

Driving Monitoring Steering Wheel

Nicholas Antoniades

2022

Table of Contents

1. Project Summary
2. Key Requirements and Assumptions
3. System Overview
4. Concept Creation
5. PCB Design

Project Summary

As part of an Innovate UK funded project starting 1st May 2021, Fuell is exploring the feasibility of recording heart rate variability (HRV) data of a driver in a vehicle using bipotential recording directly from the steering wheel. This poses a number of challenges for development, particularly in dealing with electromagnetic interference which would be inherent to such a system, as well as expected noise and signal ‘down time’ as the driver moves their hands along and at times off the steering wheel.



Key requirements & assumptions

A basic Proof of Concept (PoC) to demonstrate the principle of operation must also be developed. It is expected that this PoC will be functional under idealised conditions, meaning that the environment of operation will be as low-ambient-noise as can be achieved and that the user is expected to maintain a static grip on the steering wheel to minimise movement artefacts. The functionality, usability and practicality of the steering wheel electrodes will be the main focus of the work package and account for the remaining effort to be allocated after the initial research phase.

The steering wheel rig and electronics system will be basic, incorporating a simple R-peak extraction algorithm and a standard HRV calculation from this metric. A Steering wheel mounted Raspberry Pi with an accompanying screen is initially proposed, acting as a user display for the demo. This will display data stored locally on the device, removing any reliance on wireless connectivity or cloud infrastructure.

Goals

- 1) Research vehicle ambient and driver-movement noise within the expected application setting, exploring prior literature and possibly running experimentation in order to better understand the size of the challenge.
- 2) Develop a PoC demonstrator comprising of
 - a) Steering wheel cover versions demonstrating different electrode technologies that may be incorporated into future products.
 - b) Simple steering wheel test rig for tabletop surface placement.
 - c) Biopotential capture electronics and simple user display, powered by a standard rechargeable Lithium-Ion battery.
 - d) Simple R-peak extraction feature and HRV calculator.

Things to be considered

1. The position of the hands on the steering wheel.
2. Rotation of the steering wheel.
3. The number of hands on the steering wheel.
4. EM and vibration noise.
5. Moisture and humidity.
6. How much pressure is being applied?
7. Electro Conductive materials and long term UV exposure

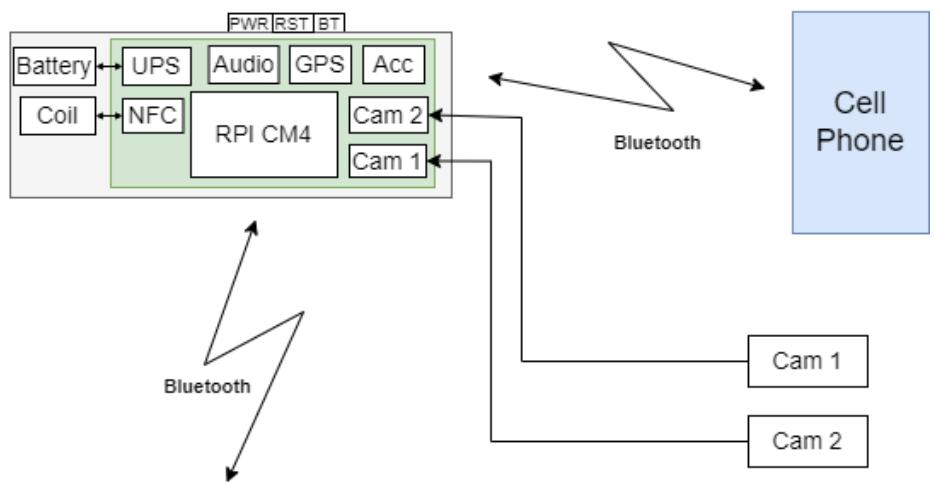
Hardware Requirements

1. ECG
2. Accelerometer
3. Force sensors
4. Real Time display of data

System Overview

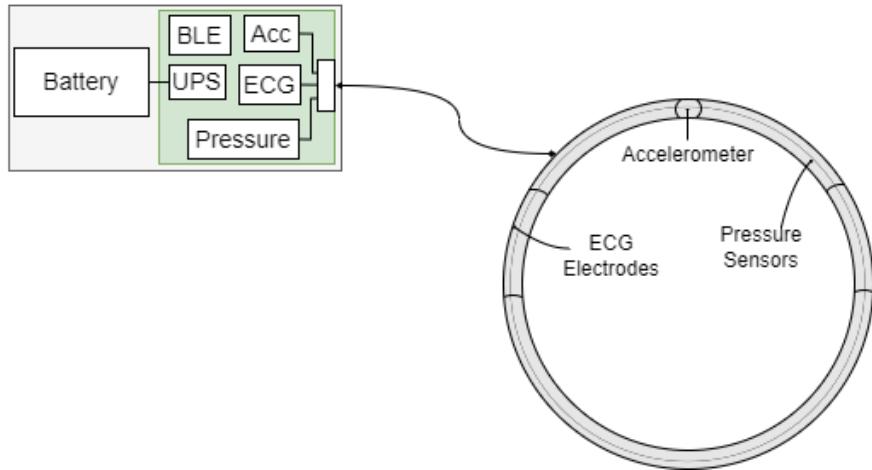
Black Box

- (Receive Bluetooth data).py
- (Fetch GPS data).py
- (Fetch Accl data).py
- (NFC).py
- (Camera stream).py
- (DMS).py



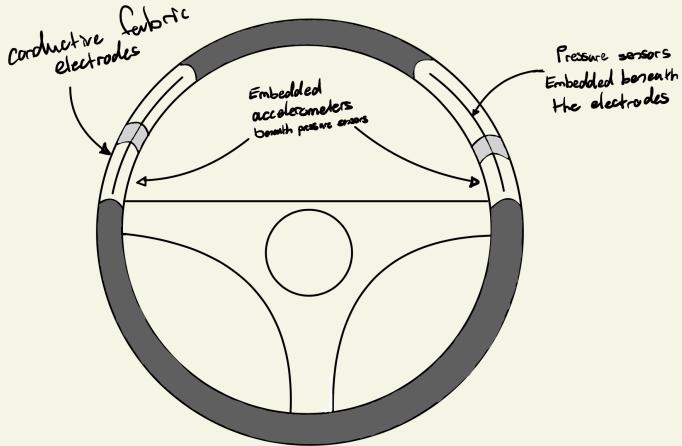
Steering Wheel

- Fetch ECG data.
- Fetch Accl data.
- Fetch Pressure data.
- Transmit data over Bluetooth

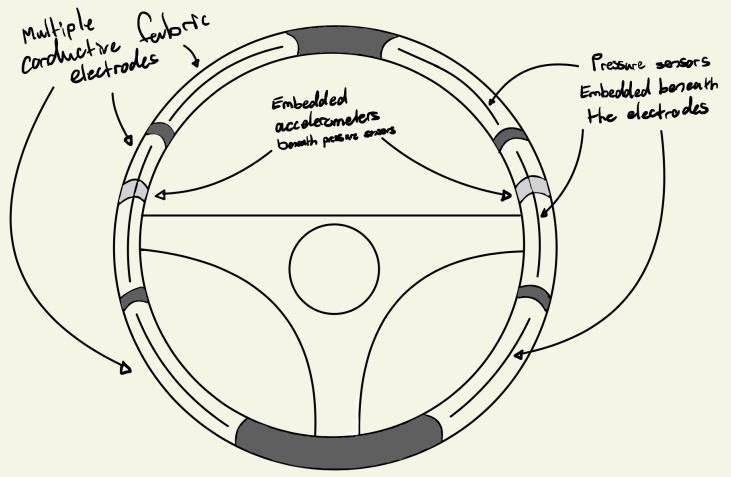


Concept Creation

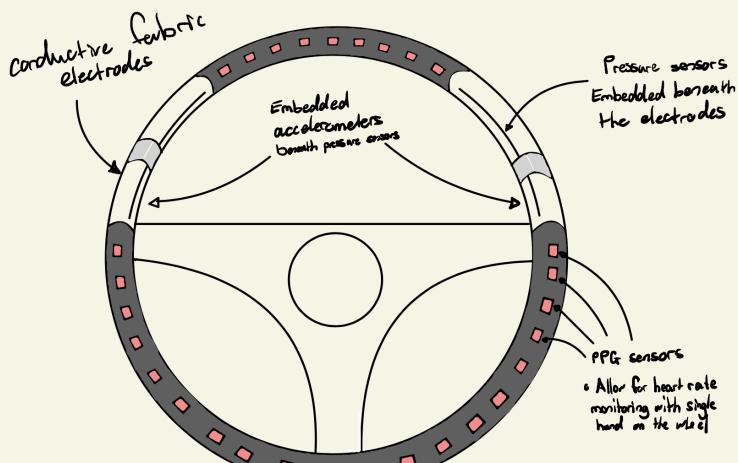
Steering wheel cover MK 1



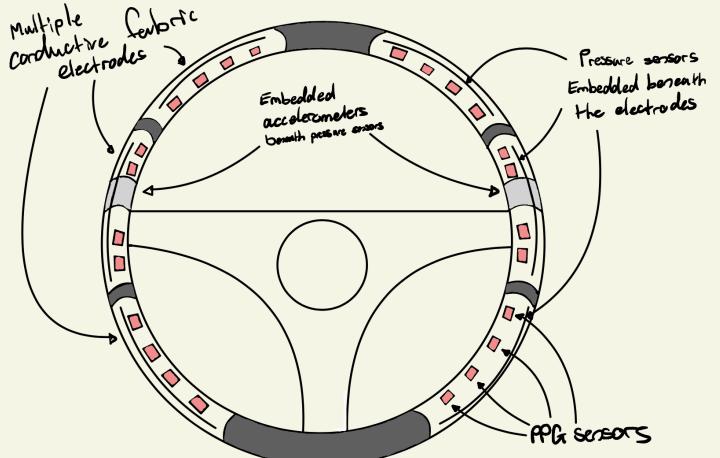
Steering wheel cover MK 2



Steering wheel cover MK 3



Steering wheel cover MK 4



PCB Design

