Telemedical System With The Biophotonics

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Abstract- Telemedical system is an efficient communication system. WBAN is the main component of Telemedical system. Wireless body area network (WBAN) can be implemented in military, entertainment and portable audio/video system etc. By combining smart sensors and micro electro mechanical system (MEMS) technology, WBAN can be designed. Another Technology is Biophotonics based on optical com-munication. Biophotonic sensors are new low cost, low power consumption and easy to use in magnetic environment sensors.

This paper presents a discussion on the application of Telemedical system. Telemedical system provides better quality of life of patient and greater doctor-patient efficiency. This technology provides the facility to monitor patient remotely and give them health information, reminders and medical support. And by combining wireless body area network with biophotonic sensors, a new cost effective Telemedical system is designed.

Keywords: Wireless Body Area Network, Personal Server System, Medical Server System, Biophotonics Technology, Photonic crystal fiber based sensors, Optical breath sensor.

I. INTRODUCTION

With the development of wireless communication and advance micro electro mechanical system (MEMS), a new wireless sensor network can be designed, that use biosensor as a sensing element and foam a wireless body network (WBAN). The WSN having their application in environmental habitat monitoring, acoustic detection, seismic detection, military surveillance, inventory tracking smart spaces etc. To improve the quality of life, wireless sensor network (WSN) can be implemented in medical system. WBAN continually monitor the human body and if any biological changes happen, sense it and forward this information to PSS, PSS forward this to MSS, supporting medical staff analyze the data, prescribed some exercise and again forward to the patient through reverse process. Once data is at the medical server calculation, referencing and forecasting can be done. The patient’s normal physiological states and normal activities are not affected by the implementation of sensors inside the body.

In WBAN the most use common protocols is IEEE 802.15.6 because it provide low power in body and on body wireless communication.

Another technology is also new and has attracted the attention of many researchers that is “Bio-Photonics”. The term Biophotonics means a combination of biology and photonics, with photonics being the science and technology of generation, manipulation, and detection of photons, quantum units of light. Photonics is related to photons and electronics. Biophotonics having their applications in sensing technology which give various merits over the electronic sensing technology.

When these two technologies combine together, this gives a new untouched dimension for exploring the untapped potential for the future.
WBAN is the primary part of telemedical system. It contains a number of control nodes. Each node having a capability of sensing, sampling, processing and communicating physiologic signals. Main units of WBAN:

A.1 MICROCONTROLLER
For the processing of data it is used.

A.2 MEMORY
For locally storage of data, memory is provided in WBAN.

A.3 RF TRANS-RECEIVER PAIR
For transmission and reception of data RF transmitter and receiver are used in WBAN.

A.4 POWER UNIT
For operation of these units, battery is used as power supply unit.

A.5 SENSING ELEMENT
In WBAN, biosensor acts as a sensing element. Biosensor sense the biological changes inside the human body. Mostly used biosensors are as follows:

A.5.1 ECG SENSOR
For monitoring heart activity ECG sensor is implemented in WBAN.

A.5.2 EMG SENSOR
For monitoring muscle activity in human body this type of sensor is used.

A.5.3 EEG SENSOR
For monitoring brain’s electrical activity EEG sensor is designed.

A.5.4 BLOOD PRESSURE SENSOR
For monitoring blood pressure of patient’s body, it is designed.

A.5.5 TILT SENSOR
For monitoring trunk position inside human body, it is used.

A.5.6 BREATHING SENSOR
For monitoring respiration process, it is designed.

A.5.7 MOTION SENSOR
For monitoring to discriminate the user’s status and also estimate his or her level of activity.

The complete set of these five units foam nodes. Each node receives commands for initialization and it also responds to the queries of personal server. Nodes are implemented as tiny patches or inbuilt into the clothes or shoes. Nodes are continuously observe biological changes in human body and collect all information, send it in the form of secure data to personal server and PSS process it to the MSS.

Fig.3- Inside WBAN system.

B. PERSONAL SERVER SYSTEM

Personal server is implemented on a PDA, cell phone or home computer. It setup and controls WBAN, also provides graphical or audio interface to users. PSS transfers patient health information to the medical server through internet or mobile phone network (using GPRS or 3G). The interface between PSS and WBAN nodes, is network configuration (nc).

Fig.4- Personal server system.

B.1 NETWORK CONFIGURATION

Interface between WBAN and PSS include network configuration interface. It performs following tasks:

- Sensor node registration (by type and number of sensors).
- Initialization (by specific sampling frequency and operation mode).
- Customization (by user specific signal processing procedure upload).
- Set up of a secure communication.

PSS performs several functioning like Network management, care of channel sharing, time synchronization, data.
retrieval and processing. It also performs data storing if link is not available and then upload it to the link when it is available.

C. MEDICAL SERVER SYSTEM

Medical server keeps all record of users in electronic foam and provides various services to the users. It is also connected to the mobile clinic. Medical server authenticate users, accept health monitoring session uploads, format and insert this session data into respective medical records, it also analyze the data patterns, recognize health problems and provides regarding medical care. It also forward the new instructions to the user such as physician prescribed.

III. OPERATION OF TELEMEDICAL

Operation of telemedical system includes following steps:

- Initially Biosensors sense all events and data are collected by node and forward it to PSS.
- PSS forward this data to MSS where Physician can receive and analyze data.
- Based on the result of analysis physician recommends patient for some exercise.
- Relayed to PSS.
- Patient can review this new prescribed exercise through PSS.

By using some sets of protocols these data is transmitted from one server to another server. Data transformation between Nodes and PSS are completed using ZigBee or Bluetooth technology, and between PSS and MSS using mobile network like 3G or Internet.
IV. APPLICATIONS OF TELEMEDICAL SYSTEM

A. CARDIOVASCULAR DISEASE

At present cardiovascular disease is also main cause of several deaths. This problem can be minimized by implementing various smart sensors inside the patient body. These smart sensors continuously observing the cardiovascular activity of patient, collect all information in the form of data and forward it to PSS and then medical server. Depending upon the results of analyses if medical treatment is needed then it is provided by medical staff.

B. CANCER DETECTION

At present cancer is also the main cause of death. It is the biggest threat for human life. To detect the cancer cells in human body a special kind of smart sensors are designed. These sensors detect the nitric oxide (which is emitted by cancer cells) and it is placed in the suspect locations of human body. These sensors also having the capability to differentiate cancerous cell from other cells of human being, collect the data, transfer it to the medical server and it is analyzed by the doctor, and if reports are positive then treatment will be started at initial level of disease.

C. GLUCOSE LEVEL MONITORING

At present many people are suffering from diabetes disease and it causes some other diseases like heart disease, high blood pressure, blindness, and kidney diseases. Using the biosensor glucose levels can be regularly monitored inside the human body and these results are send to node and then MSS, so if level of glucose is slightly increased inside the body it will detected by the sensor and they require treatment is provided to the patient before any false occur.

D. ASTHMA

This disease is also sensed by smart sensor. The smart sensor nodes sense the allergic agent in the air and then report it to the patient and doctor.

E. PREVENTING MEDICAL DETECTION

Approximately 98,000 people die every year due to medical accidents caused by human error [8]. This can also be prevented by the Tele medical system. It contains all the data regarding that accident in its database and if it again happens, it gives pre notification of occurrence of same accident and thus can reduce many medical accidents.

F. HIP-GUARD SYSTEM

This system is beneficial for the patients who are recovering from hip-surgery.

V. ISSUES IN TELEMEDICAL SYSTEM

Health care is a big concern for each human being. This health monitoring system mainly used when patient is not physically present. Using WBAN medical staff continuously monitors the patient health. For health monitoring system it is necessary that patient knows the primary symptoms of his disease and before Tele monitoring of patient the corresponding medical staff also completed some basic diagnosis test of patient in hospital. Using health monitoring system health care applications of wireless sensor network allows home assistance, smart nursing homes, clinical trial and research argumentation [10]. But Telemedical system is also having its own issues:

A. POWER CHALLENGE

Many devices which are based on wireless network are battery operated. This limitation of WSN becomes major challenge when it is implemented inside the human body. A full active mode node can operated only one month because its battery provides only 50 watt-hours of energy, but in health system there is a need of such kind of devices which is not replaced after a long time. So to deal with power limitation a new kind of algorithm and power handling techniques are designs.
B. COMPUTATION CHALLENGE

With the limitation of power and memory, calculation are also becomes a limiting factor in Telemedical system. Due to the lack of enough memory biosensor cannot perform large computations. In comparison of other sensor network memory and power level of biosensor are very small so its computation capability are also very low. Since it is deal with the wide range of communication and it has low memory and power, so very low amount of power remains for calculation. At present scientists are working on increasing battery life, which also solve this issue.

C. INTERFERENCE /SECURITY CHALLENGE

Security and interference is one of the very concerning issues. In wireless system, communication links are wireless microwave links and if necessary security is not provided then data can be accessed by any one. In Telemedical system data which is health information of patient and very personal in nature, is collected from each node and forward it to the medical server through wireless link. To prevent its unauthorized access from anyone more security is provided. For this some encryption before the transmission of data at transmitter end and at the receiver side some authentication technique is provided so that it is received to the correct destination. In Telemedical authenticity is important because if data is changed then it gives false diagnosis of patient health. But still some problem of interference is presented in the system.

D. MATERIAL CONSTRAINTS

It is also very important issues in health care system because all the sensors are mounted on the human body, It is necessary that the material used for the designing of sensor is harmless to the human body.

VI. BIOPHOTONICS

Biophotonics is the branch of photonics. And photonics is related to light which includes generation, process and manipulation of photons. Biophotonics is an optical technique, used for the study of biological molecules, cells and tissues etc. It can be implemented in life science, medicine, agriculture and environmental science etc. Various optical sensors are designed using biophotonic principle.

A. PHOTONIC FIBER SENSORS

Micro structured fibers having regular pattern of air holes along the axis of fiber, are called PCFs (fig.10). In PCFs core and cladding both are made-up by the same material, so all the property of light propagation inside PCFs depends on air holes. PCFs are also classified into two categories:

- Index guided PCFs (Core of fiber is solid , light propagation is based on total internal reflection condition)
- Photonic band gap guided fiber PBFs (In this propagation of light is based on photonic band gap of material.)

Fig.10- Types of PCFs.

By using PCFs, various types of biosensors are designed like HIV detection photonic sensors, DNA detection sensors, optical breath sensor, which is designed using PCFs interferometer and it is safe to use inside magnetic resonance environment.

B. TELEMEDICAL WITH BIOPHOTONIC SENSOR

Biophotonics is the very challenging technology, depending upon the operating principles, Photonic technologies having long variety, Manufacturing platforms and also diverse sensing capabilities, with in which optical fibers (SMF, PCF, POF), plasmonic devices, multimode interference devices MMI are used as a part of sensing applications. These sensors are embedded as a low power consumption wireless sensing node. By the designing of suitable “PHOTONIC DEVELOPMENT “kit, this photonic based optical biosensor is implemented in telemedical system, which reduces the overall cost and power requirement of system.

VII. CONCLUSION

Telemedical system that monitor vital signs promise ubiquitous, yet affordable health monitoring. We believe that Telemedical system will allow a dramatic shift in the way people think about and manage their health .This more proactive preventive healthcare will not only improve the quality of life, but also reduces healthcare cost. The complete set of telemedicine system provide full mobility of users with secure and near real time health information. Wireless biomedical sensor networks enhance the medical performance by integrating smart sensors, wireless communication and network technologies. This paper first provides the necessity to integrate these three technologies. And to make Telemedical system more efficient, the current electronics-sensors are replaced by biophotonic-sensors.

VIII. FUTURE WORK

By combining this biophotonic based telemedical system with the Cloud computing technology its range of facility is also increased.
IX. ACKNOWLEDGMENT

The author would like to thank the referees for their constructive comments which helped to improve the quality of this paper. I also thank to Vijay Laxmi Kalyani, (Assistant Professor, Department of Electronics and communication, Govt. Mahila Engineering College, Ajmer) for her input on many aspects of this work.

X. REFERENCES


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