CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

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Project Number

S0422

Project Title

Building a Smartphone Application to Test Alertness before Drivers Take the Wheel

Abstract

Objectives/Goals

According to the National Highway Traffic Safety Administration (2013), more than 10,000 people die each year in alcohol-impaired and drowsy driving crashes. To prevent such fatal accidents, my goal is to create a smartphone application to check mental agility and motor skills BEFORE a person takes the wheel. The app identifies key biometrics that measure the sobriety/drowsiness of drivers and maps them to smartphone features for instant and accurate detection of alertness.

Methods/Materials

The app analyzes 3 biometrics: vocal, cognitive, and balance abilities. It then compares the results to pre-recorded baseline data and suggests whether a person should drive.

To test for balance, I devised an algorithm to check the balance of a person walking 9 steps heel to toe. It uses the OrientationSensor on the Android phone to collect motion data along the 3 coordinate axes. I tested this 1) when the user was alert 2) when the user wore goggles simulating inebriation 3) when the user was drowsy.

For cognitive ability, I coded a game to test the subject's reflexes. I tested on subjects 1) while sober 2) while wearing "inebriated" goggles 3) while drowsy.

To test for voice, I conducted two tests--one to measure slurring with the Google Speech Recognition API, and one to detect the volume of a person's voice using an algorithm integrating the AudioRecorder and FFT libraries. I tested on subjects 1) while awake 2) while drowsy.

To test the impact of inebriation on voice, I used the ALC Corpus database, which provided voice samples of sober and intoxicated persons. I ran these samples through the same voice algorithm.

Results

I found that a person's balance was 3x as worse when "inebriated" than "sober." Also, 90% of my subjects deviated from their balance by 44% more than they did when drowsy.

The reflex test showed that 75% of my subjects scored worse while "inebriated." 60% of my subjects scored worse on the reflex test while drowsy. From the slurring and volume tests, I found that pronunciation accuracy decreased by 40% for all subjects while volume decreased by about 20%. After testing samples from the ALC Corpus, I found that 66% of these samples showed a decrease in volume when inebriated.

Conclusions/Discussion

This experiment was successful in identifying the right biometrics for measuring inebriation/drowsiness through an intuitive smartphone app.

Summary Statement

This project uses smartphone capabilities to analyze the impact of inebriation or drowsiness on its user to detect alertness before driving.

Help Received

Advised and guided by John Shelby (Computer Science Dept Chair at Homestead), friends and family that I tested on, ALC Corpus Database for inebriation samples, parents for purchasing hardware and testing goggles