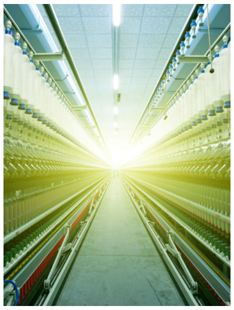



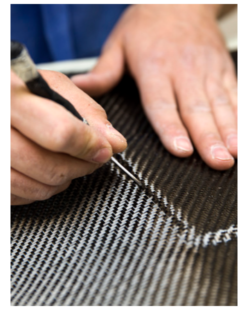


2022

ITMC

Hosted by CTT September 19-21, 2022 Montréal

Conference and Smart Textile Salon

Grande Bibliothèque, Bibliothèque et Archives nationales du Québec, Montréal (Québec)

PROTOTYPES AND INNOVATIONS

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Introduction

Welcome to the 8th edition of the Smart Textile Salon!

Initiated in 2009 by the European Coordination Action SYSTEX, the Smart Textiles Salon is meant to bring visibility upon potential commercial breakthroughs of intelligent textiles. The smart textiles field have been the object of thousands of projects, research and papers but very few products have reached the commercialisation stage. Through this exhibition, we encourage designers, academics, researchers and industrialists to showcase their work; allowing participants to interact with their prototypes by touching, feeling and experiencing the final-end product.

Furthermore, this edition extended the scope of the prototypes beyond smart textiles by also including innovative textile products, smartly designed, without electronic functions.

The Smart Textiles Salon Vol.8 is organised by CTT Group and is hosted in a meaningful location that is Quebec National Library and Archives.

We appreciate your active participation and hope you enjoy this event!

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SMART MATERIALS&SYSTEMS: HAS EMBRACING UNCERTAINTY BECOME VITAL TO COMMERCIALISATION?

→ Marie O'Mahony

Dr. Marie O'Mahony is a sole proprietor of O'Mahony Consultancy with more than twenty years' experience in smart materials and wearable technology. She is also Visiting Professor at the Royal College of Art (RCA) and has written six books on smart materials and advanced textiles, five of these published with Thames and Hudson. She has previously served on the Australian Government's Textile, Clothing and Footwear Innovation Council (TCFIIC) and is currently a Leadership Council Member with intelliWEAR.

THE ROLE OF SMART TEXTILES IN THE FUTURE OF HEALTH.

→ Pierre-Alexandre Fournier

Pierre-Alexandre Fournier is co-founder and CEO of Montreal-based Hexoskin (www.hexoskin.com), a world leader in smart clothing for vital signs monitoring and AI software for clinical applications. Hexoskin was founded in 2006 and launched in 2013 the first iPhone compatible smart clothing for health monitoring, which won several international awards. In 2018 Hexoskin launched Astroskin, a set of smart garments for clinical research that has been adopted for the remote health monitoring of astronauts in the International Space Station. Pierre-Alexandre is also an advocate for transparency in healthcare, patient empowerment, and healthcare innovation through design.

INTELLIGENT GARMENTS FOR ONLINE MONITORING OF HUMAN HEALTH AND WELL-BEING.

→ Xianyi Zeng

Xianyi Zeng is a distinguished professor in ENSAIT Textile Engineer School, France, Director of the GEMTEX Laboratory. His main research interests include artificial intelligence, digital fashion, sensory analysis, intelligent wearable systems, computerized garment design and customized production management. He has published more than 130 papers in peer-reviewed international journals and presented more than 200 papers at international conferences, and supervised more than 30 PhD students. In addition, he has been a PI of three European projects such as FBD_BModel (H2020 Program) and a number of national and regional research projects as well as industrial projects in cooperation with international groups in France and Europe.

Prototypes and innovations:
Blink sports bra

Blink sports bra is a wearable technology that displays wearer's heart rate with blinking LEDs. It uses Pulse Sensor Amped, Arduino Nano microcontroller and NeoPixel RGB LED ring. Arduino Software (IDE) is used for coding and programming the microcontroller to measure heart rate and actuate LEDs signaling wearer's pulse. Pulse Sensor Amped, which detects pulse via arterial saturation of oxygen measured using light shone on veins, is located on the front right strap of the bra corresponding to a major artery. NeoPixel RGB LED ring is located on the center front of the bra while the microcontroller is placed on the right side of the front hem for easy access to connection to power source.

Blink is designed with wearer comfort in mind using active dry wicking jersey mesh. It features laser-cut auxetic patterns strategically located on high sweating locations on the front and back torso to maximize ventilation as well as to add extra strecth. Hems and inseams are finished with Thermoplastic Polyurethane film lamination for tactile comfort and color blocking effect.

To see Blink in action, please visit:

https://youtu.be/-x9UY9Zkm44

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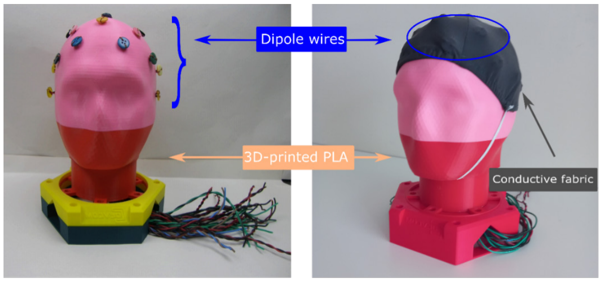
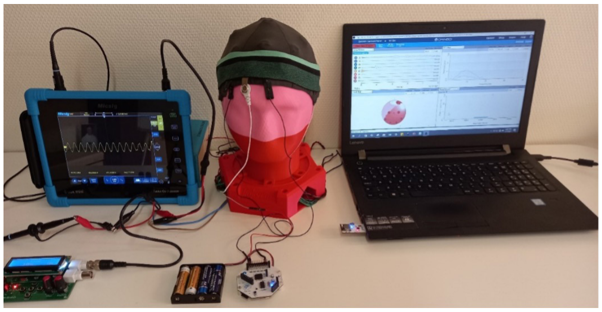
Prototypes and innovations:
Textile-Based Head Phantom for EEG Electrodes Validation

In this work, we explored a long-lasting and lightweight head phantom that allows synthetic wave injection and measuring at a performance similar to the commonly used ballistic gelatin-based head phantoms. It was found to perform similarly, and for some parameters like the SNR even better than the gelatin-based one. The result proved that the textile-based head phantom can accurately mimic body-electrode frequency responses which make it suitable for the controlled validation of new electrodes. While the textile-based phantom was designed for EEG, it can also be adapted to electrocardiogram, electromyogram, electrooculogram, and other related studies as well.

The new textile-based head phantom has a much lighter weight than the gelatin-based i.e., 0.5 and 6 kg, respectively. Therefore, the weight reduction is 91.67% which makes it more suitable for handling and moving from place to place. In addition, it is not delicate like the ballistic gelatin-based one, where the shape of ballistic gelatin could be distorted and decays fast even when kept in a refrigerator. In our case, the gelatin-based head phantom began decaying after a week of its construction which may also depend on the weather where it is placed during testing. In contrast, the textile-based head phantom does not decay at all. All these will play an enormous role from an economic and sustainability point of view.



Textile-based head phantom



Synthetic EEG wave generation, injection to head phantom, and EEG measurement

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Prototypes and innovations:
Bloom: Touch-Actuated Interactive Collar

Bloom is a touch-actuated interactive wearable that addresses shape-changing structures by bridging across fashion, art, technology, and design disciplines. The research prototype presents a speculative design approach to skin hunger also known as touch starvation or deprivation which is defined as a condition when people don't get enough or any positive physical touch. During Covid19 pandemic and lock downs, the fundamental human need for physical contact and touch became even more evident as people lost the daily tactile interactions like handshakes, friendly hugs or pats on the back. When there is not enough positive tactile stimulation, people become anxious, stressed, or depressed, which then leads to increased cortisol levels, heart rate, respiration rate, blood pressure and muscle tension (Banerjee et al., 2021). Bloom displays the positive impact of touch in the form of a shape memory alloy (SMA) integrated blooming flower in response to a gentle tap input received by a pressure sensor inside the collar (Watch Bloom in action: https://youtu.be/AZfSGqQ7_As).

The project utilizes the methods and materials of direct 3D printing on textiles, e-textiles and shape-memory alloys to demonstrate a reciprocal interaction between human and a wearable, whereby human touch transforms the aesthetics and visual impact of an interactive collar through movement. Direct 3D printing on textiles refers to the method of depositing polymer materials directly onto textiles during 3D printing process to create hybrid structures with flexibility and hard components adhered on the textile surface (XXX, 2019; Goncu-Berk, Karacan&Ilkis, 2022). E-textiles enable soft circuitry using conductive yarns, fabrics, inks or polymers and embedded electronic components. Finally, shape memory alloys, under the influence of temperature stimuli, are capable of spontaneous and reversible changes of shape (Bartkowiak, Dąbrowska & Greszta, 2020). SMA materials can be deformed by applying an external force and will recover to the original form when heated beyond a certain temperature either by external or internal heating (Jani et al., 2014). While some applied research explored integration of movement into clothing, they employed servo motors (Jung, Lee & Achituv, 2013) or pneumatic systems (Sung, Yu & Gunju, 2014) to initiate the aesthetic form change while Bloom attempts at a much fluid and silent actuation by employing shape memory alloys.

Bloom is composed of an inner collar that houses the e-textile circuit, an outer collar with 3D printed and laser cut patterns and SMA integrated interactive textile petals that are actuated by touch. The petals of the Bloom respond to a gentle tap on the shoulder by opening up and mimicking the bloom of a flower. 0.5mm diameter, untrained straight SMA wire that gets activated at 45 Celsius temperature was integrated into textiles by cording it along the outline of the petal form. Since the SMA was corded by bending it to the petal form, once it is heated, it responds by changing into its original straight form causing the petals also open up (*Figure 1*).

Bloom also offers a dynamic visual impact through its interactive design. When the SMA integrated interactive textile petals on the collar open up, they display a rich visual and tactile texture. For actuation, joule heating is employed to heat the SMA wire, where the passage of an electric current through the SMA wire produces the heat. The movement of the SMA is activated by a thin film pressure sensor and e-textile circuit controlled by an Arduino Nano microcontroller board.

Figure 1.

Muslin prototype of SMA wire corded petals.

The Arduino Nano board is programmed using the Arduino Software (IDE) to run electrical current through the SMA for 10 seconds once the pressure sensor gets activated by the pressure of touch. The e-textile circuit utilizes copper tinned, Kevlar core conductive thread with electrical resistance of 0.85 Ohm/m

Figure 1. Muslin prototype of SMA wire corded petals.

Figure 2.

E-textile transmission lines and electronic components sewn to the collar lining.

The outer collar displays cohesive and dynamic patterns achieved by rapid prototyping technologies. The first part of the outer collar is an application of direct 3D printing of a flexible thermoplastic polyurethane filament directly on a mesh textile surface. The 3D printing pattern is digitally modelled by using a Nurbs modelling software and printed with a Fused Deposition Modeling 3D printer. The second part of the collar is an application of laser cutting with the same the 3D printed pattern form. The laser cut knit fabric is fused on the mesh textile. The overall aesthetic of the collar displays rhythmic use of foreground/background relationships and it does so by the see-through nature of the mesh textile that allows wear's skin color to show and hide based on the arrangements of 3D printed and laser cut patterns.

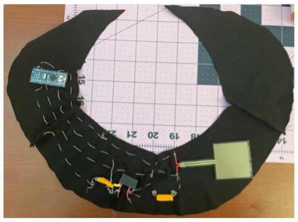

Figure 2. Muslin prototype of SMA wire corded petals.

Figure 3.

Top layer of the collar with 3D printed (left side) and laser cut (right side) patterns.

Bloom contributes to scholarship in fashion, design and technology by exploring the potential of an SMA based actuation and pressure sensing e-textile systems using a speculative design approach. It engages with a series of interdisciplinary challenges ranging from multi-material 3D printing and SMA integrated textiles to development of a novel e-textile circuit. Bloom, as an interactive wearable that react to touch with movement and transformable aesthetics, offers an original vision by provoking questions about the long-term impacts of Covid19 pandemic lockdowns, specifically touch deprivation.

Figure 3. Muslin prototype of SMA wire corded petals.

References

– Banerjee, D., Vasquez, V., Pecchio, M., Hegde, M. L., Ks Jagannatha, R., & Rao, T. S. (2021). Biopsychosocial intersections of social/affective touch and psychiatry: Implications of 'touch hunger'during COVID-19. International Journal of Social Psychiatry, 0020764021997485.

– Bartkowiak, G., Dąbrowska, A., & Greszta, A. (2020). Development of Smart Textile Materials with Shape Memory Alloys for Application in Protective Clothing. Materials (Basel, Switzerland), 13(3), 689. https://doi.org/10.3390/ma13030689=

– Jani, J. M., Leary, M., Subic, A., & Gibson, M. A. (2014). A review of shape memory alloy research, applications and opportunities. Materials & Design (1980-2015), 56, 1078-1113.

– Jung, E.-M., Lee, Y.-S., Achituv R. (2013). Venus. CHI '13 Extended Abstracts on Human Factors in Computing Systems, ACM (2951-2954).

– Sung, J.W., Yu, H.-B., Gunju, R.-J. (2014). Design Transforming Dress based on pneumatic systems, TechArt: Journal of Arts and Imaging Science, Vol. 1, No. 2, (5-9).

– Goncu-Berk, G. (2019, December). 3D Printing of Conductive and Phosphorescent Filaments onto Textiles. In International Textile and Apparel Association Annual Conference Proceedings (Vol. 76, No. 1). Iowa State University Digital Press.

– Goncu-Berk, G., Karacan, B., & Balkis, I. (2022). Embedding 3D Printed Filaments with Knitted Textiles: Investigation of Bonding Parameters. Clothing and Textiles Research Journal, 40(3), 171-186.

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Prototypes and innovations:

Distanced: Proximity Sensitive Morphing Dress

“Distanced” is a responsive garment that recognizes proximity and reacts to distance between the wearer and others by changing its physical form (Watch Distanced in action: https://youtu.be/E4xeqcak6a4). It presents a speculative design approach by probing into how Covid19 expanded the boundaries of personal space. The sudden changes in day to day lives caused by Covid19 such as wearing masks and social distancing have also impacted how we take part in social interactions. We started practicing the fairly unnatural behavior of social distancing. Recent research showed that individual’s personal space increased 40 to 50 percent from the typical 2-3.3 feet to 4.1 on average (Holt et al., 2021). This research prototype provokes questions about whether the changes to comfortable personal space will persist and the long-term mental health consequences of these changes.

Previous research attempted proximity responsive transformation in clothing design via manual actuation and use of motors and rods to make the wearer more noticeable (Tomico & Wilde, 2016). For example, the proximity dress by Annouk Wiprecht uses thermal sensors and activates a 3D printed mechanism to expand the hem creating distance between the wearer and a person approaching (Froelich, 2021). However, none of these previous works explore shape memory alloys as actuators for form changing in response to proximity. “Distanced” explores how proximity data can be used to create new forms of nonverbal communication. The dress responds to invasion of the personal space by erecting and expanding the cascades running vertically from shoulders to hips. The dress also engages with a series of technology development and design issues. It demonstrates how shape memory alloys (SMAs), which can engage in spontaneous and reversible changes of shape under the influence of temperature stimuli, can be integrated in clothing design as actuating systems that can physically respond to environmental stimuli (Bartkowiak, Dąbrowska & Greszta, 2020).

0.5mm diameter, untrained SMA spring that gets activated at 45 Celsius temperature was integrated into the dress. A PIR, passive infrared, sensor is employed to detect human motion in and out of sensors range to activate the form change of the garment via shape memory alloys. PIR sensors can detect levels of infrared radiation to sense motion within range of 20 feet. The SMA spring and PIR sensor are controlled by an Arduino Nano microcontroller board. Arduino Software (IDE) is used for coding and programming the microcontroller to run electrical current through the SMA once the PIR sensor is activated by the proximity of a human to the wearer. The e-textile circuit utilizes copper tinned, Kevlar core conductive thread with electrical resistance of 0.85 Ohm/m. The PIR sensor SMA spring are housed on the chest while Arduino Nano and relay are located on the shoulder of the middle layer mesh dress as seen in *Figure 1.*

The visual aesthetics of the dress draws inspiration from contemporary "Droog" design, which means "dry" in Dutch referring to simplicity and dry humor of the objects. Specifically Marcel Wanders' "Knotted Chair" (created by the low-tech handcraft knotting techniques using hi-tech Aramid and Carbon fibers) and Diana Scherer's "Hyper Rhizome" (textiles created with plant root weaving as metaphors for the networks of computers forming the Internet) inspire the visual design of "Distanced" (Hobson, 2020). "Distanced" also combines low-tech and hi-tech materials and processes to create unique transformable aesthetics. The cascades running from shoulders down to hips and on the chest are hand knitted using 1.2mm diameter blue paper string mixed with 22 gage bright green copper wire. The mixing of paper string and copper wire not only created sculptural 3D forms defying gravity but also allowed ease of movement as a result of its flexible and lightweight structure which can be easily pulled with the actuation of the SMA spring mechanism (*Figure 2*). The hand knitted cascades are attached to a polymer mesh sheath dress where the e-textile circuit and the electronic components are located. The inner layer is a fitted princess seam dress constructed from silk fabric.

Figure 3 : Hand knitted cascade form and texture detail.

"Distanced" contributes to scholarship in fashion, design and technology by exploring the potential of an SMA based actuation and proximity sensing e-textile systems using a speculative design approach. The project questions the increased personal space of individuals during Covid 19 pandemic through a dress design that moves and expands when the wearer's personal space is invaded.

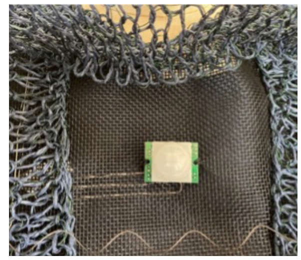

Figure 1:

PIR sensor located on the chest; electronic components located on the shoulder.

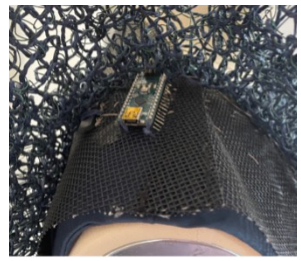

Figure 2:
SMA spring mechanism

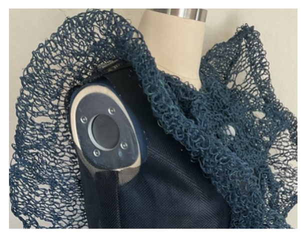

Figure 3:
Hand knitted cascade form and texture detail.

References

– Bartkowiak, G., Dąbrowska, A., & Greszta, A. (2020). Development of Smart Textile Materials with Shape Memory Alloys for Application in Protective Clothing. Materials (Basel, Switzerland), 13(3), 689. https://doi.org/10.3390/ma13030689

– Froelich, P. (2021). Designer's Spider Dress melds fashion with tech to enforce social distancing. The New York Post. https://nypost.com/2021/08/07/designers-spider-dress-enforces-social-distancing/

– Hobson, B. (2020)> Interview with Renny Ramakers. Dezeen. https://www.droog.com/author/droog/page/4/

– Holt, D. J., Zapetis, S., Babadi, B., & Tootell, R. B. (2021). Personal space Increases during the COVID-19 Pandemic in Response to Real and Virtual Humans. medRxiv.

– Tomico, O., Wilde, D. Soft, embodied, situated & connected: enriching interactions with soft wearables. mUX J Mob User Exp 5, 3 (2016). https://doi.org/10.1186/s13678-016-0006-z

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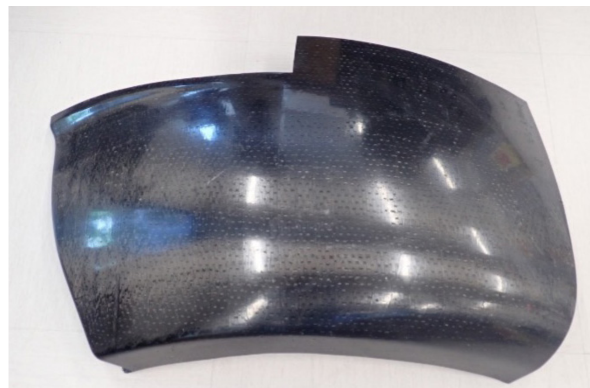
BEST INNOVATION AWARD

Prototypes et innovations :
Aile de camion 100 % carbone

Le prototype montre la fabrication d'un garde-boue de camion en composite moulés avec des préformes en fibres sèches. Les préformes sont fabriquées par dépôt robotisé de rubans de fibres de carbone et/ou de verre (bandes étroites). Ce procédé de fabrication permet de placer les rubans dans une multitude de configurations, en termes d'angles et de nombre de couches. Cette flexibilité permet d'optimiser la conception des pièces à fabriquer et de réduire la quantité de matériau nécessaire et donc de réduire le poids des composantes. Les préformes peuvent couvrir 100% de la surface ou être combinées à d'autres renforts textiles pour ajouter de la résistance localement, et ce uniquement dans l'axe des principales contraintes. Des préformes sèches seront présentées ainsi que des pièces composites réalisées avec ces préformes.



Prototype aile de camion 100% carbone

Préforme partielle mixte verre carbone localisé avant infusion

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Prototypes and innovations:
Hexoskin Pro Shirt

Hexoskin Pro

The Hexoskin ProShirt delivers a host of new features with 20 upgrades & improvements compared to the Hexoskin Smart Shirts Collection. The new Hexoskin ProShirt for Men & Women comes with an all-new design to withstand the most active lifestyle. The Hexoskin ProShirt comes with built-in textile ECG & Respiratory sensors, and a precise Activity sensor in one washable and comfortable smart clothing to monitor your activities and your sleep. The Hexoskin Pro Kit for Men offers advanced longitudinal physiological health monitoring, for clinical studies, stress monitoring & performance training. The key Features of the Hexoskin ProShirts include:

- Enhanced form factor comfortable to wear at night or for light to extreme activities
- New adjustable elastic belts incorporated into the Hexoskin ProShirt
- New Dual-Pocket for the Hexoskin Smart recording device to adapt to a wide range of activities and sleeping positions
- Designed to withstand tough conditions.

Hexoskin ProShirt Specifications:

- Machine washable (piling and stretching resistant)
- Lightweight & quick to dry Fit optimized for regulation of moisture/heat
- 99.9% antibacterial treatment (no odors)
- Excellent UV Protection
- 73% Polyamide Micro/27% Elastane
- Made in Canada with Italian textiles.

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HEXOSKIN HEALTH SENSORS & AI

Prototypes and innovations:
Astroskin Vital Signs Monitoring System

Astroskin Vital Signs Monitoring System

The Astroskin Vital Signs Monitoring System is a non-invasive monitoring system consisting of a machine-washable smart shirt designed for continuous and longitudinal health monitoring. The Astroskin garments are available in several sizes for men and women (from 2XS up to 4XL) and are composed of embedded health sensors such as textile 3-Lead ECG sensors, two Respiratory Inductance Plethysmography (RIP) sensors, and a neoprene encapsulated thermistor which collects skin temperature.

The Astroskin Shirt connects to a removable and reusable Astroskin data recorder which includes a 3-axis accelerometer and a Bluetooth 2.1 radio. The system is powered by two AA batteries, which can be quickly replaced. The system allows the continuous physiological monitoring of the five primary vital signs without interruption for 48 hours of autonomy. The system is completed by the Astroskin headband which includes a photoplethysmogram (PPG), Heart rate, and Pulse Oximeter (SpO2) sensor. Astroskin also provides a continuous measure of systolic blood pressure. The end-to-end system includes iOS apps for iPhones & iPads, data synchronization software, and a web dashboard. Hexoskin also provides custom software, data hosting, data science & AI services to suit the most stringent requirements of any organization.

Both women's and men's Astroskin Shirts have a dual pocket with a zipper for the Astroskin recording device to adapt to a wide range of activities and sleeping positions. The shirt also has two embedded adjustable elastic belts which allows the shirt's ECG sensors to remain close to the body to accommodate highly intensive activities while minimizing artifacts with the signal.

The textile is made from a fabric made of 73% Polyamide Micro/27% Elastane. The fabric has technical properties with UV protection and is made to quickly dry and regulate moisture & heat. The textile has an antibacterial treatment that prevents 99.9% of the formation of bacteria to prevent odors. Astroskin is proudly made in Canada.

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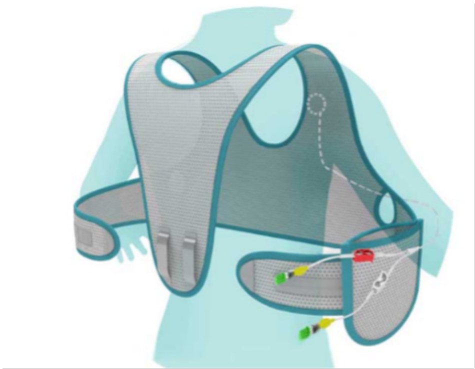
HEXOSKIN
HEALTH SENSORS & AI

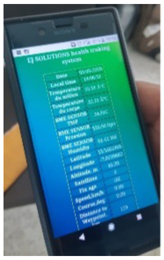
BEST PROTOTYPE AWARD
EX-AEQUO with Flame-retardant textile articles, ESITH

Prototypes and innovations:
Covid preventive vest

Covid preventive vest

The Covid prevention vest allows to detection of people affected by the virus thanks to two sensors (temperature and humidity) incorporated in the vest. These sensors will be in contact with the body of the wearer of the vest to take real and continuous measurements of temperature and humidity. The data from these measurements will be transmitted to the server and processed by an algorithm that will do the analysis and geolocation of the person affected by the Covid virus.





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BEST PROTOTYPE AWARD
EX-AEQUO with Covid preventive vest, ESITH

Prototypes and innovations:
Flame-retardant textile articles

Introduction

Sustainable alternatives for wool valorization.

Our main objective

- Development of the complex coating
- Development of the coating process
- Analysis the properties

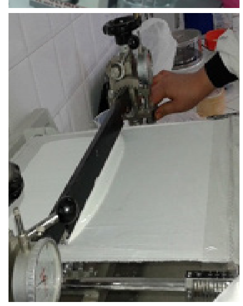
Conclusion

The results of this study indicated that with waste wool we obtain higher performance: Flame retardant

From this results, we confirm that PU-Wool coating is promising solution for high technical textile application

This is the use of wool powder as a flame retardant in coating treatments to obtain flame-retardant textile articles :

First, we prepare the wool from the fleece or wool waste to make them into powder.



After, we mix a certain percentage of powdered wool with the polyurethane-based coating paste.

This mixture is applied to a textile support (cotton, polyester) flammability tests are performed.

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Prototypes and innovations:

The graphene-based end-of life sensors (EOL)

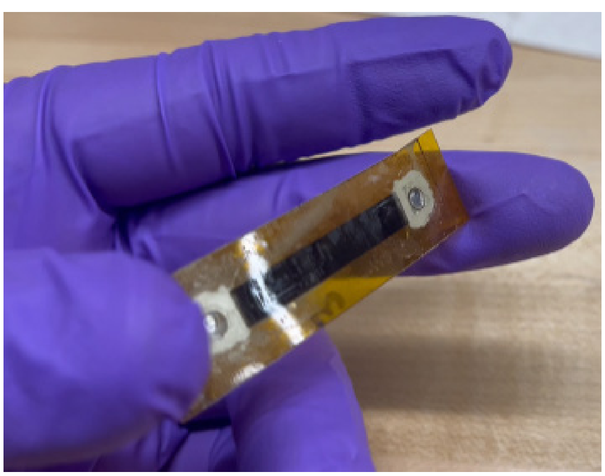
The graphene-based end-of life (EOL) sensors (thermal, moisture, and UV) will monitor the condition of the fire-protective clothing, help determine its lifetime, and verify if it is safe to use or not.

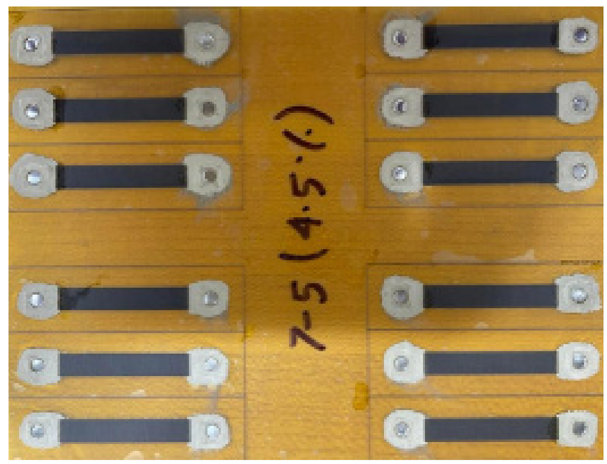
The sensors will be placed as patches on the outer shell of the fire-protective clothing. A support fabric will be used as a base on which the EOL sensor will be applied.

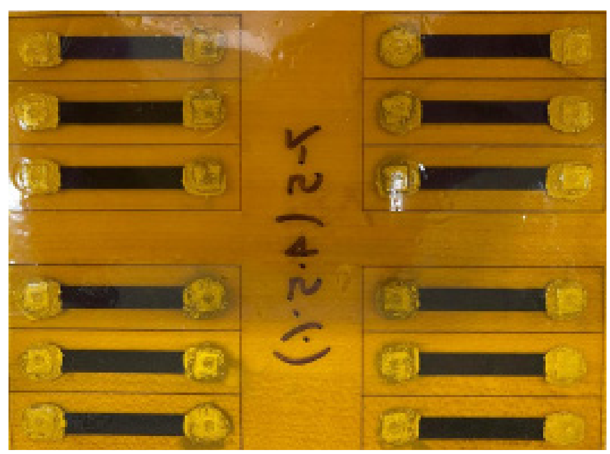
The change in the resistivity of the graphene layer will indicate the degree of degradation the fire-protective garment experienced.

The prototype represents the thermal graphene-based end-of-life sensor.

The sensor consists of several layers. Each layer serves a purpose: a polymer layer, a conductive tracks layer, and an encapsulation layer.







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Prototypes and innovations:
Air filters with sensors

Nowadays, air filters have an important role in public areas such as swimming pools and shopping malls in improving air quality by transferring out particles of different sizes produced by various activities. Clogging is one of the most significant matters of the fibrous filters caused by the accumulation of small particles in the pores, which industries are trying to solve. However, the first step is the detection of the clogging of filters by particles which indicates that a filter has to be replaced or cleaned. Over the years, textile sensors including pressure, and strain sensors are strongly used in various fields of applications such as medicine, and electronics sectors. They could also be used to notify the clogging of a filter, considering different conditions including humidity, temperature, etc., before and after the filter. *Figure 2*, indicates the textile sensors in a filtration system. The nanofibers have very interesting mechanical properties and can detect a very small variation in the airflow, therefore, they allow the sensing of clogged areas. *Figure 2* shows the electrospinning method to produce the nanofibers. TPU is one of the synthetic polymers, which could be easily electrospun into the fibrous membrane as it shows stretchability and flexibility properties. To have conductive parts, the carbon paste was printed on the surface of membranes as shown in *Figure 3* using different patterns.

In this project, as the membranes made of nanofibers are electrically conductive, the variations in the airflow will be detected by a simple measurement of the electrical resistance within the Wheatstone bridge. Additionally, these properties permit the detection of clogging in air filters of the filtration system. In this presentation, first, the videos of electrospinning and printing

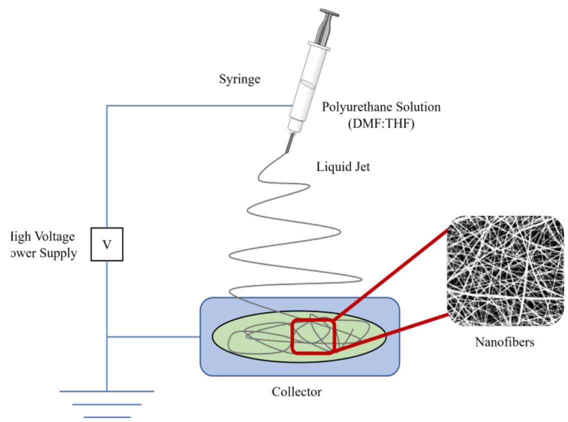

Figure 1. The textile sensors in the filtration system.

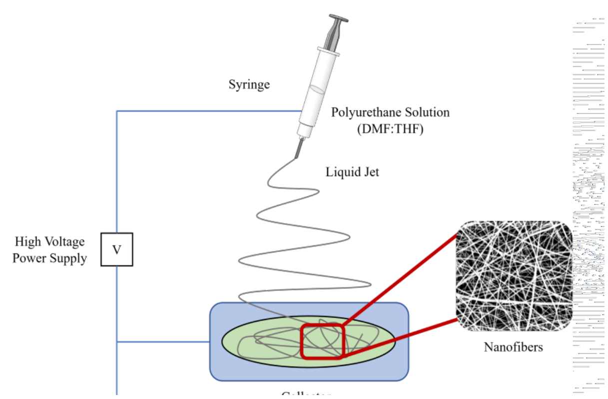

Figure 2. The electrospinning machine

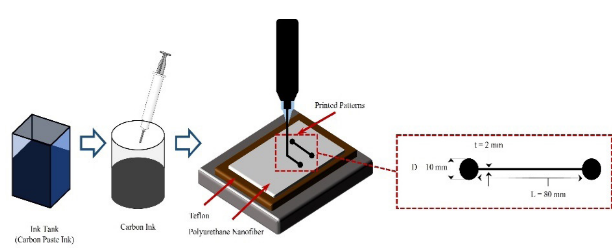

Figure 3. The printing method

systems will be shown to see the methods of sample preparation and then, the conductive membranes will be presented visually. In the next step, the electromechanical properties of these strain sensors will be examined by measuring the change of the resistance using a multimeter during stretching. Finally, the videos of the samples in the ventilation tunnel will be represented to see how they could be placed in the filtration system, deform under small variations of air because of their low weight, and detect the clogging by changing their electrical resistance under loading/unloading cycles.

In addition, the air could pass easily through these textile sensors due to their porosity which will not disturb the filtration mechanism. *Figure 4* demonstrates the strain sensors placed in the ventilation tunnel before or after the filter.

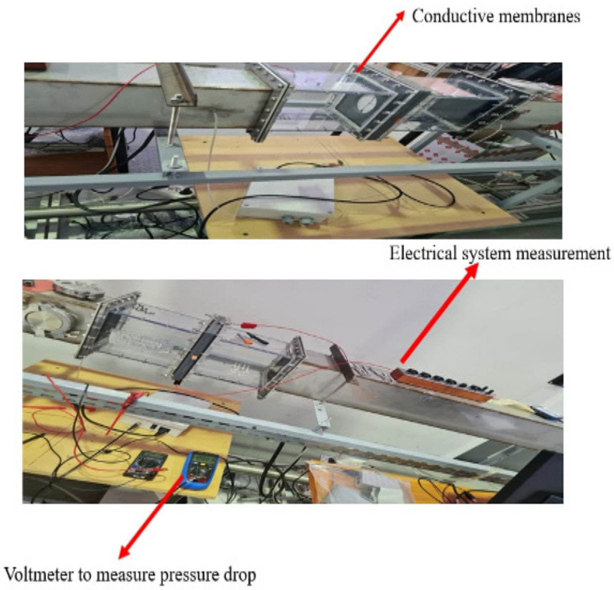

Figure 4. strain sensors placed in the ventilation tunnel before or after the filter.

Pictures of the prototype

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Prototypes and innovations:

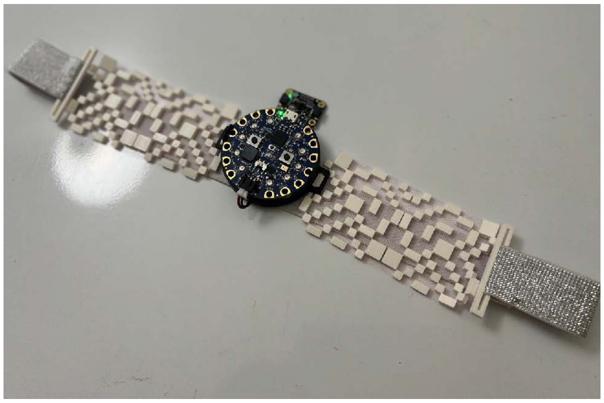
A 3D-printed computer-generated pattern for a smart waist belt to detect obstacles for visually impaired people

The smart belt senses the obstacles in the 120 mm range and provides an alert through beeping sound to visually impaired people. It is lightweight and easy to be donning doffing for visually impaired people. Beyond this novel functionality of the belt, the aesthetic choice was taken into account, and the body (of the belt) is made with a 3D-printed textile for the high tactility.

Design details: The 3D-printed textile body design is generated from a pattern generator. The algorithm of the pattern generator is designed in JAVA processing software with a few coding constraints and pre-defined functions that look like a grid and provide random patterns with every mouse click. This algorithm will provide unlimited computer-coded patterns for the textile design. For this wearable belt, a pattern was picked from the pattern generator, traced in the Adobe Illustrator, and extruded in Fushion 360—the stl. file was 3D printed, and tulle fabric was sandwiched halfway through the 3D printing process. The belt face is also 3D printed to fit the technological components of the smart belt. The final belt is finished with a white elastic, which will fit people from sizes 4 to 10.

Application details: I have chosen to incorporate this 3D-printed computer-generated pattern to design a smart belt for visually impaired people to detect obstacles and alert the wearer. The 3D-printed textile provides a tactile aesthetic to the belt structure. To add functionality to this smart belt, I have used the Adafruit Circuit Playground, which will provide an alert through beeping by sensing any obstacles by the Adafruit VL53L0X time of flight sensor. Both circuit playground and the sensor were attached to the 3D-printed belt face. The threshold level for the flight sensor is set at 120 mm.

The computer-generated pattern provides unlimited random patterns with a unique aesthetic for 3D printing. It is an excellent digital tool for creating generative computer patterns that could be used in various applications in wearables. The technological aspect of this project is a work in progress and needs more research to be more precise and seamless integration.



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Prototype en vedette :

Prototype of transparent surgical face mask

The prototype is a transparent surgical face mask. The transparent face mask is aimed at people who can benefit by clear transmission of facial cues during the usage of a face mask. Examples of such personnel include doctors, patients, speech pathologists/therapists and their students. Unlike current transparent masks in the market, the prototype is made from a fully transparent construction using one type of material. In contemporary masks, there is a transparent window made from clear plastic/ polycarbonate that doesn't have any filtration capability or breathability. Surrounding this transparent window is conventional melt-blown textile material that is not transparent and is responsible for filtration capacity of the face mask.

Our prototype, on the other hand, is made from a fully transparent material that also has filtration capabilities. Construction of the whole mask is done using one type of material, unlike currently available masks that involve seam stitching between the transparent window and the rest of the mask material.

Other salient features of our prototype are :

- 95% bacterial filtration efficiency according to ASTM F2101-19 standards
- 7 mmH2O of differential pressure drop
- 95% of submicron particulate filtration efficiency
- Synthetic blood resistance of 80 mmHg according to ASTM F1682-17
- Class 1 flame spread according to 16 CFR Part 1610 (2008)
- Anti-fogging coating on the inner side of the mask
- Water-repellent coating on the outer side of the mask
- 6 dB of sound reduction when measured from a distance of 6 ft.
- Satisfies ISO-10993-1, 5 and -10 standards for biocompatibility : cytotoxicity, sensitization and skin irritation
- The option of being manufactured using environmentally friendly materials : compostable, biodegradable

The prototype transparent face masks are planned to be priced very competitively relative to currently available face masks

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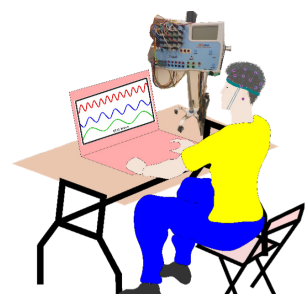
Prototypes and innovations:
EEG Cap for Brain Activity Monitoring

EEG electrodes currently on the market are not suitable for long-term monitoring or wearable applications. The introduction of textile electrodes would solve associated issues. As a result, this research looked into textrodes to track brain activity. Textile-based EEG electrode was constructed from a silver-plated hook fabric that collects good quality EEG signals comparable to Ag/AgCl dry comb electrodes. The hook fabric textrode avoids the use of adhesive conductive gel and no shaving of the hair is necessary. The skin-to-electrode impedance was lower than that of Ag/AgCl dry comb electrodes. A knitted net bridge EEG cap was also developed and compared against universal EEG caps. Both the hook fabric textrode and knitted net bridge EEG cap were validated at the clinical level via Brain Quick® Clinical EEEG Line.

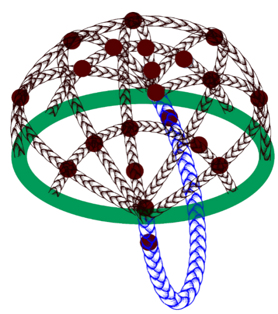
Overall, the Hook fabric EEG textrode gave comparable EEG signals and ITC, ERSP, and log power spectral density plots across all main EEG bandwidths.

EEG Electrode (photographic)

EEG bridge (photographic)



EEG measurment (schematic)



EEG bridge (schematic)

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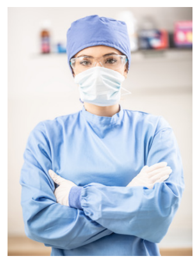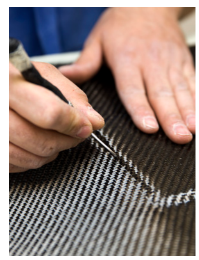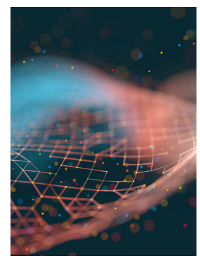

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