**SEMINAR REPORT**
**ON**

# SMART FABRICS

**By**

**NIXON PHILIP**
**Roll no.:40**

**GUIDE**
**Assistant professor: MR.OMPRAKASH YADAV**

**DEPARTMENT OF COMPUTER ENGINEERING**

**XAVIER INSTITUTE OF ENGINEERING**

**Mahim Causeway, Mahim**

**Mumbai-400 016**

**2010-2011**

# XAVIER INSTITUTE OF ENGINEERING

**Mahim Causeway, Mahim**
**Mumbai-400 016**

## DEPARTMENT OF COMPUTER ENGINEERING

## CERTIFICATE

This is to certify that the seminar entitled "SMART FABRICS" has been carried out by Mr. NIXON PHILIP(Roll No. 40) under my guidance in partial fulfillment of Third Year of Bachelor of Engineering in Computer Engineering of Mumbai University during the academic year 2010-2011. It is also certified that this work is not been presented anywhere else forward of any other degree or diploma prior to this.

Guide　　　　　　　　　　Head of Department

(__________________)　　　　　　( ______________)

# ACKNOWLEDGEMENT

I would like to acknowledge all the professors at Xavier Institute of Engineering, for their continuous and relentless support.

I thank my guide Mr.OmprakashYadav for his support, timely guidance, knowledge and all the valuable direction that kept me going and inspired me to perform better.

I would also like to take this opportunity to thank all my friends for their constant support and for sharing their experiences, knowledge and information with me.

I express my gratitude,

-NIXON PHILIP

# PAGE INDEX

# FIGURE INDEX

**FIGURE** **PAGE NO.**

## ABSTRACT:

Based on the advances in computer technology, especially in the field of miniaturization, wireless technology and worldwide networking, the vision of wearable computers emerged. We already use a lot of portable electronic devices like cell phones, notebooks and organizers. The next step in mobile computing could be to create truly wearable computers that are integrated into our daily clothing and always serve as our personal assistant. This paper explores this from a textile point of view. Which new functions could textiles have? Is a combination of textiles and electronics possible? What sort of intelligent clothing can be realized?

Today, the interaction of human individuals with electronic devices demands specific user skills. In future, improved user interfaces can largely alleviate this problem and push the exploitation of microelectronics considerably. In this context the concept of smart clothes promises greater user-friendliness, user empowerment, and more efficient services support. Wearable electronics responds to the acting individual in a more or less invisible way. It serves individual needs and thus makes life much easier. We believe that today, the cost level of important microelectronic functions is sufficiently low and enabling key technologies are mature enough to exploit this vision to the benefit of society.

# 1. INTRODUCTION

## SMART FABRICS

Electronic textiles (e-textiles) are fabrics that have electronics and interconnections woven into them. Components and interconnections are a part of the fabric and thus are much less visible and, more importantly, not susceptible to becoming tangled together or snagged by the surroundings.

Consequently, e-textiles can be worn in everyday situations where currently available wearable computers would hinder the user. E-textiles also have greater flexibility in adapting to changes in the computational and sensing requirements of an application.

The number and location of sensor and processing elements can be dynamically tailored to the current needs of the user and application, rather than being fixed at design time.

## 2. TEXTILE GAIN INTELLIGENCE

Advances in textile technology, computer engineering, and materials science are promoting a new breed of functional fabrics. Fashion designers are adding wires, circuits, and optical fibers to traditional textiles, creating garments that glow in the dark or keep the wearer warm. Meanwhile, electronics engineers are sewing conductive threads and sensors into body suits that map users' whereabouts and respond to environmental stimuli. Researchers agree that the development of genuinely interactive electronic textiles is technically possible, and that challenges in scaling up the handmade garments will eventually be overcome. Now they must determine how best to use the technology.

The term 'smart dresser' could soon acquire a new meaning. An unlikely alliance between textile manufacturers, materials scientists, and computer engineers has resulted in some truly clever clothing. From self-illuminating handbag interiors to a gym kit that monitors workout intensity, the prototypes just keep coming. But researchers have yet to answer the million-dollar question, perhaps critical to consumer acceptance; will they go in the wash? .

Designers have been quick to jump onboard the high-tech fabric bandwagon, adopting electronic display technologies to create colorful, novelty clothing items. For example, the Italian-made fabric Luminex®, which contains colore light emitting diodes (LEDs), has been used to make a glow-in-the dark bridal gown, sparkly cocktail dresses, and costumes for opera singers. Luminex is made by binding LED fibers into the ends of ordinary fabric, which then form the seams of tailor made clothing.

France Telecom has gone one step further, developing a flexible, battery-powered optical fiber screen that can be woven into clothing. Each plastic fiber-optic thread is illuminated by tiny LEDs that are fixed along the edge of the display panel and controlled by a microchip. The threads are set up so that certain portions are lit when the LEDs are switched on, while other sections remain dark. These light and dark patches essentially act as pixels for the display screen. A prototype version integrated into a jacket displayed crude but readable symbols. More sophisticated versions may support advertising slogans, safety notices, or simply a range of different geometric patterns can be switched on and off.

The marriage of woven fabric with electronics is finding favor in the world of interior design as well. The novel fabric contains interwoven stainless steel yarns, painted with thermochromic inks, which are connected to drive electronics. The flexible wall hangings can then be programmed to change color in response to heat from the conducting wires (Fig. 1).

***Fig 2. Optoelectronic fabrics***

*Fig. 1 Optoelectronic fabrics may find a market in the world of interior design owing to their originality and aesthetic appeal. (Courtesy of Maggie Orth, International Fashion Machines.)*

## 3.WEARABLE-INTELLIGENCE

Self-heating hats and glow-in-the-dark sweatshirts might correctly be labeled as ‘smart’, but how about a shirt that ‘knows’ whether you are free to take a cell phone call or retrieve information from a 1000 page safety manual displayed on your inside pocket? Such items, termed ‘intelligent’ clothing to distinguish them from their lowertech cousins, have proved more difficult to_patch unobtrusively into everyday apparel. Indeed, the first prototype ‘wearable computers’ of the early 1990s required users to strap on a head-mounted visor and carry heavy battery packs in their pockets, leading some to question the appropriateness of the term ‘wearable’.

Batteries are now smaller and lighter, and sensors far less cumbersome. But researchers are going to have to integrate electronic components into the fabric itself, if this technology is going to fulfill its potential.

Sewing in electrical networking capability is just the first stage though. Genuinely intelligent clothing would be woven from a selection of thread-like electronic sensors and battery fibers, as well as flexible, conductive fibers. Garments would then be able to function as standalone computers, providing wearers with information about their environment. For example, a context-aware shirt for the blind might be woven with tiny vibrating motors to provide warnings about approaching objects, while workers in the chemical industry could wear overalls capable of detecting a nearby spillage.

The cost of developing and manufacturing such sophisticated fabrics is likely to put them beyond the reach of the fashion industry for the time being. The main applications are going to be medical, military, and industrial.Those are the only places that are going to be able to bear the additional cost of the clothing, at least at the outset. And they are also the kind of places that have some compelling applications where it is difficult to use discrete components strapped onto the body.”

**Fig.3LucyDunnemodels the smart jacket she designed in an undergraduate project.**

## 4.COMPLEXITY VERSUS DURABILITY

The simulation environment is already being used to model a garment that can sense its own shape. Professional golfers and tennis players could also use the shirt to perfect their swing or serve. The finished item is likely to be fabricated from cloth containing piezoelectric film fibers that produce a voltage in response to a force and vice versa. “The film strips allow us to detect movement of the limbs so that we can find their position.

Team members are also working to create a wearable version of a giant textile ‘sensornet’ designed to detect noise. The fabric, developed with support from the US military, is fitted with an acoustic beamformer capable of picking up and pinpointing the location of an approaching vehicle. Electrical connections are made by weaving wires into the heavy-duty cloth, and discrete microphones are attached at suitable points (Fig. 3) though these could also be replaced by piezoelectric film sensors in the future.

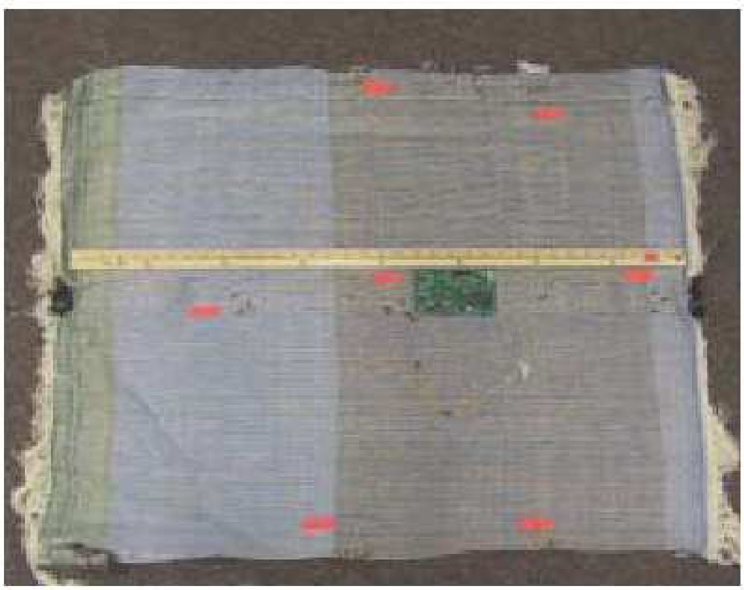

***Fig4.The cloth sensornet developed at Virginia Tech could help military personnel detect and locate approaching enemy vehicles***

The researchers are using standard metal snap fasteners (press studs) to make electrical connections between ‘e-buttons’ and conductive fibers. The e-buttons, essentially small PC boards, contain the garment’s core electronics. One part of the fastener is attached to the button, and the other to the item of clothing (Fig. 4). Buttons can then be fixed on when required, swapped with different e-buttons if alternative functionality is required or removed entirely when the garment is washed.

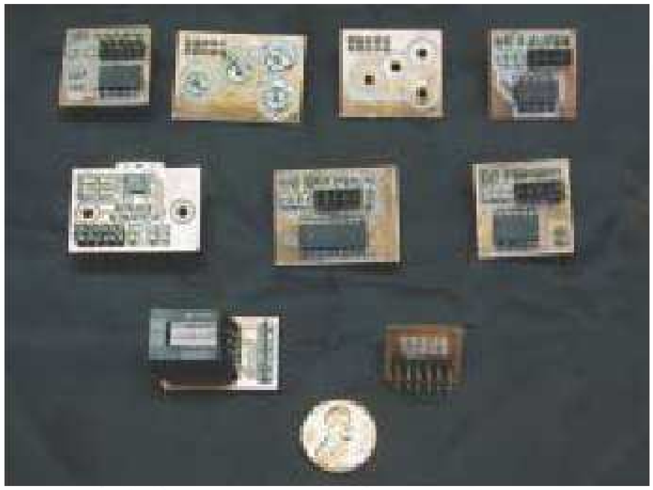

***Fig. 4.1* Use of established mass-manufacturing techniques may help keep the cost of intelligent clothing down. Electronic 'buttons' are fitted with metal snap fasteners that garment makers are already familiar with. (Credit: David Lehn.)**

# 5. PROJECT EXAMPLE

## 5.1 WEARABLE ANTENNAS

In this program for the US Army, Foster-Miller integrated data and communications antennas into a soldier uniform, maintaining full antenna performance, together with the same ergonomic functionality and weight of an existing uniform. We determined that a loop-type antenna would be the best choice for clothing integration without interfering in or losing function during operations, and then chose suitable body placement for antennas.

With Foster-Miller's extensive experience in electro-textile fabrication, we built embedded antenna prototypes and evaluated loop antenna designs. The program established feasibility of the concept and revealed specific loop antenna design tradeoffs necessary for field implementation.

This program aimed at developing soldier ensemble of the future, which will monitor individual health, transmit and receive mission-critical information, protect against numerous weapons, all while being robust and comfortable.

## 5.2 Georgia Tech Wearable Motherboard

Georgia Tech developed a "Wearable Motherboard" (GTWM), which was initially intended for use in combat conditions. The Sensate Liner for Combat Casualty Care uses optical fibers to detect bullet wounds and special sensors that interconnects in order to monitor vital signs during combat conditions. Medical sensing devices that are attached to the body plug into the computerized shirt, creating a flexible motherboard. The GTWM is woven so that plastic optical fibers and other special threads are integrated into structure of the fabric. There are no discontinuities in the GTWM. The GTWM is one piece of fabric, without seams. Because the sensors are detachable from the GTWM, they can be placed at any location, and is therefore adjustable for different bodies. Furthermore, the types of sensors used can be varied depending on the wearer's needs. Therefore, it can be customized for each user. For example, a firefighter could have a sensor that monitors oxygen or hazardous gas levels. Other sensors monitor respiration rate and body temperature or can collect voice data through a microphone. GTWM identifies the exact location of the physical problem or injury and transmits the information in seconds. This helps to determine who needs immediate attention within the first hour of combat, which is often the most critical during battle

### 5.2.1 The Value Added by GTWM

The GTWM is a breakthrough technology because it is the first unobtrusive and noninvasive way of monitoring vital statistics. Furthermore, the GTWM is worn comfortably underneath clothing, like an undershirt, and can be sized to fit a variety of people. Therefore, it is flexible and customizable to the wearer. Another interesting feature of the GTWM is that it is washable.

The GTWM could be classified as a wearable computing device. Once the wearer has plugged the sensors into the GTWM, he or she proceeds as if wearing any other item of clothing. It is intended to be as unobtrusive as possible, and no direct manipulation of the device is required once the initial setup is completed. It is unlike other wearable computers in that it is nearly invisible since it is worn underneath normal clothing.

### 5.2.2 Availability and Success of GTWM

The GTWM is currently being manufactured for commercial use under the name "Smart Shirt". Sensatex/Lifelink is manufacturing the "Smart Shirt", which should be available early next year. The company plans to develop relationships with firefighter groups, doctors and others in order to create "wearable motherboards," that meet their different needs

The commercial applications for the "Smart Shirt" are: (See Figure 4)

- Medical Monitoring
    - Disease Monitoring
    - Infant Monitoring
    - Obstetrics Monitoring
- Clinical Trials Monitoring
- Athletics
- Biofeedback

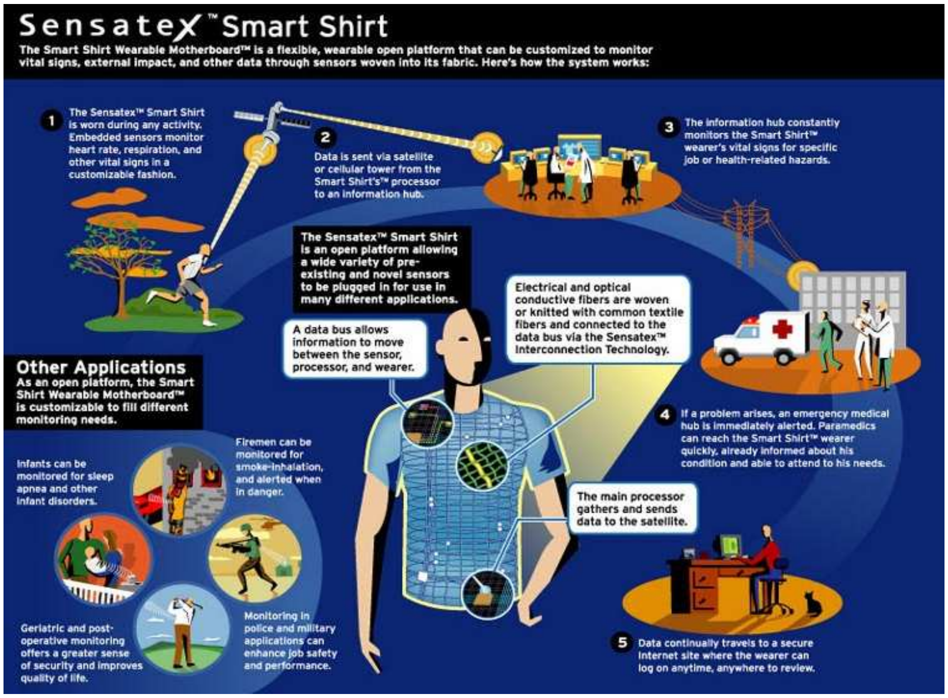


*Figure 5.2.2.1: Scenarios of Use for the "Smart shirt".*

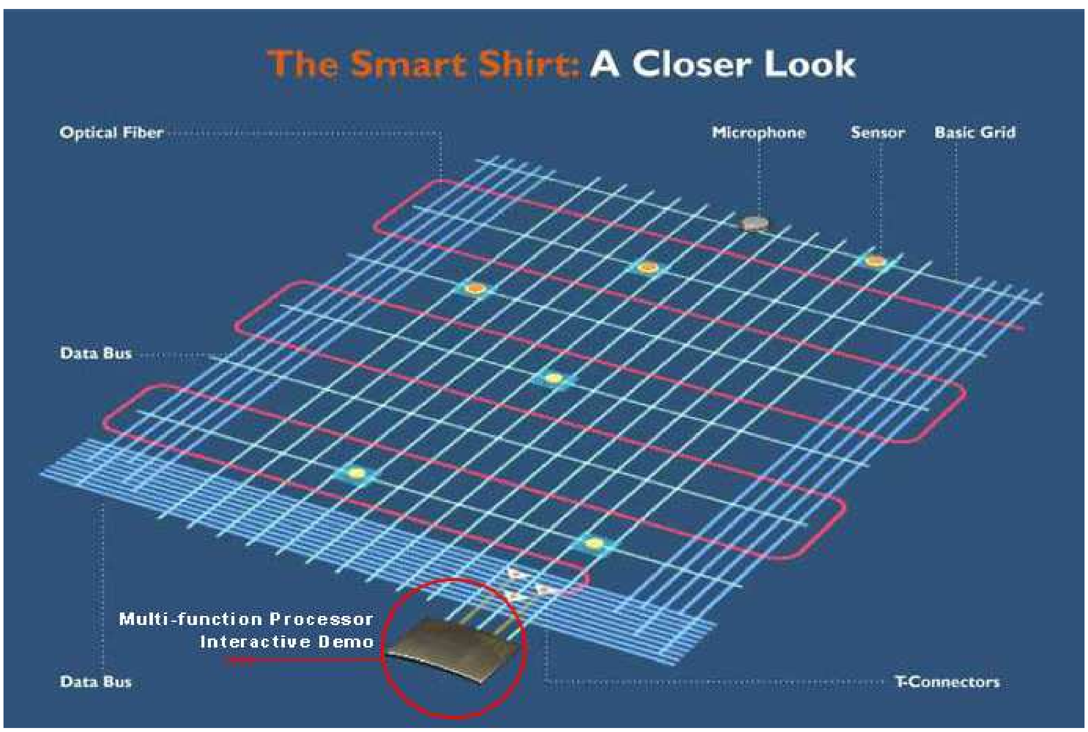


***Fig5.2.2.2 :details of smart shirt***

### *5.2.3 Limitations and Issues of the "Smart Shirt*

Some of the wireless technology needed to support the monitoring capabilities of the "Smart Shirt" is not completely reliable. The "Smart Shirt" system uses Bluetooth and WLAN. Both of these technologies are in their formative stages and it will take some time before they become dependable and widespread. (See Figure 7)

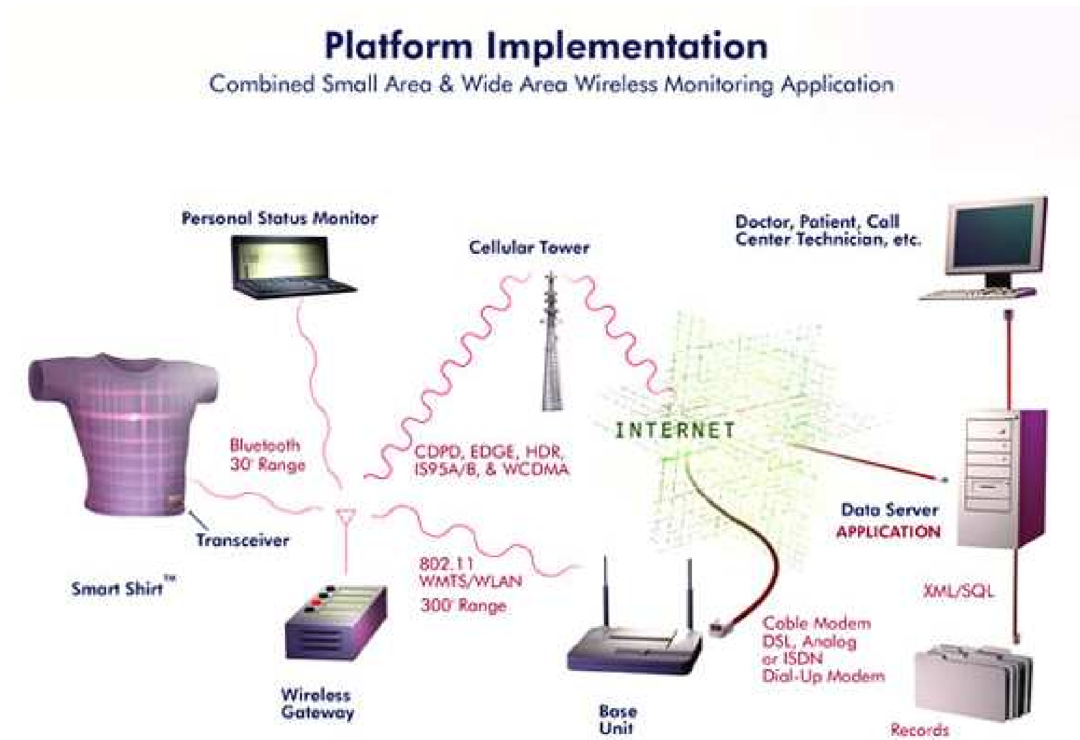


*Figure 5.2.3.1: "Smart Shirt" Platform Implementation*

Additionally, the technology seems to hold the greatest promise for medical monitoring. However, the "Smart Shirt" at this stage of development only detects and alerts medical professionals of irregularities in patients' vital statistics or emergency situations. It does not yet respond to dangerous health conditions. Therefore, it will not be helpful to patients if they do face complications after surgery and they are far away from medical care, since the technology cannot yet fix or address these problems independently, without the presence of a physician. Future research in this area of responsiveness is ongoing.

As is the case for any monitoring system, the privacy of the wearer could be compromised. For example, a GTWM that is outfitted with a microphone or GPS may compromise the wearer's privacy. Additionally, the data that is transferred by the "Smart Shirt" could be used for purposes other than the intended, and could be viewed by unauthorized people. Databases about individuals could also be linked to provide more information than is necessary for this application. All of these possibilities could compromise the privacy of the individual.

In the case of telemedicine and the aforementioned scenario of use with patients recovering from surgery, there is also the possibility that patients may be released from hospitals prematurely because doctors may depend on this technology to monitor them.

## 5.3 Thermoelectric Power Generator

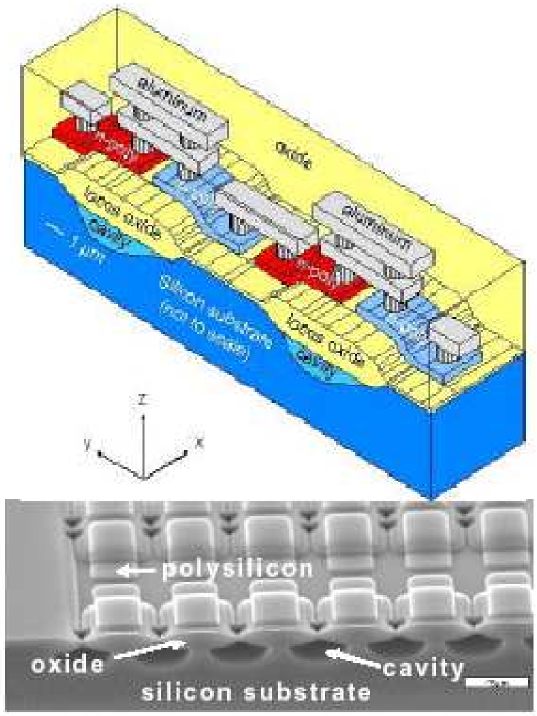


*Fig. 2: Schematic view (top) and photomicrograph (bottom) of the thermogenerator.*

Micromachined CMOS-compatible thermoelectric generators have been realized, as shown in Fig. 2. They produce an electrical output power of 1.0 µW per cm² under load and achieve an open circuit voltage of 10 volts per cm² for a temperature drop of 5 K across the device.

These values are comparable with expensive thermoelectric generators made of high-end compound semiconductors. The power delivered is suitable for application in wristwatches.

The thermoelectric generators have been implemented directly into the fabric of clothes. For coupling to the outside world small copper plates are placed both at the warm and cold ends utilizing the high thermal conductivity of this metal. Excellent thermal contact both to the skin and to the ambient air is achieved.

# 6.FABRIC COMPUTING INTERFACES

## FABRIC COMPUTING DEVICES

Designing with unusual materials can create new user attitudes towards computing devices. Fabric has many physical properties that make it an unexpected physical, interface for technology. It feels soft to the touch, and is made to be worn against the body in the most intimate of ways.

Materially, it is both strong and flexible, allowing it to create malleable and durable sensing devices. Constructing computers and computational devices from fabric also suggests new forms for existing computer peripherals, like keyboards, and new types of computing devices, like jackets and hats.

*EXAMPLES:*

### 6.1 Two Fabric Keypads

Our fabric keypads offer far greater physical flexibility and softness than existing flexible keyboards. Unlike fabric sensing of the past, these keyboards offer the precision and repeatability necessary to create reliable sensing devices. These keypads can be used to interface with Fig. 2 Quilted Fabric Keypad, Flat, Folded and Rolled everything from a desktop computer, to a pager and an interactive dress.

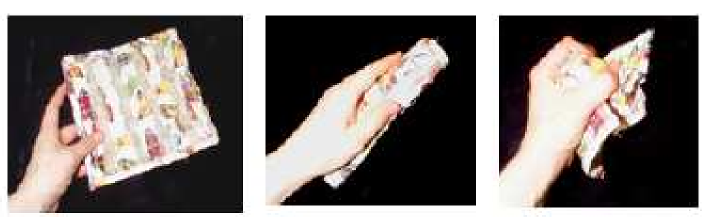

***Figure 6.1***

Fig. 2 Quilted Fabric Keypad, Flat, Folded and Rolled

### *6.2 Musical Jacket*

Fig. 3 Musical Jacket

The Musical Jacket incorporates an embroidered fabric keypad, a sewn conducting fabric bus, a battery pack, a pair of commercial speakers and a miniature MIDI synthesizer. When the fabric keypad is touched, it communicates through the fabric bus to the MIDI synthesizer, which generates notes. The synthesizer sends audio to the speakers over the fabric bus as well. Power from the batteries is also distributed over the fabric bus.

The embroidered keypad and fabric bus allow the elimination of most of the wires, connectors and plastic insets that would make the jacket stiff, heavy and uncomfortable.

### ***6.3 Firefly Dress and Necklace***

The Firefly dress and necklace uses conductive fabric to distribute power throughout the dress. As the wearer moves, LED's (small lights) to which we attached fuzzy conductive p ads (the electrical contacts), brush lightly against the fabric power and ground layers, creating a dynamic lighting effect. The necklace, (having no power supply of its own), creates dynamic light effects when its conducting beads and tassels brush against the surface of the dress. These "opportunistic" connections allow power to be distributed without hard and fast connectors and wires. The dresses design is reminiscent of the 1920's and suggests a level of detail and romance rarely associated with technology.

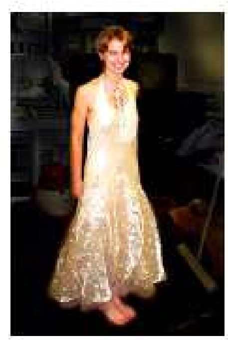

Fig. 4 Firefly Dress

# CONCLUSION

What smart fabrics cannot is not as important as what it can. This intelligent textiles have managed to pervade into those places where you least expect to find them. That is the real charm of knowing them. It can engender a myriad of wild imaginations which are not impossible.

Right from the technically versatile battlefields of the future to the very core of wearable, pervasive, ubiquitous computing technologies that have vowed to make computing an activity so tightly bound with the normal life, will the smart fabrics make their presence felt. One may not be able to forfeit the joy of being in a smart-wear.

It will get hold of your rhythm like a lover. It will enlighten your ways like a mentor. It will care for you like a mother. It will be cautious like a friend. The smart-wears will definitely make you feel in good company, how alone you maybe.

One day we may correct Seneca of his saying "As often I have been with men, I have come back less a man", and suggest that "As often I have been in a smart-wear, I have come back wiser a man".

One day will our senses become superfluous?

# BIBLIOGRAPHY

[1] Textiles gain intelligence", Paula Gould, Materials Today, October 2003

[2] "Smart fabric or 'Wearable computing'" , E Rehmi Post, Margaret Roth, MIT Media Laboratory

[3] "E-textiles, the ultimate in Flexible computing", Virginia Tech Bradley Department of Electrical & Computer Engineering, Annual report 2003.

[4] "Interactive electronic textile development " a review by Dina Meoli and Trci May Plumlee, North Carolina State University.

[5] "Wearable computing lab", ETH Zurich

[6] REFERENCE TAKEN FROM:

[7] http://www.sensatex.com

[8] http://www.abcnews.go.com/sections/living/DailyNews/bodysensor000919.html

[9] http://www.tdctrade.com/imn/imn177/gallery.htm

[10] http://www.wearcam.org/personaltechnologies/index.html

[11] http://www.healthsurfing.com/health/1999/11/09/

[12] http://www.infosec.jmu.edu/computerethics/issues.htm

[13] http://www.infineon.com

[14] http://www.international fashionmachines.com

[15] http://www.philipsdesign.com

[16] http://www.softswitch.com

[17] http://www.sensatex.com

[18] http://www.avantex.com