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Transmission of emergency data over wireless networks by using biosensors

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Abstract— The biggest challenge in heal theme is the assurance of healthcare for every individual. People suffer from major health problems and are not provided with appropriate monitoring due to inadequate infrastructure and lacking human resources. Therefore using bio-sensors, medical data can be collected and can be supervised. The main objective is to establish a network of bio-sensors on the human body which transmits data over multiple hops based on ZigBee communication module using WLAN 802.15.4 in Qualnet simulator 5th and use this data for medical treatment. Using this concept, constant medical supervision can be assured to patients. In this paper, the entire network is designed in a way in which, sensors would be placed on the body or clothes of the patient so as to collect data from time to time and transmit it through wireless networks to the appropriate doctor for supervision. If in case the health condition of the patient becomes abnormal, the signal would be transmitted directly to the emergency ward or the nearest healthcare center.

Keywords — ZigBee, WLAN 802.15.4, Qualnet simulator.

I. INTRODUCTION

A body area network also known as wireless body area network is a collection of wireless network of wearable computing devices. The network consists of various body sensor units together with a single body central unit (BCU). The body area network field is an area which allows inexpensive and continuous health monitoring with real-time updates of medical records through the Internet. A number of bio sensors can be integrated in a wearable wireless body area network and can be implanted inside the human body or on the clothes that are comfortable and do not affect normal activities [1]. The body central unit collects and integrates various physiological changes in order to monitor the patient's health status independent of their location (Figure 1). The signals will be transmitted instantly in real time to the doctor in-charge, through wireless network for continuous diagnostic of the patient's health. The star or mesh network can be used for wireless transmission. Bidirectional transmission technique can be used for feedback from the doctor through the same route back to the patient. In case of emergency or the patient is in abnormal heath condition, an emergency signal will be transmitted to nearest healthcare center. This paper focuses on transmitting the data to the access point in a bounded time frame and using low power sensors to implant on the body of the patients. Here medium access control (MAC) protocol is used, which provides addressing and channel access control mechanism that makes it possible for various networks to communicate and transmit data. It is known that all the data that is received from the sensors is not equal. Some critical signal needs emergency supervision, therefore MAC is used [1]. For wireless control and monitoring applications ZigBee technology is used which is based on the IEEE standard 802.15.4. ZigBee modules can be installed on devices like mobile phones, computers, etc and a variety of information can be transmitted through it.

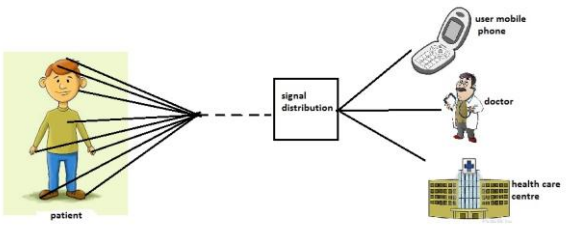

Figure 1: Overview of the idea

II. ARCHITECTURE

In an era where people are prone to diseases, constant monitoring is very essential and can be done by using biosensors. A biosensor is a device for the detection of an analytic signal that combines a biological component with a physicochemical detector component [4]. For constant monitoring, biosensors are to be placed on the body or on the clothes of the patient. In this paper we are using eight biosensors which collect signals from different parts of the body and all the different signals are centralized on a single node. There are different types of sensors which sense signals like ECG, blood pressure, heartbeat, etc. These signals are combined together and are stored in a single node (node can be any device like computer, phone, etc.). This node further transmits these signals through ZigBee wireless communication module. Time to time the data collected is sent to the doctor concerned and the healthcare center to maintain the patient's record. ZigBee physical and data /link comprises of two layers: one being the physical layer and the second is the Medium Access Layer (MAC). Physical layer is responsible for sending and receiving data from a resource. MAC is responsible for networking and acts as a sensor .The signals must be avoided from colliding so as to initiate the command. ZigBee network layer enables the correct use of MAC and acts like a bridge by making networks based on topology by using application layer ZigBee data/link level. These ZigBee network layers are responsible for networking and security. If a particular route is busy or unavailable, then this network layer enables to find another suitable and nearest route. Application layer is reserved for communication protocols and acts as the user interface. Bellman-ford algorithm is used to solve the routing problem in the network. The Bellman–Ford algorithm calculates shortest paths from a single source vertex to all of the other vertices in a weighted digraph [5].

The modified ZigBee module adopted in this paper encompasses the following aspects.

A. Network work topologies

ZigBee supports three types of topologies- mesh, star and tree. The mesh network topology has strong robustness and system reliability, it is more flexible which makes it very suitable for the sensor network, and hence mesh topology is mostly favored among the all other topologies. Mesh topology captures and disseminates its own data and also serves as a relay to the other nodes. Star topology is the most common computer network topology. FFD (full function device) and RFD (reduced function device) are types of function devices. FFD acts as the centre of the network and coordinates operations of the whole network. RFD on the other hand needs the help of FFD to set communication and make the coverage simple [2].

B. ZigBee wireless module functioning

ZigBee module mainly includes coordinate mode and terminal mode [2]. ZigBee router node first indentifies the signals transmitted by the wearable wireless biosensor and then sets data packet routing path through forwards data packets. Next the packets are transmitted to ZigBee coordinator which is responsible for network and network distribution. Controlling devices (host computer) controls the operation of the whole network and decides where the packets are to be sent in the network and hence maintains synchronization between the sender and the receiver device (Figure 2).

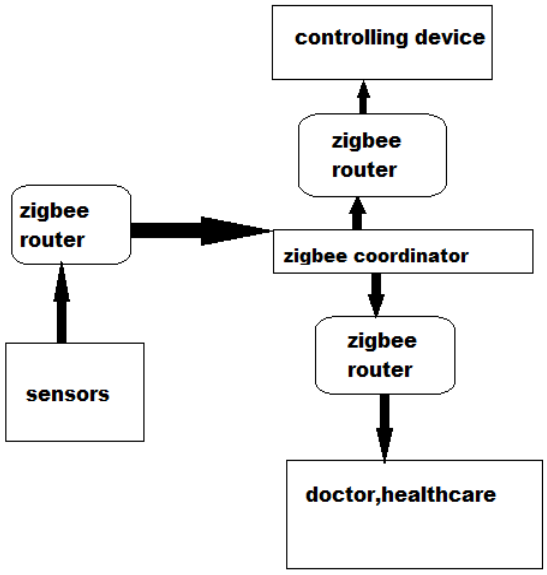

Figure 2: ZigBee wireless communication module

This paper mainly focuses on making the whole system cost effective and using low power sensors that consume less power and do not have to be charged very frequently after implantation onto the human body [3] (Figure 3). To reduce cost and working efficiently, IEEE 802.15.4 standard is used which supports FFD and RFD. FFD can work efficiently in the coordinator and device. As a network coordinator, FFD uses the routing nodes and terminal nodes to communicate with any type of network equipment. RFD can only be used as a terminal node. RFD nodes cannot be used in isolation and require the functioning of the FFD nodes. Hence, adopting this combination helps in reducing cost of the network.

III. ALGORITHM

In this paper we assumed that signals coming from sensors as (SS), signal send to doctor (DS), and signal at time of emergency (ES).

Step 1: START
Step 2: If SS is greater than 1then
If SS is greater than 1 then
Go to Step-4
Else
Go to Step-3
Step 3: Signal is normal and is transmitted to DS
Step 4: Signal is not normal and is further transmitted to ES
GOTO Step3
Step 5: END

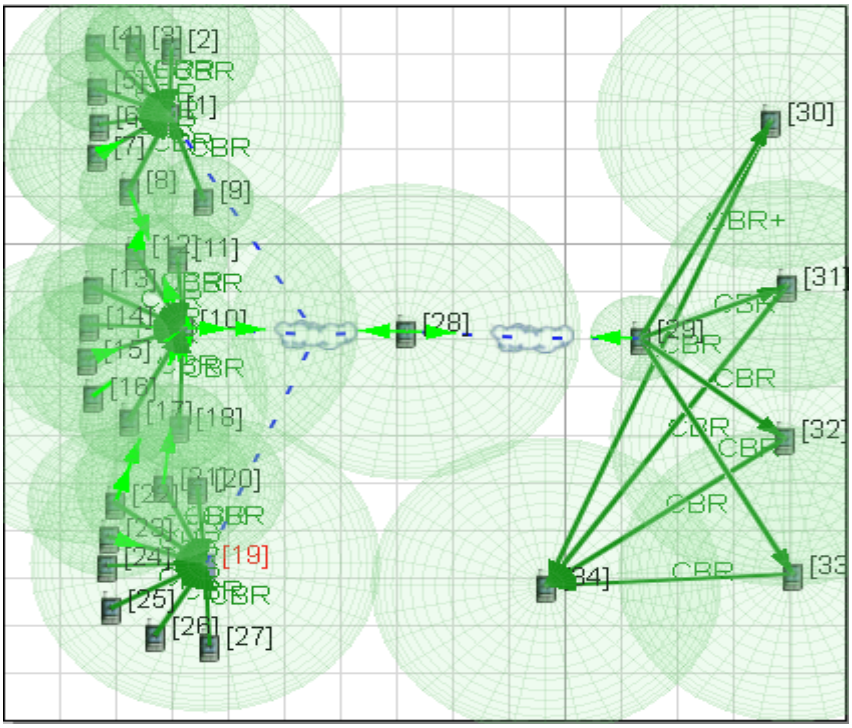

Figure 3: Scenario of the data transmission

IV. PARAMETRIC TABLE

The parameters and values used in data transmission for this paper were used from IEEE IEEE 802.15.4 routing protocol AODV in qualnet simulator and are given in Table I.

TABLE I
PARAMETERS AND VALUES USED IN DATA TRANSMISSION

Parameter	**Values**
Topology	Mesh,star
Nodes used to collect signals	8
Stimulation time	60 sec
Channel frequency	2.4 GHz
Data rate	2 Mbps
Path loss model	AVOD
Mobility model	ZigBee
Packet size	512 bytes
Physical Layer Radio Type	IEEE 802.15b
MAC Protocol	IEEE 802.15
Antenna Model	Unidirectional

V. Conclusion

This paper proposes an idea of transmission of emergency data based on ZigBee protocol and attempts to reduce the cost of the transmission. Network of low power wearable sensors is created which are implanted on the body. They collect the required data and transmit it to the doctor and the healthcare center for constant monitoring. Irrespective of the patient's location, the transmission will take place. In case of emergency, the data will also be transmitted to the nearby health care centre so that necessary treatment can be provided instantaneously in order to avoid further complication in the patient's health.

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