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A Survey- Energy efficient techniques in WBAN

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Abstract- *Wireless technology is the most growing technology in this era and used in many of the real time applications, for example our daily usable smart phones lies on wireless technology. These days more number of the human beings die from variety of diseases like heart attack, blood pressure, asthma, cardio vascular dieses etc. It is interesting to use wireless technology which is combination of wireless networking and wireless communication to increase the life of human mankind by technique named wireless body area networks (WBAN). The different type of sensor nodes is connected in and around the human body to sense the changes, fetch the data and pass the fetched data to the server which is in the remote place for remote health monitoring purpose. This paper concentrated on techniques that were used to increase the network lifetime by minimizing the energy consumption of sensor nodes which were deployed on the body of the patients or in the cells means inside the body of the patients. The minimization of energy consumption in WBAN is carried out using the SMAC, WISEMAC protocols.*

Key Words: *WBAN, WSN, MAC, SMAC, WISEMAC*

1. INTRODUCTION

In WBAN the sensor deployed are very small and smart sensors but the issue is that the energy source in these types of devices is not replaced or recharged. An essential part in wireless body area networks is to minimize the energy consumption from the sensor or actuators that were planted on the human body or else whole network or communication is wasted due to energy drain. The WBAN has most of the advantages in that first allows the mobility of the patients in the network and second is that physicians can monitor the patients from remote area or remote place. In these days many of the human beings suffers from variety of diseases they aware of the diseases at last stage but till that time it is so late and people die from the same. WBAN helps in early detection of the diseases and save the human mankind who suffers from these types of issues, so that mankind can lead a better quality of lifestyle.

Figure 1 depicts the important variety of communication tiers that takes place in the WBAN which are intra communication, inter communication, beyond communication. In tier1 the hardware device used are sensor devices which senses the changes that occur in the human body and transmit that data to the next level. In tier2 a personnel device (PD) can be used which receives the information from the deployed sensor nodes. PD can be our smart phones or tablets which fetches the data from the deployed devices through the Bluetooth or zigbee technology. In tier3 beyond communication is present which uses the hardware like a server or system with large amount of internal storage and RAM (Random Access Memory).

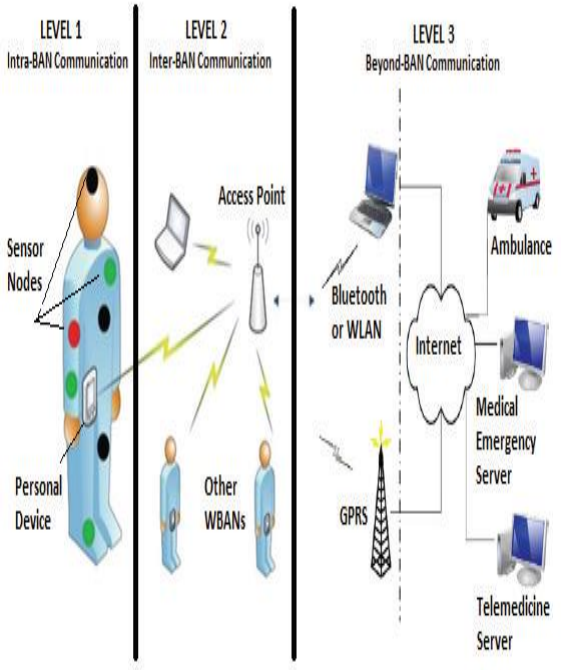


Figure 1: Variety of communication tiers in WBAN

This paper gives detailed evolution of WBAN protocols used to minimize the energy consumption of the sensor nodes which are not rechargeable and replaceable. Protocols like SMAC(Sensor Medium Access Control), WISEMAC(Wireless Medium Access Control) used for energy efficiency purpose. But these protocols reduced the energy consumption to an extent that was proved by adaptive energy efficient MAC protocol and dynamic duty cycle algorithm. Adaptive energy efficient MAC protocol and dynamic duty cycle algorithm proved more efficient than the SMAC and WISEMAC protocols where simulation carried out using the network simulator-2 (NS-2). NS-2 is an open source and it is developed using the TCL and C++ languages. The paper flow is as follows. Part 2 explains about the source of energy wastage in the sensor nodes. Part 3 explains about the

related work carried out in the past research. Part 4 explains about the applications of WBAN in different fields, finally conclusion of the paper is explained in part 5.

2. ENERGY WASTAGE RESOURCES

Widely explained sources in the past work impact the wastage of energy of the sensors due to which whole communication can loss. Collision of packets, overhearing, over emitting, idle listening, fluctuations in the traffic are the some sources through which the energy wastage occurs in the network. Collision of packets in the network means two or more nodes transmits the data simultaneously and collision between packet happens and again source has to retransmit the data, because of this energy can be wasted. Overhearing incur when source node transmit data to one node that is destined to another node in the same transmission range. Idle listening incurs when an node is in idle state and waiting for some possible events to occur , wasting energy by keeping idle all the time. If the traffic is managed by the central base station so that idle listening and over hearing issues can be avoided. Master-slave architecture with Time Division Multiple Access (TDMA)/ Clear Channel Assessment (CCA) network technique can be used to avoid collisions, overhearing, and idle listening problem. This technique is used to overcome the issues mentioned above and use the power efficiently.

3. RELATED WORK

Himangi Pande et.al[1], in this paper author has proposed, adaptive energy efficient MAC protocol to minimize the energy consumption from the sensor nodes that deployed in the WBAN network. The proposed protocol in this paper incorporates adaptive contention window and dynamic duty cycle approaches. The proposed protocol is simulated in ns-2 environment in which contention window is adaptive to the different traffic rates (For example if contention window size is fixed to 500 bytes at a time where Cmin is set to zero and Cmax is set to 1500, then if traffic of above 500 bytes is transmitted means window size is adaptive to conditions and transmit the traffic accordingly). Dynamic duty cycle classifies the different variety of traffic based on the conditions such as audio, temperature, ECG etc.

Jun Sung Choi et.al[2], in this paper author has proposed synchronized flexible state switching method to reduce the energy consumption. This paper talks about the issue energy consumption when there is increase in number of nodes in the network. The proposed protocol in this paper is activated only when there is some data to transmit or else turned to sleep mode. The MAC protocol implemented between the master and node to be low power, hence to reduce the energy consumption. The node which attached to or in the body which senses data is known as node, where as node that collects the sensed data is the master node. The proposed state switching of frame structures in this paper avoids collisions of packets in the network and retransmissions of packets avoided automatically hence prevention of energy wastage occurs. If power consumption of nodes is higher, results in body damage of patients in WBAN.

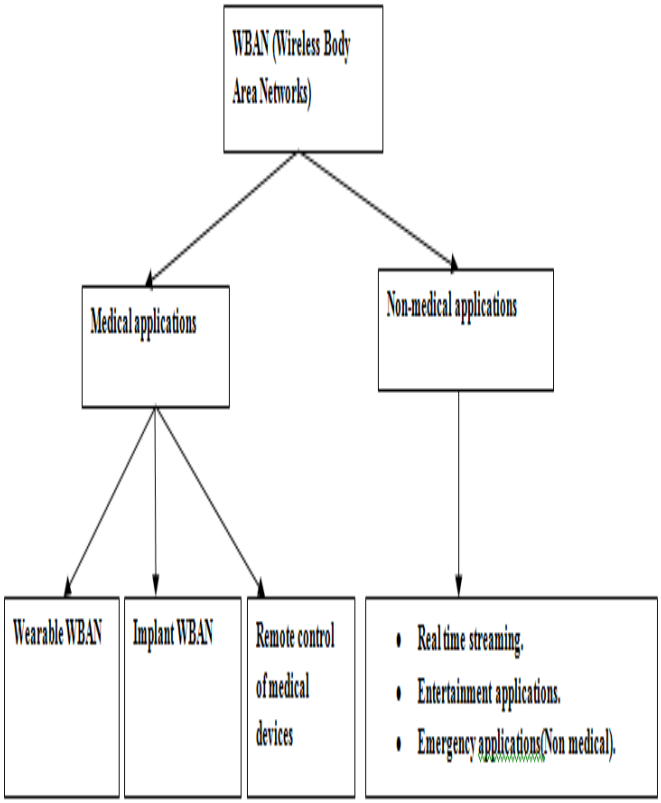
Jingjing Yuan et.al[3], In this paper author has proposed EMAC(Enhanced Medium Access Control) protocol to minimize the consumption of energy in WBAN. The relay nodes are deployed in to the network so that energy can be reduced. The relay nodes are the alternative nodes for the sensor whose residual energy is less than the preset threshold value. When residual energy is less than the threshold the affected node request for the relay node for load balancing purpose. Relay nodes introduced in the network to increase the network life, load balancing purpose and provide the fault tolerant capacity in the network which takes some burden from affected sensor node. Relay nodes are placed in the network after receiving the RSSI(Receive signal strength indicator) packet from the affected node or sensor. This paper proposed an dynamic power control algorithm to minimize the energy consumption which rely on feedback information provided. Integrating relay nodes, power control algorithm and adjustment in super frame structure using all these EMAC increased the network lifetime.

Samaneh Movassaghi et.al[4], In this paper the author concentrated on evolution and present status of WBAN by giving brief explanation about the importance of WBAN in remote monitoring, applications of WBAN, History of IEEE standard 802.15.6, WBAN requirements and its characteristics, WBAN different layers, channel model, WBAN security like confidentiality, authentication, authorization, integrity. Routing in wireless body area networks also explained in this paper with WBAN address allocation, radio techniques used, comparison with variety of wireless technologies is depicted briefly. Challenges and open issues in WBAN discussed

Bandar Alghamdi et.al[5], In this paper author given attention towards the system architecture and general architecture of WBAN from hardware and software point of view. Paper incorporated fully distributed architecture of WBAN to minimize the energy consumption of nodes. In this paper they proved that distributed architecture also consume more energy than the centralized approach. Diseases are identified depending upon the fetched data that is compared with threshold value that is predefined. Disease diagnostic from remote area can be elaborated in this paper by the author.

4. APPLICATIONS OF WBAN

The below Figure 2 shows the applications of WBAN, which has its applications in area of medical and non-medical field.



1.1 Medical applications

Use of WBAN in medical applications helps in improving the life quality of mankind by remote monitoring of patients. WBAN use in medical applications allows to measure physiological attributes of human beings which again classified into three types as shown in Figure 2. The below are the medical applications of WBAN.

4.1.1 Wearable WBAN

Wearable WBAN as the name indicates refers to which wear on the human body by the patients. For example wearable T-shirts. Medical applications of WBAN used in military conditions to check the soldier fatigue and battle readiness, Sports WBAN can be used to check the movement of the person, to avoid sleep staging applications where large amount of people suffer from sleep disorders, asthma where WBAN finds the allergic contents in the air and provide real time monitoring.

4.1.2 Implantable WBAN

Implantable WBAN as the name indicates injected into the body of the patients to find the disorders like Diabetes, cardio vascular diseases, cancer detection.

4.1.3 Remote control

Remote control of medical devices has applications for remote monitoring of the patients, telemedicine system.

4.2 Non-medical applications

Non-medical applications of WBAN such as live streaming or video streaming (Eg: live cricket), entertainment applications (gaming applications, cameras, mp-3 players etc), emergency applications in area of fire engine, emotion detection speech and visual power, secure authentication like (iris matching, pattern matching, biometric).

5. CONCLUSION

This paper concentrated on briefly explaining the sources of energy consumption such as collision, overhearing, idle listening, over emitting. Some of the techniques to reduce the energy consumption of sensor nodes in WBAN are discussed like adaptive energy efficient MAC protocol which incorporated adaptive contention window scheme and dynamic duty cycle method, Flexible frame structure by state switching method where the channel between master and node is improved and EMAC protocol is incorporated. In future further medium access control protocol can be defined which minimize the energy consumption compare to above mentioned protocols.

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