CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

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Project Number

J1401

Project Title

Using Machine Learning and Infrared Imagery to Detect Drunk Drivers

Abstract

Objectives

Our goal was to develop an effective technique utilizing the power of artificial intelligence (AI) to prevent millions of alcohol-related crashes and save countless lives. We hypothesized that a convolutional neural network (CNN) could be developed and trained with infrared (IR) thermal images of the faces of drunk and sober individuals to estimate their blood alcohol content (BAC) within a margin of error of ±0.01%.

Methods

We designed and built a convolutional neural network, a widely used AI technique that specializes in image recognition, then wrote a script to parse the images and train the network using an open-source database. The program is written in Python 3.6. It uses Tensorflow.Keras to train and test the model along and NumPy for data processing. We varied learning rates (0.00005 to 0.0002), epochs (15 to 25 iterations), and the number of images (1024 to 4096) to optimize the accuracy of the model.

Results

We found that the learning rate had the most significant impact on accuracy. The model s peak accuracy improves with increasing number of epochs and images. While the higher number of images and epochs, and lower learning rates improve the peak accuracy, these conditions lead to longer training times. Although the larger learning rates (0.0002-0.0001) yield higher accuracies (97.5% or ±0.0043% BAC), the network diverges with a larger number of training images. At lower learning rates (0.00065-0.00005), the models behave more predictably and show more consistent trends. However, due to slower convergence, the models with lower learning rates require more training images to hit peak accuracy, reaching 94.5% with 4096 images (or ±0.0094%). If the model had been trained on more epochs and images, it would have achieved a peak accuracy greater than 97.5%. We also observed that the quality of the training data set has a significant influence on the end results, as an unbalanced ratio of sober to drunk images can lead to overfitting.

Conclusions

We developed an AI technique that can determine the blood alcohol content of an individual accurately with only an IR image. The consistently high accuracy of our neural network model proves that our hypothesis and exceeded our initial goal of achieving ±0.01% BAC margin of error. This technique can be developed into a smartphone app to provide accurate and fast results to replace the existing breathalyzers and blood tests used by law enforcement and doctors. Ultimately, automobile manufacturers could integrate IR cameras and our AI model in their cars to prevent drunk drivers from making it onto the road, saving countless lives.

Summary Statement

Our project uses artificial intelligence powered by a CNN to accurately and instantaneously estimate the BAC of a person from an IR thermal image of the face, achieving 97% accuracy. Millions of lives could be saved by using this technique.

Help Received

We got help in understanding the effect of alcohol on body heat through an online research paper published by Dr. Hermosilla s group from the University of Santiago in Chile. We designed and tested the machine learning model and program by ourselves.