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EXPLORING WEARABLE BIOSENSORS IN HEALTHCARE MONITORING SYSTEMS: A COMPREHENSIVE SURVEY

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Abstract:- This research aims to review the various types of wearable biosensors. The theoretical foundation of this paper was formed by conducting a review over wearable biosensors. It aims to explain the features and applications of wearable biosensors in the medical services. Wearable biosensors are capable of continuous vital signs, monitoring and feedback to the user are significantly effective in timely prevention, diagnosis, treatment, and in the control of diseases. They have various clinical applications that make them one of the most important tools in the medical device industry. Although wearable biosensor's use in healthcare is still in an infant stage, but they have the capability to have a magic effect on healthcare because of their compact and diverse nature. Smart wearable biosensors in the technology industry are one that is looking to be a big and profitable market.

Keywords: *Wearable biosensors, ring sensor, smart shirt biosensor wearable sensor for preventing road accident, automatic stress recognition.*

INTRODUCTION

Wearable biosensors are gaining endless interest nowadays and today they promise to be one of the greatest developments in the sector of wearable health technology. WBS, a main category of biosensors is best to use for healthcare, sports applications, military etc. Rapid growth of these devices is on the way which will help to provide benefits like easy to use, low cost and providing real time information and interaction between doctors and patients.

WEARABLE BIO SENSORS

WHAT IS WBS

WBS are the digital devices that can be worn on the body. Wearable systems or devices as like smart shirts, smart watches, thin bandages or tattoos allowing blood glucose levels, blood pressure, heart beat rate and other biometric data to be calculated continuously and constantly. This real time information is then transferred wirelessly to healthcare providers or monitors.

*WEARABLE BIOSENSORS = WEARABLE +
BIOSENSORS*

Wearable Biosensors are generally a combination of wearable objects and biosensors. Objects that can be worn

are called wearable. For e.g. smart watches, clothes, bandages, rings etc. are some wearable objects. While, Biological Sensors in short are composed of three main parts: Bioreactors systems: For sensing the presence and concentration of a substance.

Transducer: It provides the interaction between the device and body and help in conversion to electrical energy.

Output system. Biosensors are designed in order to react only with a particular substance and the result of this reaction comes in the form of messages that can be analyzed by a microprocessor. These biosensors can be considered as a receptor or stimuli; communication systems based on sensors can display, stimulate, treat, and substitute human biophysics performance. Wearable Biosensors create a two-way feedback between the doctors and patients and most rapidly used nowadays.

These biosensors provide the vital monitoring of patients, athletes, premature infants, children, psychiatric patients, people who need long-term care, and people in impassable regions far from the health and medical services.

They are significantly effective in the prevention, proper diagnosis, control, and treatment of diseases.

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TYPES OF WEARABLE BIOSENSORS AND THEIR APPLICATIONS
I.SMART SOCKS

Smart socks are equipped with sensors that can control walking and the manner by which the feet are placed on the ground in different situations, walking, running, or sitting position. It can particularly be used as a tool to help the elders who have difficulty in walking, training tool to help children who are learning to walk, prevent possible injuries during walking etc. In addition, athletes use them to modify exercise pattern. Data recorded in sensors are transmitted wirelessly to the user's computer or cellphone,

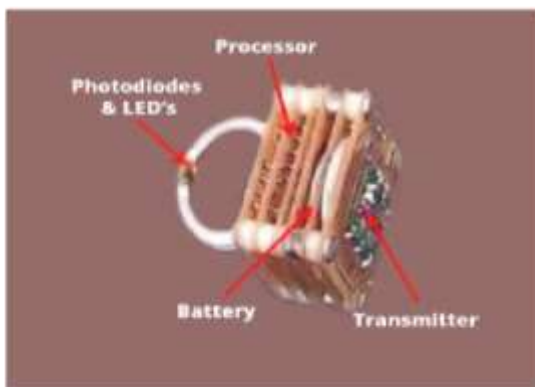


Figure 1

The ring sensor can be worn every time. Due to this, continuous monitoring of health is hence possible. Each time heart muscles contract, blood ejects from the ventricles and a pulse of pressure is conveyed through the circulatory system. The pressure pulse when travels through the vessels cause the vessel wall's displacement which is measurable at various points in order to detect pulse or beat blood volume changes by the photoelectric method. Photo conductors are used normally and photo resistors are used for the amplification purpose photo transits or are used.

III SMART SHIRT

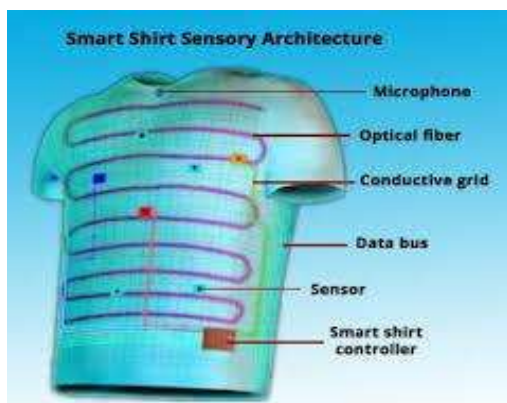


Figure 2

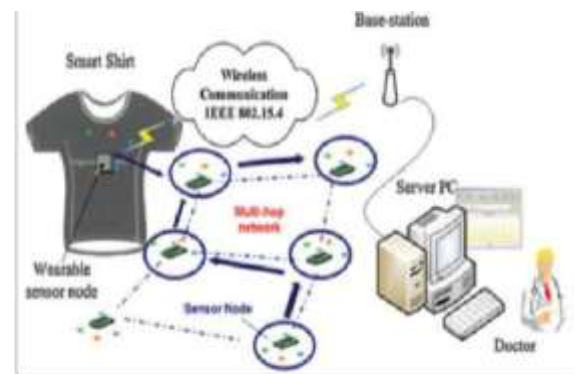
Shirt developed at Georgia tech used optical bears to identify wounds and special sensors and to interconnect to monitor the vital signs of the body This smart shirt provides a frame work for monitoring, information processing

after which it can be analyzed through a proprietary program; the alarm will be set for the person if necessary.

II.RING SENSORS:

Ring Sensor is a pulse oximetry sensor which permits monitoring of heart rate and oxygen saturation. The device is shaped like a ring and it can be worn for extended period of time. Red LED, Infra-red LED and photodiode are embedded in the ring. The whole of the process is planned and controlled by a single processor.

The transmitted waves are transferred through a digital wireless communication link which when received are analyzed by a home computer.



devices and sensing of the wounds. The sensors can be positioned on the right places for all the users and it can be washed without any damage.

The basic benefits of smart shirt as wearable biosensors are that it helps in monitoring the heart rate, respiratory rate and temperature. In smart shirt, integrated sensors and conductive fiber grid are attached to a shirt which has shirt band connectors that detects parameters and sends signals to a personal controller's wireless system that carries out the further process of the medical care.

IV. SMART CLOTHING FOR THE PREMATURE BABIES

Annually, 15 million babies are born premature in this world. More than one million of this population dies or suffers physical and psychological complications due to the loss of body water. Polish researchers have succeeded in designing a smart clothing to be worn by premature babies. This clothing is composed of two layers: one layer is of ordinary fabric and the other is a membrane which prevents excessive sweating in the baby.

V.DIGITAL CLOTHING THAT EXAMINES MENTAL CONDITIONS

The tiny sensors in this clothing can measure heart rate, body temperature, and even skin conductance (which is one of the most important physiological indices for determining the mental state of the people). Then, data are sent to a database through a mobile phone, where an appropriate response is sent considering the current

situation and general interest of people. There is a screen equipped with LED lamps in the clothing, which can display hopeful statements when people are in a grieve or panic.

UPCOMING APPLICATIONS OF WEARABLE BIOSENSORS

#WEARABLE SENSOR FOR PREVENTION OF ROAD ACCIDENTS:

To solve the query of road accidents, different sensing techniques have been introduced such as measuring of vehicles characteristics (steering wheel, breaks, gears etc.),

AUTOMATIC STRESS RECOGNITION

To mitigate the chronic physiological stress, the technologies are present to recognize the stress by their own that leads to the introduction of wearable biosensors which are easier to wear. In this stress recognition technique, the loss function of support vector machines is advanced to encode an individual's ability to feel greater or lesser stressed.

RESULT

Wearable technologies may provide an integral part of the solution for providing health care to an increasing world population that will be strained by a ballooning aging population. By providing a means to conduct telemedicine — the monitoring, recording, and transmission of physiological signals from outside of the hospital — wearable technology solutions could reduce the burden on healthcare personnel and use hospital space for more emergent or responsive care purposes. In addition, employing wearable technology in professions where workers are exposed to dangers or hazards could help in saving their lives and protecting health care personnel's.

CONCLUSION

This paper gives basically the detailed view of most of the applications of wearable biosensors usually utilized in our daily life. As it consists of various applications such as ring sensor, smart shirt, stress recognition, prevention of road accidents. For every individual's consideration, many applications and techniques of these sensors are introduced nowadays. We are pointing a few challenges in this area. The Ring Sensor is further developed for the other medical applications such as detection of Arthritis and Kidney's Disease Diagnosis. The smart shirt also has a great impact as it leads the quality of life thereby reducing the healthcare expenses and lastly realizing the future healthcare systems.

So, we can conclude that wearable sensors have a great impact on the future health care. Instances of textiles with the ability to process and record medical data and display biological signals by placing carbon nanotubes in the warp and weft of the fibers, which in practice plays the role of biosensors, have been tested in medical, firefighting, sports, and military industrial settings and similar cases where the results have been emphasized. Soon, wearable biosensors will find their use in the routine clinical applications. The use of wearable biosensors satisfies a quote brought to line, "wearable healthcare easy to useless costly. Anywhere, Anytime, Anyone."

environmental conditions (fog, darkness, humidity etc.), and

driver's behavioral pattern. Wearable computers continuously monitor the safety measures for avoiding road accidents and also help to provide the information immediately to the recovery agencies whenever a road accident takes place. The major cause for the road accidents is the consumption of alcohol by the driver, longer driving hours, lack of sleep, drowsiness, etc. However, wearable devices are not the final solution for avoiding the road accidents.

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