

Hong Kong Student Science Project Competition 2023

Team Number: SAPE188

Project Title: 智駕勢 DriveFit

Project Type: Invention

To our best knowledge, there are similar works in the market.



Tesla Cabin Camera (<https://www.tesla.com/support/vehicle-safety-security-features#cabin-camera>)

Our enhancement:

1. Hugely increased available market and more straightforward use
2. Able to encourage safe driving awareness with gamification
3. More transparent data collection process with open-source app to address privacy concerns

Existing technologies / libraries used:

1. Flutter (<https://flutter.dev>)
2. Pub.dev (<https://pub.dev>)
3. BlazeFace (<https://arxiv.org/abs/1907.05047>)
4. Google ML Kit (<https://developers.google.com/ml-kit/vision/face-detection>)

I. Background

According to global statistics, inattentive driving is the leading cause of traffic accidents around the world, which results in an estimated 1.3 million annual deaths. Being drowsy is another significant factor. The AAA Foundation for Traffic Safety estimates that 328,000 drowsy driving crashes occur annually, comprising 9.5% of all crashes.

While an increasing number of mobile phones are installed in vehicles which are important for useful information and functionality, there are still a few challenges of ensuring safe driving:

1. Drivers are not fully conscious of their own driving fitness and attentiveness.
2. Drivers have limited incentive to practice vigorous safe driving measures as the consequences of inattentive driving are not as apparent to them.

II. Objectives

1. Detect instances of drowsiness and inattentiveness when driving and send live alerts
2. Build driver awareness of their own driving fitness
3. Educate and encourage safe driving within society, in order to reduce number of traffic accidents

III. Methodology

In DriveFit, inattentiveness is defined as: (i) Driver's head rotated left or right $> \sim 30^\circ$ for > 2.5 seconds. Drowsiness is defined as: (i) Driver's head tilted down $> \sim 20^\circ$ for > 1 second. (ii) Driver's eyes are closed for > 1 second. These values are still going to be refined throughout the development process.

We conducted preliminary testing by asking classmates to simulate driving positions with given prompts, with masks on or off. The trials were conducted in a bright room which could be turned into a dim environment to simulate driving in both daytime and night.

The classification accuracy (CA) and time required for alert was measured. Average reaction delay (ARD) was determined by comparing the alert time with the base warning delay coded in the application (i.e. 1 second and 2.5 seconds respectively). Standard deviation (SD) of reaction delay was also calculated.

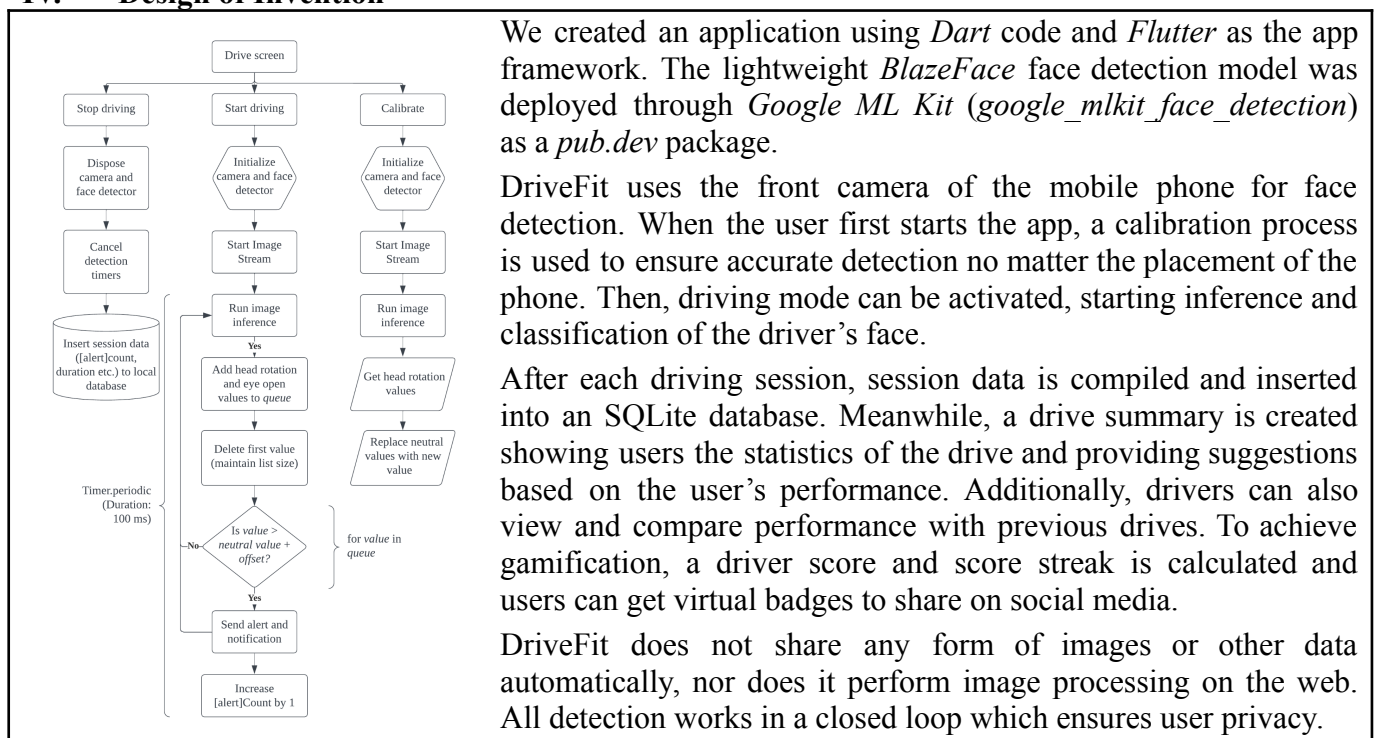
Preliminary results are summarized as follows and presented in order of CA (%), ARD (s) and SD.

Environment	Overall results (mask off):		
Bright	96.4%	0.553s	0.375
Dim	90.0%	0.623s	0.347

(Results for the mask on parameter are detailed in the report.)

Practical testing is also in progress. DriveFit was installed in a few users' vehicles and a short drive was conducted to test the reliability and accuracy of detection. From preliminary feedback, most users showed satisfaction with the app, commenting that it was "simple and useful in reducing traffic accidents".

IV. Design of Invention



V. Application / Market Need

DriveFit is designed to be free for ALL drivers, but it is especially beneficial to drivers who frequently drive for extended periods of time, such as commercial truck or taxi/uber drivers, as they fatigue more easily. DriveFit helps drivers build awareness of their own driving fitness with appropriate alerts, reports and suggestions for improving driving fitness.

DriveFit also complements existing safe driving measures. The use of mobile communication devices while driving is strictly regulated in a lot of places such as Mainland China, the United States and Japan. In Hong Kong, it includes the hands-free driving law and the proposed 2-device cap on car dashboards (<https://www.legco.gov.hk/yr2022/english/panels/tp/papers/tp20220715cb4-629-1-e.pdf>). DriveFit stays true to their original intentions. It is designed to run passively, and users can choose to turn off the live camera preview for better focus, while still being able to receive alerts.

Finally, DriveFit fills the technology gap between old vehicles and new vehicles. We have noted that a small number of modern vehicles (e.g. Teslas) have in-built cameras detecting driver attentiveness and giving alerts. However, a lot of drivers do not own these types of vehicles and there is still a privacy concern regarding these cameras. By making a mobile app, we hugely increase the available market.

Besides, we do not store any image or video in our app, and all image recognition processes are done on-device. DriveFit is also open-source, to increase transparency of how user data is collected and used, thus building more trust in the user base.

VI. Sustainable Development Award

DriveFit is related to goal 3 “Good Health and Well-Being” and goal 11 “Sustainable Cities and Communities”. In particular, one of the targets of goal 3 is to “halve the number of global deaths and injuries from road traffic accidents by 2020” (<https://www.un.org/sustainabledevelopment/health/>), and for goal 11, to create safe communities for everyone.

These two goals match the objective of DriveFit - to promote safe driving. By reminding the drivers to keep their eyes on the roads, DriveFit can reduce the chance of casualty-causing traffic accidents from happening, making it safer for drivers, pedestrians and other people to use the roads. Other than sending alerts, DriveFit also encourages drivers to build a safe driving attitude by giving relevant suggestions to them and creating friendly competition by gamification.

We believe DriveFit will be an effective way to achieve the aforementioned goals. It is a free application available for everyone, providing the general public a simple-to-use application to help them drive safely at little to no cost.

VII. Social Innovation Award

It is estimated that there are around 180,000 professional drivers in Hong Kong, in which a majority of them have to drive for a long period of time as part of their job. Studies have shown that long periods of driving does correlate to increased traffic accidents. In fact, taxis and lorries together are accountable for 32% of the traffic accidents in 2021 in Hong Kong. We believe DriveFit can act as a tool to safeguard the safety of the professional drivers.

Driving for a long period of time will make drivers drowsy and distracted from the roads. When this happens, DriveFit will remind drivers to focus and drive safely. Moreover, relevant safe driving suggestions will be provided, letting drivers understand the importance of safety on roads.

DriveFit can be set up in most of the professional drivers’ cars for free using their existing mobile phones and phone holders. Thus, DriveFit can leverage the mobile phone use of these drivers to obtain navigation info or cab-calling features, while safeguarding their safety. We believe DriveFit will be an effective way to promote safe driving to the professional drivers, and bring subsequent benefits to different shareholders. This includes the drivers themselves, who can prevent injuries from accidents, their employers, who do not have to bear the economic loss from accidents, and more.

VIII. Conclusion

According to user feedback, most users consider DriveFit simple and effective, meeting our objectives of this project. In the near future, we hope to further broaden the use cases with our app, e.g. in driving schools, and add even more functionality in DriveFit to meet safe driving goals such as crash detection emergency response system or offering voice control for various actions.

