

Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques-Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks. Case study-smart fabric for monitoring biological parameters - ECG, respiration.

4.1 Introduction to smart textile

The term "Smart Textiles" refers to a broad field of studies and products which extends their functionality and their use. Smart Textiles are defined as textile products such as fibers, filaments, and yarn which are woven, knitted or non-woven which can interact with the environment or wearer. The combination of textile with electronics which is all known as e-textiles can be applicable to the development of smart material.

"Smart textiles are the fabrics that have been developed with new technologies that provide added value to the wearer"

Smart textile is the material which can react to the environment. These are the fabrics which can enable digital components and electronics in itself. Pailes-Friedman of the Pratt Institute states that "what makes smart fabrics revolutionary is that they have the ability to do many things that traditional fabrics cannot, including communicate, transform, conduct energy and even grow". The smart textile can sense and react to environmental conditions or stimuli from mechanical, thermal, chemical, electrical, magnetic or other sources. Smart textiles must contain three components i.e. sensors, actuators and control units. Smart textile presents a challenge in several fields such as the medical, sports, military and aerospace.

Types of smart textiles

Smart textiles can be divided into four types based on their functions.

1. Passive smart materials: These are the material which only senses the environmental conditions or stimuli.

These are just sensors such as changing colour, shape, thermal and electrical resistivity.

g. a shirt with in-built thermistors to log body temperature over time.

2. Active smart material: These are the material which can both sense and respond to the external conditions or stimuli.

If actuators are integrated into the passive smart textile, it becomes an active smart textile as it may respond to a particular stimulus.

g. the shirt senses the surrounding temperature. It reacts in the form of rolling up of sleeves when the temperature gets high.

3. Very smart materials: These are materials are able to execute triple functions; first there are sensors which can receive signals, secondly, they are able to give reaction based on the received

singles; thirdly they can adapt and changes the shape, size, colour or act according to the given function.

4. Materials with the even higher level of intelligence develop artificial intelligence to the computers.

These kinds of materials are not fully achieved in the current investigation of human beings.

This may be achieved with research and development in the field of textile and electronics. By using the smart fabrics or smart materials with advancement in computer interface this can be possible.

Materials used

The materials which are used to manufacture products of wearable smart textile can interact, communicate and sense.

- * Metal fibers
- * Chromic materials
- * Organic semiconductors
- * Optical fibers
- * Inherently conductive polymers
- * Conductive Inks
- * Coating with nanoparticles
- * Shape memory materials
- * Quantum tunneling composites

Conductive threads are mainly used in technical areas like garments, military apparels, medical application and electronic manufacturing. These conductive yarns and fibers are made by mixing pure metallic or natural fibers with conductive materials. Stainless steel filament, metallic silk, organza, special carbon fibers etc are used for manufacturing of fabric sensors. Materials like metallic, conductive polymers, optical fibers supply electrical conductivity, sensing capabilities and data transmission. These materials are resilient, light in weight, flexible, inexpensive and easy to process.

Applications

1. Thermotron

Thermotron of UNITIKA is a particular fabric which is able to absorb sunlight and convert the light energy into thermal energy. It stores heat without wasting it. Inside the thermotron, there are microparticles of zirconium carbide which allow the fabric to absorb and filter sunlight. The inner layer of the fabric holds the heat generated by the fabric and prevents it from going in surrounding atmosphere, thus providing a favorable effect on the human body. It offers a comfortable, waterproof yet breathable wearing experience.

2. Stone Island

Stone island is a jacket which is made to give information about surrounding temperature. It's a liquid crystal heat sensitive coating. At 27 degree celsius, the molecules which are present in

the coating undergo a rotation which modifying the light course. As a result of the colour of the garment gradually begins to change from the dark colour to the much lighter and brighter colour of the fabric base. When the garment returns to its normal temperature, it recovers its original dark coating colour.

3. Polar seal

Feeling cold would be the thing about past there's a product called polar seal which gives instant heat at the touch of a button. There are three different warming levels high, med and low. There are two heating zones one in the upper back and lower back so that we can feel warm in winter. These are easy to use and are tested in alpine conditions. These are flexible, lightweight, breathable and water resistant which makes them ideal for sports or outdoor. These can be worn on gloves or inside shirts. These can keep warm up to 8 hrs in a single charge.

4. Zerol

Zerol is a cap which is built-in with bone conduction speakers. We don't have to use earphones to listen to music or to make phone calls. As it is a cap our ears are never blocked. It is water resistant, because of which we can also use it while it's raining.

5. ORII

Orii is a ring, by using it we are able to have called. Orii is a voice assistant ring that turns our finger into smartphone all through just a touch to the ear. It uses bone conduction and bone conduction has been used in many medical grade devices. To adjust the ring there are silicon pads incorporated in design which are durable and allergy proof. It has been packed in such a way that it sends vibrations through your finger directly into your ear, so only you can hear. So that allows you to talk and listen just through your finger. There is dual noise-canceling microphone and bone conduction, we can hear and talk even in loud places. By using this we are able to do things like navigation, alarms, translation, texting, weather, messaging, calling, timer, map routes etc. it is water resistant. It has the custom notification, there are four LED lights that can tell us what kind of messages are coming through.

6. Lumo Run

Self-motivation can be runners greatest assets but self-evaluation can be greatest challenge luco run are for those who want to get trained by themselves. Luco run is a motion sensor that collects data and provides motivation all while you run and it fits in a waistband of your shorts. Luco run analyses running biomechanics then suggest judgments on your form that maximises true potential by avoiding any injury. You can access data anywhere which gives full post analyses on the smart phone. We don't need any goggles, smartwatch, wristband no cables.

7. AIO Sleeve

Aio sleeve is a sleeve which can be worn in one hand and gives information which only doctors can give. It gives you self- analyses, sleep duration, quality of sleep on your mobile phone. It can play your favorite music. While workout it measures heartbeat, ECG, steps/distance as well as calories counter. While work it measures your stress level. All these things we are able to see just on your smartphone anytime any place.

4.2 PASSIVE SMART TEXTILES

These fabrics have functions beyond what you would normally expect clothing to do. However, they do not use electronics or internet connection at all.

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.

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.

On the topic of static, preventing static cling is one function that passive smart textiles can have. There's nothing more frustrating than pulling laundry out of the dryer to find out it's all stuck together by static cling. Anti-static textiles can help reduce this effect.

You might also have anti-microbial textiles. These fabrics aim to reduce how often you get sick by preventing viruses and bacteria from remaining on your clothes. This helps promote the health and well-being of the wearer.

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.

4.3 ACTIVE SMART TEXTILES

On the other hand, active smart textiles are closer to what you probably think of when you talk about smart technology. These fabrics will actually change to adjust the conditions of the wearer. Some can even connect to apps and computer software.

In other words, these fabrics actively do something to make the wearer's life more comfortable or convenient, rather than the fabric itself being what makes it smart as a passive smart textile does.

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.