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SMART TEXTILES

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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, nano engineering, 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 close 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.

Index Terms: *Smart fabric, silk organza, cotton to advanced Kevlar materials, smart kerchief and capacitive keyboards.*

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1. INTRODUCTION

Smart textile or smart fabric is also known as E-textile, are fabric that enables digital components such as a battery and a light (including small computers) and electronics to be embedded in them. Smart textiles are fabrics that have been developed with new technologies that provide added value to the wearer. Pails-Friedman of the Pratt Institute states that "what makes smart fabric including communicate, transform, conduct energy and even grow".(1) Smart textiles can be broken into two different categories aesthetic and performance enhancing. Aesthetic example includes fabrics that light up and fabrics that can change colour. Some of these fabrics gather energy from environment by harnessing vibrations, sounds or heat, reacting to these inputs. The colour changing and lighting scheme can also work by embedding the fabric with electronics that can power it. Performance enhancing smart textiles is intended for use in athletic, extreme sports and military applications. These include fabric designed regulate body temperature, reduce wind resistance and control muscle vibration-all of which may improve athletic performance. Other fabrics have been developed for protecting clothing to guard against extreme environmental hazards, such as such as radiation and the effect of space travel. The health and beauty industry is also taking advantage of these innovations, which range from drug-releasing medical textiles, fabric with moisturizers, perfume and anti-aging properties. Many smart clothing, wearable technology and wearable computing projects involve the use of r-textiles.(2,3)

2. MATERIAL

Smart textile fabrics can be made from materials ranging from traditional cotton, polyester and nylon to advanced Kevlar with integrated functionalities. For years the textile industry has been weaving metallic yarn into fabrics for decorative purposes. The first conductive fabric is explored was silk organza which contains two types of fibres, as shown in fig.2.1 on the warp is plain silk thread. Running in the other direction on the weft is silk thread wrapped in thin copper foil. This metallic yarn is prepared just like cloth-core telephone wire, and is highly conductive. The silk fibre core has high tensile strength and can withstand high temperature, allowing the yarn to be sewn or embroidered with industrial machinery. The spacing between these fibres also permits them to be individually addressed, so a strip of this fabric can function like ribbon cable. This sort of cloth has been woven in India for at list a century, for ornamental purposes, using silver, gold and other metals.(4)

2.1 Micrograph of silk organza

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, circuit formed in this fashion have many degree of flexibility (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 fibres interspersed throughout. Varying the ratio of the two constituent fibres leads to differences in resistivity. These fibres 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 connection 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 connector between the fabric and electronics. Since the snaps pierce the yarn it creates surprisingly robust electrical contacts. It also provides a good surface to solder to. In this way subsystems can be easily snapped into clothing or removed for washing.

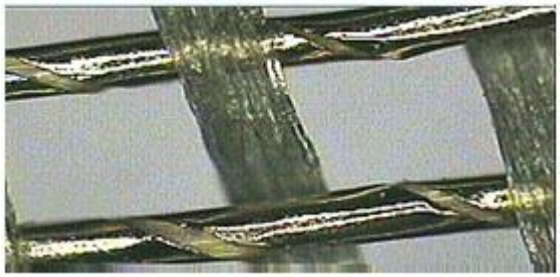

Fig-2.1: Micrograph of silk organza

3. IMPLEMENTATIONS

3.1 A fabric breadboard or "Smart kerchief"

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 touch pads. In the microcontroller circuit shown in fig.3.1, a PIC16C84 microcontroller and it supporting components are soldered directly on to a square of fabric. The circuit use the bidirectional input 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 system in this way is easy because components can be soldered directly on to 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.

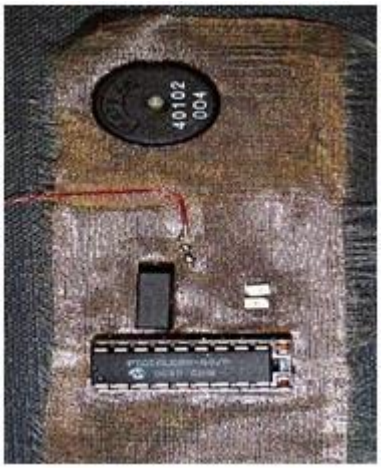

Fig-3.1: Smart kerchief

3.2 All fabric switching contact and capacitive keyboard

One kind of fabric keyboard uses pieced conductive and nonconductive fabric, sewn together like quilt to make a row and column addressable structure. The quilted conductive columns are insulated from the conductive rows, with soft, thick fabric, like felt, velvet or quilt batting. Keyboards can also be made in single layer of fabric using capacitive sensing. Where an array of embroidered or silk-screened electrodes make up the points of contact. A fingers contact with electrodes can be sensed by measuring the increase in the electrodes total capacitance. A printed circuit board supports the components necessary to do capacitive sensing and output keypress events as serial data stream. The circuit board makes contact with the electrodes at the circular pad only at the bottom of the electrode pattern.[5,6]

Fig-3.2(a): Fabric switching contact keyboard

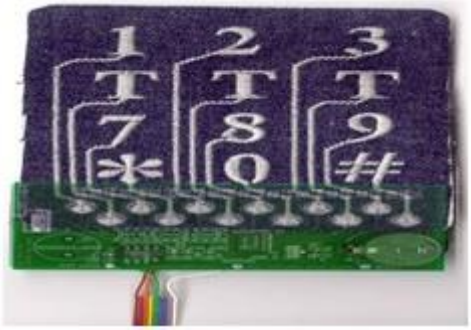

Fig-3.2(b): Capacitive keyboard

4. APPLICATION

4.1 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 wearable's. 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 paraffin's. As the body gets hot, the paraffin's 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.[7]

4.2 Health monitoring fabrics

Now regular visits for health related tests can be forgotten! Wear the Health monitoring electronic wearable's and stay free of worries. The most prevalent among these health smart fabrics are the microencapsulated fabrics, especially in the natural health sector. The clothing's enriched with substances like vitamins, algae or nutrients along with other substances to delay ageing or for improving blood circulation or other such benefits is 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 clothing's include fall-detecting smart shirt that uses 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.[8]

4.3 Life jacket

Life jacket is a medical device worn by the patient that consequently reads their blood pressure or monitors the heart rate; the information is transferred to a computer and read by medical staff. A specialized camera in the form of headwear has been developed to be worn by paramedics. Visual information captured by the camera can be transferred directly

To medical staff at the hospital enabling them to advised instantly on appropriate treatment. Hypertension is another common disease found in the elderly population. Elevated BP increases the workload of the heart and scars the artery walls. Increases in either BP or BP variability (BPV) are partly responsible for various cardiovascular events. Nevertheless, most individuals with hypertension experience no symptoms, which often make them overlook their ailment. Thus, early detection of BP for health condition assessment by wearable devices before a severe event occurs is very important. Technologies advanced in wearable BP monitoring focuses on continuous and non-invasive measurement without using a cuff. Cuff-less BP can be measured from the radial pulse waveform by arterial tonometry by using this life jacket.

4.4 Military/Defence

In extreme environmental conditions and hazardous situations there is a need for real time information technology to increase the protection and survivability of the people working in those conditions. Improvements in performance and additional capabilities would be of immense assistance within professions such as the defense forces and emergency response services. The requirements for such situations are to monitor vital signs and ease injuries while also monitoring environment hazards such as toxic gases. Wireless communication to a central unit allows medics to conduct remote triage of casualties to help them respond more rapidly and safely.[9]

4.5 Emergency fabrics

Although the health monitoring fabrics are in 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.

4.6 Fashion and entertainment

Club wear that reacts to movement, heat and light. They include garments with panels that illuminate

when the dancer moves, or clothing that contain fibre optics woven and integrated into the fabric. The development of high-tech advanced textiles for initial high value applications such as extreme sports will eventually find its way into street fashion, with designers employing their creativity to use these emerging materials in new ways. We are becoming increasingly reliant on technology carrying MP3 players, laptops, mobile phones and digital cameras. These devices all contain common components such as power supply, microprocessor, and data transmission. As the technology is becoming more flexible these could ultimately be integrated into a common textile substrate our clothes, becoming truly portable devices. Already there are textile switches integrated into clothing for the control of such devices. While technology may be hidden through invisible coatings and advanced fibers, it can also be used to dramatically change the appearance of the textile, giving new and dazzling effects. Light emitting textiles are finding their way onto the haute couture catwalks, suggesting a future trend in technical garments. The haute couture catwalks, suggesting a future trend in technical garments.[10,11]

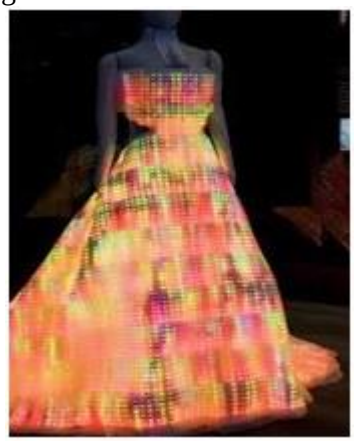

Fig-4.6: Fashion wears

Fig-4.7: Sports wears

4.7 Sports Wears

Sports enthusiasts are able to benefit from integrated fabric sensors and display panels. They monitor heart rate and blood pressure during a gym workout or morning run and are able to analyse the information giving feedback on performance along with playing mood performance enhancing music. Some sports clothing such as car and motor bike racing and also astronauts suits contain integrated electronic components.[12]

5. CONCLUSION

We have shown how to combine conventional sewing and electronics techniques with novel class of material like fabric, sensors, buttons and switches to create interactive digital smart fabrics. Its application are widely use in many fields such as medicine, military, industry, sport, etc.

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REFERENCES

[1] Gaddis, Rebecca (May 7, 2014). "What Is The Future Of Fabric? These Smart Textiles Will Blow Your Mind".

[2] Cherenack, Kunigunde; Pieterson, Liesbeth van (2012-11-01). "Smart textiles: Challenges and opportunities". Journal of Applied Physics (published 7 November 2012).

[3] Saddamhusen Jamadar: Application of smart and interactive textiles.

[4] Conductive textiles for smart fabrics by N.v. bhat, D.t.sheshadhari, M.m.nate and A.v.gore.

[5] E. Rehmi Post and Maggie Orth: Smart fabric or washable computing, MIT Media Laboratory, Cambridge.

[6] Microsystems and Smart Integrated Systems: A key enabling technology for AAL Dr Andreas Lymberis andreas.lymberis@ec.europa.eu 2005.

[7] Axisa, F., Schmitt, P., Gehin, C., Delhomme, G., McAdams, E., & Dittmer, A. (2005). Flexible technologies and smart clothing for citizen medicine, home healthcare, and disease prevention, Information Technology in Biomedicine.

[8] L.van langenhove, smart textile for medicine and health care: material system and application, woodhed publishing limited Cambridge, England Technical textiles international octomber 2011, wearables help develop a sixth sense for saftey and protection by Adrian Wilson.

[9] Smart fabric & interactive textile wearable systems Prof. Danilo De RossiInter departmental Research Centre "E.Piaggio"University of Pisa.

[10] Smart Fabrics and Interactive Textile Enabling Wearable Personal Applications: R&D State of the Art and Future Challenges. Lymberis, R. Paradiso.

[11] https://www.google.co.in/search?q=sports+fabric+smart+textile&source=lnms&tbm=isch&sa=X&ved=0ahUKEwjgh8ax2r_WAhUPR48KHfaWAVMQ_AUICigB&biw=1366&bih=662#imgrc=qW7hxp4q-ZwuHM