Blood Flow Measuring Principles and Devices

**Facts:**

Concentration of O2 and other nutrients in cells are very difficult to measure
Second-class measurement: blood flow and changes in blood volume, correlate well with concentration
Third-class measurement: blood pressure, correlates well with blood flow
Fourth class measurement: ECG, correlates adequately with blood pressure

**Measuring Blood Flow by Applying Hall Effect:**

Hall Effect: While magnetic field is at right angle to a current flow inside a conductor, it pushes the moving electron towards the button edge of the conductor.
The bottom edge becomes negatively charged while the upper edge becomes positively charged.

a. Tiny voltage probes are attached on either side of the blood vessel.
b. Poles of an electromagnet are placed Perpendicular to these probes.
c. The amount of voltage generated due to the Hall effect created by the ions within the blood supply is a direct indication of a persons blood pressure.

Thinking: Can we intergrate this technique onto ou product for measuring the blood pressure of a certain part of human body?

**Measuring Floating Speed by Interferometer**

a. Laser light brought into censor by optical fiber, and then split into two beams.
b. One light beam crosses a micromembrane which is deformed by pressure
c. Deformation changes light properties.
d. Different propagation speeds results in phase shift.

Chip size: 0.3 mm x 5 mm
**Ultrasonic Flowmeters:**
Based on the principle of measuring the time it takes for an acoustic wave launched from a transducer to bounce off red blood cells and reflect back to the receiver.

![Ultrasonic Flowmeter Diagram](image1)

**Transit Time Flowmeter:**
Effective velocity of sound in blood:
velocity of sound (\(c\)) + velocity of flow of blood averaged along the path of the ultrasound (\(u\))

![Transit Time Flowmeter Diagram](image2)

The quantity \(\Delta T\) is typically very small and very difficult to measure, particularly in the presence of noise. Therefore phase detection techniques are usually employed rather than measuring actual timing.

![Phase Detection Diagram](image3)