EVA Moccasin

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EVA Moccasin: Creating a research archetype to explore shoe use.

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Abstract

This sample paper describes the formatting requirements for SIGCHI Extended Abstract Format, and this sample file offers recommendations on writing for the worldwide SIGCHI readership. Please review this document even if you have submitted to SIGCHI conferences before, as some format details have changed relative to previous years. Abstracts should be about 150 words and are required.

Author Keywords

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ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous; See <http://acm.org/about/class/1998> for the full list of ACM classifiers. This section is required.

Introduction

The Eva Moccasin is a result of prototyping as Vehicle for inquiry as defined by Wensveen and Mathews (2015). The final result is intended as a Research artefact with the purpose of "Illustration or Demonstration, Physical embodiment of research concept or design research space." (Wensveen and Mathews 2015)

Designing the shoe

Figure 1 The Sole and upper of the shoe are designed so that the sole is inserted into the upper. This is classic to a moccasin construction.

Figure 2 The Heel and Talon of the sole are printed separately allowing for the use of everyday 3D printers with the common 20cm x 20cm print bed.

Figure 3: Moccasin Shoe created as a research archetype

Concept

In 2014 Feijs et al [] demonstrated the possibility of algorithms and standard 3D printing technology to create shoe soles. Building upon this research we created a 3D printed shoe and sensorized sole capable of gathering data in multiple ways. This data is intended to be used to create the next iteration of shoes for the wearer. This project explores multiple methods of collecting data and asked the observer for a critical reaction as to the use of none to all of these approaches? The approaches used may be more or less novel; Their combined uses are certainly so.

The shoe, Fig.3, is intended as part of a product service system. The systems assumes that the shoes are "rented" and returned. The data gathered from the shoes is used to generate the next pair of shoes. This breaks from traditional shoe manufacturing [].

Technological Innovation

Three approaches to measuring the use of the prototype are employed in the sole of the EVA moccasin archetype. They are incorporated into a single prototype in Fig. 4 These are:

1. The use of flexible, conductive PI-ETPU 95-250 to create a resistive pressure sensor.
2. The use of color change in filament application so that photographic analysis can be used to determine wear.
3. Geometric micro structures are printed in the the sole that wear can be observed in the form of elongation and breakage. How innovative is the use of technology: have advances been made in the use of standard tools for a new purpose? Have new

Figure 4 All three approaches in a single sole.

Early Development

Figure 1 Although lab evaluation was not the intent of this research, developing a consistent sensor required testing.

Figure 2 Processing code used to create the gCode

technologies been developed? What does the technology bring to the wearer or the viewer in the wearable environment?

Execution

A team of shoe maker and researcher joined together to craft a shoe that is wearable. The style was contemporary in nature. The shoe is tailored to the needs of the electronics so that the wearer need not be aware of their presence

Audience/Usability:

The shoe is based upon work into parametric design demonstrated at Dutch Design Week and on Solemaker.io. The shoes are generated specifically for the person wearing them. While these are completely wearable, the intended audience is the wearable computing research community and the discussion they create.

Research

The shoe is the result of a prototyping as a vehicle for inquiry [] process. Several iterations were made and the significance of the case was analyzed. It is important to this prototype is not intended as an experimental component or as a means of inquiry as described by Wensveen and Mathews []. Rather, The shoe is at best intended as a research archetype with the purpose of "Illustration or Demonstration, Physical embodiment of research concept or design research space." (Wensveen and Mathews 2015)

Prototyping as a Vehicle for Inquiry

The iterative prototypes in this study are a series of 3D printed artefacts intended to be worn on the body as part of a shoe. As part of a shoe sole I was interested

on how information about the use of the wearer could be gathered in order to create a future iteration of the shoe. This future iteration is intended to be more personalized to the wearer and their needs. Each prototype is intended to create data that can be collected and used to remake another iteration of the Prototypes express integrated electronics and non-integrated electronic approaches were created iteratively for the research. They were also combined to illustrate possible co-existence. These artefacts were created to facilitate interviews with experts.. The reasoning for this approach. Based upon the method of Prototyping as a Vehicle for inquiry summarised by Wensveen and Mathews 2015 [14], the role and contribution is tied to the process of crafting the artefacts". Engaging the expert in this phase of the process allowed more concentrated and thoughtful analysis of the material and fabrication instead of thinking about the prototype as a conceptual object.

Prototypes

Three different approaches were taken in creating the prototypes; Electronic, Photographic, Geometric. The prototypes required more than 200 hours to create. An initial series of prototypes was created using standard STL methods. Then a series of prototypes are created with gCode generated by software created by the author and fellow researchers at the institution []. 3D printing via gCode was used to allow for exact structures to be created for later analysis. Soft, flexible materials were used so that the Wearable materials resemble the materials commonly used in the creation of soles in the shoe.

Sensor Creation

Figure 3 Positioning the electrode wires on the flexible insulator

Figure 4 Printing the resistive pressure sensor

Figure 5 Finished print with resistive sensor, color change and geometric indicators

ELECTRONIC

In the electronic approach, conductive PI-ETPU 95-250 Carbon Black filament was printed into the sole as a resistive sensor with conductive wires measuring the resistance using a common Arduino microprocessor. Data is visualised in processing in fig. 2. The data was recorded so that it could be used to inform future iterations. The process began by writing gCode that allowed the tuning of the electronic output to the force small iterations were created and tested to determine the best geometric structures to use. More details on this are to be presented in a forthcoming paper. Once an acceptable structure was identified, a layered prototype was created and tested. The layers involved were situated in a way to act as a sensor:

1. An experimental, shore 75a version of FilaFlex TPE used to create a soft foot bed and insulate the body from the electronics.

Figure 6 Checking the 3D printed pressure sensor

2. Multicore wire to serve as an electrode for the sensor.

3. Sensor created with flexible, conductive PI-ETPU 95-250 Carbon Black filament.

4. Multicore wire to serve as an electrode for the sensor.

5. FilaFlex TPE, shore 95A, as the tread and isolation from the ground.

These were attached to an Arduino Teensy where the pressure was monitored and recorded. The teensy is integrated into the shoe.

PHOTOGRAPHIC

In the photographic approach, different colors of flexible filament were applied in the creation of the sole to track how the material abraded, Fig 4. This is facilitated by a photograph of the sole taken by the user and an approximation of consumption of the material to be calculated. A scenario where the wearer is prompted occasionally by an application on their cell

Open source software for processing by Cedric Kiefer [] was modified to create an example of the system. Tracking the difference in the images over time would reveal how the material was consuming and communicate use that can be used to generate future iterations. We speculate to the use of an app to facilitate the completion of this phase.

Sensor Creation

Figure 7 3D printing a geometric heel

Figure 8 Early prototype of color change heel

Figure 9 Multiple colors placed in Bowden tube

Figure 10 Filament color change is used to illustrate wear

GEOMETRIC

By creating micro structures inside the sole material, we can track use by how the structures break over time. A more brittle material, NinjaTek Cheetah, was used and micro internal structures were developed. These structures were available due to the precision allowed by the software in its creation of the gCode. A scenario where the user counts how many of the internal structures are broken periodically emerged in

the process. Tracking this over time allows for an estimation of consumption and use, Fig 5.

In the prototyping process these approaches were merged together to save time in printing and allow for a finished prototype that can present all three methods together.

The engineering and evaluation of the effectiveness of these methods of gathering data lies outside of the scope of this paper. Here we hope to understand and describe how the community approaches these methods and how we might implement them in design.

Figure 11 Macro view of the internal connections used to monitor usage through breakage.

Results

The result is an archetype shoe with three integrated methods for remembering the wear and tear created by the wearer. Each method has advantages and

Sensor Creation

Figure 12 Bottom view of EVA Moccasin

disadvantages. This shoe shows that there are electronic and non electronic methods used to achieve the goal of remembering use.

We ask the observer for their opinion. Which approach, or combination of approaches is better? Why is it better? More feedback is needed from the expert community to move forward.

The prototype is a way of gathering signs of wear, or memory of use. The EVA Moccasin thus asks for expert opinions to be gathered and analyzed to be formulated in a future full paper.

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