Review Article

The role of technological textile design in preventing child abduction

ABSTRACT

Today, it is possible that our clothes can monitor our security. Indeed, the design allows to innovate textiles that are able to detect, react and adapt, in order to protect their wearer thanks to sensors and woven, printed, or embroidered structures. Smart textile contains a sensor, an actuator and a control unit which can be in the form of optical fibers, phase change materials, shape memory materials, thermochromic dyes, etc. Their integration can be during the yarn-forming, fabric-forming or finishing phase. In this survey, in the beginning, those new technologies will be reviewed before presenting some smart textile used in preventing child abduction.

In this survey, the concept of conductive textiles will be studied and mainly the smart textile applications. It will be applied to the case of textile product in preventing child abduction.

Keywords: Conductive textile, smart textile, preventing child abduction, Wearable Smart textile,

1. INTRODUCTION

Among the fields affected by design, we cite the textile industry, which has been evaluating and innovating several technologies over the years [1]. In fact, textile design consists of creating new models and styles for different uses (clothing, interior decoration, automotive, etc.) from fabrics resulting from the transformation of textile fibers. Most of the innovations in the textile field are technological [2].

This innovation means any production of new machines to innovate new techniques or the creation of new types of textiles that are connected and interact with their environment. These are smart textiles or connected textiles [3].

Today, it is possible that our clothes can monitor our security. Indeed, the design allows to innovate textiles that are able to detect, react and adapt, in order to protect their wearer thanks to sensors and woven, printed, or embroidered structures [4]. The intelligent textile must contain a sensor, an actuator, and a control unit that can be in the form of optical fibers, phase change materials, shape-memory materials, thermochromic dyes ... etc [5]. Their integration can be during the thread forming, fabric forming, or finishing

phase. Similarly, sensors and activators are capable of being integrated into the textile structure during the weaving phase for example [6]. Whereas, the synchronization of the electronic control units with each other can take place during the finishing phase.
In the same spirit, the intelligent textile is also intended for children to ensure their safety [7]. In addition, there is also the creation of textiles for children that fight against heat stroke. It is a textile that has thermosensitive pellets which are able to make appear the word alert according to temperature in order to protect the child or the baby from a heat stroke [8].
The intelligent textile does not only intervene as a security agent in the work of the firemen and the military but also tries to establish the security and the protection of the newborns and children by guaranteeing them good health [9]. But the question that arises is that the intelligent textile is able to protect the children from other dangers as the kidnapping for example?
Therefore, in this article, we have dealt with the sector of personal protective textiles, which has main technological challenges conveyed by innovation, such as the integration of tracking systems and personal GPS (global positioning systems), integrated communication, and sharing data in real-time, in order to fight against child abduction [10]. Indeed, we tried to explain the methods and technologies necessary to integrate intelligence into the polyester so that it fights against kidnapping by locating the position of the kidnapped child.
This project thus emphasizes the importance of intelligent textile and their properties in preventing the abduction of children while they are alone outside. It helps them to be monitored and in communication with their parents by sending an alert message when they are in danger or kidnapped.

1. Technologies and methods to make textiles smart

In order for a textile to become intelligent, it is necessary to make the fibers or fabric conductive so that it will have power, data transfer, and sensing properties. These characteristics can be present in a fabric through plasma treatment, fiber coating, printing, weaving of conductive yarns, or integration of electronic components [11].
In addition, we can use materials with specific functionalities other than conductivity to make the textile smart. Examples include antibacterial, surface property influence, water vapor transport, heat transfer, or sensor functions [12].
Among the technologies involved in different smart textiles, we distinguish three categories:

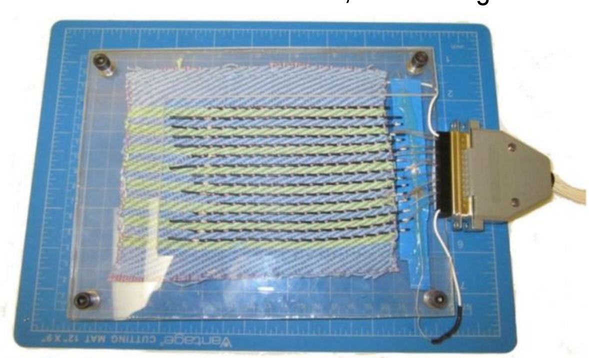

Fig.1. Mounting a sensor

- Sensors: which detect the input signal and as examples we cite sensors sensitive to temperature, gas, deformation and positioning or electrodes. These sensor technologies, solutions and products were then categorized according to the type of stimulus to which they react among the following: thermal, mechanical, chemical, electrical and physical. The integration of biosensors into clothes enables daily physiological monitoring through a continuous and personalized detection of vital signs, while garments with strain- and stress-sensing capabilities enable tracking of posture and gestures of the subject, where figure 1 represents how mounting the sensors in textile structures . The e-textile systems comprise fabric electrodes and sensors capable of capturing bioelectrical and biomechanical signals like electrocardiogram, electromyogram, respiration, bioimpedance, skin conductivity, and sweat characteristics.

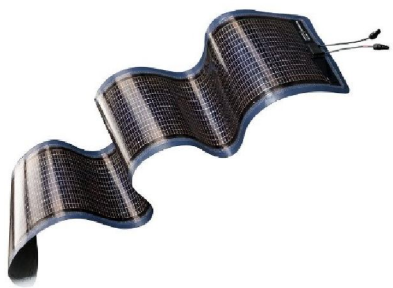

Fig. 2.: a fabric with photovoltaic fibers

- Indicators/actuators: are interested in the output signal, i.e. they intervene in the repair phase, for example: heating fibers, antibacterial fabrics, self-cleaning surfaces, photovoltaic fibers.Applications of wearable actuators mainly include wearable robotics, haptic devices, and smart textiles. Smart textiles are textiles that can interact with the environment or respond to stimuli [13, 14]. Examples of smart textile applications include electrocardiography-T-shirts/wristbands, electroencephalography caps and photovoltaic curtains, as represented in figure 2 using photovoltaic flexible structures [15]

Fig. 3. A textile antenna

- Materials and components: Ensure the production of smart textiles. Textile antennas, figure 3, are a special class of antennas that are partially or entirely made out of textile materials, in contrast to conventional antennas, which consist of rigid materials. The textiles composing a textile antenna are divided into electrically conductive fabrics, denoted electrotextiles and applied for the radiating and grounding parts, and dielectric materials for the insulating parts of the antenna.
  Among them we mention polymers, carbon, metals, inks, connectors, antennas etc… To better understand the details, the properties, the operation of these three categories we choose some structures to define them

A. Metalic fibers

Fig 4. Metal wires

These fibers are of metallic origin and they are fine fibers. Obtaining these threads can be done with two methods: the first is a bundle drawing process and the second is shaving the edge of a thin sheet of metal so that they will then be woven or knitted; as represented in figure 4.

Fig. 5. Integration of metallic threads in the textile

Metal fibers are generally used to form interactions between components or they are used as electrodes to maintain monitoring of electrical physiological activity such as electrical cardiogram signals; as represented in figure 5.

B. Conductive inks

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Fig. 6. Conductive ink

Conductive inks, in figure 6, are used to create screen printing for a layout or to form interconnections between different components.While there are many different strategies to make fabrics conductive – such as applying inks printed onto a stretchable substrate – particle-free inks are well suited to directly printing on textiles.Conductive ink is the most important component in printing of metallic structures. Several conductive materials could be considered for this purpose, such as conductive polymers, carbon, organic/metallic compounds, metal precursors, and metal NPs.

Fig. 7. Screen printing of conductive inks

We can also add carbon, copper, silver, nickel or gold to conventional printing inks so that they become conductive and therefore the printed areas become pressure pads which activate the circuits, as represented in figure 7.

C. Optical fibers

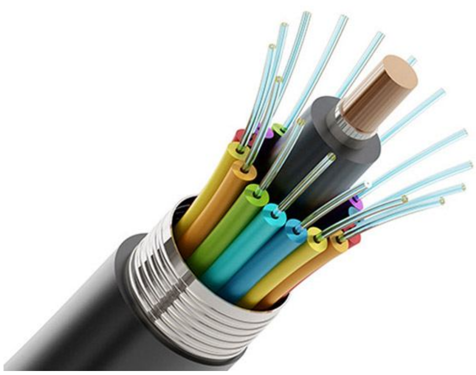


Fig. 8. Optical fibers

The plastic optical fibers are easy to be integrated into the textile material. They have many advantages such as they do not generate heat and they are insensitive to EM radiation. In addition, these fibers play a major role in the transmission of garment data signals, as represented in figure 8.
These fibers consist of transmitting light for optical detection, that is why they are used for luminous fabric to emit its own light for this reason we cite the example of safety vests. In this context Professor M. Skorobogatiy asserts "The optical fibers are woven together to create a synthetic textile, the ends of which join at a common point through which the light coming from an LED is injected. Thus, they detect any deformation of the tissues due to the stresses and even carry out the chemical detection.

D. Shape Memory Material (SMME)

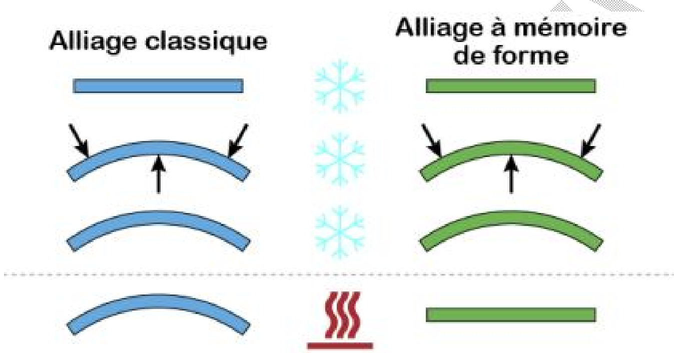


Fig. 9. Shape memory alloy

Shape memory materials (SMMs) are featured by the ability to recover their original shape from a significant and seemingly plastic deformation when a particular stimulus is applied, as represented in figure 9. This is known as the shape memory effect (SME). In recent years we have seen significant progress from shape memory alloys (SMAs) to shape memory polymers (SMPs). These are shape memory alloys such as nickel and titanium that ensure and offer protection against heat. The alloy contains different properties below and above the temperature at which it is activated. This temperature stimulates the alloy to exert a force to return to a memorized shape.
The choice of temperature is made by modifying the nickel/titanium ratio in the alloy, but shape memory polymers are still compatible with the textile than nickel/titanium alloys. These electroactive polymers (EAP) have a high conductivity for some areas of a garment.

E. Intrinsically Conductive Polymers (ICPs)

These polymers are both sensors and actuators and among the best known are: polyacetylene, polypyrrole and polyaniline. Polypyrrole is the best because it has high mechanical strength, high elasticity and relative stability to air and electro. The advantage of these polymers is common; they retain the natural texture of the material, figure 10.

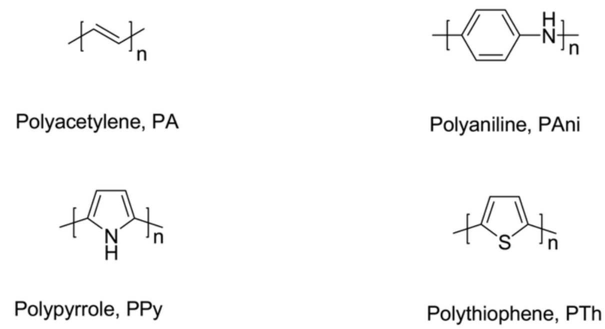


Fig. 10. Molecular composition of conductive polymers [13]

The main condition for polymers to become conductive is the modification of the bond from a single bond to a double bond. Afterwards, these polymers must be released so that they will become conductors either by oxidation reaction (elimination of electrons) or by reduction reaction (insertion of electrons).

F. Chromic materials

The most important chromic phenomena – thermochromism, photochromism, ionochromism and electrochromism – are dealt with in individual sections, each providing a description of the physicochemical principles underlying the colour changes and a discussion of the molecular structures of the most important colorant classes.

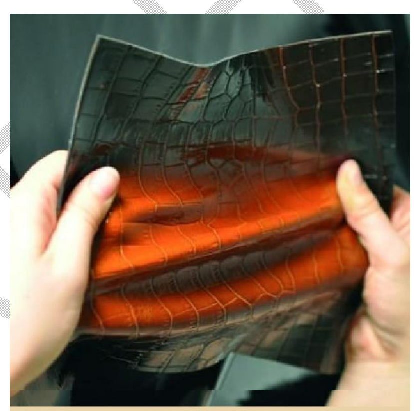


Fig. 11. a fabric with a changeable color

According to the external conditions, these chromic materials change its color and they are used rather in the field of fashion to add changing patterns, as represented in figure 11. These materials are classified into five categories based on stimuli:

- Photochromic: external stimulus is light
- Thermo chromic: external stimulus is heat
- Electromechanical: external stimulus is electricity

- Piezorochromic: external stimulus is pressure
- Chromic solvate: external stimulus is liquid or gaseous

G. Phase Change Materials (PCM)

Phase change materials are used to create thermal comfort. They are able to create a thermal balance between the heat of the human body and the climate. Indeed, when it is cold the garment tries to raise the heat of the body and vice versa.
These materials therefore have a stock of energy that will be released later depending on the conditions and external stimuli. It is possible that "You almost connect your phone to your t-shirt and it is he who will recharge your battery", enthuses Guillaume Tartare.

The thermal properties of phase-change materials allow them to be perceived as the material of choice for thermal insulation of the human body. The possibility of keeping the wearer as long as possible in his thermal comfort zone, and at the same time to reduce the thickness of the garment, is a conceivable objective, taking into account the thermal insulation capacity of textile support containing PCMs. Indeed, these are active during the phase change period and stop when the phase change of all PCMs is complete. This insulating effect is generally referred to as effective thermal insulation. The choice of PCMs to be used is therefore based on the feeling of comfort that the user can feel, regardless of his metabolic activity and external conditions. The effectiveness of PCMs inserted in a textile structure will depend mainly on the temperature differential between the body temperature and that of the surrounding environment.

2.1 Nanotechnology

Making clothing and fabric with nanoparticles or nanofibers allows the improvement of fabric properties without a significant increase in weight, thickness, or stiffness. For example, incorporating nano-whiskers into fabric used to make pants produces a lightweight water- and stain-repellent material. The CEA laboratory (Commissariat for Atomic Energy and Renewable Energies) carries out and fixes its research on the easy integration of chips in textile processes using micro and nanotechnologies, as represented in figure 12 [17].

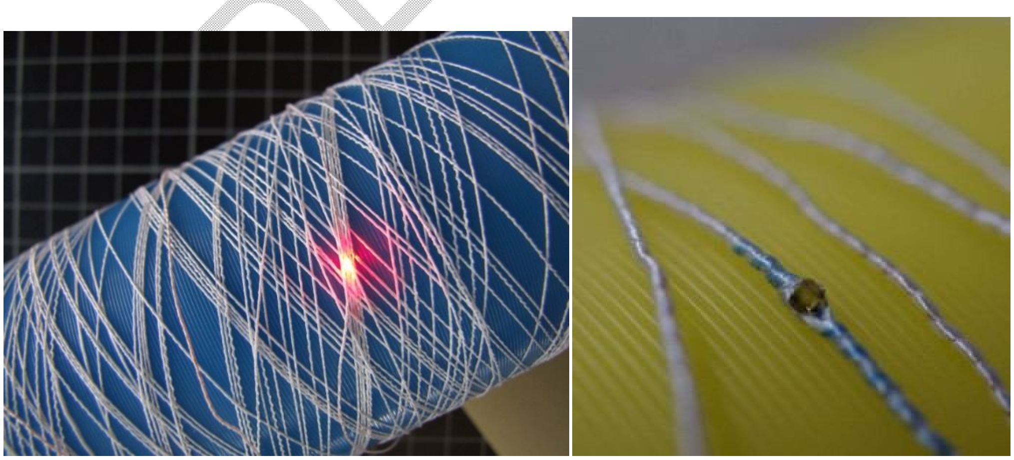


Fig.12. Nanocomponents [13]

In this technology it is important to pass the components through the e-Thread which is used to reduce their size in nanometers in order to be able to introduce them into the yarn or the fabric.
These components go through two main paths to become nanocomponents: the descending path is used to "cut" the material so that it has as small a size as possible and an ascending path, which is defined in the form of an assembly of matter atom by atom which gives rise to a number of molecules which will be integrated into larger systems.
In the same spirit, there are the nanofillers which intervene in the fiber manufacturing phase so that the mechanical properties of the product are modified or to cause changes in the feel of a woven textile surface.
The unique properties of nanotechnology are born first, thanks to the small dimensions which ensure the increase in speed and functional density. Second, by the lightness and small size of the sensors and devices. Third, using sensitivity elevation and surface effects.
Additionally, the large surface size enhances catalytic effects and novel molecular structures with new material properties such as high-strength nanotubes, nanofibers, and nanocomposites. These characteristics play a very important role and promote the properties of nanotechnology.

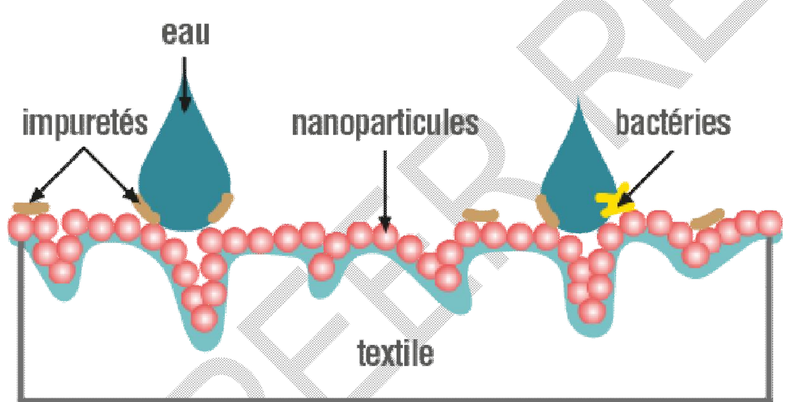


Fig. 13. The nanoparticle coating [18]

The use of nanotechnology adds permanent effects and provides durable fabrics, "So a material formed from fifteen nanometer copper nanoparticles is almost three times stronger than a copper material composed of fifty nanometer nanoparticles, as represented in figure 13. The material also becomes more malleable and therefore more difficult to break under the effect of an impact. So coating with nanoparticles is used to improve the performance and functionality of textiles since it is widely used in the textile industry.This coating is able to bring about a textile improvement by integrating several properties such as: Antibacterial, UV protection and self-cleaning while maintaining the breathability and tactile properties of the textile. Taking the example of Nano tex which innovates textile products with the aim of resisting splashes, repelling and releasing stains and resisting static electricity [18].

2.2. How a smart textile works

The incorporation of smart materials, conductive polymers, encapsulated phase change materials, polymers and shape memory materials with the integration of electronic sensors and communication equipment give

rise to an interactive fabric that is what we call smart textiles. This innovation undergoes an interaction with external stimuli after it transfers an energy so that the material responds to the stimulus.
Smart textiles are able to process, analyze, respond and adapt to the environment, so they change according to temperature, pressure, density or internal energy. Likewise, the properties of the material are responsible for the amount of energy transferred to effect the previous changes.
In addition, this ratio between the amount of energy required for the change and its degree determines the properties of the material and their behavior, including even the most intelligent ones. For example, the amount of heat (energy) needed to change the temperature will be determined by the specific heat (property) of a material [19].

2. SMART TEXTILE CATEGORIES

A smart textile is one which can sense changes in the environment and respond by modifying one or more of its parameters to perform a function. There have been three generations in the development of smart textiles. First generation - or 'passive' - smart textiles are those that sense changes in the surroundings but cannot adjust their properties in response. For example, fabrics coated with various metal oxide nanoparticles can produce IR/UV resistant clothes; cotton impregnated with silver nanoparticles has anti-microbial properties. Second generation – or 'active' - smart textiles include fabrics which first percieve the changes or stimuli from the environment and then respond accordingly. Examples include thermochromic textiles which respond to changes in temperature by changing colour and shape-memory textiles which can respond to mechanical deformations. Third generation - also called 'super-smart' - active textiles are integrated with soft and smart electronics involving sensors, optical gadgets, nano-generators and energy storage devices.

3.1. Passive textiles

Fig. 14. The waterproof-breathable aspect of passive ports [20]

These textiles are able to just detect the environmental condition or the external stimulus and inform the microfibers by each stimulation. They are more or less comparable with other textiles that have high performance [20].The ports of these microfibers are very passive, they easily allow the passage of water in the form of a vapor and not a liquid, so they have a waterproof and/or breathable aspect.This also means that these fabrics don't contain sensors or wires. They do not need to change because of the conditions around them. All you need to do is wear a piece of clothing made with a passive smart textile and know that it is working, as represented in figure 14.

A passive smart textile's functions are going to be much simpler than those of an active smart textile. This is because the state of the fabric will never actually change. There are no electronics involved in these fabrics whatsoever.This means that all of its functions will allow it to remain in a static state the entire time it's worn.Another way to promote health and well-being is by protecting yourself from harmful UV rays. This can help prevent sunburns and skin cancer. And this is also a function that passive smart textiles can have.

3.2. Active textiles

These textiles sense and react to every stimulation or environmental condition. Its primary functions are the detection and response to an abnormal situation. This shows that active textiles are both sensors and actuators.Active textiles are those clothes that provide care, freshness, comfort and protection for your skin. Active textiles bring new possibilities to your fashion concepts and collections. The principle of active textile is simple: Build active ingredients into the fabric of clothing so that with the natural movement of your body, your skin is slowly freshened and revitalized.

A classic example of active textiles is **sportswear**. Active textiles adapt and change their functionality in response to the external environment. For that reason, active sportswear should provide sufficient heat transfer for the skin temperature to remain within a comfortable range. These textiles may change shape, store and regulate heat, as well as other functions. Among the most common applications of active textiles is in outerwear; specifically, garments that regulate the body's temperature.

The applications of active smart textiles can be much more varied. This is because there are many different ways that these fabrics can be changed and adjusted.

First of all, the healthcare industry may find some of these fabrics useful. Smart textiles can monitor a patient's heart rate, for example. This can alert nurses to any potential problems earlier enough to help.The military can also use some of these fabrics. They can use wires integrated into the fabric to transport data from one place to another quickly. This means that military strategies can be updated in real-time.

They can also be used for disaster relief. Some of these textiles can be used as power sources for housing during natural disasters. This means that no matter what happens, people will have a warm place to stay.

Finally, these fabrics can also be connected to the internet. This can help tell you all sorts of things like heart rate and blood pressure right on your smartphone. But it can also be used for fun activities, such as gaming.

3.3. Interactive textiles

These are very smart textiles and they are able to perform three functions.

First, they receive the stimulation and sense it. Secondly, these textiles react against this stimulation and finally they directly adapt and repair the external condition.

Interactive smart textiles, a form of E-Textiles, are fabrics that enable digital components, and electronics to be embedded in them and thus are capable of sensing, actuating, generating/storing power/communicating/interacting. These textiles offer a good substitute to wearable computers that were widely used in fashion accessories offering an individual the comfort of fabric and still maintaining the fashion quotient and therefore continuous research is being done to develop these materials. Electronic circuits entirely out of textiles to distribute data, power, and perform touch sensing have already been made.

This mechanism reminds us of the chameleon system which is able to detect the color of its environment (tree, table, wall...) so that it reacts afterwards by changing the color of its skin for the same color of its environment and s automatically adapts in order to protect itself. Passive and active smart structures contain phase-change materials, shape-memory materials, conductive materials or waterproof-breathable materials [22].

Fig. 15. The smart hood for firefighters [22]

Taking the example of a firefighter's balaclava which has sensors to measure skin temperature, heart rate and movement. Thus it is equipped with a microphone and a speaker as represented in figure 15 [21].

Fig. 16. A connected military suit [23]

These textiles are used even in the military field to increase the security and efficiency of military forces. In dangerous work situations, it is necessary to make use of information technology that provides protection and promotes the chance of survival of people working in dangerous occupations, as represented in figure 16 and 16a.

Fig. 16a. An intelligent communication textile

Additionally, smart textiles are capable of enhancing the performance and additional capabilities of emergency response services. Likewise, they facilitate communication between the doctor and the injured person so that he treats him remotely and in complete safety.

3. TEXTILE PREVENTING CHILD ABDUCTION ALTERNATIVE

In our conceptual part, we will focus on the textile as alternative for preventing child abduction.
The intervention of technological textile design to solve the problem of child abduction is done through the innovation of a new intelligent textile that is able to accompany the child in complete safety and warn him of the abduction but before everything, we have to choose the textile material. For this, it is necessary to specify the textile properties that can be adapted in the event of removal, as represented in figures 17 and 18.

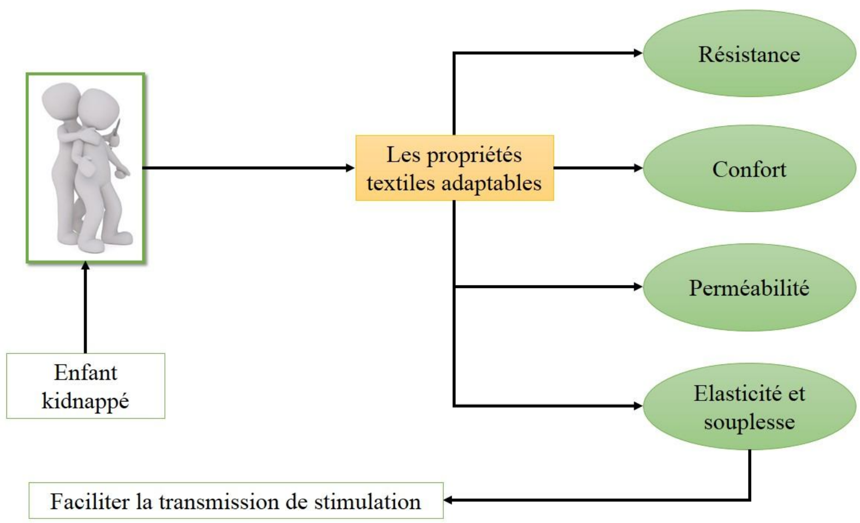


Fig. 16. The textile properties adapted in the event of removal

For this reason, we decided to analyze the textile properties having two almost identical textures (weave, weight, etc.), but one in 100% cotton, the other in 100% polyester to choose the most suitable material for our research case, providing more resistance, comfort and well-being necessary for the child.

Our choice of these two fabrics is not random, it is justified. We decide to work on two fabrics that do not belong to the same family, cotton is natural while polyester is synthetic.

In addition, cotton is the most used fabric for children thanks to its softness, suppleness, comfort and absorption. Also polyester is the synthetic textile most used in clothing because it has the lowest cost, which is why it replaces, practically, the natural fiber in the textile industry. Similarly, polyester has good resistance.

Our project lies in the creation of a polyester textile connected to the parents' smartphone Bluetooth. This fabric is equipped with sensors that detect the change in the position of the abducted child as soon as he passes the hundred meters. Indeed, the system warns the parents by sending them an alert message which includes the GPS coordinates of their kidnapped child so that they can intervene or ask for help.

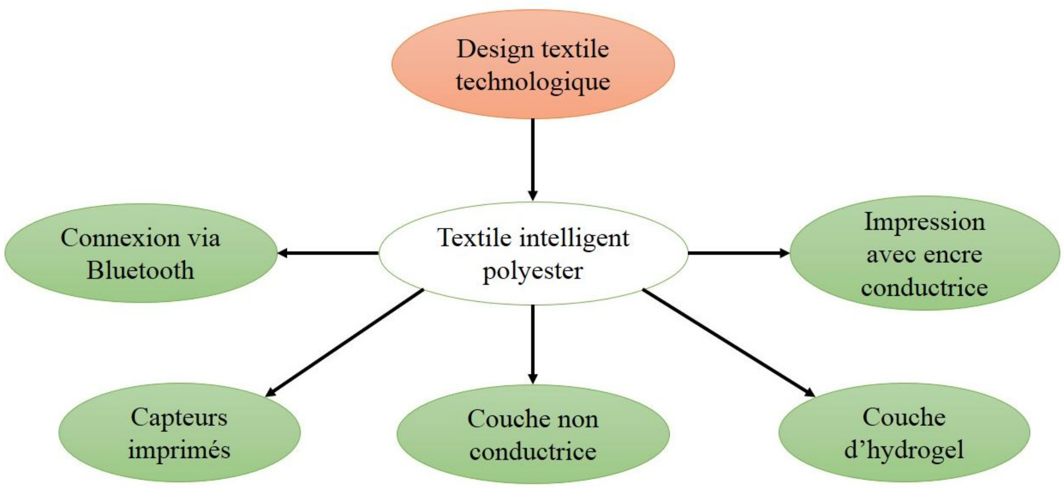


Fig. 17. Different smart textile components

We choose electronic 3D printing as a method of integrating intelligence at the polyester level. This is a screen printing which consists, first of all, in passing the conductive ink through the meshes of the screen. Indeed, the screen consists of a frame which stretches a canvas of steel wires lightly covered with photosensitive resin to ensure the definition of the patterns to be printed.

The reproduction of these patterns is carried out by coating the ink on the substrate frame and then spreading it with a doctor blade. Afterwards, depending on the initial composition of the deposited ink, it undergoes a heat treatment. In fact, the type of ink deposited differs according to the field of application (conductive, resistive or insulating function) and the substrate, for this in this context expresses Hélène Debéda "There are two types of inks: polymer inks and mineral inks which, of different compositions, do not undergo the same heat treatments after screen printing. » [24], as represented in figure 18.

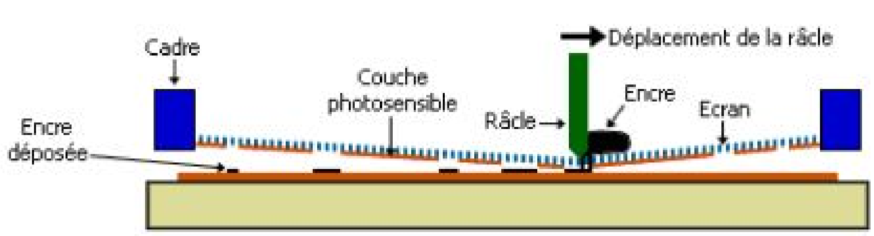


Fig. 18. Screen printing principle [25]

In addition, the adhesion of the layer to the substrate and its cohesion are ensured through these heat treatments. Indeed, electronic printing allows electronic sensors and a circuit, which consists of several layers, to be printed on the polyester so that it is intelligent, as represented in figure 19.

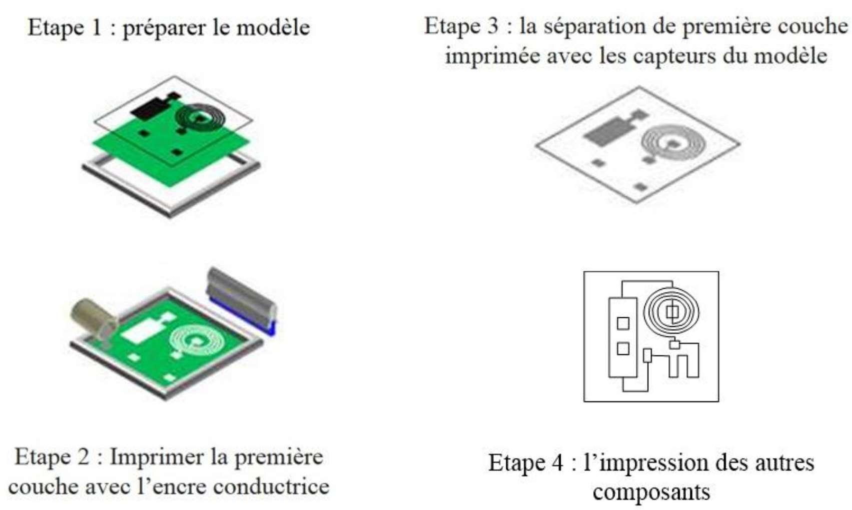


Fig. 19. Screen printing steps for printing polyester

The printed polyester textile obtained incorporates several components and three layers. So, first we mention the different components explaining the function of each.

Our fabric, consists of an altimeter which is able to measure and determine the distance between a point and a reference surface, i.e. its role is to detect the hundred meters passed by the abducted child to trigger the circuit through the stimulation of the inductor which serves to produce an inductive effect for the purpose of inducing an electromagnetic field for circuit activation, as represented in figure 20.

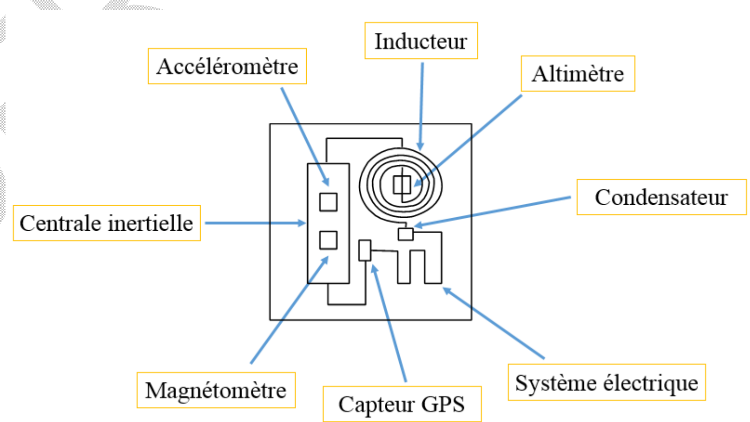


Fig. 20. Different circuit components

Then, our circuit contacts the 6-axis inertial unit which specifies the movements of the kidnapped child, its acceleration and its speed in order to estimate its orientation along the six axes (A 3-axis accelerometer, a 3-

axis magnetometer), as represented in figure 22. Afterwards, the system activates the GPS sensor to specify the geographical coordinates of the abducted child. Finally, our product connects the electrical system to analyze geographic data streams and send it via Bluetooth to parents' phones, as represented in figure 21.

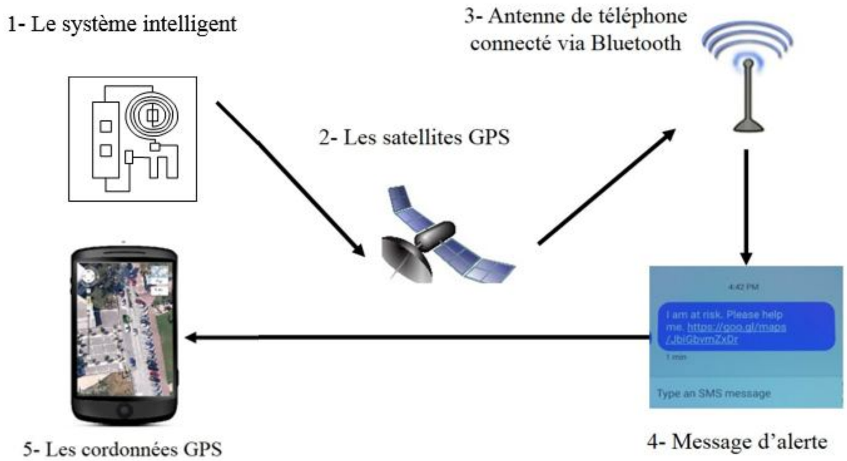


Fig. 21. Operation of the intelligent system

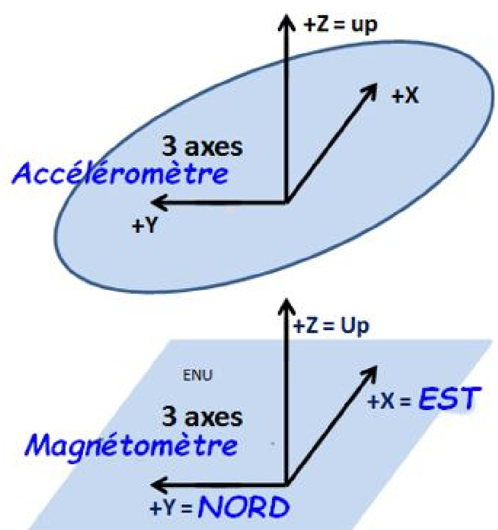


Fig. 22. The six axes of the inertial unit [25]

The application of these steps is carried out thanks to an embroidered and not printed capacitor innovated by the team from the University of Massachusetts, as represented in figure 23. "It is an interwoven weaving of nylon, polyester and a conductive silver-based fiber to create a twisted thread that will be sewn onto our smart textile, in order to create a frame of flexible electrodes" says the team from the University of Massachusetts.

This capacitor is a light, flexible, breathable and washable component. It is able to store energy and transmit it to the various circuit components.

Fig. 23. The embroidered capacitor

Second, we cite the three circuit component layers, as represented in figure 24. The first is a conductive layer equipped with all the sensors and a circuit, the second is a non-conductive layer to avoid short circuits between the different components and the last is a hydrogel layer which is a component gel of insoluble polymers in water. The objective of using the latter is to make our smart textile washable without destroying the various sensors.

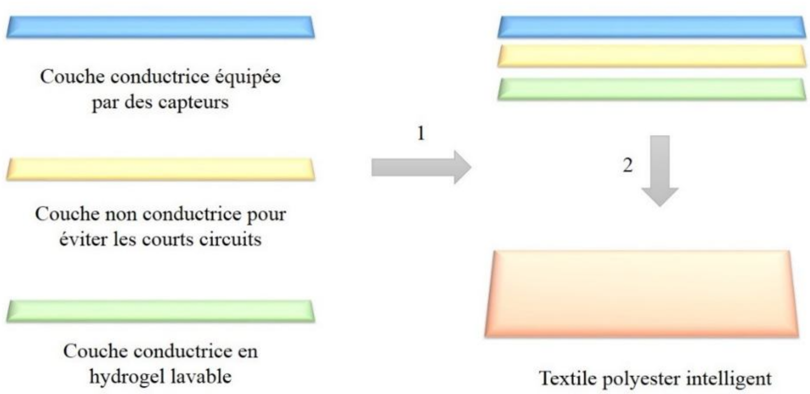
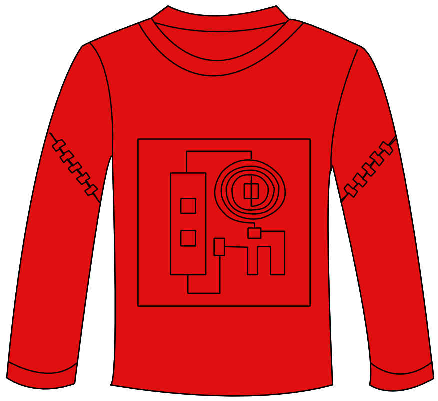


Fig. 24. The three layers of the smart stuff

After studying the circuit and choosing printing as a technique to introduce the intelligent system into the polyester, we try to sketch the final product in Illustrator. Indeed, we choose to create a red sweater, which is a feminine and masculine color, and to name it “Smart electronic sweater”, as represented in figure 25. The latter has removable sleeves thanks to two integrated closures at the half-sleeve in order to have a sweater worn in the spring/summer seasons, as represented in figure 26 and 27.



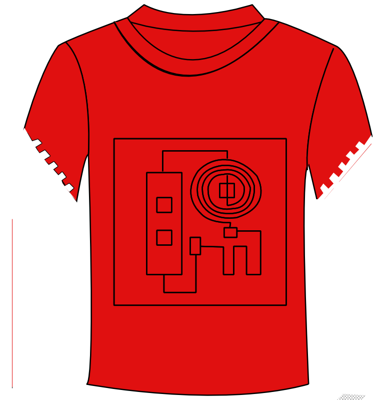


Fig. 25. Front with printed circuit **Figure 26: Front with half sleeves and sleeves**

Fig. 27. Child wearing the smart electronic jumper

4. CONCLUSION

This research work discusses the technological textile design in the service of child safety and it first presents a theoretical part which firstly deals with the definitions of design and innovation.

Secondly, the role, impact and influence of design in innovation (the process, design thinking, user-centered design, research and development) and thirdly, the multidimensional aspect of innovation (temporal, relational, productive and cooperative) and finally, the different types of innovation.

The resistance properties and characteristics of polyester are better than those of cotton, for this they make it the most suitable and practical fabric for a kidnapped child who lives in a painful situation full of stress and fear.

Although polyester is a hydrophobic textile, we have chosen it while modifying this characteristic by applying a plasma treatment to make it hydrophilic.

In addition, its properties and characteristics facilitate the printing phase because the polyester has good elasticity which is considered an advantage in the progression of stimulation and information. So the technological textile design or the intelligent textile becomes able to warn the child of an abduction thanks to its artificial intelligence.

After defining of smart textile and its evolution over time. Then, we mention the different technologies and methods integrated into the textile to make it smart and we also define nanotechnology in this part.

Afterwards, we explained how a smart textile works, citing its different types and its application in the service of security. Finally, this part deals with the problem that lies in the creation of an intelligent textile that fights against the abduction of children by ensuring their safety.

Regarding the conceptual part, firstly, it discusses the types of child abduction (parental abduction and abduction by a stranger) and the design intervention in raising children's awareness of the abduction issue (web design and graphic design). Second, this part deals with the psychological consequences of child abduction.

Finally, there is a practical part which first presents the role of smart textiles in preventing the removal and characterization of polyester and cotton, the two textiles chosen to be compared. Then, in this part we have mentioned the different resistance properties of these two fabrics. Then we chose the polyester which will undergo a plasma treatment so that it becomes hydrophilic.

At the end of this part, we explained the methods and technologies necessary for the integration of intelligence in the polyester so that it fights against the kidnapping by locating the position of the kidnapped child. This explanation was accompanied by a technical file.

This project thus emphasizes the importance of smart textiles and their properties in preventing the abduction of children while they are alone outside. It helps them to be monitored and in communication with their parents by sending an alert message when they are in danger or kidnapped.

Child abduction affects all countries and all social classes. For this our "smart electronic sweater" may be inaccessible for poor families because of its cost which is a bit high since it incorporates innovative components and materials.

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