3D Printed Footwear: SMART Insole

Raise3D Case Study
Apr 13, 2018

Dr. Roy Cheung, Associate Professor in the Gait & Motion Analysis Lab, is the inventor of the 3D printed SMART insole. Roy himself is a jogger and wanted to learn about his own running stance but the expensive market price of a smart insole drove him to initiate this project.
Roy' specializes in: biomechanics in runners, efficacy of prophylactic devices for sportsmen, and gait retraining for rehabilitation and injury prevention, and has obtained major research grants e.g. Early Career Scheme, General Research Fund from the HKUGC, Health & Medical Research Fund from the Food & Health Bureau, and Innovation & Technology Fund from the Innovation & Technology Commission.
The Gait & Motion Analysis Lab is based in the Department of Rehabilitation Sciences at the Hong Kong Polytechnic University. Research in the Gait & Motion Analysis Lab focuses on running mechanics, performance, rehabilitation, and injury prevention. It aspires to understand the interplay between the brain, neurophysical regulatory systems, and human movements during walking and running. Both traditional insole customization and smart insole creation are complicated processes with high costs that are typically only consumed by professional athletes.

3D Printed SMART Insole designed by Dr. Roy Cheung.

Summary

Before including 3D printing, the industry's traditional methods include:

-High production costs
-Large batch molding
-Inaccurate hand-made production

By applying Raise3D N2, they were able to:

-Reduce production time by 64.29%
-Reduce production costs by 99.5%
-Design accurate and efficient models using computer precision.

Gait & Motion Analysis Laboratory, Department of Rehabilitation
Footwear / Medical / Research

Roy T.H. Cheung
Associate Professor

Process

The smart insole consists of electronic sensors and a thermoplastic insole structure. The production process has three main phases including :

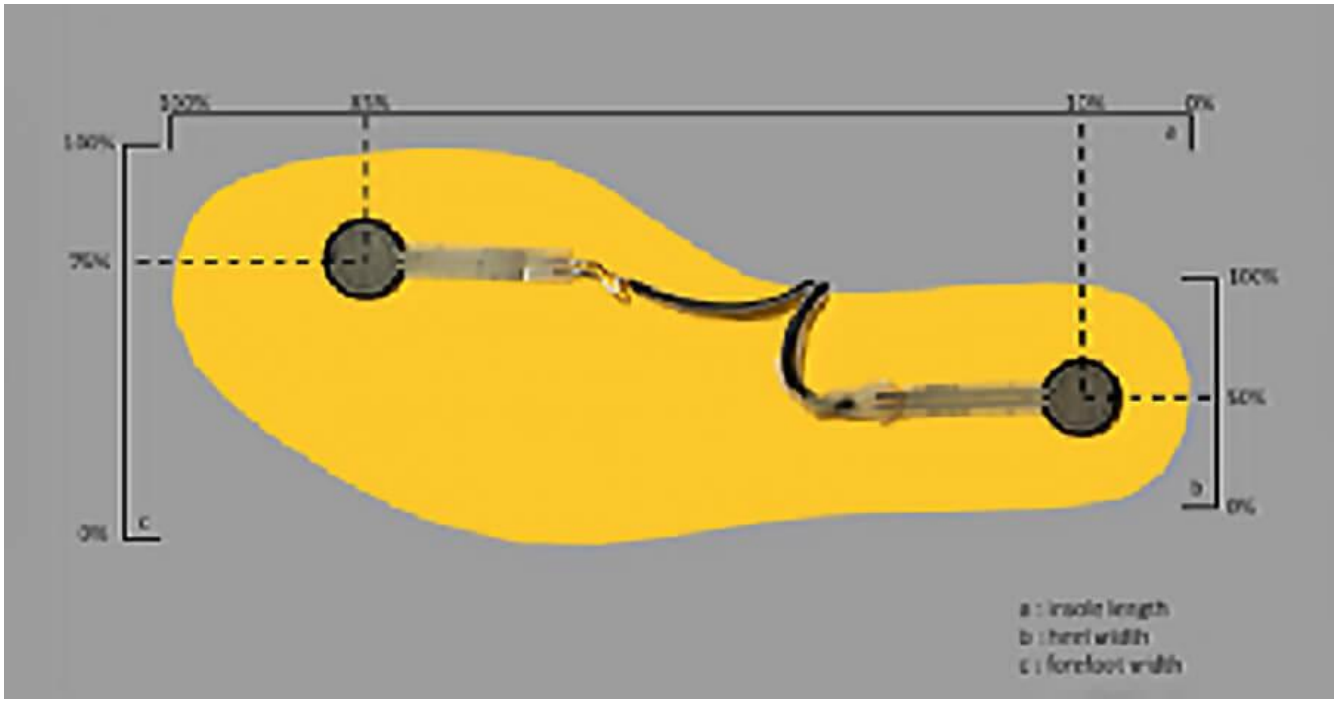
Foot Scanning

Insole Modeling & Sensor

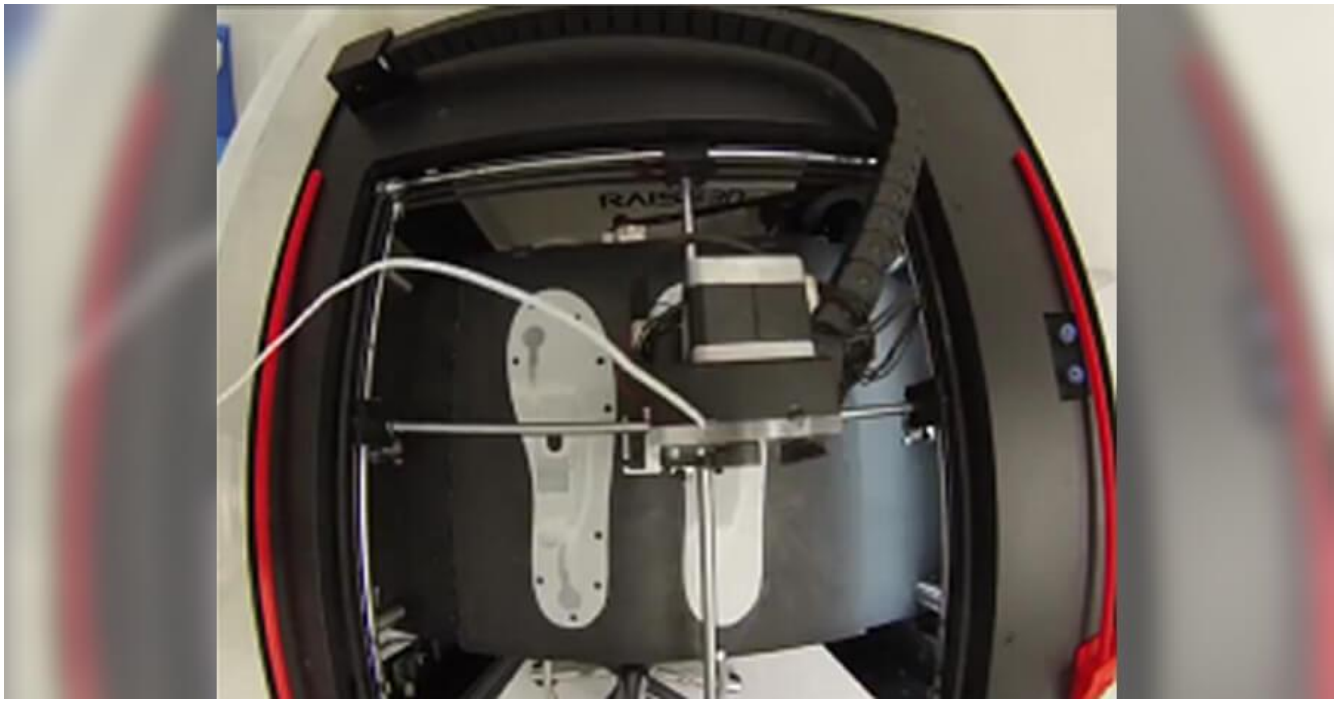
Layout / Design Printing / Electronics Enclosure

Roy begins by scanning a model of the foot which will be used for modeling the insole. Using the visualized scan data in the modeling software, he can easily locate the correct position on the insole by aligning the insole shape with the model of the feet. Roy's design places two pressure sensors in the position of the heel and the second metatarsal. Bluetooth modules are also installed in the arch area.

By using a visual model and 3D printing, Roy can maximize the protection of enclosed electronics by designing an appropriate space layout and controlling the hardness of the insole with filament selection and infill rate. All components will be enclosed between layers of filament.



Roy's insole diagram of the circuitry layout.



Insole printing exposed circuit slot on Raise3D N2.

Challenges

If the smart insoles were created using a traditional manufacturing process, the complete smart insoles with pressure sensors would have cost upwards of 100 thousand HK dollars and would only be durable for one year.

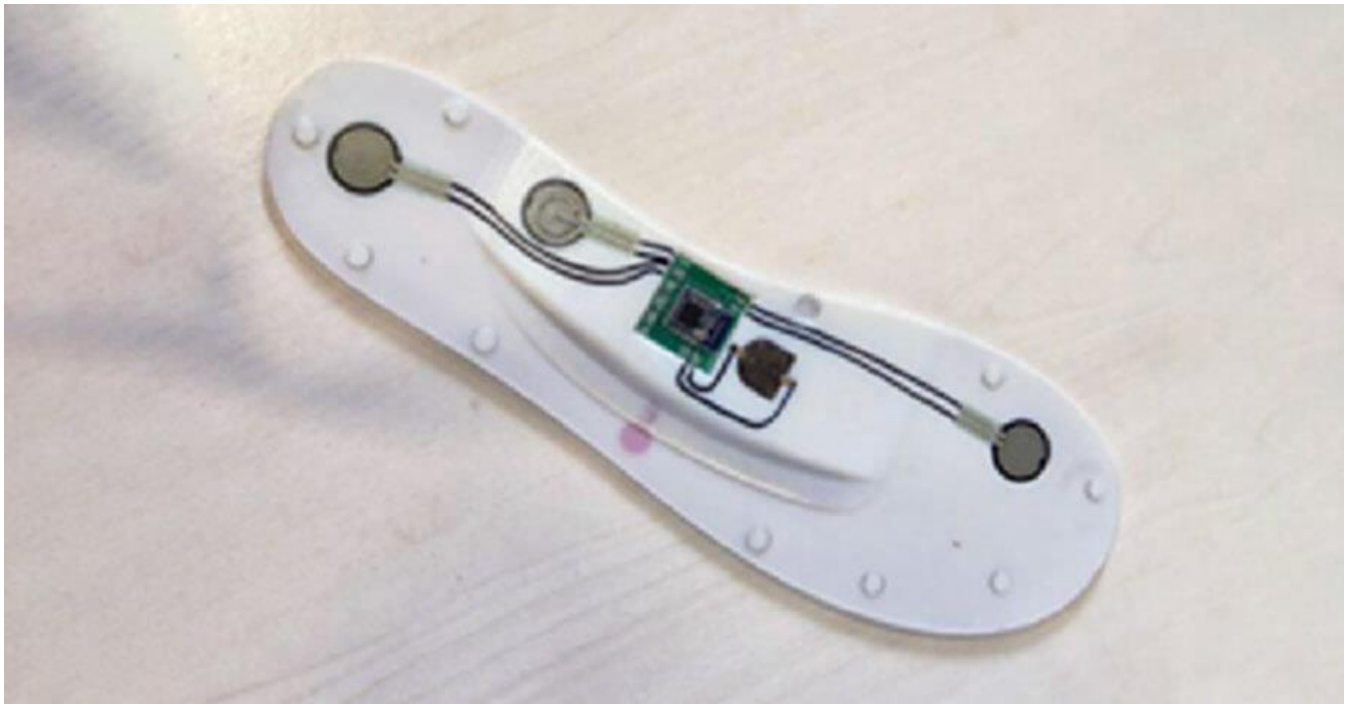
Both traditional insole customization and smart insole creation are a complicated process. Generally, insole customization manufacturing requires:

-impression molding from foam, silicon or plaster,
-thermoforming insole material in foot impression,
-correcting the insole and finishing.

The smart insole production additionally requires insole manufacturing and circuit integration setup. The challenge is, without molding for large batch order, the small-batch producing or prototyping can only rely on hand making which will result in a very inaccurate layout.

Solution

By applying 3D printing, Roy eliminated most processes involved in the creation of the insole. The Raise3D N2 is able to directly build a final production model with customized insole geometry and will automatically leave the space and slot exposed for circuit setup. After installation, the printer will completely enclose the electronics by printing the consecutive layers over them. Labor cost, facility and equipment cost, and lead time are shortened by this automation. Most importantly, his Raise3D printer allows him to combine insole customization and circuit set up together in one print run. As a result, the price of the insole is reduced to 500 HK dollars from 100,000HK dollars. Lead time is reduced from 2 weeks to less than 5 days. The equipment required is reduced to a computer, scanner, and printer instead of a foam pad and thermoforming machine and grinding machine.



Insole printing exposed circuit slot on Raise3D N2.

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Do you have a great 3D printing success story and think it would be cool to be featured on www.raise3d.com, we would love to learn more! Write to us at inquiry@raise3d.com

For more information about Raise3D printers and services, browse our website, or schedule a demo with one of our 3D printing experts.