Review of WSN Integrated with Wireless Technology in Health Monitoring Applications

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Abstract: Wireless Sensor networks integrated with wireless technology is rapidly growing and widely used in variety of applications such as Agriculture, Medical Healthcare, Millitary Tracking, Smart homes, Industrial Monitoring, Environmental Monitoring and many more. This paper covers specifically the health care monitoring application using Wireless Sensor Networks. Wearable or implanted sensors on our body can sense the various physical parameters of our body such as heart rate, blood pressure, ECG, EEG, oxygen level and many more in regular intervals which can be transmitted through wireless technologies to the end server and then to doctor's PDA with the help of SMS or email. In this review paper we specifically consider the health monitoring application with WSN architecture, wireless technologies used & issues of WSN integrated with Wireless Technology.

Keywords: Wireless Sensor networks, Wireless Technologies, routing protocol, Zigbee, WiMAX, WiFi, Bluetooth

I. INTRODUCTION

WSN along with wireless technology has many applications which include Military Target Tracking, Smart Houses, Natural disaster Relief & Health Monitoring. Wireless Sensor Networks are effectively used in health care to enhance the quality of health care services provided to patients and fastest way to cope up in any medical emergency. In health care applications wireless sensor networks provide interface for the disabled, integrated patient monitoring, drug administration, diagnostics in hospitals. Patients equipped with wireless sensors need not to be present with the physician for their diagnosis. In case of continous monitoring of patient physical parameters such as temperature blood pressure, heart rate, EEG,ECG , SpO2 levels etc there are no wires or electrodes connected to patient body so they are free to move anywhere. There are number of small & intelligent medical sensors are available which can be worn or implanted in human body. Fig. 1 shows the basic wireless Network architecture in which various bio medical sensors will track the physical parameters for continuous health monitoring from patient's body and transmit information which will store in back end server having unique id of patient.[1] Any abnormality detected in data can send immediate message to physician with the help of SMS or e-mail. [11]

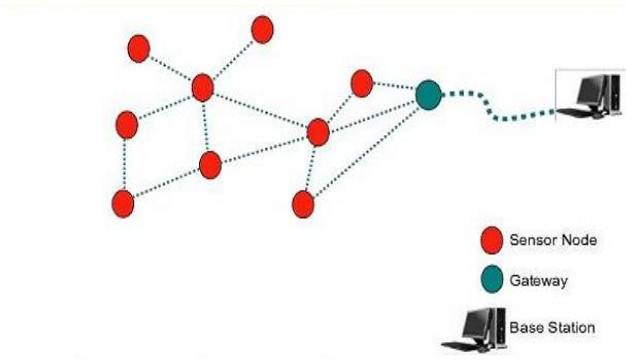

Fig.1: Wireless Sensor Network [3]

II.WIRELESS TECHNOLOGIES

The various wireless technologies such as WBAN, WLAN, WPAN, WiMAX [8] are used in medical applications to capture the data from wireless sensors implanted on human body & transmit them to secure server for further access.

A. WLAN (Wireless Local Area Network):

WLAN uses IEEE 802.11 communication standard along with 802.11aand 802.11b. With this we can easily communicate the patient data anywhere in hospital or from hospital to hospital. The main application of WLAN is in Telemedicine.[10]

B. WBAN (Wireless Body Area Network):

In WBAN technology as shown in Fig. 2 the different sensors are incorporated in patient body which sense the physical parameters & transmit them to doctor or nurses for periodic monitoring. In WBAN, the sensors can be placed on patient body or it can also be implanted on patient body for monitoring the vital parameters. Patient & doctor can be static or in mobile state. For transmitting the data over server WBAN network uses ZiGBee protocol standard which is small, lightweight & consumes very low power. WBAN is used to monitor the patient parameters in very critical condition.[9]

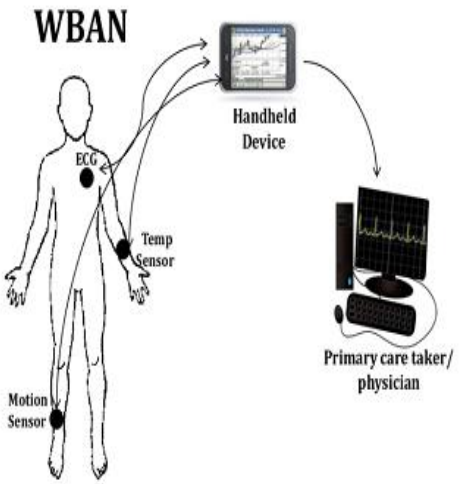

Fig 2: Wireless Body Area Network [5]

C. WPAN (Wireless Personal Area Network)

Wireless Personal Area Network also uses Zigbee or Bluetooth protocol standard for physical monitoring of patients. This standard is also useful to track patient location in case of any emergency. This is based on IEEE802.15.4 which is an ultra low power , low cost, flexible network architecture and compatible with other equipments for data collection & processing.

D. WMAN (Wireless Metro Area Network)

Wireless MAN standard based on WiMAX (IEEE 802.16) having data rate upto 70Mbps & data transmission is upto 50Km. WIMAX is having very strong security with radio technologies such as QoS framework, AMC (Adaptive Modulation & Coding) ,OFDM (orthogonal frequency division multiplexing) technologies are incorporated in it. With the help of WiMAX ultrasound images or radiology related data can be transmitted at very high bandwidth in secure mode. [4]

E. RFID

RFID (Radio Frequency Identification) is basically used to transmit the data collected from nodes in the form of unique serial no. with the help of radio waves. RFID can track patient , doctor or medical equipment location. Any abnormality read in patient parameters an alarm or message can be send to hospital staff on immediate basis.

F. Cellular System

These systems use2.5 G, 3G or 4G standards are used for communication among nodes and server. These provide end to end encryption in telemedicine. Fig 3 shows the combine wireless technologies used in Health Monitoring System.

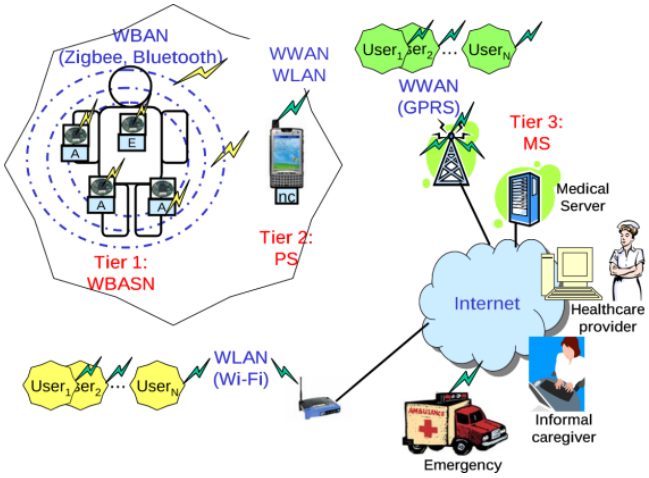

Fig 3: WSN integrated with Wireless Technologies

III. PROTOCOLS

A wireless sensor network consists of wireless communication, data acquisition, processing, and fusion stages .Earlier Bio medical sensors extract information from patient body and interface with wired devices such as RS232, USB & Ethernet. With the invention of wireless communication the data can be communicated wireless using standard protocols short range devices such as Bluetooth, ZigBee and long range such as Wi-Fi, WiMAX wireless communication to nearby computers or smartphones. The Protocol standards used in WSN have different radio range & transmission capacity which is concluded in Table 1. [8]

S.No.	Parameters	Zigbee	BT	WiFi
1	Standard	802.15.4	802.15.1	802.11a
2	Memory Requirement	4-32 KB	250KB+	1MB+
3	Battery Life	Years	Days	Hours
4	No. of Nodes	65,000+	7	32
5	Data Rate	250Kbps	1-3 Mbps	11Mbps
6	Range	300m	10-100m	100m
7	Modulation Scheme	Offset-QPSK	Guassian FSK	64-QAM
8	RF Band	2.4GHz ISM band	2.4GHz ISM band	2.4GHz ISM band

Table 1: Wireless Technology Standards & their features

IV. ISSUES IN WSN

The wireless technologies in health care system proved to be revolutionize as Health monitoring as it is inexpensive, non – invasive and provide real time updates of medical conditionsthrough internet. Apart from various advantages there are several challenges in WSN such as security, privacy, reliability, low power consumption, Fault tolerance, Node failure etc. [13]

A. Security & Privacy

Security is major issue in WSN in healthcare as its very important that right user should access the real data in real time. Security in WSN is composed of system security and hospital security. System security includes the transmission of data from nodes to server and to the doctor PDA or smartphone. The data packets should be encrypted while routing towards destination. Hospital security is very important in case of criminal headed people.[12]

B. Reliability

Reliability is one of the most important factor in healthcare system. Proper care should be taken in location of sensor nodes as any unreliable information coming through nodes can risk patient life.[6]

C. Fault Tolerance

Sensor nodes used should be capable of maintain connectivity with main server in case of any failure. In case of any failure among nodes, working protocol should be capable of transmitting this information on main server.

D. Node Failure

Node failure in WSN affects the performance of the routing protocol and may track wrong parameters of patient which may lead to the wrong diagnosis phyisician.

E. Low Power Consumption

Sensors used should consume very low power. For this low power techniques such as solar cells, fuel cells should be used.

F. Patient's Comfort

Patient's comfort is verv important as they should move freely after carrying sensors on their body. All wireless sensors should be small, safe, light weight, easy to carry on body.

V. CONCLUSION

In Today's world mobile devices have become important part of our life and are extremely useful in health monitoring of patient. WSN with wireless technologies has a great impact in health care monitoring system which provides benefits to patient and also doctors, nurses in case of critical condition where regular monitoring of patient vital parameters is required. The WSN system can effectively connect with main server and provide information among the different department within hospital or it can also be shared from hospital to hospital without any delay. This review paper discussed the basic WSN architecture with different wireless technologies. With many advantages there are some technical which are analyzed. In future, there is still more scope of research in WSN with their technical issues.

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