SMART FABRICS

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CERTIFICATE

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SMART FABRICS

1. ABSTRACT:

Humans are close to textiles more than anything, and certainly we carry it most, other than anything. The last few decades have shown enormous growth in the development of wireless communication technologies, nanoengineering, information technologies, and miniaturization of electronic devices. These developments draw the attention of researchers to envisage the significant characteristics of these advancements to the belongings with whom we are most close to. Researchers are now evaluating the new ideas and possibilities to functionalize this 'natural necessity feature of human beings' with emerging technologies into different arrays of human life especially in the Medical and Healthcare management - as mobile monitoring of health care, protection from life risk factors, life style management, rehabilitation and into other facilitation of our lives, by *Hybridizing the Smart or Intelligent Technology in Textiles.* The aim of this paper is to describe the analysis on how 'Smart', 'intelligent' or 'active' materials and textiles are being incorporated in the healthcare sector to aid diagnostics, recording and transmitting of bio-physiological signals or ambulatory tele-monitoring of the body vitals, by encompassing the core concepts of smart materials under the light of the recent developments and projects.

2. INTRODUCTION:

The world is distinctly rising towards the new era, an era of smart and intelligent discoveries; problem solving and creativity − the smart automobile vehicles (cars, metro system), intelligent jets, smart homes and amongst from many of such aristocratic paradigms, the 'Smart and Intelligent Textiles'.Before going further, a clarification of the term and definition of smart and intelligent textile is essential. There is a substantive difference between the terms, 'Smart' and 'Intelligent', *Smart materials or textiles can be defined as the materials and structures which have sense or can sense the environmental conditions or stimuli*, whereas *intelligent textiles can be defined as textile structures which not only can sense but can also react and respond to environmental conditions or stimuli* . These stimuli as well as response , could be thermal, chemical, mechanical, electric, magnetic or from other source . According to the manner of reaction, they can be divided into passive smart, active smart and very smart materials:

1. Passive smart materials can only sense the environmental conditions or stimuli; they are sensors;

2. Active smart materials will sense and react to the conditions or stimuli, besides the sensor function, they also have actuation characteristics;

3.Very smart materials can sense, react and adapt themselves accordingly;

4. An even higher level of intelligence can be achieved from those intelligent materials and structures capable of responding or activated to perform a function in a manual or pre-programmed manner.

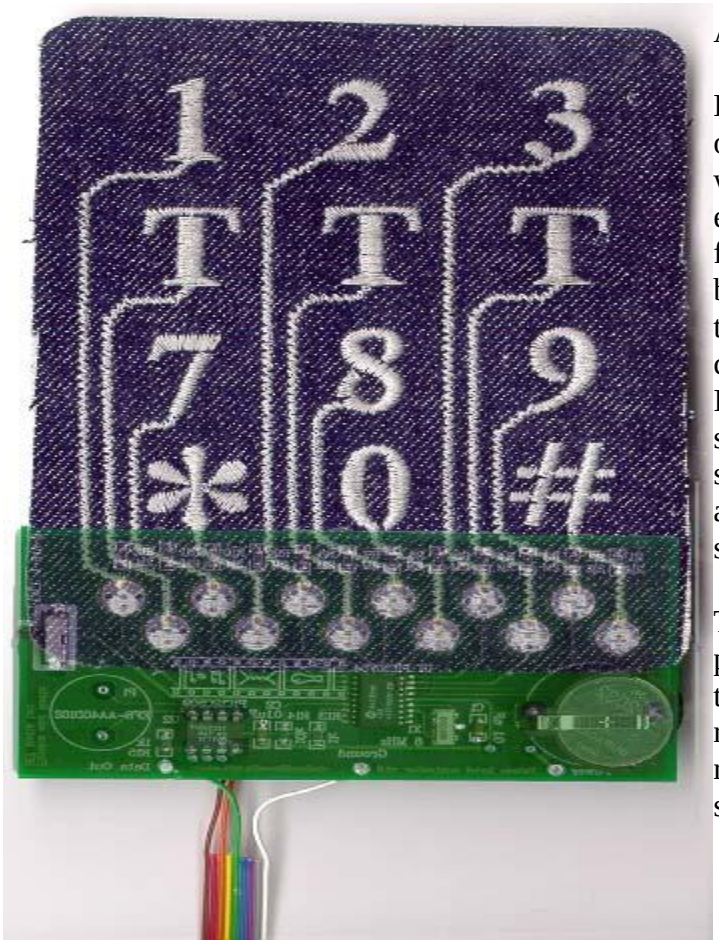
3. MATERIALS:

For years the textile industry has been weaving metallic yarns into fabrics for decorative purposes. The first conductive fabric we explored was silk organza which contains two types of fibers. On the warp is a plain silk thread. Running in the other direction on the weft is a silk thread wrapped in thin copper foil. This metallic yarn is prepared just like cloth-core telephone wire, and is highly conductive. The silk fiber core has a high tensile strength and can withstand high temperatures, allowing the yarn to be sewn or embroidered with industrial machinery. The spacing between these fibers also permits them to be individually addressed, so a strip of this fabric can function like a ribbon cable. This sort of cloth has been woven in India for at least a century, for ornamental purposes, using silver, gold, and other metals. Circuits fabricated on organza only need to be protected from folding contact with themselves, which can be accomplished by coating, supporting or backing the fabric with an insulating layer which can also be cloth. Also, circuits formed in this fashion have many degrees of flexibility (i.e. they can be wadded up), as compared to the single degree of flexibility that conventional substrates can provide. There are also conductive yarns manufactured specifically for producing filters for the processing of fine powders. These yarns have conductive and cloth fibers interspersed throughout. Varying the ratio of the two constituent fibers leads to differences in resistivity. These fibers can be sewn to create conductive traces and resistive elements. While some components such as resistors, capacitors, and coils can be sewn out of fabric, there is still a need to attach other components to the fabric. This can be done by soldering directly onto the metallic yarn. Surface mount LEDs, crystals, piezo transducers, and other surface mount components with pads spaced more than 0.100 inch apart are easy to solder into the fabric. Once components are attached, their connections to the metallic yarn may need to be mechanically strengthened. This can be achieved with an acrylic or other flexible coating. Components with ordinary leads can be sewn directly into circuits on fabric, and specially shaped feet could be developed to facilitate this process. Gripper snaps make excellent connectors between the fabric and electronics. Since the snap pierces the yarn it creates a surprisingly robust electrical contact. It also provides a good surface to solder to. In this way subsystems can be easily snapped into clothing or removed for washing.

4. WORKING:

Several circuits have been built on and with fabric to date, including busses to connect various digital devices, microcontroller systems that sense proximity and touch, and all-fabric keyboards and touchpads. In the microcontroller circuit shown in Figure 1, a PIC16C84 microcontroller and its supporting components are soldered directly onto a square of fabric. The circuit uses the bidirectional I/O pins on the PIC to control LEDs and to sense touch along the length of the fabric, while providing musical feedback to reinforce the sense of interaction. Building systems in this way is easy because components can be soldered directly onto the conductive yarn. The addressability of conductors in the fabric make it a good material for prototyping, and it can simply be cut where signals lines are to terminate.

One kind of fabric keyboard uses pieced conductive and nonconductive fabric, sewn together like a quilt to make a row- and column-addressable structure. The quilted conductive columns are insulated from the conductive rows with a soft, thick fabric, like felt, velvet, or quilt batting. Holes in the insulating fabric layer allow the row and column conductors to make contact with each other when pressed. This insulation also provides a rewardingly springy, button-like mechanical effect. Contact is made to each row and column with a gripper snap, and each snap is soldered to a wire which leads to the keyboard encoding circuitry. This keyboard can be wadded up, thrown in the wash, and even used as a potholder if desired. Such row-and-column structures can also be made by embroidering or silk-screening the contact traces.



All-fabric capacitive keyboard.

Keyboards can also be made in a single layer of fabric using capacitive sensing [Baxter97**]**, where an array of embroidered or silk-screened electrodes make up the points of contact. A finger's contact with an electrode can be sensed by measuring the increase in the electrode's total capacitance. It is worth noting that this can be done with a single bidirectional digital I/O pin per electrode, and a leakage resistor sewn in highly resistive yarn. Capacitive sensing arrays can also be used to tell how well a piece of clothing fits the wearer, because the signal varies with pressure.

The keypad shown here has been mass-produced using ordinary embroidery techniques and mildly conductive thread. The result is a keypad that is flexible, durable, and responsive to touch. A printed circuit board supports the components necessary to do

capacitive sensing and output keypress events as a serial data stream. The circuit board makes contact with the electrodes at the circular pads only at the bottom of the electrode pattern. In a test application, 50 denim jackets were embroidered in this pattern. Some of these jackets are equipped with miniature MIDI synthesizers controlled by the keypad. The responsiveness of the keyboard to touch and timing were found by several users to be excellent.

A view of the component side of the circuit board has been superimposed to show its extent and its connections to the fabric. A flexible circuit board can be substituted for the rigid one used in this implementation. Ultimately we hope to do away with the circuit board entirely.

5. APPLICATIONS:

➢ Temperature Sensitive Fabrics:

From protecting body from harsh temperature to start thinking for the wearer, clothes have come a long way! This is the next generation of textile- the smart fabrics- the electronic wearables! This can not only keep the wearer warm or cool but also dry, moisturized, free from bacteria, allergy, odor and stains and at the same time monitor the heart rate, blood count and oxygen! Fabrics are really going to give a tough competition to human intelligence!.Not only protecting human body against heat and cold, the fabrics are now accepting the role of regulating body temperature. These heat modifying textiles are mostly used to make outdoor garments such as hats, beanies, windbreakers and jackets. There are many techniques for making such clothes, one of which is- treating the fabric with paraffins. As the body gets hot, the paraffins become more liquid to let the heat pass out and as the body gets cold, it solidifies so that it keeps back the heat with the wearer. Some other fabrics that are wired up, conduct electricity for monitoring body temperature. At the same time, the inbuilt mp3 player can entertain the wearer! The amazing part is that, when made from conductive yarn, they are machine washable, wear and feel like any conventional clothing. They are the first generation smart fabrics, and guess what, the second generation smart fabrics will be treated with Inherently Conductive Polymers (ICP) allowing the fabric to transmit energy to heat and cool the body

➢ Health Monitoring Fabrics:

Now regular visits for health related tests can be forgotten! Wear the Health Monitoring Electronic Wearables and stay free of worries. The most prevalent among these health smart fabrics are the microencapsulated fabrics, especially in the natural health sector. The clothings enriched with substances like vitamins, algae or nutrients along with other substances to delay ageing or for improving blood circulation or other such benefits are fast becoming popular with

the masses. Medically beneficial electrically conductive smart fabrics are no far behind. These life vests can track heart rate, ECG and body temperature. Now the research results are claiming to have developed a smart fabric that could warn its wearer of allergens, by glowing in response. The other health-enhancing electronic clothings include fall-detecting smart shirt that uses a built-in motion-detection hardware to detect if the user has fallen and can't get up. Really useful for older people! Then there is underwear having sensors woven into the fabric to detect heart rate. Some of them can even dial emergency number if they detect a problem. Now, that's called a real smart fabric!!

- **Emergency Fabrics:**

Although the health monitoring fabrics are in a way emergency fabrics only, yet certain other developments in the field of smart fabrics are in the pipeline that can really be called Disaster wear! A system is being developed to monitor the wearer and the outside environment which can be helpful for rescue workers like fire fighters. Some projects are aiming at stretchable electronics by developing conducting substrates within the very weave of fabric, which will allow sensors to move with the body. Many researches are aimed at using optical fibers because of their potential flexibility and their capacity to use light both as an information carrier and a sensor in itself. It can find applications in oximetry – a smart non-invasive way to measure the oxygen content of blood. Some projects are targeting at developing sensors which can measure body fluids like sweat, too, which will be very useful in sport wears. It will be able to measure the conductivity, electrolyte level, temperature and pH of the users' sweat, all very useful indicators for sporting applications.

6. SOME INTERESTING SMART FABRICS:

There are certain clothings that not only are an important landmark in the world of smart fabrics but are also very effective in handling day-to-day problems that look small but in fact which are very typical and sometimes embarrassing too. The new generation of wool fabrics, the moisture wicking wool helps in keeping the body dry by pulling moisture away from it. They are extensively used in active sportswear. Silver is extensively added to the composition of the fabric itself.There are certain clothings that not only are an important landmark in the world of smart fabrics but are also very effective in handling day-to-day problems that look small but in fact which are very typical and sometimes embarrassing too. The new generation of wool fabrics, the moisture wicking wool helps in keeping the body dry by pulling moisture away from it. They are extensively used in active sportswear. Silver is extensively added to the composition of the fabric itself. Its not that the smart fabrics are only used in making clothing. Certain other products are also been made for the comfort of human kind. There are bags that have iPod controller built into the strap. Thus, the user can control music when even the iPod stays in the bag. Not only this, the

bags keep the valuable items protected from thieves, weather, and bumps and scratches too! Then there are hi tech portable fabric keyboards that can be rolled up when not in use so that they fit into a pocket or a handbag! They are full size typing surface that can pair through bluetooth to smartphones, PDAs & other hand held devices to give the users a totally mobile office!

7. CONCLUSION:

We have shown how to combine conventional sewing and electronics techniques with a novel class of materials to create interactive digital devices. All of the input devices can be made by seamstresses or clothing factories, entirely from fabric. These textilebased sensors, buttons, and switches are easy to scale in size. They also can conform to any desired shape, which is a great advantage over most existing, delicate touch sensors that must remain flat to work at all. Subsystems can be connected together using ordinary textile snaps and fasteners. Finally, most of what has been described can be thrown in the wash if soiled by coffee, food, or sand at the beach.

8. REFERENCES:

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