

Background

The footwear design process is highly iterative and currently relies heavily on qualitative feedback from testers to evaluate comfort and fit. This makes it difficult to objectively analyze pressure distribution. Our project aims to improve footwear fit evaluation by providing real-time quantitative pressure data to support the shoe design process.

We developed an instrumented smart sock with a network of pressure sensors to measure foot pressure in key footwear regions. Sensor data is transmitted wirelessly to a user interface for dynamic real-time visualization. The system uses a lightweight sock with conductive textile materials and flexible routing for comfort and wearability.

Hardware Components



ESP32 Feather

Microcontroller that collects data over I2C and transmits it via Bluetooth



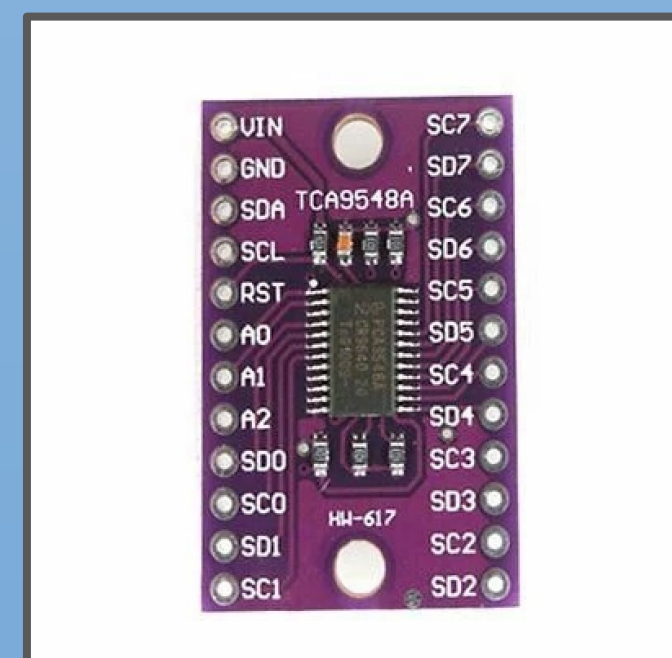
SingleTact Pressure Sensors

Measures PSI values on a linear scale, allowing for easy calibration and usage



Lithium Polymer Battery

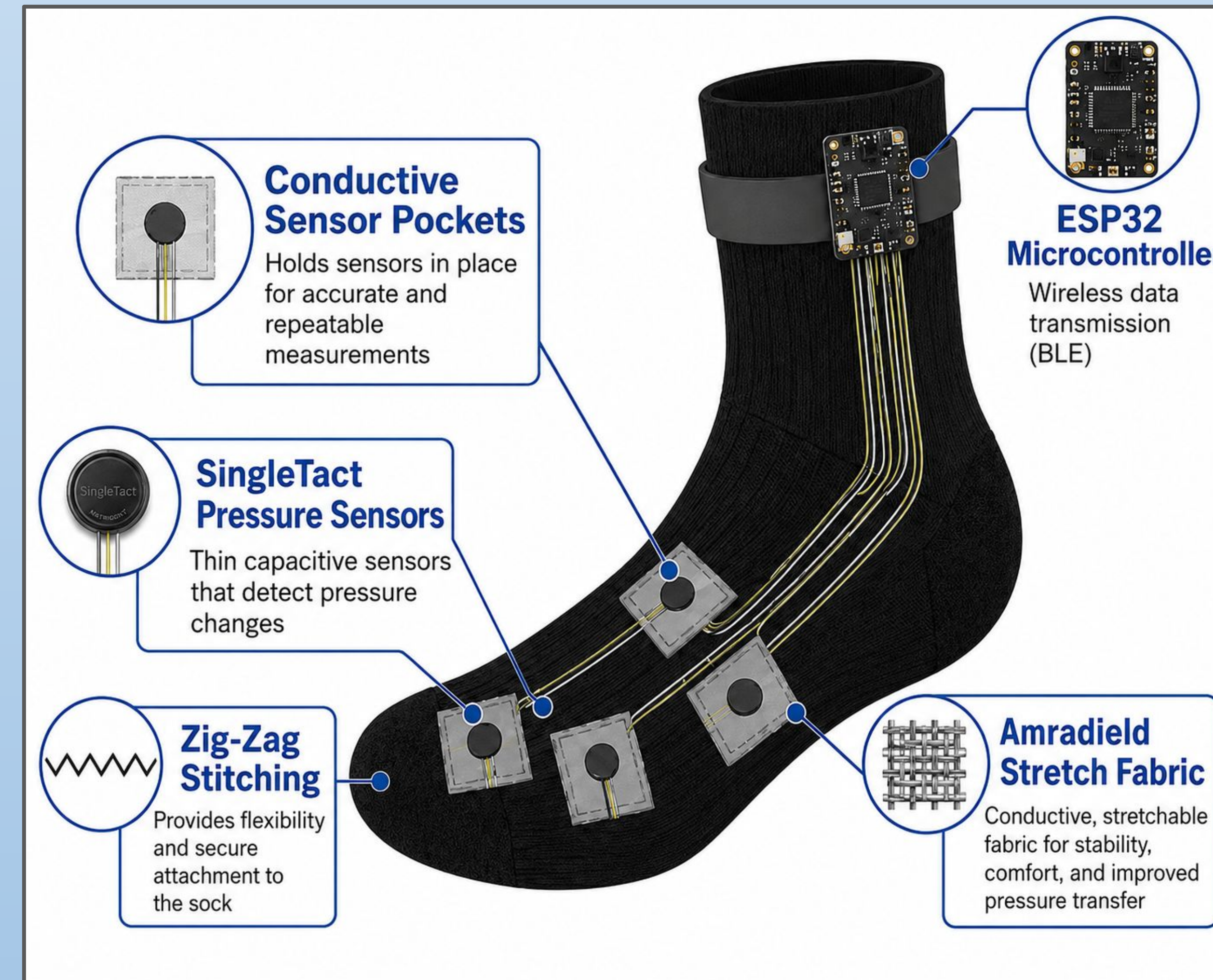
Powers sensor system and microcontroller



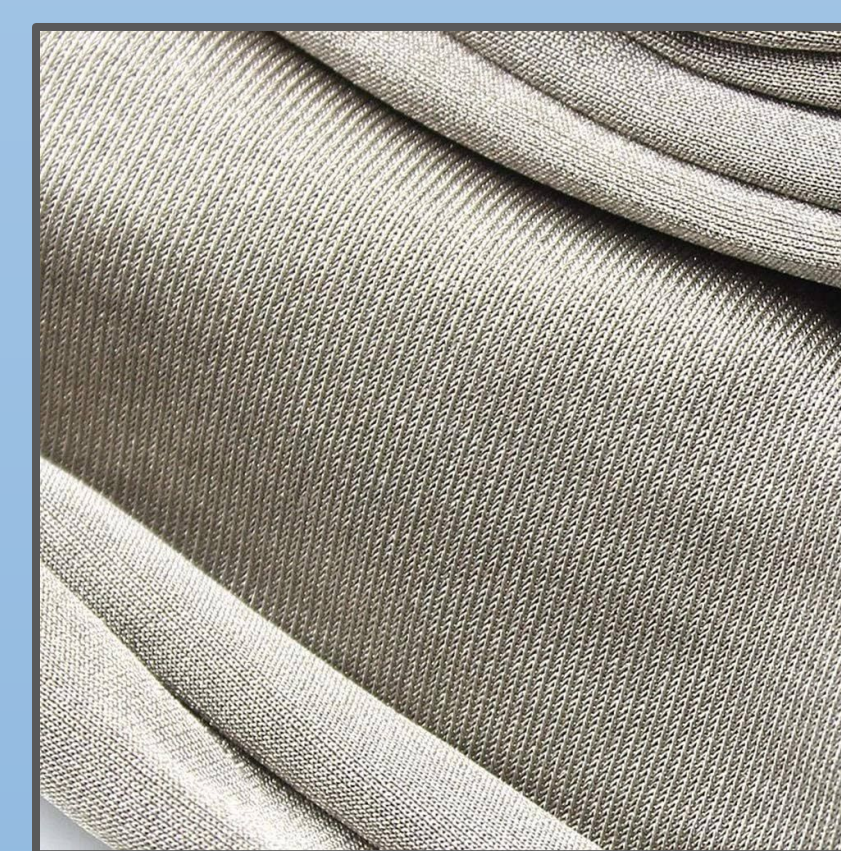
I2C Multiplexer

Expands I2C connectivity, enabling communication with multiple identical pressure sensors simultaneously.

Design



Material Overview



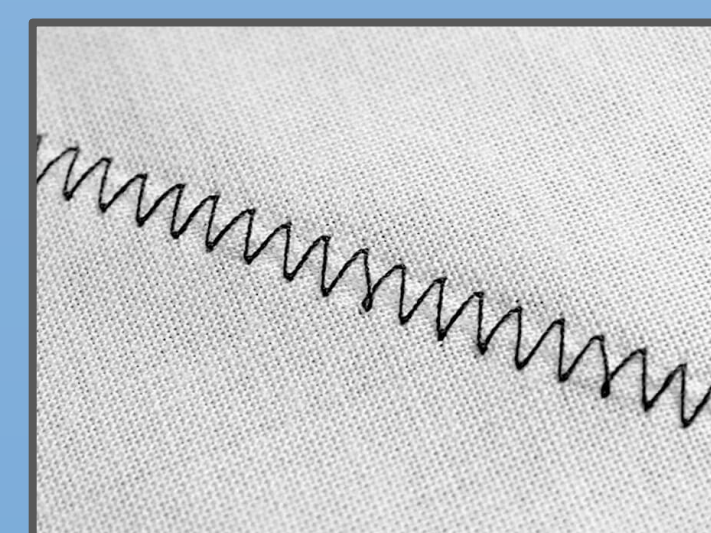
Amradiel Conductive Fabric

Used to construct the pockets that hold the sensors in place. It is both conductive to allow for accurate readings and flexible for maximum comfort and movability.



Running Stitch

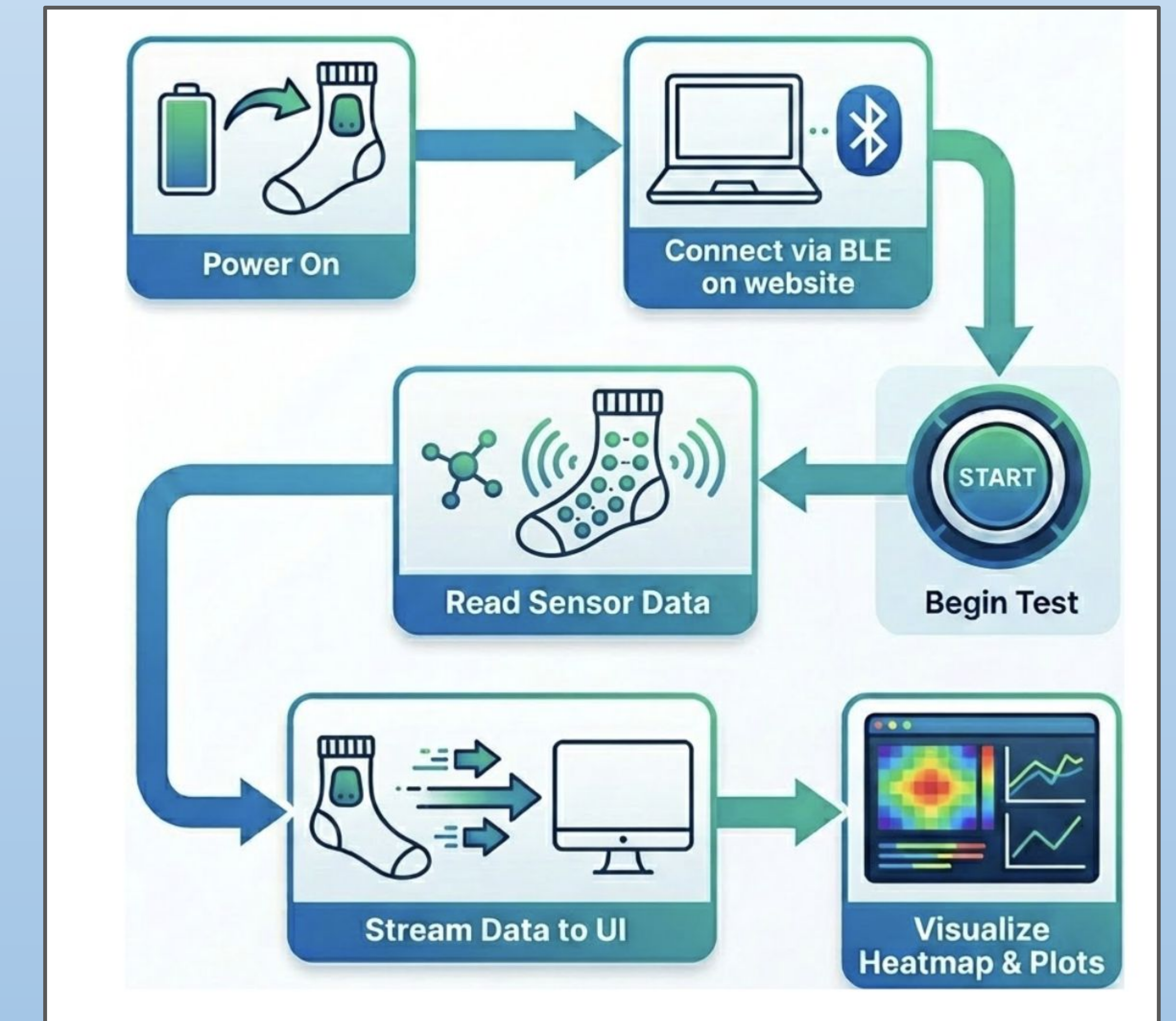
A simple stitch used on the pocket for minimal bulk while securing sensors.



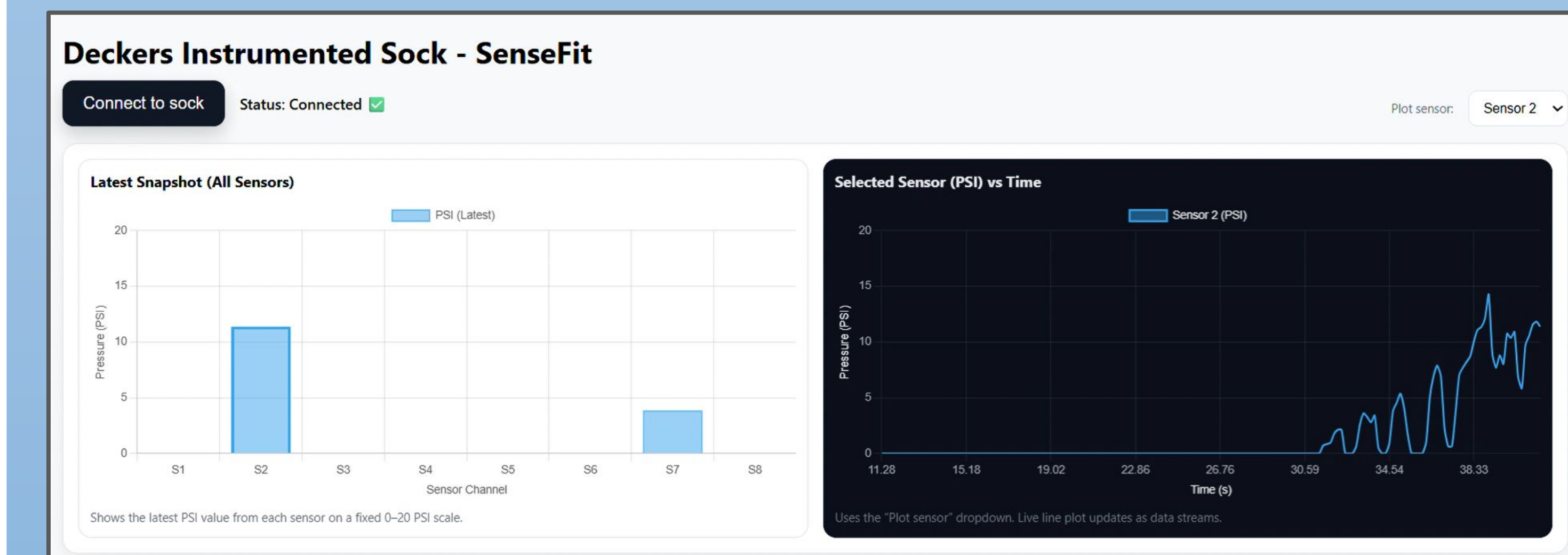
Zig Zag Stitch

Used to attach the pockets to the sock. It is a slightly bulkier stitch that has more elasticity and allows for movement without breaking.

Functional Flow Diagram



User Interface



The user interface is a website that displays time-series plots for each sensor as well as a pressure heatmap that updates data in real time.

