Optical Fiber Textiles: Smart Textiles for Medical Care

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Abstract - *Smart textiles are the new generation product with great potential in the field of healthcare and other markets. The function of smart textiles is not only limited to healthcare, it also meets its function in the field of sports, protection, and automotive industries respectively. The manufacturing of smart textiles demands an innovative approach, the stitching or insertion of optical fibers into the wearable textiles requires a simple yet complex approach such as weaving, knitting, and electronic sphere technologies such as coating, lithography, and ink-jet.*

The smart textile discussed describe in this review paper is based on the smart textiles working on the principle of optical fiber. The optical fibers which are formed by silica and polymer optical fibers are used for testing vitals as their manufacturing and integration are possible and achievable with other fabrics.

***Key Words*: smart textiles for healthcare, textile sensors, wearable technology, stitching technology, medical textiles.**

INTRODUCTION

The textile and apparel market is one of the largest and ever-growing industries contributing to the development of the economy, human race. There are more than 4.5 crore employees contributing in the sector with more than 3 million looms to cater to the needs of the people of the world. The technological development of the sector is very crucial as the function of textiles is increasing in different sectors. The innovation of textiles in different sectors such as the healthcare and automotive industry is possible due to its specific properties such as flexibility, dimensional variability, and other outstanding properties which make it worth meeting the smart textiles need by modifying its structure and surface at different stages.

There are several successful examples of modification and up-gradation in the properties of textiles depending on their functionalities.

In recent decades, there are major successes and inventions in textile innovation and technological development.

Smart textiles are textiles having the properties of conventional textile fabric with smart features such as sensing and monitoring functions. The conglomerate of the above textiles with the electronics sector results in applications in different healthcare sectors and fields.

These textiles are contributing the healthcare and other such crucial industries contributing in every possible sphere of human development. Another field of smart textile application is technical textiles for monitoring structural health, automotive, civil, geotechnical, and other engineering industries. Several research projects are dedicated to the development of smart textiles.
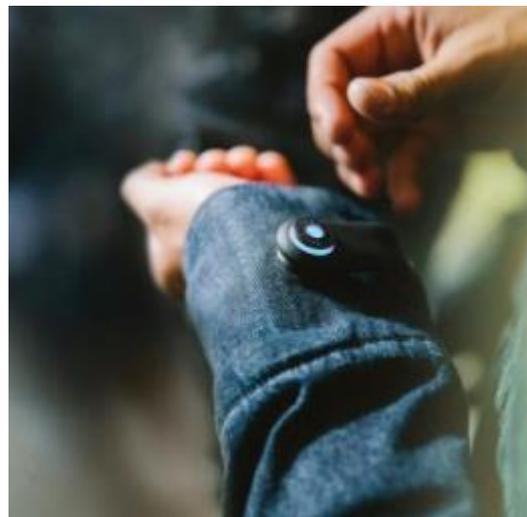

1.1 Why smart Textiles?

Patients suffering from cysts, tumors, bleeding, swelling, developmental and structural abnormalities, infections, inflammatory conditions are taken for the MRI(Magnetic resonance imaging) scan to get to know the details and seriousness of the disease. But MRI is very detrimental to the health of the patient which can worsen the health condition of a patient, if it is performed in the presence of a metallic or electronic component it creates a disturbance in the MRI field which can often leave scars on the patient's body.

To deal with the above lethal and serious problem **smart textiles based on the principle of optical fibers** deliver themselves. They are not equipped with any kind of metallic or electronic component and be can be remotely controlled with the help of an optical cable so that the monitoring can be done without any harm.

The MRI test is often performed on the patients after getting them into an anesthetized state, and at this state the monitoring of several functions of the body becomes crucial, the monitoring requires one or more machines and monitors often to check the vitals of the patient, the monitors becomes difficult when the transfer of the patient from one emergency room to another, the monitoring of the patient becomes tedious. But it would be easy if the vast number of machines can be eliminated.

The optical fiber-equipped textile fabric can be used for monitoring purposes as the monitoring is easy and less tedious.
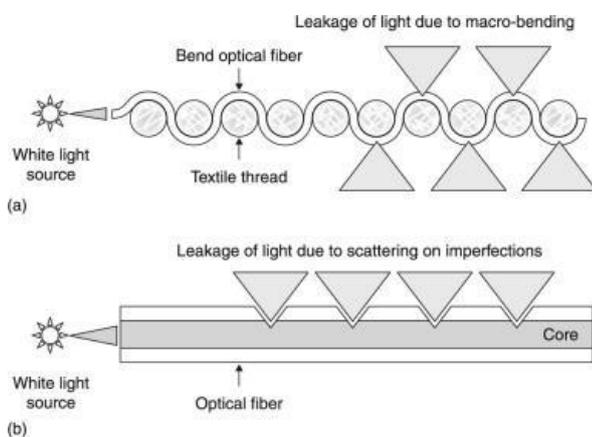
1.2 Principle

The optical fibers which are formed by silica and polymer optical fibers are used for testing vitals as their manufacturing and integration are possible and achievable with other fabrics.

The fiber sensors consist of a periodic perturbation of the refractive index along the fiber core length. **It reflects a very narrow range of wavelengths while transmitting all the others. They are used as a monitoring method to measure different physical statistics such as temperature, blood pressure, and pulses.** Also, they are used in the monitoring of the temperature during the thermal excision of cancer.

The flexibility and non-toxic nature make them compatible for the application in the high electromagnetic environment.

1.3 Stitching Methods

The stitching or the insertion of the optical fibers onto the normal textile fiber can be done as same as the normal textile yarn. The process of **Knitting or weaving and stitching** is done.

This should be done by keeping the note of the bending and agile property of the optical fiber.

Silica fibers have a limited strain of 1%. Plastic Optical Fiber can endure a large amount of strain but have limits in the terms of the curvature angle. The weaving process must be carried out keeping the above properties in mind.

The mature fibers must be long enough to work as a major reflector which will ensure the better measurement and monitoring of the vitals. Fibers with external diameters of less than 500pm are considered as they create a perfect balance between comfort and monitoring.

2.1 Advantages of Smart Textiles in Medical care

*In Smart textiles it can detect early warning signs that indicate disease.

*It can be used in a professional medical settings.

*It can be used to monitor personal health.

*Telemedicine allows for a doctor to watch a patient without being with them.

*GPS tracking in e-textiles are often wont to track senior relations affected by Dementia or Alzheimer's

2.2 Disadvantages Of Smart Textiles In Medical Care

* Colour changes or vibration are used to get attention it might be useful but if we get a lot of buzzes or colour changes people will get irritated and make them feel sick.

*As it is not 100% waterproof and can't be wore continually in the water.Not for all medical or healthcare wearables come under the scan of medical rules.

3. CONCLUSIONS AND DISCUSSIONS

Smart textiles find their functions in different industrial and medical healthcare sectors developing the medical and automotive industries. Their Monitoring and other technological functions are of great importance.

Investment and innovation in smart textiles are fruitful for all the respective sectors. Various shortcomings are in call for the correction, such as the flexibility and weaving methods. The replacement of the silica fiber with another possible fiber will make the smart textiles even more contributive.

Smart textiles will surely deliver their significant contribution in the medical and technological fields.

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