**Group 6 Project Proposal**

**Project Title**: Driver drowsiness detection using deep learning

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1. **Introduction**

The primary motivation for choosing this topic is to apply deep learning concepts and techniques we learn in the class to a real-life problem with practical use.

Drowsiness is identified as one of the major causes of fatal traffic accidents. Unfortunately, about 20% of drivers tend to show drowsiness while driving, reported by National Safety Council[1]. This project aims to build a deep learning-based real-time drowsiness detection system that will contribute to improving road safety.

1. **Materials and Methods**
   1. Approaches

Drowsiness detection is a supervised binary classification task. We plan to design and implement a deep network consist of one or multiple CNN-based deep networks that may include but not limited to ResNet, VGG-FaceNet[7], InceptionV3, AlexNet[6], FlowImageNet[8] as recommended in some similar works[2][3].

We will train multiple networks separately and ensemble good performing networks to cover all necessary features essential to detect drowsiness[4].

* 1. Models to be used

As listed in section 2.1, we will focus on training various CNN-based networks. CNN is commonly used to analyze visual imagery, compared to Fully Connected network(FNN),

CNN has the advantage of params sharing and partial connection, as a result, the efficiency of CNN is greatly appreciated.

As pointed out by previous works[5], eye-based methods and mouth-based methods are the two main categories of drowsiness detection methods. We plan to cover both aspects by using multiple networks.

AlexNet is fine tuned to learn features related to drowsiness. The VGG-FaceNet is trained to learn facial features related to drowsiness, which is robust to genders, ethnicity, hairstyle and various accessories adornment. FlowImageNet takes a dense optical flow image extracted from consecutive image sequences and is trained to learn behaviour features related to drowsiness, such as facial and head movements. We are going to apply a transfer-learning approach to our model using one of the above mentioned pre-trained models. We will plan on using the below proposed system architecture in figure 1 as a guideline to complete this project. More so, we will consider different levels of drowsiness according to table 2 below for our final classification or output.

* 1. Dataset to be used

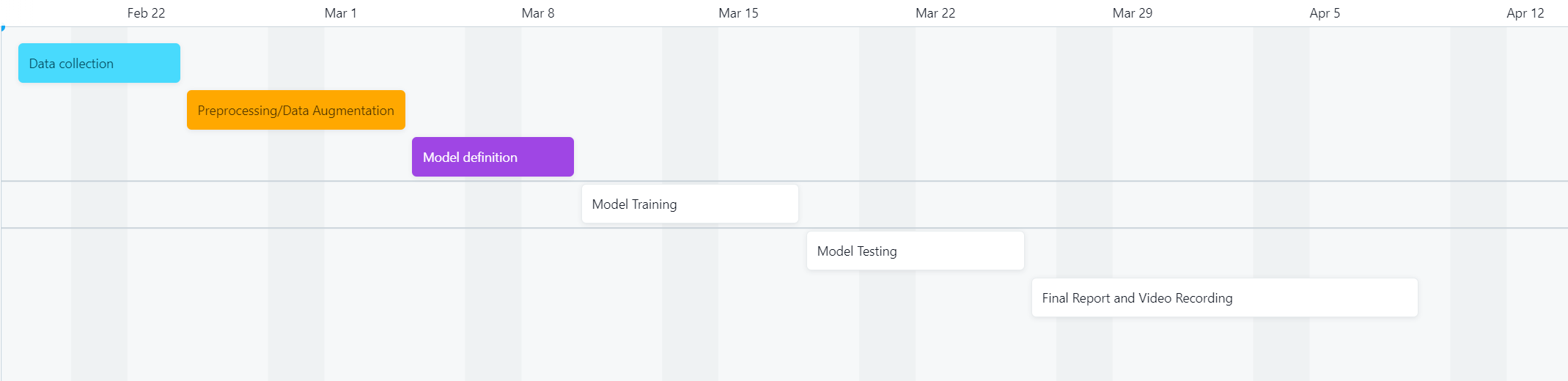
We have several existing datasets found on various sources, including six image datasets from [Kaggle](https://www.kaggle.com/search?q=drowsiness+detection+in%3Adatasets) and one video dataset from [NTHU](http://cv.cs.nthu.edu.tw/php/callforpaper/datasets/DDD/)[9]. Another publicly available data set is MRL Eye Dataset which we will be using to train our model.These samples are collected from 37 subjects with/without glasses for both left and right eye. MRL eye dataset is based on manually cropped on manually eye region images that is perfectly appropriate for our proposed CNN model. Alternatively, we are also prepared to build our own dataset by OpenCV to capture real time dataset to be used to train our model.

* 1. Metrics to be computed

Since this is a classification task, the most critical metric to tune hyperparameters and to represent training/validation score is accuracy. We will still record other classification metrics such as accuracy, precision, recall, F1-score, ROC, and AUC[10].

We will use Categorical Cross Entropy (CCE) as a metric in the loss function. We would also be comparing the accuracy of different pretrained models applied in the transfer learning approach model.

**3.0 Project Timeline**

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|  |  |
| --- | --- |
| **Task** | **Team Member** |
| Data Collection | Tianhan Jiang, David Laditan, Yuhua Guo, Peiyun Zhao |
| Preprocessing and Data Augmentation | Peiyun Zhao, Yuhua Guo |
| Model Definition | David Laditan, Tobi Lawal, Peiyun Zhao |
| Model Testing | David Laditan, Peiyun Zhao |
| Final Report and Video Recording | Tobi Lawal, Tianhan Jiang, David Laditan, Peiyun Zhao,Yuhua Guo. |

**Figures and Tables**

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**Figure 1. Our Proposed System Architecture**

|  |  |
| --- | --- |
| **SYMPTOM** | **OUTPUT** |
| Eye Open, No yawning | No drowsiness |
| Frequent Blinking, no yawning | Less Drowsiness |
| Eye Closed over 1.5 seconds | Drowsiness |

**Table 2: Level of Drowsiness**

**References**

[1] Drivers are falling asleep behind the wheel, National Safety Council. <https://www.nsc.org/road/safety-topics/fatigued-driver>

[2] Vijayan, Vineetha, and Sherly, Elizabeth. "Real Time Detection System of Driver Drowsiness Based on Representation Learning Using Deep Neural Networks." Journal of Intelligent & Fuzzy Systems 36.3 (2019): 1977-985. Web.

[3] Park, Sanghyuk, Pan, Fei, Kang, Sunghun, and Yoo, Chang D. "Driver Drowsiness Detection System Based on Feature Representation Learning Using Various Deep Networks." Computer Vision – ACCV 2016 Workshops 10118 (2017): 154-64. Web.

[4] Dua, Mohit, Shakshi, Singla, Ritu, Raj, Saumya, and Jangra, Arti. "Deep CNN Models-based Ensemble Approach to Driver Drowsiness Detection." Neural Computing & Applications (2020): Neural Computing & Applications, 2020-07-20. Web.

[5] Zhao, Lei, Wang, Zengcai, Zhang, Guoxin, and Gao, Huanbing. "Driver Drowsiness Recognition via Transferred Deep 3D Convolutional Network and State Probability Vector." Multimedia Tools and Applications 79.35-36 (2020): 26683-6701. Web.

[6] Krizhevsky, A., Sutskever, I., Hinton, G.E.: Imagenet classification with deep convolutional neural networks. In: NIPS, pp. 1097–1105 (2012)

[7] Parkhi, O.M., Vedaldi, A., Zisserman, A.: Deep face recognition. In: BMVC, vol. 1, p. 6 (2015)

[8] Donahue, J., Anne Hendricks, L., Guadarrama, S., Rohrbach, M., Venugopalan, S., Saenko, K., Darrell, T.: Long-term recurrent convolutional networks for visual recognition and description. In: CVPR, pp. 2625–2634 (2015)

[9] Weng, Ching-Hua, Lai, Ying-Hsiu, and Lai, Shang-Hong. "Driver Drowsiness Detection via a Hierarchical Temporal Deep Belief Network." Computer Vision – ACCV 2016 Workshops 10118 (2017): 117-33. Web.

[10] Bhargava Reddy, Ye-Hoon Kim, Sojung Yun, Chanwon Seo, Junik Jang.

“Real-time Driver Drowsiness Detection for Embedded System Using Model Compression of Deep Neural Networks” Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR) Workshops, 2017, pp. 121-128

**Member Contributions**

Each member had a different task and completed various sections of this proposal, and the workloads are distributed equally.

The table below roughly summarizes the contribution of each member followed by individual score:

|  |  |  |
| --- | --- | --- |
| **Team members** | **Contribution** | Score |
| Guo, Yuhua | Models to be used section | 3 |
| Jiang, Tianhan | Stub version of proposal and approaches to be used section | 3 |
| Laditan, Oluwapelumi David | Metrics to assess the result section | 3 |
| Lawal, Tobi | Dataset to be used section | 3 |
| Zhao, Peiyun | Visualize the tables and figures section. | 3 |