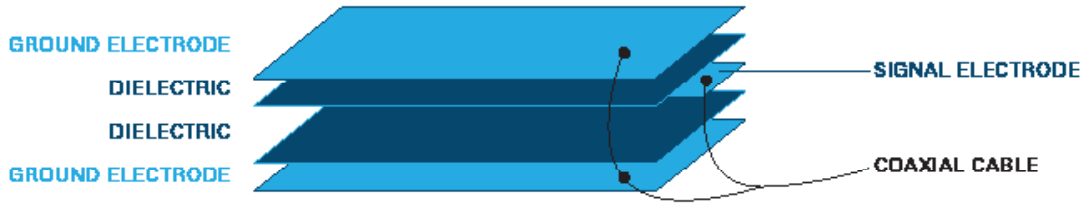
HOW TO USE SENSORS FOR WEARABLES

FABRIC SENSOR E-GUIDE

How To Use a Fabric Stretch Sensor For Wearables

A fabric stretch sensor is a perfect sensor for wearable technology! In this e-guide, I'll explain why they're so well suited for wearable applications as well as give you an overview of how they work and how you can use them in your projects.

A fabric stretch sensor is essentially a flexible capacitor.



As the sensor extends and contracts, its capacitance increases and decreases. This provides us with precise, repeatable measurements.

It may seem obvious, but one of the best features of a fabric sensor is the fact that they're made out of fabric! Sewing the sensor doesn't affect its structural integrity, or it's ability to provide accurate data. They are also very tough which is important when creating sports and fitness wearables. They're also easy to sew into garments in the testing and prototyping stage as well as in mass production. The sensors can be tacked or temporarily stitched by hand, or they can be sewed into a garment with an industrial sewing machine. Also, depending on your production needs the fabric stretch sensor can just as easily be glued or heat pressed onto a garment. This is all great news for R&D Teams, Product Managers, and wearables manufacturers. There are many other applications where fabric sensors shine such as inside gloves for VR and gaming!

We've talked about how a fabric stretch sensor gives us precise data when it's stretched, but we need to do a couple more steps to get meaningful data. We're interested in real world data about the human body not just data about the sensor! This process is called characterization. Characterization is correlating the capacitance change data we get from the motion of the sensor to motion data we gather from the real world.

Let's use an example of a sensor attached to the knee region of some form fitting leggings.
This is how it would work. As a person wearing the leggings walks, the knee bends back and forth, which causes the sensor to extend and contract. The leg at full bend will be the point where the sensor is at the maximum stretch, which will also be the sensors maximum capacitance value. Conversely, when the leg is straight, the sensor will be in its resting state. To put it another way, we establish a mutual relationship between the bend of the leg and the capacitance of the sensor. We can now effectively measuring human body motion in real time! This process can be applied to any other part of the body that moves, from the neck and chest to the fingers and feet.

CHECKLIST TO GETTING STARTED

Ready to start prototyping? Here's what you need handy:

1. Fabric stretch sensors
2. Needle and thread
3. Close fitting garment or sleeve to sew the sensors in (compression shirts are excellent)
4. Test person
5. Extra coin cell batteries
6. A mobile phone or tablet to run the App

STEP BY STEP

For this example we'll be using our Integrated BLE Fabric Stretch Sensors and our iOS Fabric Evaluation App.

1

Put a coin cell battery into the sensor

Insert the lithium coin cell battery into the fabric sensor by removing the back cover of the casing and slipping the coin cell into the battery holder.

2

Pair it with the App

The StretchSense Mobile Apps are a great tool to start prototyping quickly. You can connect up to 10 sensors at a time. With the Mobile Apps, you visualize sensor data in real-time as well as capture and log it for in-depth analysis.

To turn on the Integrated BLE Fabric Stretch Sensor, press the small activation button on the white case of the sensor. You should see a light flashing within the case indicating the sensor is ready to be paired to the App. To connect to the iOS App, ensure that Bluetooth is turned on your mobile device then press the Bluetooth symbol on the action bar at the top of the App. Once connected the circuit ID pop up. It will be displayed in grey. Click the circuit ID to connect. Once connected, the circuit ID will change from grey to green. Press 10ch BLE on the top of the App to return to the home screen.

3

Playing with the App

There are three display types: Bar graph, line graph, and value table. Click on the corresponding icon to enter that display type. Each of the 10 channels has its own colour. You can turn individual channels on and off by touching the coloured box displaying their value in pF. All 10 channels are on as default. The graphs are automatically scaled. The bottom slider is for filtering. At 0 pt the App will sample at it's maximum rate and the sensor will respond quickly. Sliding it to the right will decrease sensitivity. All the way to the right at 255 pt the response of the sensor will be much slower.

4

How to integrate the sensor

You can sew the fabric sensor into garments to measure the movement of the body or other objects. Make sure that you sew into the sewable zone only and that you don't pierce the active sensing zone. In the example below the sensor would be connected by a coax cable and has been stitched at either end. We've highlighted the active sensing zone.

5

Record data

To start recording a testing session press the record button on the Action Bar. The App will now begin to record capacitance versus time as measured by the sensor. The App will record until you press pause. The data is stored in a comma separated value (.csv) file, in pairs of Capacitance (in picoFarads), and Timestamp (in milliseconds). To export or save the session press the share icon on the Action Bar.

We hoped you've enjoyed Part One of our Fabric Sensor series. We'll be back with Part Two and Three soon where we'll dig deeper into using Fabric Sensors and the walk you through the characterisation process step by step!