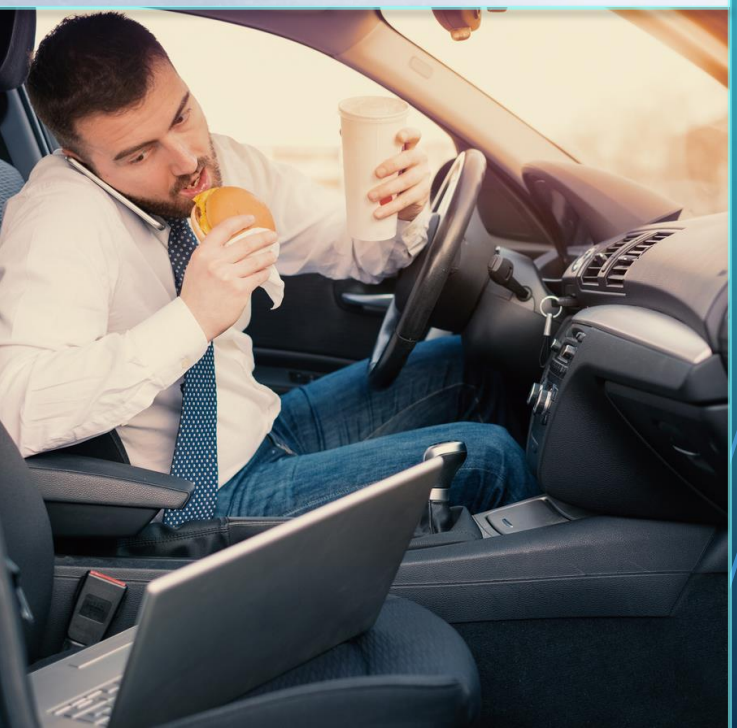
EYES ON THE DRIVER:

A MACHINE LEARNING APPROACH TO DISTRACTED DRIVING

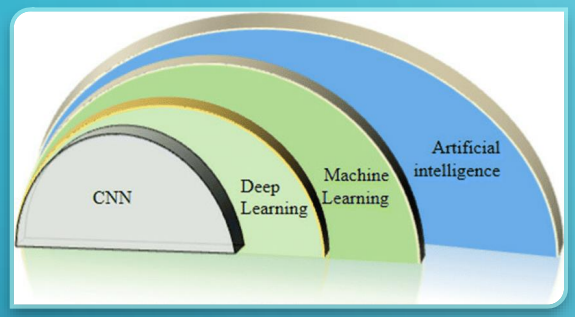
BY LEGOLAS ZHANG

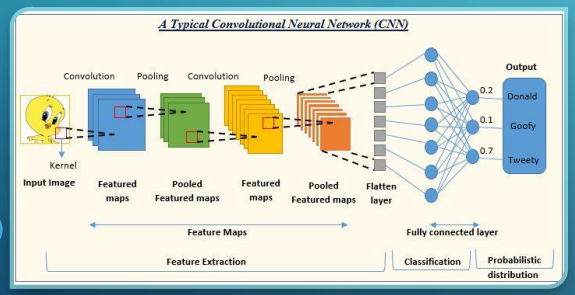


WHY

- More than 20% of fatal collisions in Canada are caused by distracted driving (CACP)
- 80% of surveyed drivers admit to being distracted while driving (CAA)
- Police can’t handle growing numbers of distracted drivers
- AI can help by quickly detecting distracted driving.

GOALS





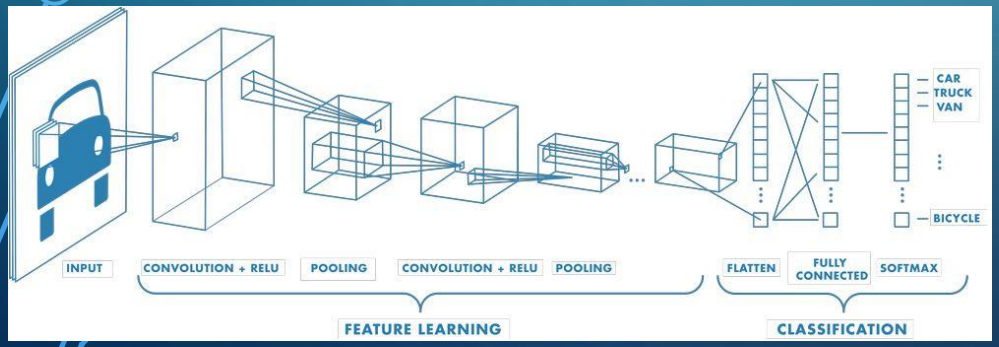
- Develop a prototype Convolutional Neural Network (CNN) for detecting distracted driving, as a proof of concept before implementation in real vehicles
- Create a lightweight and efficient enough CNN to run without specialized hardware
- Make the CNN accurate, even under challenging conditions

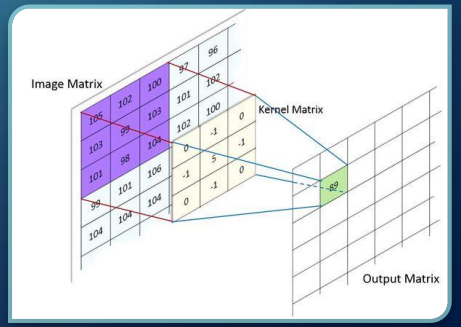
DATASET AND TOOLS

- Trained and tested with State Farm 2021 Distracted Driving Dataset of over 13,000 images
- Platform: Tensorflow Keras to build, train, and test the model itself
- Python Libraries: Numpy, Matplotlib, cv2
- Data analysis and visualization: Seaborn
- Server to run CNN program: Google Colab

WHAT IS A CNN

- A network architecture for deep learning
- Mimic how human visual cortex works to interpret visual data with entire images
- CNNs have series of layers to detect different characteristics of input images
- Best for image processing and analysis with higher accuracy and shorter test time than traditional methods



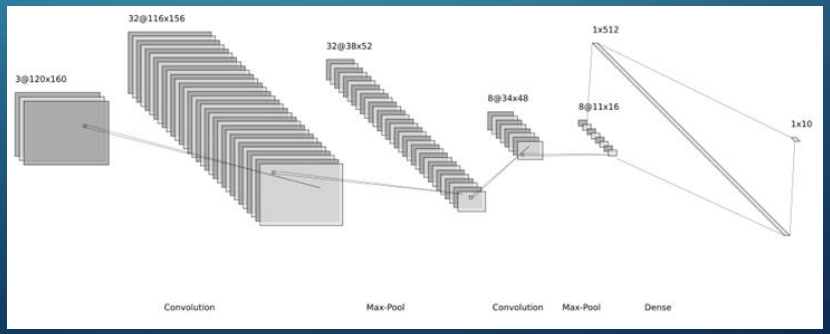


CNN DEVELOPMENT

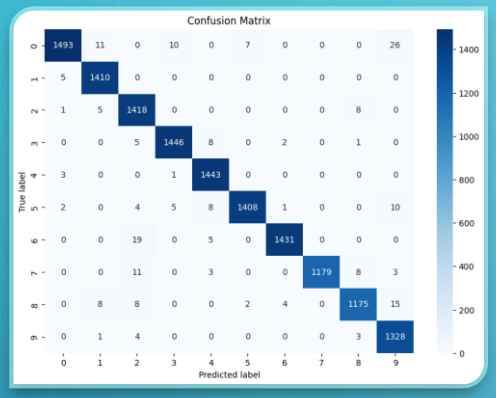
- **PRE-CNN**
  - Created linear regression model for initial testing, to make sure CNN was best candidate
  - Experimented with Perceptron model to gain insight into how images are classified
- **INITIAL CNN**
  - Created simple CNN for initial testing
  - Added visualizations to look inside CNN

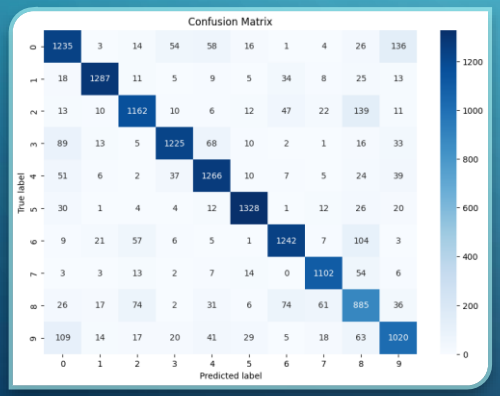
CNN DEVELOPMENT (CONT.)

- **FINE-TUNED CNN**
  - Decided on number of parameters and layers with consideration of accuracy and speed
  - Trade-off between performance and cost (computer speed and memory)
  - Refined and tweaked using visualizations from previous models



RESULTS & ANALYSIS

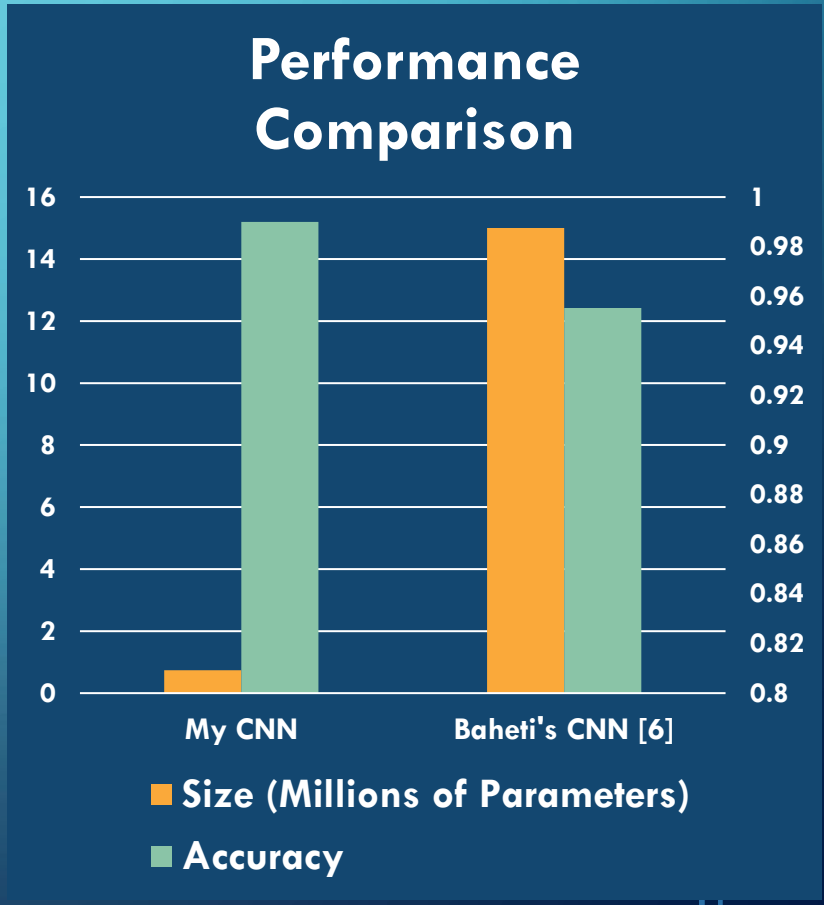




- Without transformations, CNN achieves around 99% accuracy
- With transformations, CNN achieves 86% accuracy
- Final model size: 2.8 MB

CONCLUSION

- CNN works with high accuracy and efficiency
- Compared to other CNN models, lightweight with favorable accuracy
- In challenging conditions, still works well but with reduced accuracy



PROS AND CONS

- Pros:
  - Lightweight
  - Accurate
  - Fast enough to detect in timely manner
  - Economic design provides great potential for integration into real cars
- Cons:
  - Accuracy drops with challenging conditions
    - Static
    - Rotation
    - Shift

WHAT'S NEXT

- Extend the algorithm to accept and analyze facial images to improve accuracy
- Explore the opportunity to embed this lightweight CNN in real driving assistance systems with webcams