Workshop on Wearables and Machine Learning: Applications of Artificial Intelligence, Approaches on Textile Technology

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Abstract

We describe a workshop on applications of Artificial Intelligence on Textile Technology through the usage of Machine Learning. The participants are given an overview of the state-of-the-art methods and technologies and are introduced to them through practical exercises. The exercises involve simple hands-on group work with a basic pre-built electrical circuit, as well as the possibility to train small models of Machine Learning given a user-friendly tool, whereas after the workshop, the participants can take home their own self-made electronic accessories

Keywords

Interactive Textiles, Machine Learning, Smart Textiles, Wearables, Artificial Intelligence

Introduction

The advance of the technology during the last years has provoked major changes in the design and the clothing industry. The wide availability of digital

components and accessories enabled their integration into clothes and wearable accessories. Their affordable cost made the products accessible to a big part of the market and widely recognized under the notion of Wearables. Meanwhile, the enthusiastic response of the consumer base has directed the industry into further research and development in order to fulfill more challenging requirements that can be applicable to the users' everyday life [8]. An important aspect is also the possibility of using this technology to provide solutions for the health sector and for people with disabilities [3], giving better perspectives for social inclusion and equal opportunities [6].

A basic and very important attribute of the new wearable technologies is the fact that these accessories accompany their users for a significant part of their regular activities, most of them on a daily basis. The first generation of Wearables offered intelligent functions with pre-programmed rules based on common knowledge and general world behavior. Nevertheless, the ability to follow and store the activities of the user gives the possibility to enhance the intelligent functions with empirical knowledge. This way, the accessories are capable of adapting themselves to the needs of the individual users and therefore being more useful by the time. These features are actively backed by state-of-the-art technologies that are associated with a broad spectrum of scientific research in the area of informatics. These technologies include Big Data, that allows the efficient storage and processing of the data gathered by the devices, as well as Machine Learning that offers the statistical background to analyze this data, extract the important patterns and transform them into useful actions for the user. Machine Learning is considered the core technology that is expected to shape the future in personalized technologies.

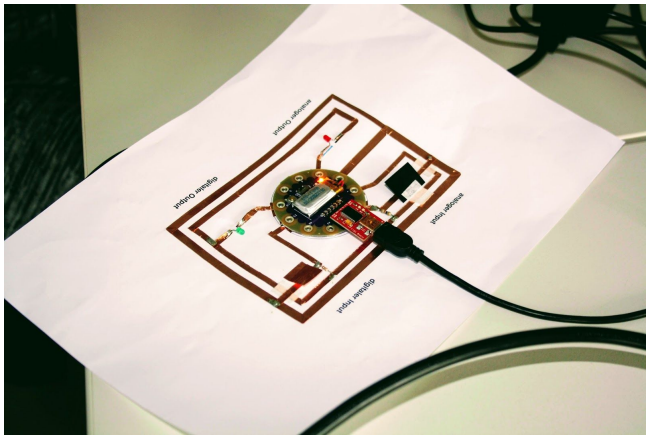

Figure 1: Sample electrical circuit controlled with Arduino

In this course, we therefore focus on this combination of Wearables and Machine Learning. We aim to offer the participants a full-framed knowledge base about the methods that form the current state of the art.

What activities does the workshop involve?

The workshop consists of a short theoretical input and several hands-on exercises on the combination of Wearables and Machine Learning.

The focus is on smart textiles and soft interfaces as a means for Human-Computer Interaction. The exercises take place in small groups and can be dynamically adapted to the level of the participants making flexible use of pre-existing material (data, software, components). The activities are organized in two parts.

Figure 2: Laser-cutted felt with coin cell battery holder for the hands-on exercise

Part 1: Wearables focusing on smart fashion

The first part consists of an overview of Wearables, focusing on smart fashion [2], [5]. The participants have a hands-on demonstration of the fundamental functioning of an electrical circuit with analog and digital input and the corresponding output controlled by a microcontroller [1].

As part of the demonstration, the organizers provide the participants with pre-built electrical circuits (Figure 1), which consist of an Arduino microcontroller, an analog switch, a digital switch and two LEDs. The microcontroller has been pre-programmed, so that the LEDs react accordingly, depending on when the analog or the digital switch is pressed. While the participants experiment with the switches, they are informed about how the electrical current is conveyed through the circuit and how the microcontroller controls the LEDs according to the two distinct inputs. This also serves as a live example on how the electrical circuits are embedded in textiles and wearables.

Finally, the participants are given the opportunity to create their own simple wearable. The organisers give to every participant a laser-cutted piece of felt attached to a coin cell battery holder (Figure 2). Then the participants are instructed to use a hot glue gun to apply a LED on the felt and then to use conductive thread in order to connect the poles of the circuit to the respective poles of the LED. The successful stitching has as a result that the LED can power on through the included slide switch of the coin cell battery holder. This way, the hands-on exercise allows a better understanding of the basic construction of a wearable.

Part 2: Practical exercise with Machine Learning

The second part of the workshop focuses on how to use Machine Learning to make the Wearable intelligent. In this exercise, the participants are given data from the interaction of users with a Wearable. By using existing user-friendly Machine Learning tools, the participants are instructed to create a Machine Learning model to empower the Wearable to decide like a human.

The exercise is based on prior work on sign language recognition with an intelligent glove [6]. After an introduction to the sensors on the glove (finger flex sensors, gyroscope, accelerometer), the participants are pointed to a dataset containing sensor values for the gestures of the American Sign Language alphabet . Then, they are guided to load this data to the online platform BigML.com, where they build a classification model able to recognize the letters of the sign language given sensor values from similar gestures. As a simple example, a Decision Tree is built, allowing a visual demonstration of the generalized criteria of the classification process. Finally, the participants are instructed how to evaluate the built models and how their performance could be improved.

Figure 3: Participants training models through the online machine learning tool

What do participants get?

We are aiming to provide the participants with an insight into application-oriented Machine Learning and smart Wearables. They learn the methods that form the current state of the art and understand their application through practical exercises. Additionally, the participants are given a quick overview of a user-oriented development process and gain insight into textile-specific interaction modes.

Workshop requirements

Participants background:

- basic knowledge of User Experience and Human Computer Interaction
- ability to perform basic functions on a browser (browse websites, transfer and open files)
- (optional): basic understanding of programming

Resources:

- separate room or section with space for hands-on (room with table) and projector for the presentation
- laptops or desktop computers (one per group, i.e. one every 2-3 participants)
- technical components for the hands-on exercises will be sponsored by our institution through the research project UPLINX

Workshop duration

- 1,5 hour

Biodata

Eleftherios Avramidis is a senior researcher specialized on Machine Learning and Artificial Intelligence. He has been a researcher at the German Research Center for Artificial Intelligence (DFKI) since 2010. He joined the Design Research Lab and the Interactive Textiles Lab of DFKI in November 2017. He has been active with the development of Machine Learning Models that predict the user qualitative preferences on text outputs and he has pursed his Ph.D. at the University of Saarland with the topic of "Quality Estimation for Machine Translation".

Friederike Fröbel is a researcher at the German Research Center for Artificial Intelligence (DFKI) in the research group of Interactive Textiles. She joined the Design Research Lab as a student assistant and pursued her M.Sc. degree with her thesis entitled "Smart Fashion as Mobile User Interface". With her background in clothing technology/fabrication and media informatics, she cooperates in several projects with industrial and university partners and also teaches students in the design and the implementation of Wearables with the focus on smart textiles.

DESIGN
RESEARCH
LAB

Gesche Joost is Professor for Design Research at the Berlin University of the Arts and since 2005 heading the Design Research Lab. With international partners, she conducts research and development projects in the areas of human-computer-interaction, wearable computing, as well as user-centered design and participation.

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The **Interactive Textiles Lab** is a research group of the DFKI, that focuses on the development and implementation of application-oriented concepts of prototypical Wearables around Human-Machine Interaction with smart textiles and soft interfaces with methods of interdisciplinary and participative design research, in close co-operation with the **Design Research Lab** of the **University of Arts Berlin** (UdK Berlin).

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