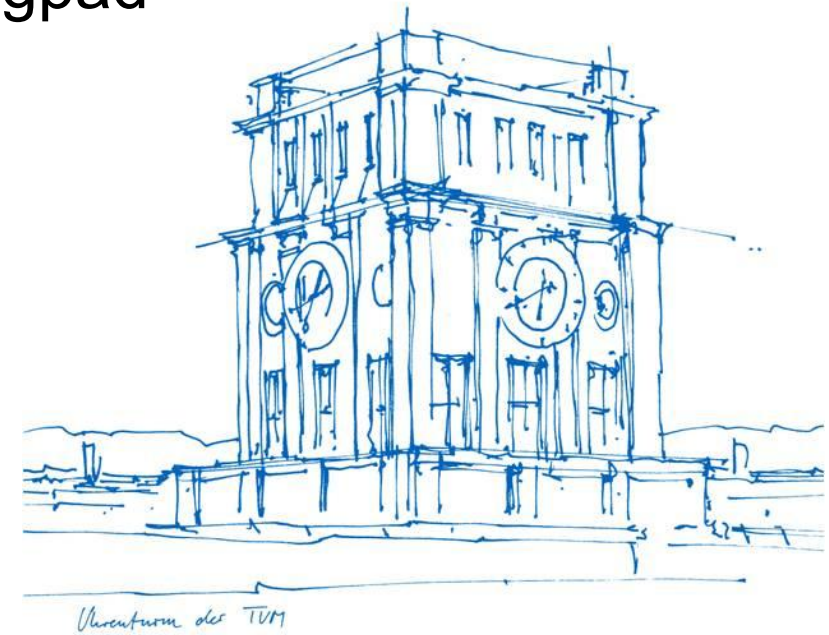
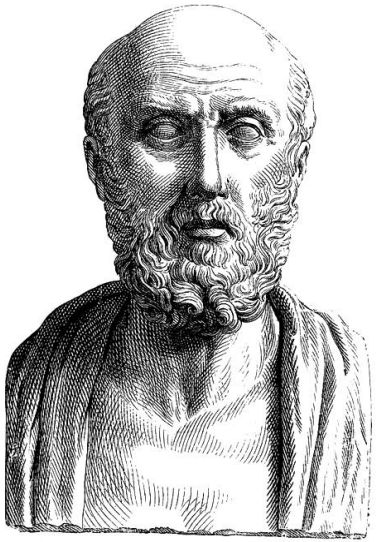
Foot Sole Pressure Sensing Device And It's Usage In Barefoot Shoes: Fullsoul Runningpad



Arved Strauch, Chutong Ren, Kai Burian


Kai



"Walking is a man's best medicine."

- Hippocrates

Daniel Liebermann – Barefoot Running

- Evolutionary biologist and paleoanthropologist at Harvard University
- Humans are "born and evolved to run"
- Studied barefoot running vs. running in shoes
- Barefoot running could prevent pain and injuries

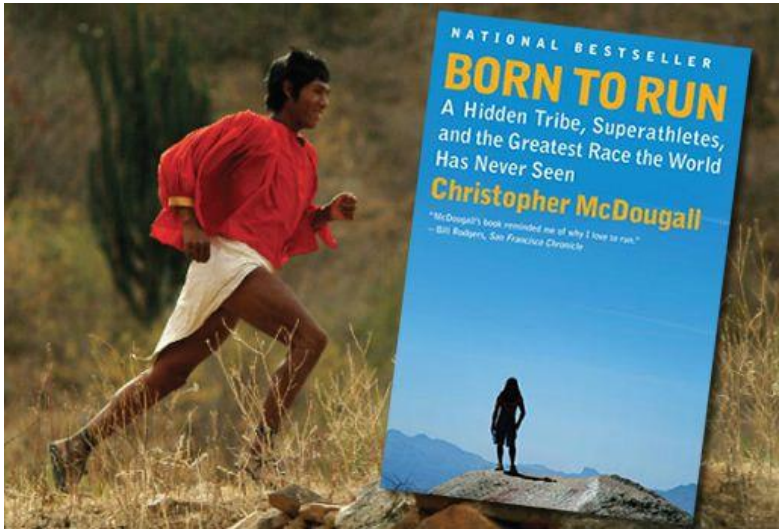
Running Barefoot vs. Running With Shoes

“Leave Those Calluses Alone”

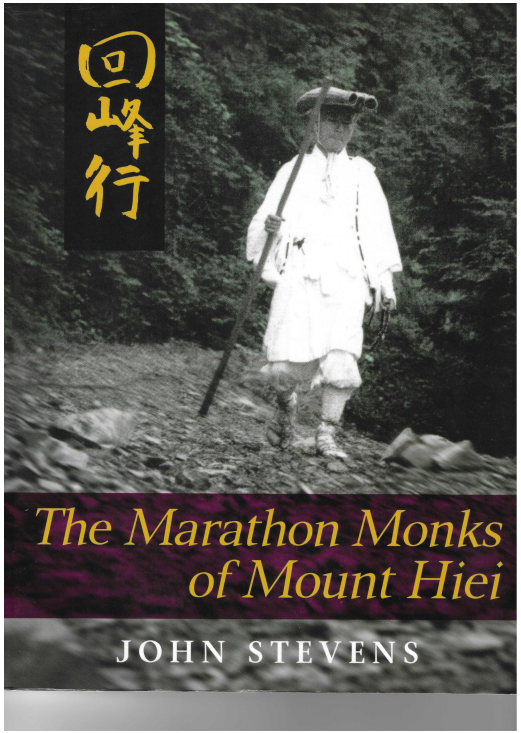
- Calluses are natural and necessary
- Calluses protect the sole of the foot **without** sensory loss
- Barefoot shoes like fullsoul: further protection **without** sensory loss

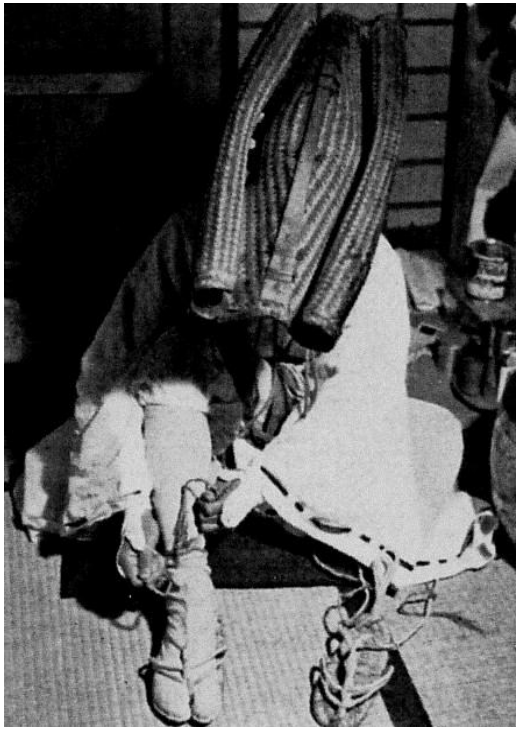
Fullsoul Runningpad

Barefoot Running – Tarahumara



Marathon Monks Of Mount Hiei, Japan





CAoCM | 30.07.2024 | Left two photos from John Steven's book | Right photo: https://www.theguardian.com/lifeandstyle/2015/mar/31/japanese-monks-mount-hiei-1000-marathons-1000-days

Barefoot Runner Abebe Bikila Wins Olympics

Motivation Funnel

Personal

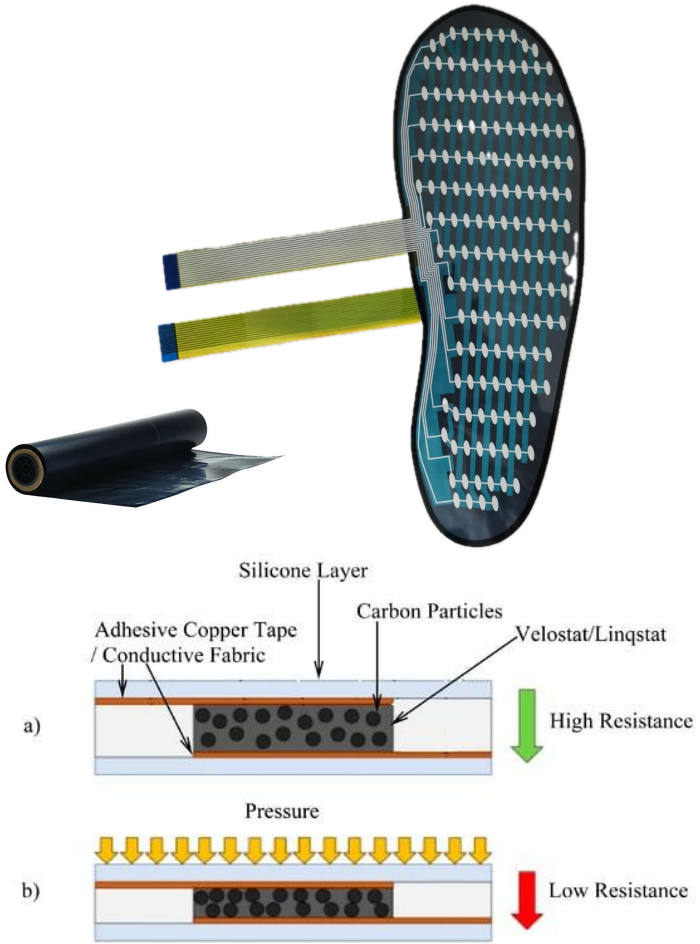
Barefoot running

Fullsoul Runningpad

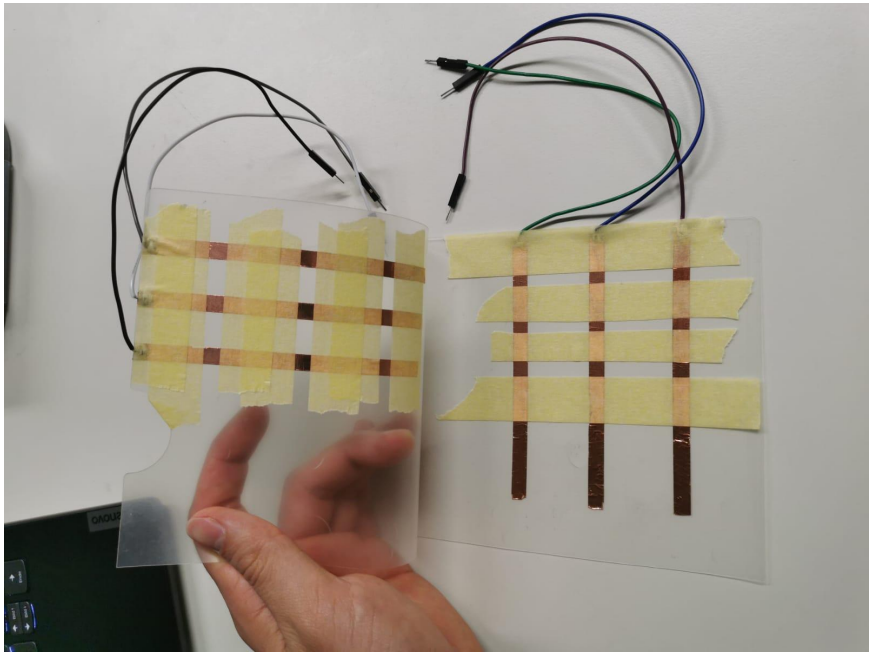
“Let‘s measure the benefits of the fullsoul!”

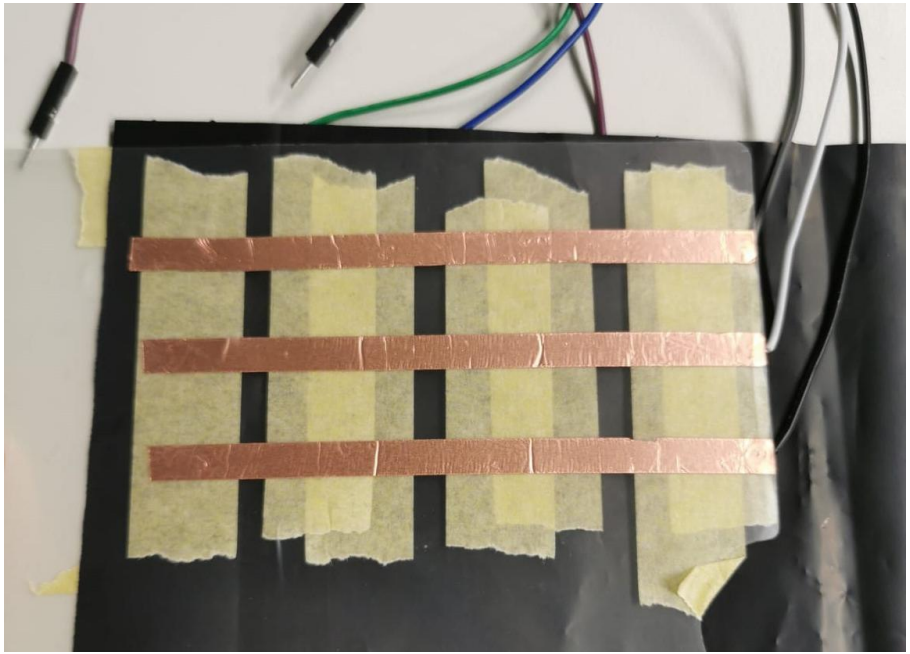
Our Sensor

- Friend visited the manufacturer in China, got a demo model of a Velostat sensor
- Piezoresistive effect: changing resistance with applied pressure
- 156 different electrodes processing data at 200 Hz
- Controller sends data to PC over serial port

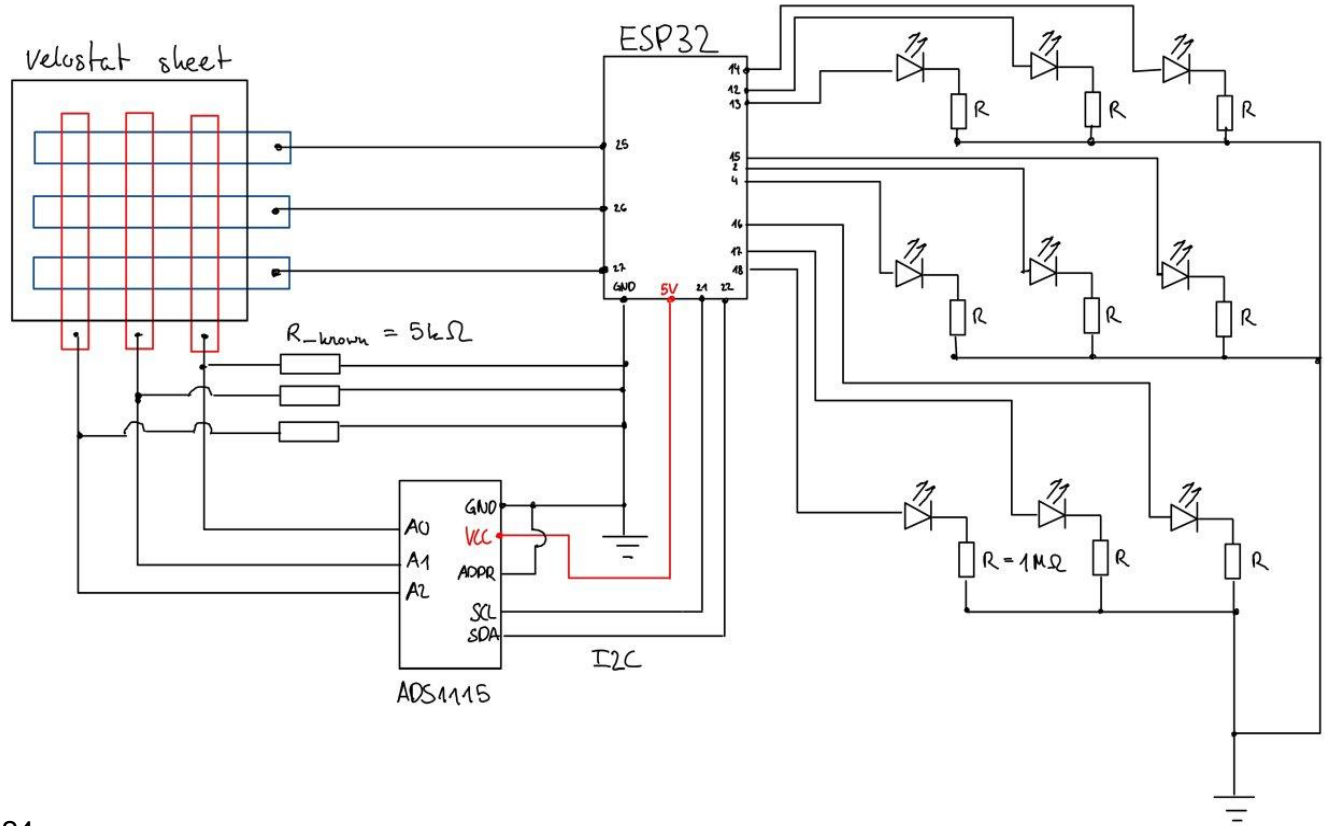


Proof Of Concept: Velostat Matrix

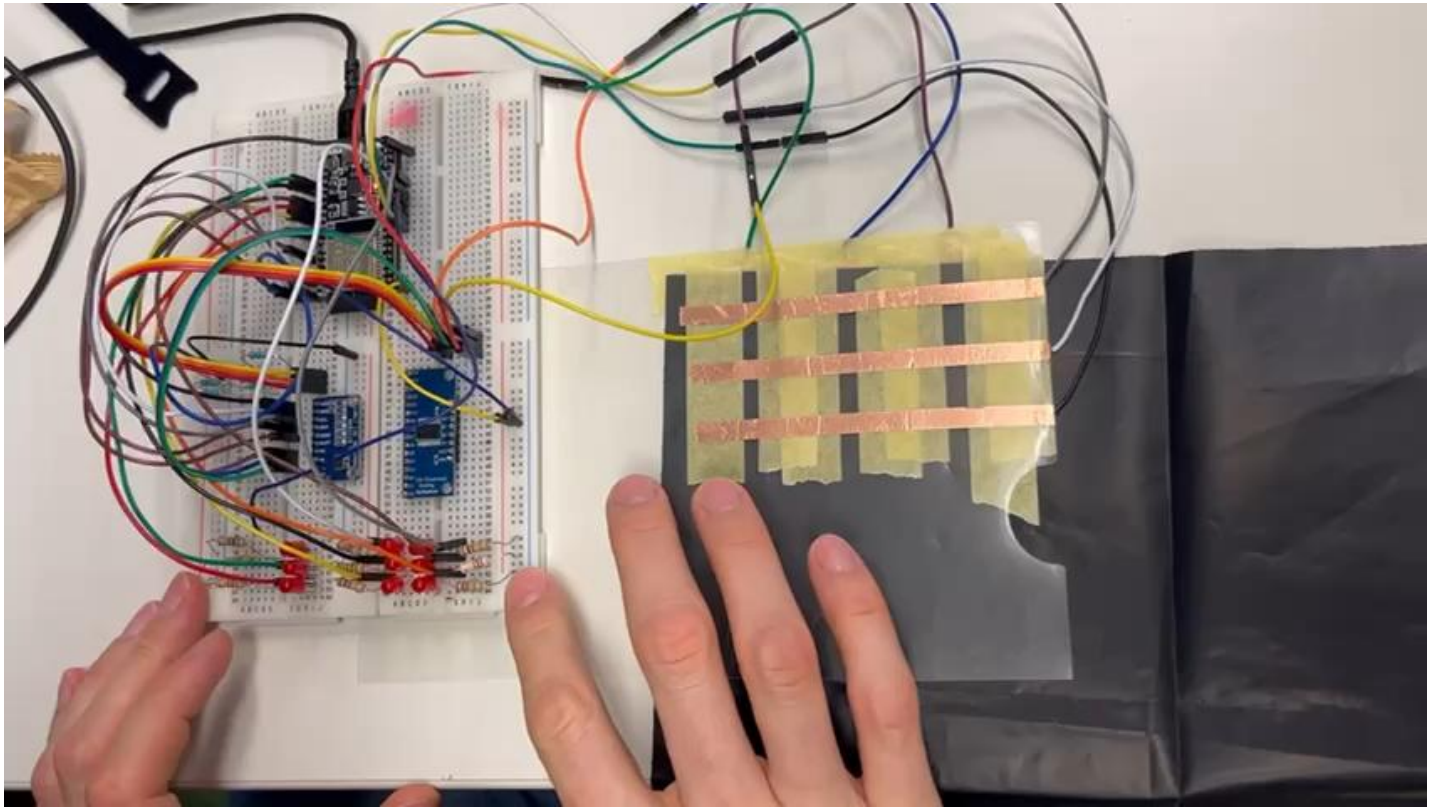




Proof Of Concept: Schematics

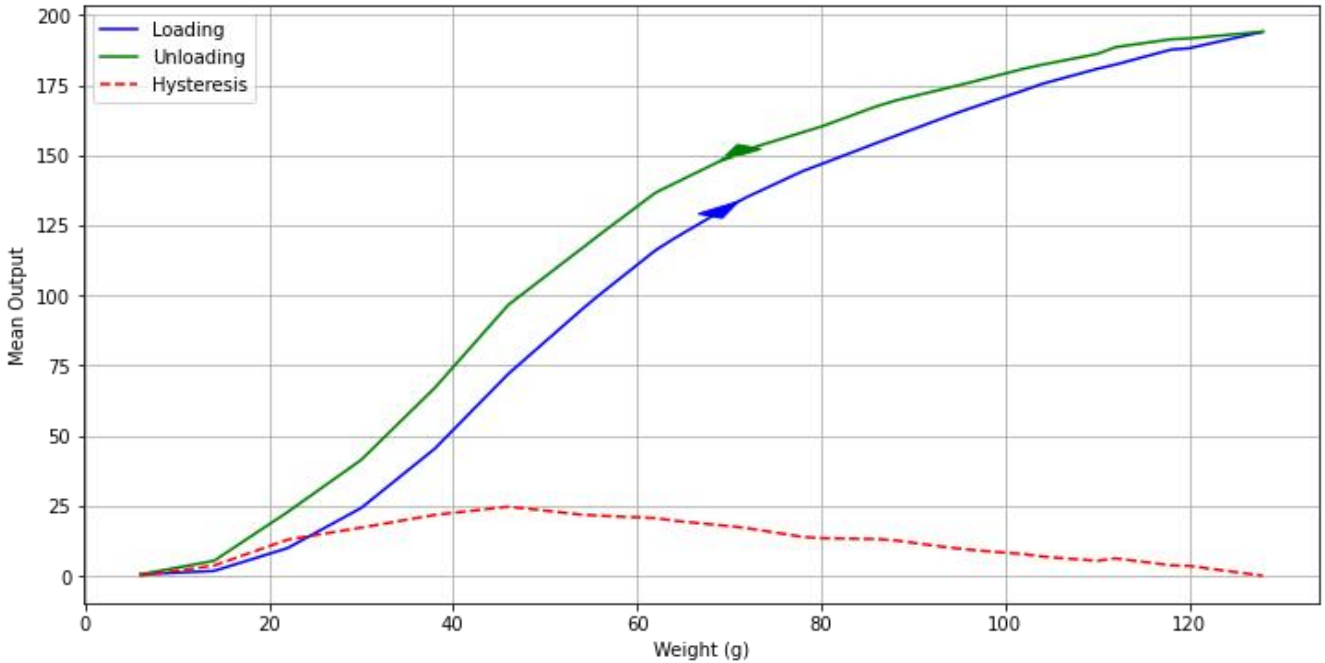


Proof Of Concept: Model



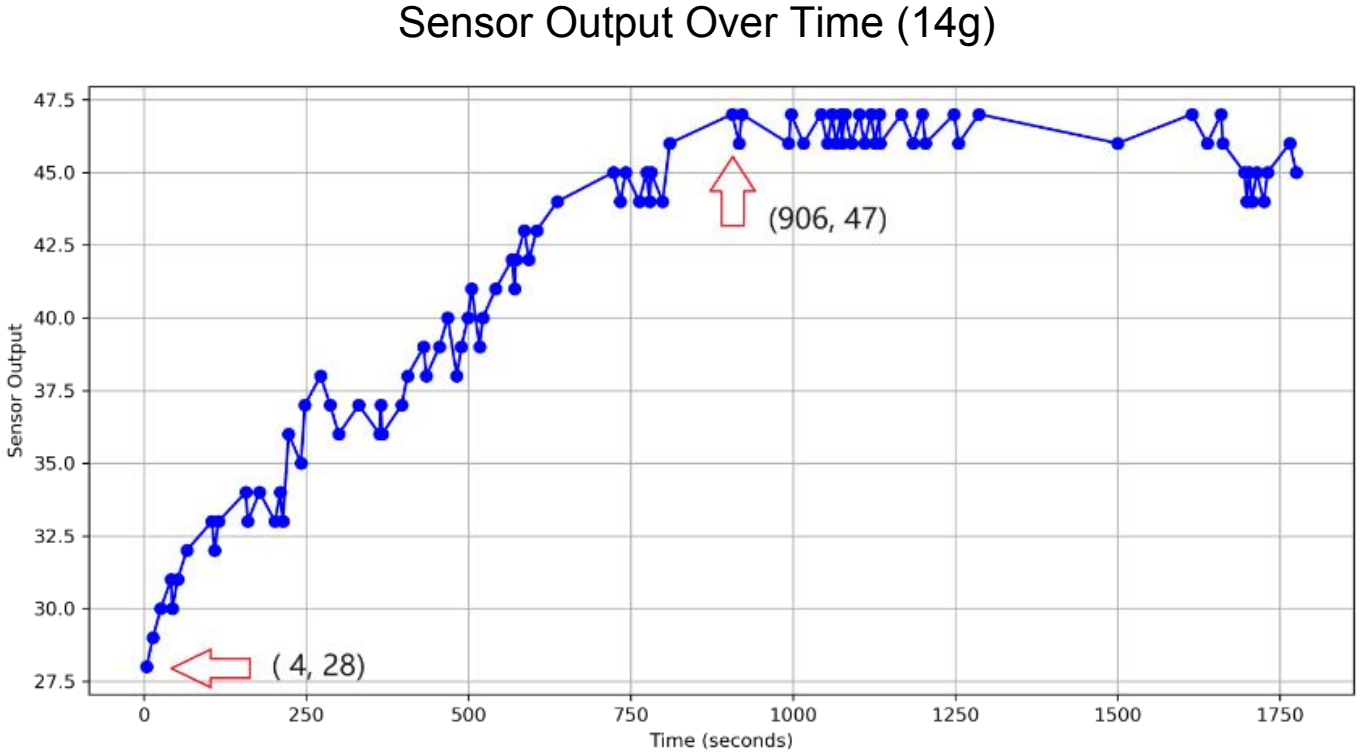
Sensor Hysteresis

Average Sensor Hysteresis During Loading and Unloading Processes



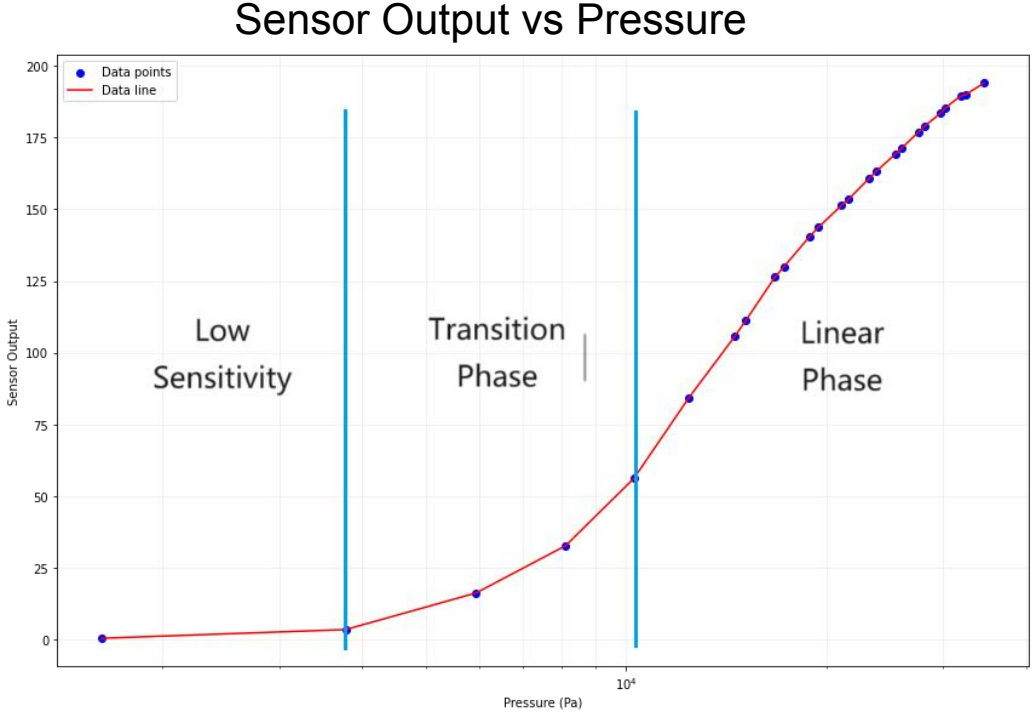
The peak hysteresis of the sensor reaches 24.6 units at 46g, accounting for about 9.8% of its output range (0-250).

Sensor Drift



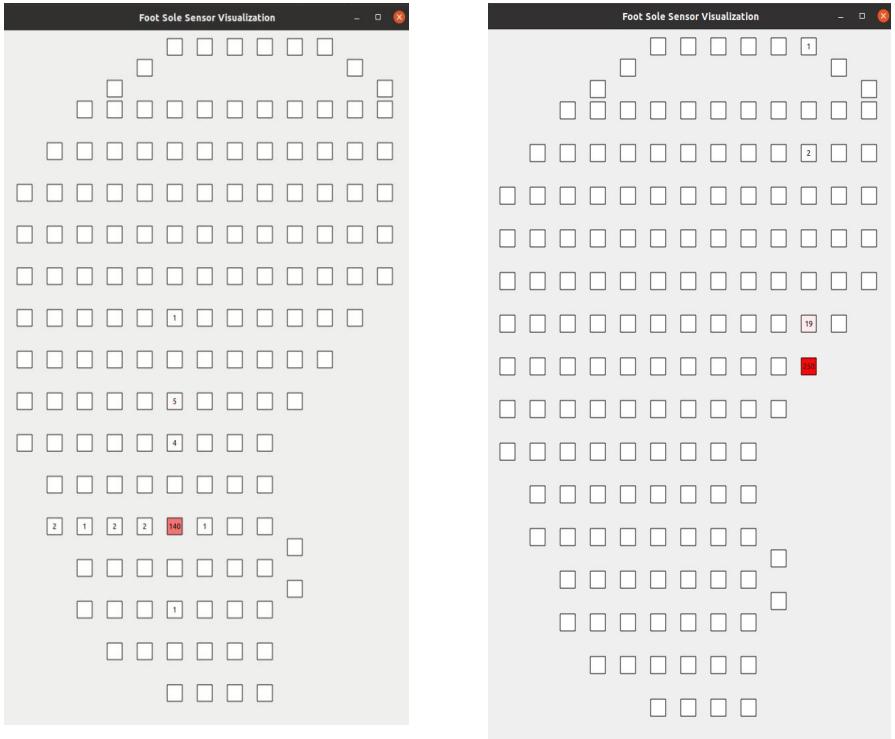
Sensor output surged from 28 to 47 in just 15 minutes, a drift of 7.6% of the total sensor output range (0-250).

Sensor Sensitivity



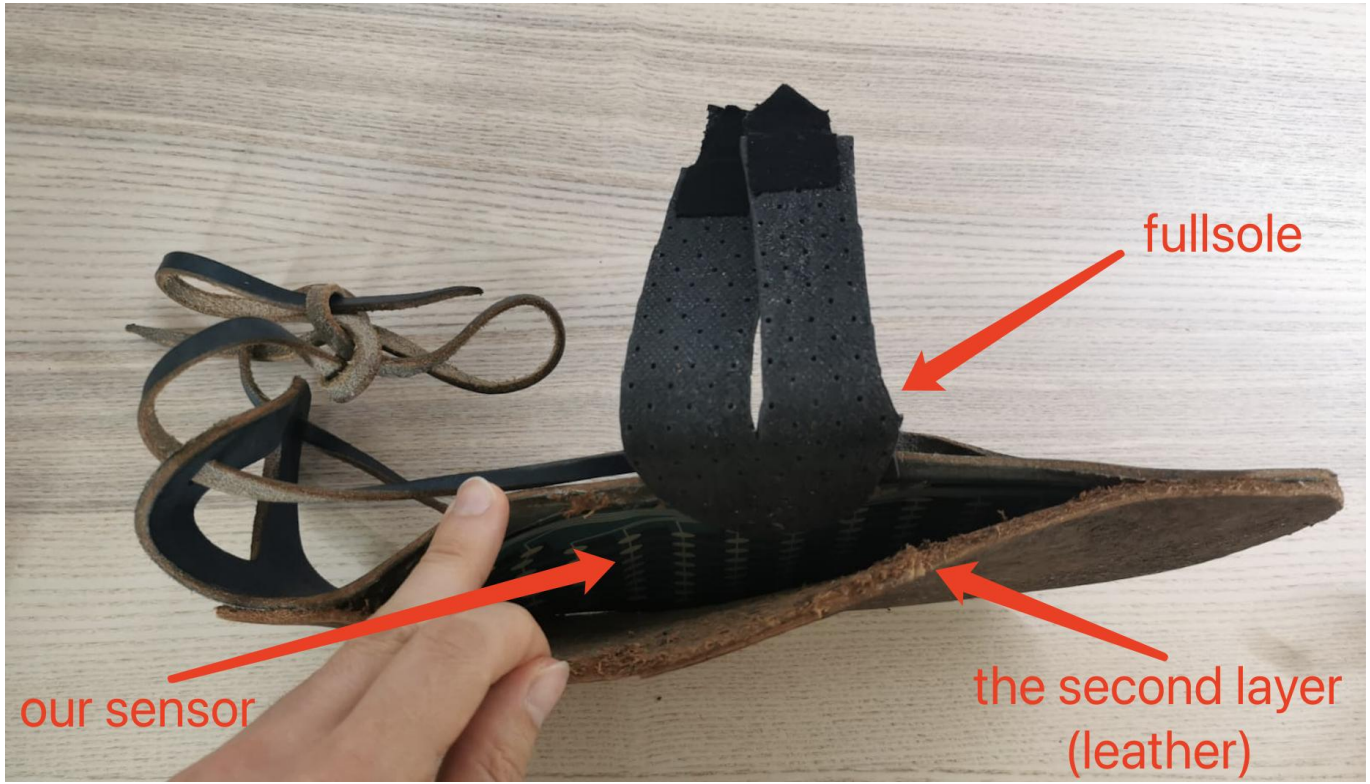
Low sensitivity when the pressure is below ~3800 Pa; Curve becomes almost linear when the pressure exceeds ~10000 Pa.

Channel Crosstalk

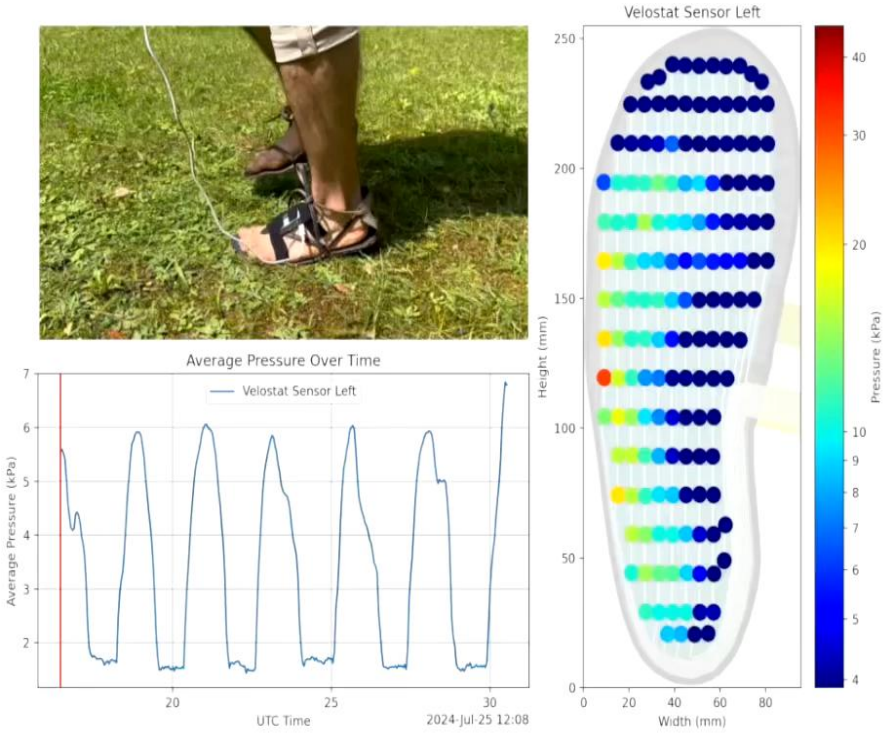


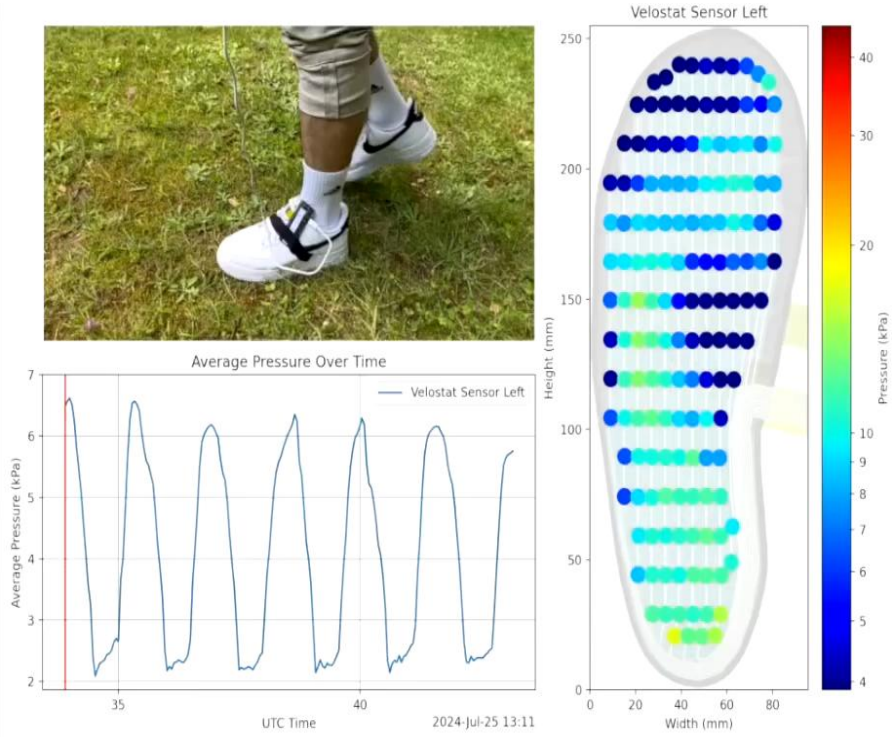
The observed crosstalk typically ranged between 1 and 6 units out of 250

Fullsoul Sensor Integration

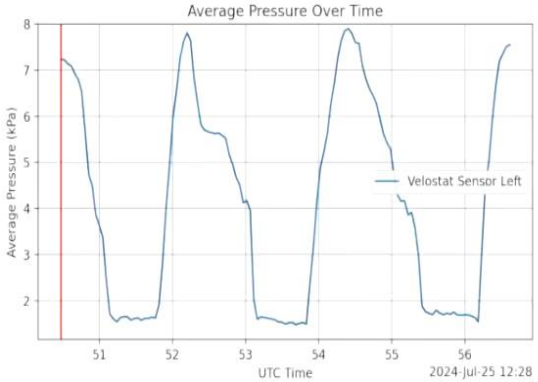


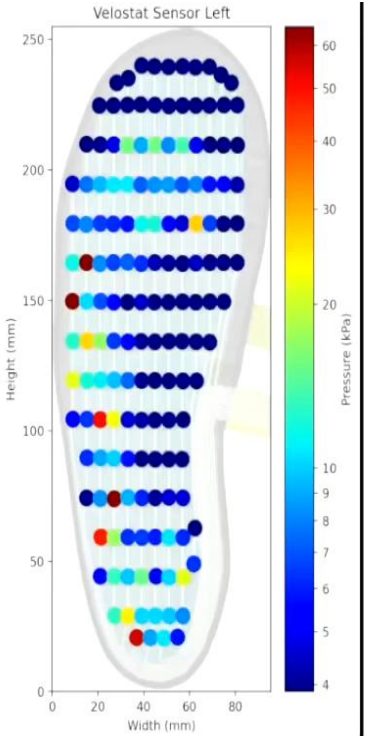
Fullsoul vs. Normal Shoe: Grass

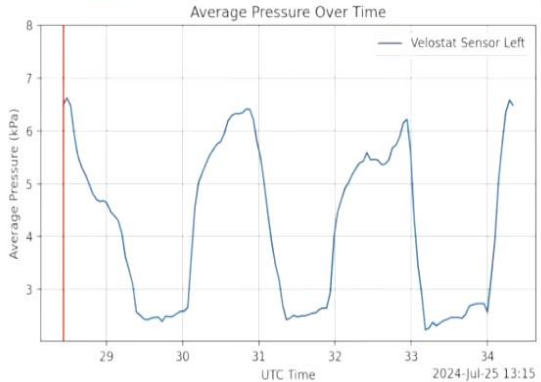


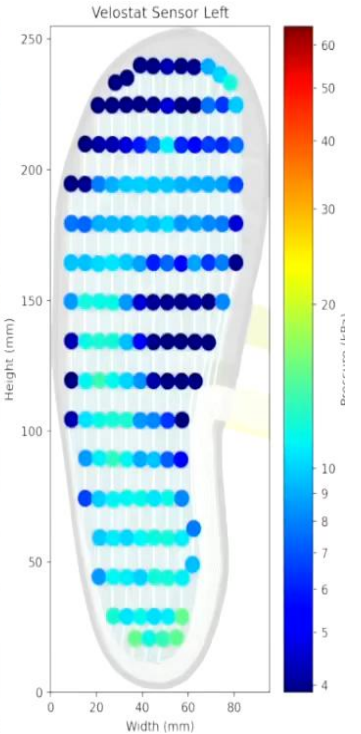


Fullsoul vs. Normal Shoe: Stone Pebbles









Conclusion – What We Managed To Do

- Acquisition of raw sensor data
- Implementation of sensor in fullsoul runningpad
- Visualizing first test trials with fullsoul and normal shoes
- Initializing communications with the sensor manufacturer for further sensor acquisition

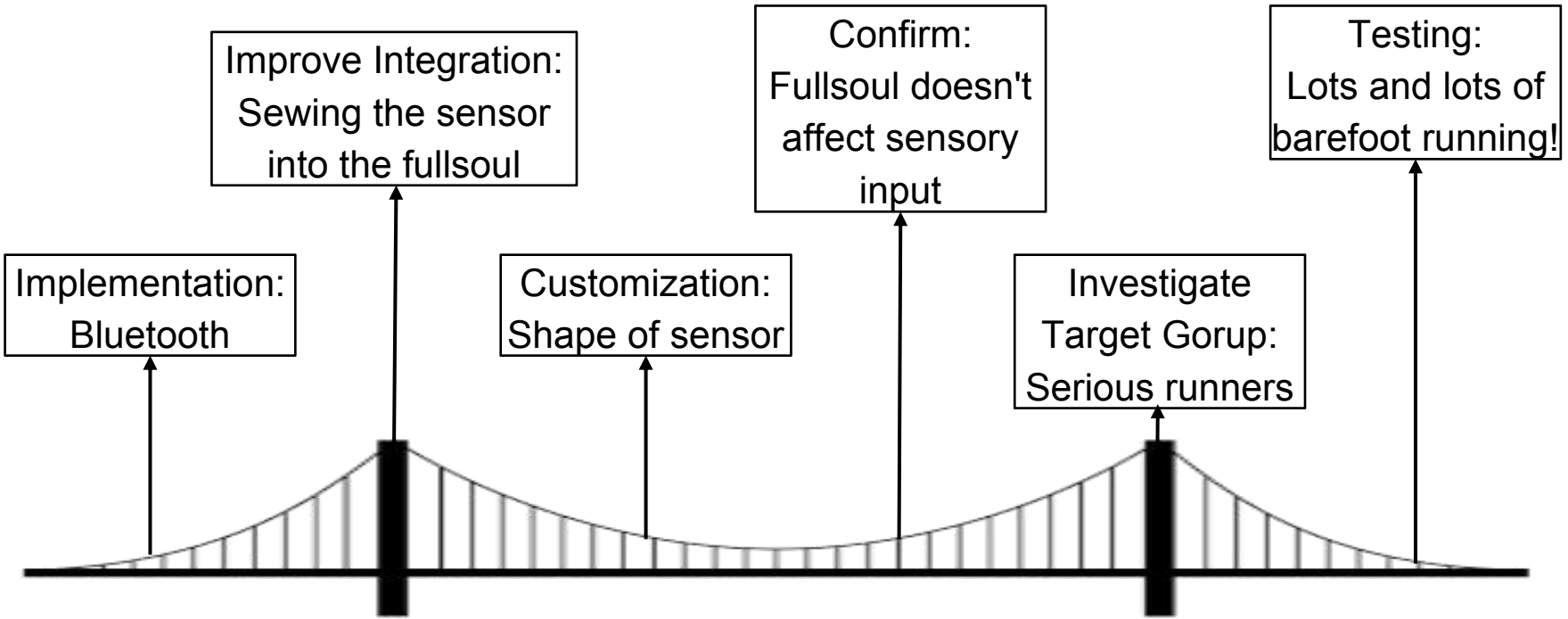
Feedback From Prof. Dr. Walther And Prof. Dr. Daumer

- Competitors in the medical field: Novel, Moticon do **not** posess the ability to be implemented with barefoot shoes

- So far health benefits of barefoot shoes difficult to measure and usually require an intricate lab setup

⟶ We might be on the way to develop a unique new technique to measure the benefits of barefoot shoes!

Future Outlook



Special Thanks

Prof. Dr. Martin Daumer

Prof. Dr. Markus Walther

Lingfeng Gu

Yuan Cao

Marco Busch

Want To Know More?

Find us on GitHub: https://github.com/weichkai/footPressureSensor

If you have a great idea or want to contribute to one of the future outlook tasks:

Contact us through E-Mail: footsolepressure.burian@tum.de