving, talking on the phone, texting, makeup, drinking and others.	Images	22,424 (training + validation) 79,727 (testing)	± 4.52 GB
University of Texas at Arlington – Real-Life Drowsiness Dataset (UTA-RLDD)	Real-life drowsiness dataset. Consists of videos recorded by 60 individuals, with each video being labelled into 3 classes – *Alert*, *Low vigilant* and *Drowsy*.	Videos	180 videos (10mins each, total ~30hrs)	± 111.3GB
National Tsing Hua University – Driver Drowsiness Detection Dataset	Dataset with 36 individuals in various simulated driving scenarios, including *normal driving, yawning, slow blink rate, falling asleep, etc.*, under day and night illumination conditions.	Videos	Training + Validation – 90 videos (1-1.5mins each, total 9.5hrs) Testing – 90 videos	± 7.45GB

Technique Comparison

There are many ways to be explored by team before deploy certain technique as product's MVP.

On the right are various technique that the team are exploring as well as multiple consideration points.

		Facial Feature	Facial expression and posture	Video classification
Model	Brief description	Using facial feature such as eyes and mouth.	Full facial expression and body posture to determine distraction	Using video frames with CNN for feature extraction and using LSTM for aggregation
	Model Type	CNN	CNN	CNN + RNN / LSTM
	Dataset	Images	Images	Video
FEATURE COMPARISON	Features			
	Model technique	Created & Training	Created + Transfer Learning	In Progress
	Compute requirement	In Progress	In Progress	In Progress
	Accuracy	In Progress	In Progress	In Progress
	Speed	In Progress	In Progress	In Progress
	Additional capabilities to be added	There are few additional capabilities that team are discussing to be added: 1. Off the shelf model to do facial recognition so that the end product will not be misidentified passengers as drivers 2. For model that recognise picture, there's a need to build the logic to avoid a moment of event being identified as drowsiness / distraction. e.g driver blinking. One example of implementation is to use few consecutive frames from video feed. 3. Alert mechanism, such as LED light or sound to notify driver		
TESTING	Testing Technique	Apart from model testing, the team intend to test with same sample that will be created. The team think this is important as the dataset and training for the 3 models are differents.		
	Result	In Progress	In Progress	In Progress
CONCLUSION	Economic value	In Progress	In Progress	In Progress
	Technical point	In Progress	In Progress	In Progress
	Summary	In Progress	In Progress	In Progress

Raspberry Pi Deployment (interim demo)

Demo video processing: Original video turned into grey scale.

LED Light Control: With python package *gpiozero*.

```python
import numpy as np
import cv2
from gpiozero import LED
from time import sleep

cap = cv2.VideoCapture(0)

led = LED(21)

while(True):
    led.on()
    sleep(0.1)
    led.off()
    sleep(0.1)

    ret, frame = cap.read()
    frame = cv2.flip(frame,1)
    gray = cv2.cvtColor(frame, cv2.COLOR.BGR2GRAY)
    cv2.imshow('frame', frame)
    cv2.imshow('gray', gray)
    if cv2.waitKey(1) & 0xFF == ord('q'):
        break

cap.release()
```

Progress Update

Task	Type	Status	%	Remark
Data gathering	Research	Completed	100%	Data from various sources had been collected [Refer to data page].
Proposal	Report	Completed	100%	Proposal completed and submitted
Model building and training for facial feature	Feature creation	In Progress	80%	Model framework for facial feature of eyes (open and close) and mouth (yawning) had been concluded, using CNN model creation
Model building and training for face and body posture	Feature creation	In Progress	60%	Model framework for facial expression and body posture are in progress. Various model with CNN had been tested as well as transfer learning from VGG16
Model building and training for video classification	Feature creation	In Progress	10%	Model framework for video classification with CNN + RNN is in progress.
Model deployment into client device	Feature creation	In Progress	5%	Some initial testing and research to deploy the model into lightweight device such as Raspberry Pi with tensorflow lite (tflite)
Comparison all model and testing	Testing	Not started	0%	The intention of the multiple model creation is to test and decide the best model or to combine more than one model in final deployment.
Final Report & Video Presentation	Report	In Progress	5%	Initial planning on video presentation & report outline

Challenges

- ✓ Huge dataset required higher compute power to test various model.
- ✓ Some dataset are harder to be used for training as it's cast doubts even for human eyes.

Next Steps

- ✓ Finalizing the model training.
- ✓ Finalizing the final testing criteria and conduct the testing.
- ✓ Deployment of the model to small device e.g Raspberry Pi
- ✓ Final Report
- ✓ Presentation video

THANK YOU!

Any questions?