FYP Draft

**Project: Smart Sock - Project in partnership with Aintree Hospital**

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Description:

The Aim of the project is to **develop socks with sensors to monitor frail/elderly heart failure patients** for development of ankle swelling due to fluid mainly as this is an important marker of heart failure decompensation, as usually these patients may not be able to weight themselves daily or are less likely to notice ankle swelling.

These will likely involve integrating stretch and pressure sensors into the sock along with a suitable microcontroller interface.

Additional features include **monitoring for development of Atrial fibrillation which HF patients** are also prone to and possible measuring oxygen saturation.

The resultant system will be capable of**undertaking continuous measurements**, **sending the relevant data wirelessly** so **it can be logged and generating an alert if swelling is detected**.

The project is challenging and prospective students need to be committed.

Aim: develop socks with sensors to monitor frail/elderly heart failure(HF) patients for development of ankle swelling

Additional: Atrial fibrillation, measuring oxygen saturation

Require: continuous measurements, sending the relevant data wirelessly so it can be logged and generating an alert if swelling is detected. Ensure it is capable of real-time monitoring, data storage, and threshold alarm functions.

Other ideas:

1. Front-end design: web display, Build a model…
2. Digital twin: Real-time monitoring real-time transmission, able to record and transmit, predictions.
3. Predict possible complications: associated symptoms and diseases…
4. Stickers or anklets (Like an electronic bracelet): Sometimes people may don't wear socks.

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# I. Specific steps

1. Research and selection

First, study physiological phenomena related to heart failure, ankle swelling, atrial fibrillation, and oxygen saturation. Understand the relationship between these phenomena and how they can be monitored through sensor technology.

“development of ankle swelling due to fluid mainly as this is an important marker of heart failure decompensation”

1. Select sensors

Select the right tension and pressure sensors, as well as heart rate and oxygen saturation sensors. Consider:

Size: small

Sensitivity: accuracy and precision

Durability: Materials, Batteries

biocompatibility. Comfortable, easy to wear

“These will likely involve integrating stretch and pressure sensors into the sock along with a suitable microcontroller interface.”

1. Select microcontroller

Select a microcontroller with low power consumption and small size for receiving and processing sensor data. Consider using a microcontroller that supports Bluetooth or other wireless communication protocols to easily send data to mobile devices or the cloud.

“The resultant system will be capable of undertaking continuous measurements, sending the relevant data wirelessly so it can be logged and generating an alert if swelling is detected.”

1. Design Socks

Design a comfortable sock that combines the sensor of choice with the fabric. Sew the sensor onto the sock(or embed it into the fiber). Make sure the sock material is skin friendly and breathable.

1. Additional

Develop a mobile app or cloud platform to receive data from the sock sensor. Design an easy to use interface that displays data and alarms.

Consider adding remote monitoring capabilities that allow healthcare professionals to view patient data in real time. (digital twine)

1. Test and verify

Test the smart socks in a real-world environment to assess their performance and accuracy. The test result is compared with the traditional method to verify its validity.

1. Optimize

To understand the needs of heart failure patients. Their input will help optimize product design and functionality.

Data security and privacy: Protecting the security and privacy of user data. Encrypt data transmission and storage.

# II. Sensors

1. Stretch and Pressure Sensors

These sensors would be able to sense changes in the volume of the foot and ankle, such as strain gauges, piezoresistive materials, and capacitive sensors could potentially be used for this purpose.

图示

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Figure 1: ELEC 207, 8 - Strain gauges

1. Heart Rate Sensor

To monitor for Atrial fibrillation, we need a heart rate sensor. Photoplethysmography (PPG) sensors, (readings might be less accurate on the foot than the wrist.)

图形用户界面

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Figure 2: Heart rate monitor BH1790GLC

https://www.digikey.co.uk/en/products/detail/rohm-semiconductor/BH1790GLC-E2/6677096?utm\_adgroup=&utm\_source=google&utm\_medium=cpc&utm\_campaign=PMAX%20Shopping\_Supplier\_Focus%20Suppliers%202&utm\_term=&productid=6677096&gclid=CjwKCAjwkLCkBhA9EiwAka9QRq-By6DDFzA3k9Q\_o69nTKsFfRav81d7w0rCwTA8anAgWLa2A3YnlhoCHJgQAvD\_BwE

1. Pulse Oximetry Sensor

To measure oxygen saturation, a pulse oximeter sensor will be required. Similar to heart rate sensors, these use PPG technology.

# III. Microcontroller

A microcontroller can read their data, process it, and wireless transmission.

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Figure 3: ESP32

https://www.espressif.com/en/products/socs/esp32

# IV. Wireless Communication

# V. Power Supply

It needs to be safe, lightweight, and small enough to be integrated into a sock. A rechargeable battery solution would be ideal.