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# Wireless Body Area Networks in Health Monitoring System

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**Abstract:** In this era of evolving technologies ranging from wireless networks to miniaturized electric devices, it comes as no surprise that every facet of our life is now becoming dependent on these complex technologies from ease of lifestyles to health monitoring.Since health is a major issue that plays a vital role, these technologies have come up with WBANs (Wireless Body Area Networks). WBANS is a combination of wireless sensor networks (WSN) integrated with GSM and the microcontrollers. Previously, healthcare system were based on the analysis made upon the blood pressure, temperature etc. This paper contains proposed system regarding the monitoring of stress hormones in pregnant women by using WBANs
**Keywords:** Body area networks, sensors, healthcare, server, MAC protocol, Cortisols.

## 1. Introduction

WBANs serve as an active field of research and development due to its wide scope in real time healthcare monitoring systems at a greater extent. Along with medical monitoring,it also provides the access to medical data and can intimate the physician through SMS or GPRS, when a patient gets confronted with an emergency situation.In addition to monitoring the health remotely,it also have an another advantage that it doesn't disrupts the normal flow of patient's life.

## 2. Design Components

The wireless body area networks consist of four components as a whole [1]

**2.i) Body wireless sensor network(BWSN)-** consists of 4 components in turn,which are detectors which are designed to store the physiological signals from the body.

**2.ii)Wireless multi-hop relay node(WMHRN)-**

it is wireless relay nodes which are at the end connect to the main base station.These nodes play the role forwarding data traffic containing health information about the patient to the base station.

**2.iii) Base station-**

Base station forwards the collected information coming from the coordinator node via wireless relay nodes to the computer which are present in the control room via cables.

**2.iv) Graphical User Interface(GUI)-**

It presents the patient's data into graphical or textual form. GUI sends the SMS to physician or patient's family when emergency situation.

## 3. Nodes and its Functionalities

Generally, it contains three types of nodes which have some vital role to play such as

**3.i) sensor nodes**

Sensor nodes plays the role of collecting data based on the physiological parameters at a specific intervals of time continuously . The interval time is set by the physician

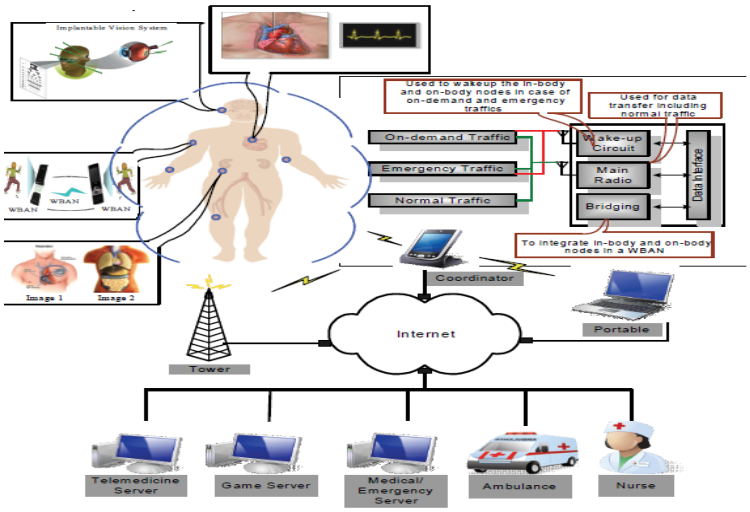


**Fig 2: architecture and various application of WBAN.**

Examples include such as BP sensor, EEG sensor etc.

**3.ii) Coordinator nodes**

The coordinator node works with a battery and it contains a unique ID for Each patient. All wireless sensor nodes are connected to this organizer node and it plays a role of collecting all the data and sending it to the base station.

**3.iii) Global Positioning System (GPS)**

GPS plays a vital role mainly in emergency situations; it gives the location of the patient so that the patient can be given medical aids quickly.

**3.iv) Central server-**

The entire database regarding patient's health is maintained in the central server which can retrieve by the physician or the consultant.

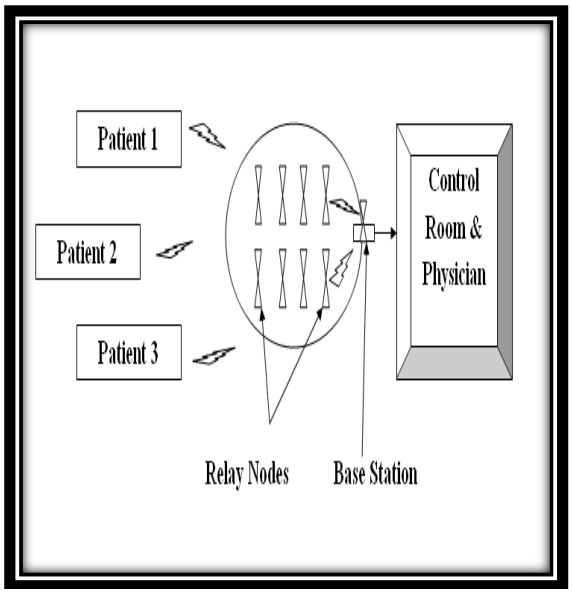


**Fig 1: components of WBAN.**

## 4. Working of WBANS

WBANs system is established by implanting the biosensors inside the patient's body which is connected to a control node which is connected to the biosensors and also the base station. These biosensors are made up of a power unit, sensor, microprocessors, memory and transreceiver.[2]The biosensor continuously

monitors the body and sends the signals to the coordinator node and the coordinator node collects all the information and sends all the data to the base station. From the base station the patient's health data is referenced by the consultant.

In addition to it, WBANs also monitors the patient's wellness in different conditions, some of these cases include [3]

**4.i) Normal Traffic**: it is the routine health monitoring which is not time critical or on demand from any doctor.Examples include- cancer detection, handicap rehabilitation.

**4.ii) Emergency Traffic:**

When nodes exceeds a predefined threshold ,emergency traffic is initiated .A wakeup circuit which is present in the coordinator node is used to intiate the emergency traffic.

**4.iii) On-Demand Traffic:**

Whenever the doctor demands for the information about the health history of patient, he initiates the on demand traffic.

It has been in turn divided into –

**4.3.a) continuous on demand traffic:** when the information demanded is for surgical events or events which containts the continuous feedback about the patient's health etc.

**4.3. b) discontinuous on demand traffic**: when the information demanded is occasional

## 5. Protocols Used for Data Traffic Loads-

Some of MAC protocols are discussed below[4]:

**5.i) Zigbee MAC:** this protocol uses two different techniques like CSMA andTDMA. When usedzigbee MAC with CSMA ,the result would be average output while switching on to TDMA ,it provides reduced power consumption.

**5.ii) TMAC**: here each node has an active time which means it is open for a particular period of time ,hence it is also called duty-cycling protocol.

**5.iii) Polling MAC:** this follows scheduled transmission technique ,since it is master-slave architecture.

## 6. 6)Topology Used in WBANS Currently

It is based on star topology which operates in two modes**:**

- **Beacon mode -**

In this mode the length of the duty cycle is specified and it uses a coordinator node which acts a center node and controls the data communication as well as defines the start and end of super frame, controls network and a synchronize device.

- **Non- beacon mode -**

In this mode, there no use of coordinator to receive the data , the nodes itself is capable of sending data to the coordinator, Sometimes carrier Access with collision avoidance (CSMA/CA)is used.

## 7. The Proposed System

Earlier, the patients were monitored by the physiological parameters such as blood pressure, temperature, heart rate etc .This paper consists of a proposed idea of monitoring the hormone named as cortisol in pregnant women.

Previously the wireless sensor network consisted of BP sensor or temperature sensor , but we can include the graphene embedded sheath which needs only sweat to detect the level of cortisol hormone in the patients body

**7.i**) **Cortisols**

Cortisols are also called as stress hormones and it is one of the steroid hormone. This hormone is produced by adrenal gland present in the body.

Its functions are as follows –

- ✓ Regulates blood sugar levels
- ✓ Regulates metabolism

- ✓ Help reduce inflammation
- ✓ Assist with memory formulation
- ✓ Reduces bone collagen to prevent from osteoporosis.

**7.ii) Impact of Elevated Levels of Cortisols During Pregnancy-**

Elevated level of cortisols triggers stress in the mother which can have adverse effects on the foetus .Some of them are discussion –

**1) Mental effects of anxiety during pregnancy-**

Exposure to high levels of stress has a significant relation with mental disorders, emotional problems, lack of concentration,hyperactivity and impaired cognitive development of children.

Increased level of stress hormones like cortisols could lead to cognitive changes, changes in language development, and it contributes to conditions like dyslexia, schizophrenia.

**2) Medical effects of anxiety during pregnancy-**

Serious illness in childhood and adulthood such as shortness of breath, rash, asthma, coronary disease and hyperglycaemia in male offspring especially.[6]

**7.iii) Cortisol Level Detection Sensor:**

The proposed idea includes implanting the cortisol based sensor in the pregnant females and monitoring the levels by the low amount of sweat produced at the transdermal level. [5]

The sensor consists of vertically assigned metal electrode system which consists of $MoS_2$semiconductivenanosheets. This can be seen in the figure below:

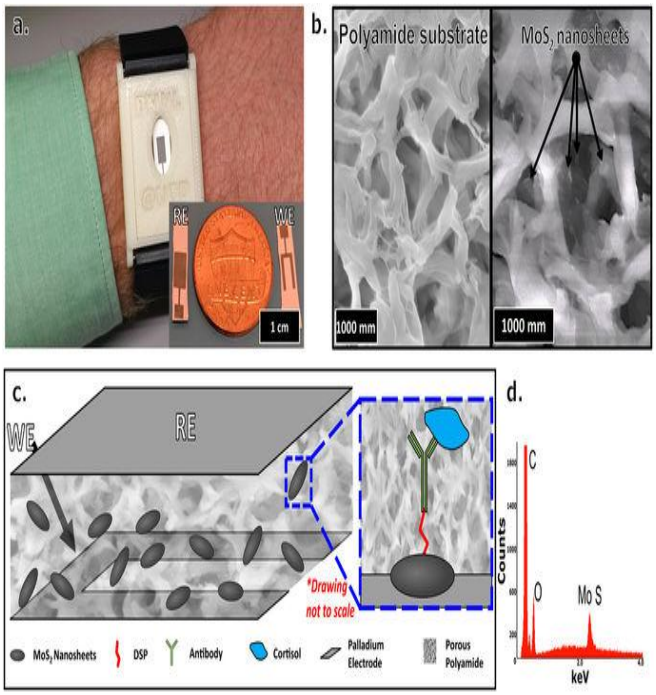


Fig 3: cortisol detecting sensor with $MOS_2$ nanosheets.

Conjugating the above sensor to the wireless networks can provide efficient and reliable monitoring of cortisols , a stress hormone in pregnant female . due ti which when the emergency situation occurs in case of high level of cortisol exceeding the point of care estimation , the data in the form of MAIL or SMS alert can be sent to the nearest family members using the GPS service . In addition to that, female exposed to higher amount of mental stress can be monitored continuously resulting in good health outcomes for both mother and the baby.

## Conclusion

This paper consists of various aspects of WBANs as an existing system. WBANs are used till now for heart monitoring,cancer detection, artificial eye, and many other health related issues. The proposed idea in the paper is to monitor the stress hormone named cortisol in pregnant female via transdermal perspired sweat, high level of cortisols in female may result in abnormal offspring with dyslexia and cushing's syndrome such problems can be eradicated by monitoring the pregnant women with cortisol detecting WBANs

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