Drowsy Driving Detection System
EE2 Year Project Group 6

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1. Introduction

Background:
- 53 fatal and 351 serious crashes(UK, 2017)[1];
- One in eight (13%) UK drivers admit falling asleep at the wheel[1];
- 89.29% people insisted drowsy driving is a serious issue;

Aim:
- Prevent drowsy driving, alert the driver when they fall asleep;
- Keep cost low, accessible and cheap for consumer and vehicle manufactures to install;

Solution:
- Blinking Detection;
- Steering Detection;

Market:
- 30% drivers: Price < 50 Pounds
- Other 28.57% drivers: No budget limits
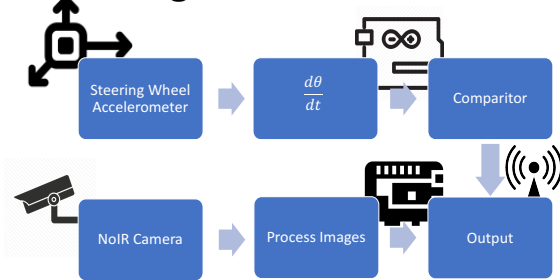
2. High Level Interface

Figure 1 High Level Interface Flow Chart

- Data and images are collected by sensors;
- Input information is processed and compared;
- Output is displayed by Raspberry Pi;

3. Steering Accelerometer

Accelerometer
- Find horizontal & vertical component of gravity
- Outputs DC voltage

Microcontroller
- DC input values to binary digital
- $\tan^{-1}\frac{y}{x} \rightarrow$ steering wheel angle
- Send data to transmitter

RF Modules
- Transmits the steering wheel angle using ASK
- Receives ASK data

Microcontroller
- Converts ASK data back to standard binary.
- Sends data via serial port to Raspberry pi.

Raspberry Pi
- Processes incoming data to detect jerky wheel movement

Figure 2 Flow Chart of Steering Accelerometer System

- Accelerometer sensor find the relative G-force acting through the vertical and horizontal axis of the steering wheel.
- This data is inputted to a microcontroller and converted to a digital numeric value. Next the arctangent of the ratio of the y and x value is calculated. This finds the angle of the steering wheel.
- This data is transmitted to the Raspberry Pi using two RF (radio frequency) modules.

4. Blinking Detection Algorithm

Eye Aspect Ratio: $EAR = \frac{|P_2-P_6|+|P_3-P_5|}{2*|P_4-P_1|}$
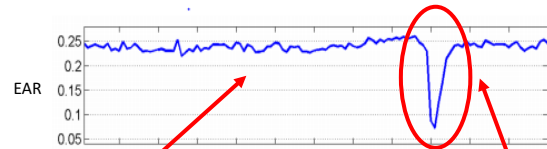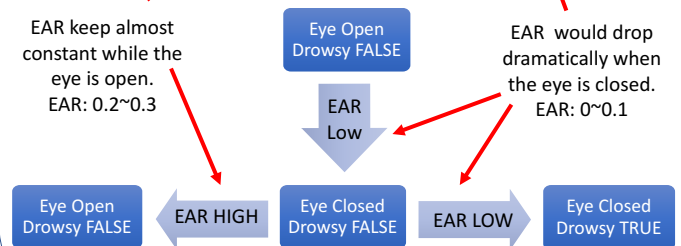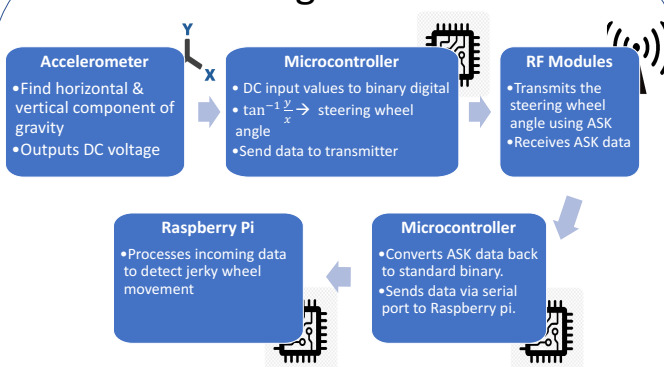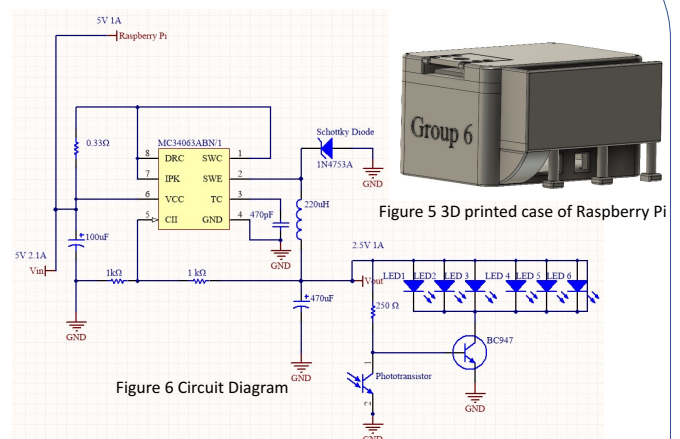

Figure 3 EAR landmarks[2]

Figure 4 EAR plot for several frames[2]

EAR keep almost constant while the eye is open. EAR: 0.2~0.3

EAR would drop dramatically when the eye is closed. EAR: 0~0.1

Eye Open Drowsy FALSE → EAR Low →

Eye Open Drowsy FALSE ← EAR HIGH ← Eye Closed Drowsy FALSE ← EAR LOW → Eye Closed Drowsy TRUE

Blinking Detection Accuracy: **94%** [3]

5. Blinking Detection Circuit

Figure 6 Circuit Diagram

Figure 5 3D printed case of Raspberry Pi

- Power Supply: 5V and 2.1A for Raspberry Pi and Infrared LEDs;
- BUCK Converter (MC34063): Decrease voltage to 2.5V to reduce power dissipation due to heating and improve efficiency;
- Phototransistor: Switch the circuit on in the dark;

Reference

[1] AA Charitable Trust, (2018 Nov) "Don't let tiredness creep up on you", *AA CHARITABLE TRUST LAUNCHED NEW DROWSY DRIVER CAMPAIGN,* Available: https://www.theaa.com/about-us/newsroom/aa-charitable-trust-launches-drowsy-driving-campaign [Accessed: March 13]

[2] L. Čehovin, R. Mandeljc, V. Štruc (eds.) R. Toplice, (2016, Feb) "Real-Time Eye Blink Detection using Facial Landmarks", *21st Computer Vision Winter Workshop,* Slovenia, February 3–5, 2016, Available: http://vision.fe.uni-lj.si/cvww2016/proceedings/papers/05.pdf [Accessed: March. 13]

[3] T. Danisman, L. M. Bilasco, C. Djeraba, N. Ihaddadene, (2010, Oct), "Drowsy Driver Detec-tion System Using Eye Blink Patterns", *International Conference on Machine and Web Intelligence (ICMWI 2010),* Alger, Algeria, pp.230-233, Available: https://www.researchgate.net/publication/251970873_Drowsy_driver_detection_system_using_eye_blink_patterns [Accessed: March. 13]