A

Seminar report

On

E -Textiles

Submitted in partial fulfillment of the requirement for the award of degree
Of ECE

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Preface

I have made this report file on the topic **E -Textiles**; I have tried my best to elucidate all the relevant detail to the topic to be included in the report. While in the beginning I have tried to give a general view about this topic.

My efforts and wholehearted co-corporation of each and everyone has ended on a successful note. I express my sincere gratitude to …………..who assisting me throughout the preparation of this topic. I thank him for providing me the reinforcement, confidence and most importantly the track for the topic whenever I needed it.

Acknowledgement

I would like to thank respected Mr…….. and Mr. ……..for giving me such a wonderful opportunity to expand my knowledge for my own branch and giving me guidelines to present a seminar report. It helped me a lot to realize of what we study for.

Secondly, I would like to thank my parents who patiently helped me as i went through my work and helped to modify and eliminate some of the irrelevant or un-necessary stuffs.

Thirdly, I would like to thank my friends who helped me to make my work more organized and well-stacked till the end.

Next, I would thank Microsoft for developing such a wonderful tool like MS Word. It helped my work a lot to remain error-free.

Last but clearly not the least, I would thank The Almighty for giving me strength to complete my report on time.

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1. INTRODUCTION

THE scaling of device technologies has made possible significant increases in the embedding of computing devices in our surroundings. Embedded microcontrollers have for many years surpassed microprocessors in the number of devices manufactured. The new trend, however, is the networking of these devices and their ubiquity not only in traditional embedded applications such as control systems, but in items of everyday use, such as clothing, and in living environments. A trend deserving particular attention is that in which large numbers of simple, cheap processing elements are embedded in environments. These environments may cover large spatial extents, as is typically the case in networks of sensors, or may be deployed in more localized constructions, as in the case of electronic textiles.

E-textiles, also known as **electronic textiles**, are fabrics that can function electrically as electronics and behave physically as textiles which enable computing ,digital components and electronics to be embedded in them. Part of the development of wearable technology, they are referred to as intelligent clothing or smart clothing that allow for the incorporation of built-in technological elements in everyday textiles and clothes. It does not strictly encompass wearable computing because emphasis is placed on the technology not being visible on the fabric and a computer is not actually embedded into the fabric. While not part of the mainstream form of fashion, its popularity is increasing and more research is being devoted to it.

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The field of e-textiles can be divided into two main categories:

1) The first category involves mounting classical electronic devices such as conducting wires, ICs, LEDs and conventional batteries into garments.

2) The second category involves creating electronic function directly on the textile fibers. These functions can either be passive such as pure wires, conducting textile fibers, or more advanced functions such as transistors, diodes and solar cells. The field of embedding advanced electronic components onto textile fibers is sometimes referred to as fibertronics.

The most common approach to e-textiles today comprise the first category, which is technically the most simple approach, and where even a number of commercial products exists such as textiles with incorporated LED components.

There are also a number of research and commercial projects that comprise the use of hybrid structures between category 1 and 2. Here usually a less advanced electronic functions that is embedded into the textile fiber is connected to a classical electronic device or component. Some examples are touch buttons that are constructed completely in textile forms by using conducting textile weaves, and then connected to devices such as music players , or LEDs that are mounted on woven conducting fiber networks to form displays.

Construction of electronic function on textile fibers requires the use of conducting and semi-conducting materials. There are a number of commercial fibers today that include metallic fibers mixed with textile fibers to form conducting fibers that can be woven or sewn. However as both metals and classical semiconductors (such as Si) are stiff material they are not very suitable for textile fiber applications where fibers are subjected to large stretch and bending during use.

Another class of electronic materials which is more suitable for e-textiles is the class of organic electronics materials, (also referred to as conducting plastics, or inherently conducting polymers). As organic electronic materials can be both conducting, semiconducting and designed as inks and plastics, they are more suitable for making electronic fibers.

Some of the most advanced functions that have been demonstrated in the lab to date include:

- organic fiber transistors , this is the first textile fiber transistor that is completely compatible with textile manufacturing and that contains no metals at all.
- Organic solar cell on fibers .

2. BENEFITS OF E TEXTILES

Electronic textiles, or e-textiles, are a new emerging inter disciplinary field of research, bringing together specialists in information technology, microsystems , materials, and textiles. E textiltes offers the following advantages:

- Flexible
- No wires to snag environment
- Large surface area for sensing
- Invisible to others
- Cheap manufacturing

The focus of this new area is on developing the enabling technologies and fabrication techniques for the economical manufacture of large-area, flexible, conformable information systems that are expected to have unique applications for both the consumer electronics and aerospace/military industries.

They are naturally of particular interest in wearable computing, where they provide lightweight, flexible computing resources that that are easily integrated or shaped into clothing. Due to their unique requirements, e-textiles pose new challenges to hardware designers and system developers, cutting across the systems, device, and technology levels of abstraction: In contrast to traditional wearable computers, which are often a single monolithic computer or a small computer system that can be worn, e-textiles will be cheap, general purpose computing substrates in the form of a woven fabric that can be used to build useful computing and sensing systems "by the yard."

3. MAKING OF E TEXTILES

E-textiles of various forms have previously been demonstrated, but have typically been hindered by one or more shortfalls. For example, geometrically complex antennas have revealed performance levels that are indistinguishable from identical designs on conventional materials. However, construction of the complex geometrical patterns has often been laborious, involving hand-stitching. Another automated method for e-textiles circuit construction uses conductive threads in an embroidery process. However, the embroidered conductive threads do not provide sufficient surface conductivity for many high-speed digital and RF applications. Furthermore, some studies have indicated that the conductive embroidery threads are more subject to breaking than conventional non-conductive embroidery thread.

The present method overcomes the limitations of the prior methods for forming the equivalent of printed circuits on cloth. A typical fabrication process according to the present method involves selecting the appropriate conductive and non-conductive fabric layers to build the e-textile circuit. The present method uses commercially available woven conductive cloth with established surface conductivity specifications. Dielectric constant, loss tangent, and thickness are some of the parameters to be considered for the non-conductive fabric layers. The circuit design of the conductive woven fabric is secured onto a non-conductive fabric layer using sewing, embroidery, and/or adhesive means. The portion of the conductive fabric that is not part of the circuit is next cut from the desired circuit using an automated machine such as a printed-circuit-board milling machine or a laser cutting machine. Fiducials can be used to align the circuit and the cutting machine. Multilayer circuits can be built starting with the inner layer and using conductive thread to make electrical connections between layers.

4. PROPERTIES OF E – TEXTILES

Electrical properties:

From the electrical points of view, conductivity is the most important factor. Electrical resistance low enough to allow a flow of electric energy, such as for power or data transmission, is critical. Metal, carbon, or optical fibers are typically well-known conductors.

Conductive yarns are either pure metal yarns or composites of metals and textiles. Metals are superior in strength and fineness, and textiles are selected for comfort. In order to produce a successful conductive yarn, the best mix of conductive and non-conductive materials is critical.

As a thread takes on a bigger portion of conductive components, it loses the typical textile properties such as flexibility or drapability and becomes more conductive. The achievement in electrical resistance has ranged from 0.2441 ohms per meter (Ω/m) to 5,000 Ω/m.

Mechanical properties

From the textile point of view, e-textiles need to be designed to exhibit physical properties similar to those of traditional textiles. E-textiles should be bendable, stretchable, and washable while keeping good electrical conductivity.

To develop practical wearable systems, mechanical properties of e-textiles are critical. However, there has been very little research that systematically evaluates the physical behaviour of e textiles .

1. *Flexibility*

Flexibility can be understood as the resistance to permanent deformation under stresses such as folding or bending. Flexibility of yarns can be improved through textile processes such as spinning or twisting because the overall geometry of the yarn is a prior factor to those of individual fibers. Generally, yarn flexibility is affected by an individual fiber's characteristics, such as fineness, flatness or Young's modulus; percentage of conductive fibers; and their geometry.

2. Sewability

Also considered as an index for bending characteristics of conductive threads. *The Curl Test* was invented to observe the residual curling and judge the sewability of conductive threads because a conventional sewing thread did not show residual curls at all. It was known empirically that most conductive threads were not eligible for machine sewing because of their lack of mechanical properties. They could not withstand mechanical stresses that machine sewing causes through the needle. Fine wires, however thin or flexible, would break under the tension in the needle, or jam the machine in the bobbin.

3. ***Washability***

Washability is a very unique characteristic of e-textiles unless the wearable system is disposable. Washability is related to chemical resistance against moisture and detergents as well as physical resistance against mechanical stresses and high temperature. Known as the most efficient conductor, copper itself is disqualified for washability because it is corroded quickly by moisture. Challenges regarding washability have a grave consequence: most smart clothing has been developed as a concept and exists only in laboratories.

A series of durability tests on stitches of conductive yarns was tried by following the existing guidelines: a washing test for textiles and accelerated aging tests for conventional electronics. In both washing and accelerated aging tests, electrical connection by stitches has been shown to be more durable when there is not a prepared hole. The conductive stitches were durable enough to withstand conventional washing without any prepared hole, but they did not withstand accelerated aging tests.

Most research pertaining to washability was testing metal-plated fabrics, possibly because plated fabrics are notorious for a lack of conductivity reliability. More or less, conductive fabrics lost their conductivity after repeated laundering. The increase in resistance could be attributed to fiber breakage and abrasion of the conductive plating. Dry cleaning was found to be a safer way to clean e-textiles than machine washing. [1]

5. RESEARCH WORKS

1) **Conductive eTextiles: Researchers move from making batteries from paper to making batteries from cloth**.

A team of Stanford researchers is producing batteries and simple capacitors from ordinary textiles dipped in nanoparticle-infused ink. The conductive textiles - dubbed "eTextiles" - represent a new class of integrated energy storage device, born from the synthesis of prehistoric technology with cutting-edge materials science. While conventional batteries are made by coating metallic foil in a particle slurry and rolling it into compact form - a capital-intensive process - the new energy textiles were manufactured using a simple "dipping and drying" procedure, whereby a strip of fabric is coated with a special ink formula and dehydrated in the oven. The procedure works for manufacturing batteries or supercapacitors, depending on the contents of the ink - oxide particles such as $LiCoO_2$ for batteries; conductive carbon molecules (single-walled carbon nanotubes, or SWNTs) for supercapacitors. Up to now, the team has only used black ink, but Cui said it is possible to produce a range of colors by adding different dyes to the carbon nanotubes. the lightweight, flexible and porous character of natural and synthetic fibers has proven to be an ideal platform for absorbing conductive ink particles, according to postdoctoral scholar Liangbing Hu, who led the energy textile research. That helps explain why treated textiles make such efficient energy storage devices, he said. [2]

2) Nanotechnology e-textiles for biomonitoring and wearable electronics

Early e-textiles were bulky and not very user friendly garments, full of wires and sensors, and they were not suitable for mass production. But as researchers have started to make transistors in yarn form, public funding for this field increased (see for instance the European project PROETEX), advances in nanotechnology promise to dramatically advance the development of futuristic electronic textiles. Point in case is a recent research report that proposes to make conductive, carbon nanotube-modified cotton yarn. This would offer a uniquely simple yet remarkably functional solution for smart textiles – close in feel and handling to normal fabric – yet with many parameters exceeding existing solutions.

Although attempts have been made to fabricate nanotube yarns or impregnate fabric fibers with nanotubes, the vast majority of the studies on textile modification with nanomaterials was carried with nanoparticles" Dr. Nicholas Kotov tells Nanowerk. "There were various reasons for adding metal and semiconductor nanoparticles to fabrics such as fashionably glittering colors, antimicrobial function, UV protection, wrinkle resistance, and anti-odor function."

In contrast, Kotov and his team developed a method to coat regular cotton yarns with single-walled and multi-walled carbon nanotubes (CNT) and polyelectrolytes. The scientists point out that their process provides a fast, simple, robust, low-cost, and readily scalable process for making e-textiles. [3]

3) **Virginia Tech Computer Engineers** constructed a functioning 30-foot swath of acoustic array fabric with interwoven wiring and integrated microphone sensors and circuit boards. The original stainless steel thread (inset) was found to fray and create shorts, so it was replaced with the purple insulated thread shown here.

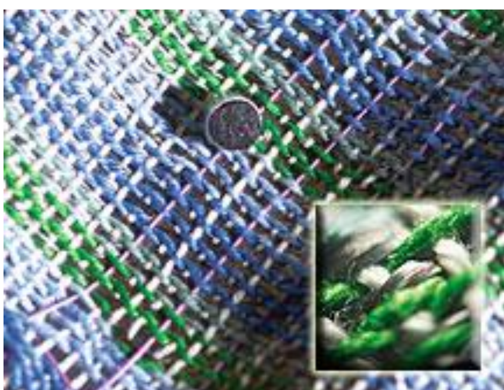

Fig.1

6. Applications of E-textiles

The future of specialized fabrics — E-textiles can be used

- To sense tank movements,
- To monitor homes for noxious chemicals
- Help firefighters maneuver in smoky buildings, and perhaps help stroke victims recover their function.
- They can also be used in a smart home to detect the movement of people and adjust the lighting or sound systems.
- For sensor network communications
- Physical therapy
- Act as batteries or chemical sensors

7. Future prospects

One of the probable future scenarios of e-textile is that as the field of fibertronics becomes more mature, the hybrid structures will include more electronic functionality at the fiber level, until we eventually end up with electronic textiles where all advanced electronic function, such as batteries, lightning, communication and computing is all embedded in the textile fibers. The field of fibertronics is therefore a crucial field for the developments of future e-texiles.

8. SUMMARY

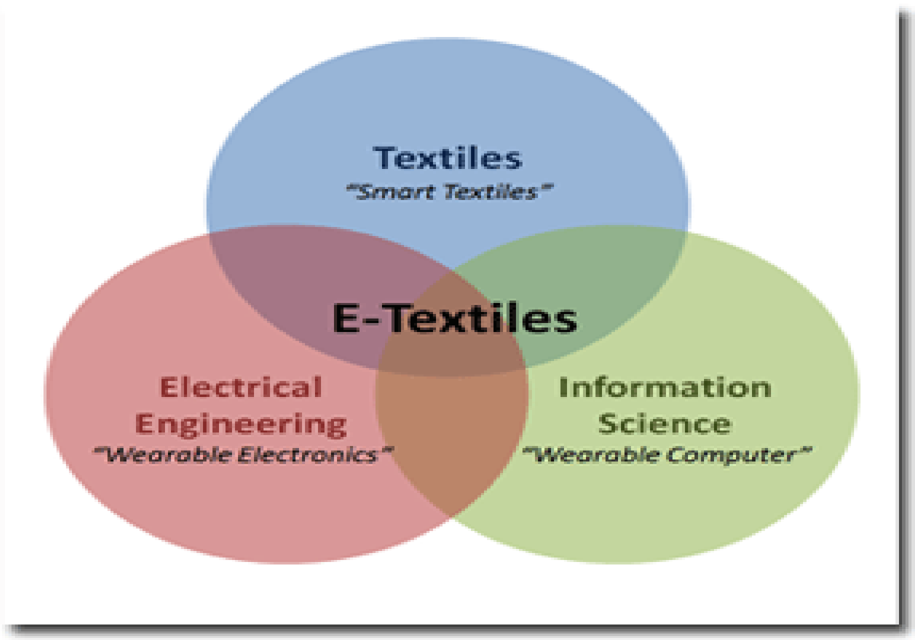

Fig.2

1. Electronic textiles or e-textiles are a newly emerging interdisciplinary field of research which brings together specialists in information technology, microsystems, materials, and textiles.
2. The focus of this new area is on developing the enabling technologies and fabrication techniques for the economical manufacture of large-area, flexible, conformable information systems which are expected to have unique applications for both consumer electronics and military industry

3. E-textiles will generate a significant body of research with deep implications in everyday's life, consumer market and applications requiring remote sensing, processing and actuation (e.g. medical, space and military).

9. CONCLUSION:

Over the past decade, electronics have been shrinking in size and increasing in functionality. The idea for the most wearable system is to attach technological components to the textile in which transmission lines and connectors are embedded. Because the electronics are attached and detached freely, they can be protected from the physical stresses of laundering. As many different electrics can be connected to any clothing, a wearable system becomes more versatile, and the user can change its look depending on environmental and situational changes and individual preference.

Standardization is the biggest challenge for the industry as it commercializes the wearable systems. It is especially critical for compatibility and connection problems. Standardization should be done in a way that covers the multidisciplinary characteristics of an e-textile as a textile, as an electronic, and as a computer. Another challenge is to ensure personal safety against potential offenses from the wearable system itself or from abusive users. For example, concerns regarding harmful effects of the electromagnetic field or leaks of confidential information must be cleared before the clothing reaches the users.

Current advances in new materials, textile technologies, and miniaturized electronics make wearable systems more feasible. It has been anticipated that batteries or memory storages could be woven directly into textiles. In the future, it might be possible that people can enjoy the freedom not to carry any electronic device, but, instead, to wear it.

10. REFERENCES

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