



Development of non-invasive, optical methods for central cardiovascular monitoring

Introduction

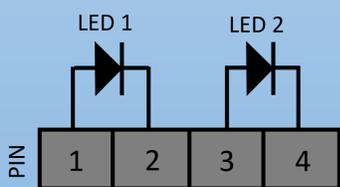
Cardiovascular disease (CVD) in New Zealand, particularly for Maori is one of the leading causes of ill health. This research involves the measurement and estimation of arterial and venous oxygenation as well as arterial pulse wave velocity. Use of these measurements will better monitor patients in the hospital ICU and has the potential to extend into care outside the hospital.

Application

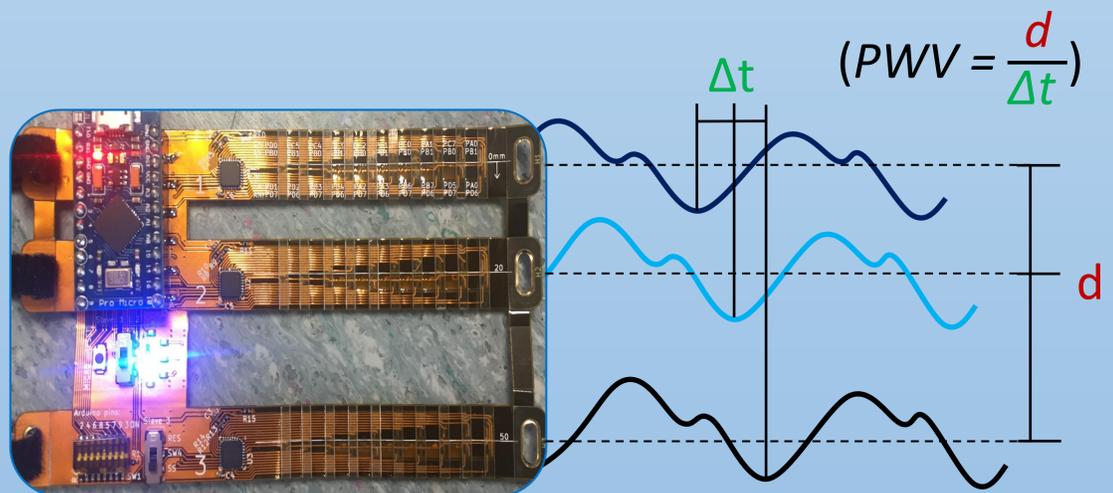
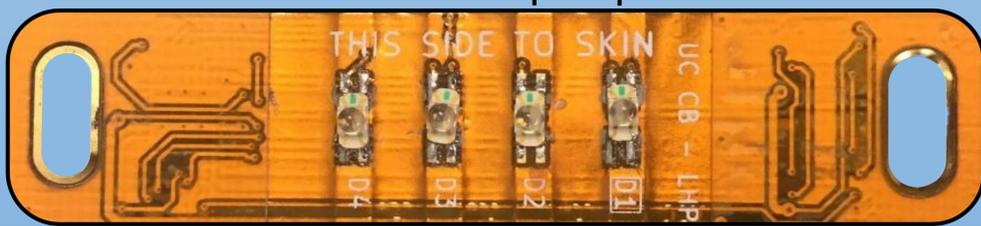
Pulse oximeters are used in hospitals and home life, providing continuous, non-invasive monitoring of heart rate and arterial blood oxygen level. By measuring across the neck, both the carotid artery pulse and jugular venous pulse can be recorded. Measuring down the neck allows the calculation of the pulse wave velocity. This sensor provides continuous non-invasive clinical monitoring which previously required invasive sensing methods.

Sensor

A digital pulse oximeter has been developed to measure blood flow in the neck. 10 red and infrared LEDs are used to both emit and detect light in an array, creating 9 sensing locations at 5 mm spacing along the array. This array is repeated at 20 mm and 50 mm spacing to measure PWV.



5 mm



Pulse Wave Velocity

Pulse wave velocity (PWV) is the measure of the rate at which pressure waves travel through an artery, with the velocity of this movement giving an indication of arterial compliance. Traditionally catheters in the carotid and femoral arteries are used to predict PWV, indicating future cardiovascular events as well as hypertension. The designed sensor removes the need for an invasive catheter in the carotid artery, reducing patient risk.

Arterial and Venous Monitoring

Arterial oxygenation (SpO₂) and venous oxygenation (SvO₂) monitoring allows the oxygen consumption of the brain to be calculated. This is currently only able to be measured using invasive methods such as catheterization. The internal jugular vein and the carotid artery on the right side of the neck are the vessels being monitored.

Waveforms

Shown on the right are the measurements from one array of the sensor. Each sensing LED provides a measure of the blood flow at that location. The red and infrared waveforms are then used to calculate oxygenation levels. Evident in the 3D waveforms is the phase delay between the arterial and venous pulse allowing pulse identification.

