

Analyzing Routing Capabilities in Wireless Body Area Networks

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ABSTRACT

Optimized routing is a mechanism utilized in WBAN so that best path can be discover when sensor nodes which are positioned over body can intercommunicate with one other. Sensor nodes which are chips introduced within body, or nodes which are in type of wearable shirts, or which are positioned over body parts evaluate patient's body's various signals to examine his/her organ's functionality and his/her fitness level. To examine his/her heart, ECG can be performed; in the same way EEG is done to examine patient's brain functionality and so on. Whether the sports person is physically fit or not to play any sport can be examined by the utilization of WBAN. Doctors or Care providers can remotely examines their patients from any area of world. For suitable functionality among nodes, routing is a significant challenge. So in the suggested project a new mechanism is introduced for optimized routing so that all the challenges are being eliminated. GA offers natural evolutionary mechanism which is an optimization mechanism to choose best route out of several different possible paths. After employing GA, better results are achieved as compared to previous results. Packet delivery among sensors represents improvement, low battery consumption while intercommunication, so on. WBAN presents its significance in the fields i.e. computerized games, to examine enemy on borders, physically handicapped person and entertainment. WBAN is famous in foreign countries as compared to India.

Index Terms – Wireless Body Area Network (WBAN), Adaptive Multi-hop tree-based Routing (AMR) and Genetic Algorithm (GA)

I. INTRODUCTION

WBAN which comes into existence from last few years and is easily used by people in their daily life functionalities. Micro and nano devices are formulated and are implemented on, within or around human body to evaluate various physiological signals of the human body that shown in figure 1. Various heterogeneous sensors [2] i.e. ECG sensor, EEG sensor, blood pressure level evaluating sensor, etc is being utilized to different evaluate body parameters. All the sensors gather the data from their respective implemented sensors and forward it to the sink node which behaves as a database in which all data is gathered or saved. WBAN is also known as Body Sensor Network (BSN) [1]. A wonderful research has been performed in this field and WBAN is employing in many fields from military to sports. For instance: - Physical fitness of the sports person can be examined by utilizing

WBAN technology. In the military field, particularly on borders normally terrorists attack anytime so there WBAN fits properly.

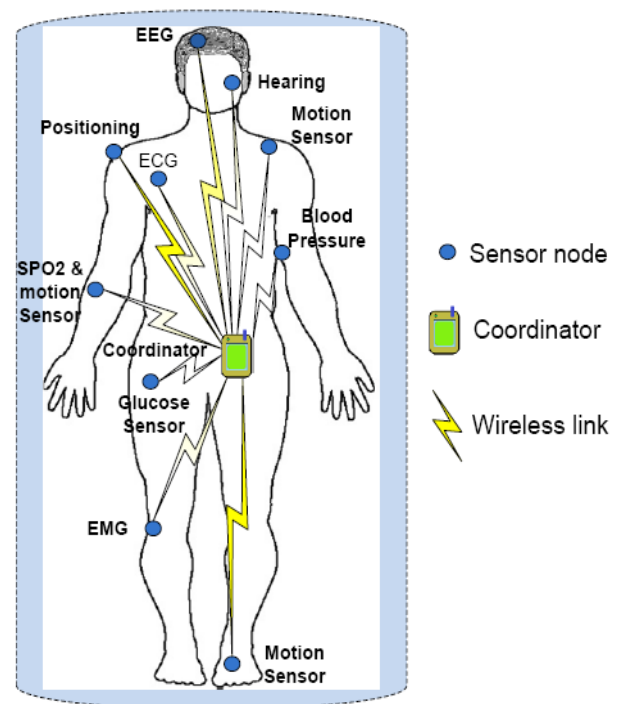


Figure1:-WBAN Micro and Nano devices

Various sensors i.e. Bio kinetic sensor which formulate angle of rotation and acceleration and ambient sensor measure environmental elements etc because of this technology, doctors hold on examining their patients 24hours. All data is saved manually is translated manually [2]. If the doctor is not existed to the patients that time the system which is programmed by programmer's works in such a way so that system can automatically give insulin to the patients who are diabetic and to others offer instructions what and how to do in situation of emergency [4]. Sensors examine motion, heart rate, body temperature, respiration, vibration, sound, patient temperature. Old age people cannot travel so much from one doctor to another doctor because if the doctor/expert is available in another country, he/she cannot move there and

then at that time by using sensors which are implemented on, in or around their body can automatically forward their status to their concerned doctors by using GPRS connectivity for

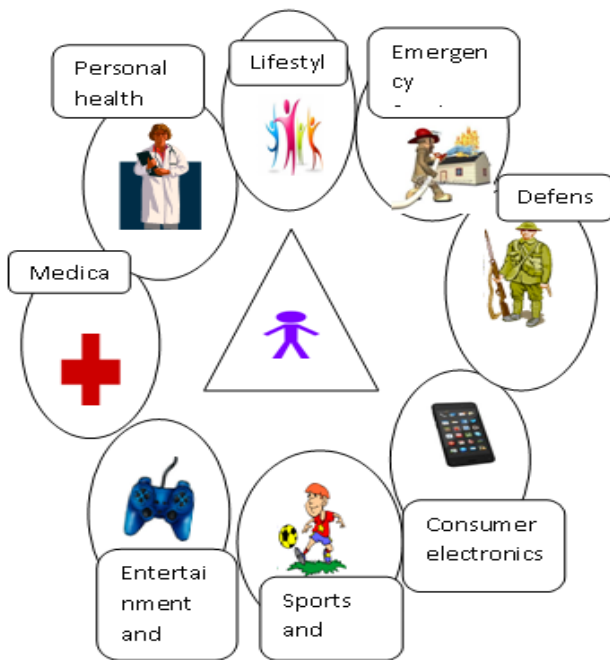


Figure 2:-WBAN Applications in Medical Field

Table:1

In-Body and On-Body Sensor Networks Applications

Application Type	Sensor Node	Data Rate	Qos(Service to Latency)
In- Body Application	Glucose Sensor	Few Kbps	Yes
	Pacemaker	Few Kbps	Yes
	Endoscope Capsule	>2 Mbps	Yes
On- Body Medical Application	ECG	3 Kbps	Yes
	SpO2	32bps	Yes
	Blood Presssure	<10 bps	Yes
On- Body Non-Medical Application	Music for Headsets	1.4 Mbps	Yes
	Forgotten Things Monitor	256Kbps	No
	Social Networking	<200 Kbps	No

distant places. Zigbee/Bluetooth is employed for short distance communication between patient and doctor as in hospitals when the doctor is available in his/her cabin. Many applications are implemented by the doctors as well as by the patients in their tablets/ mobile phone. With respect to survey by WHO, about 17.5 million people having stroke every year and 20 million people die from CVD (Cardio Vascular Disease) and 24million people suffer from diabetes and 380 million expected up to 2025 [6].

The system which is employed in hospitals or by doctors/experts contains of 3-tier architecture namely:-

1. Sensor Network Tier.
2. Mobile Network Tier.

3. Remote Monitoring Tier.

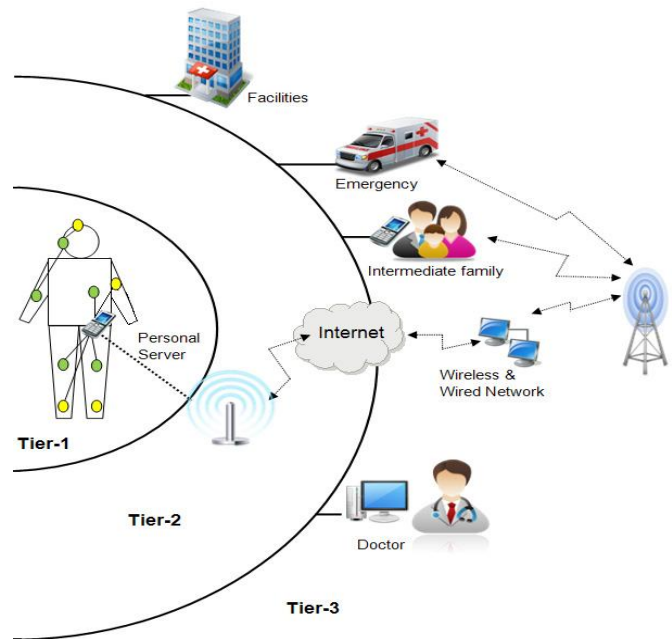


Fig. 3 Communication Tiers in a Wireless Body Area Network

1.1. Sensor Network Tier

Sensor Network Tier plays very significant role. Sensor nodes are very smart nodes because they gather several physiological signals from the human body and every and each node is able of sensing, sampling, processing and finally communicating [11]. In this type of tier, there are various modules i.e. Blood oxygen module, ECG module and for these modules there is Geometer node which is utilized to process and wirelessly transmit vital data. MAC protocol is employed to transmit data among two processes [2].

1.2. Mobile Computing Network Tier

In this type of tier, patients require many handheld devices i.e. PDA, mobile phones, Tablet by which he/she wirelessly intercommunicate with doctor. Handheld devices are composed of processor, operating system, memory, Nand or Nor Flash, UART, USB, SD, etc. All the data by this tier is sent to remote monitoring Network tier and this is the most significant tier without this tier no intercommunication is possible [14]. Monitored by personal computers but the patients who are at distant places are accessed by using handheld devices i.e. PDA, mobile, Tablet with GPRS connectivity.

1.3. Remote Monitoring Network

This is the top most tiers which offer various functions to WBAN subscribers, informal caregivers and medical personnel (doctors) [11]. There is a database in which all related data of registered patients are saved or signals gathered from body are saved in the database. Only the authorized doctor can use the database and as per physiological signals gathered, doctors suggested medicines or tips or prevention from risks to their respective patients. PHY and MAC sub layers are utilized to offer communication between a hub and a node which is defined by the standard IEEE 802.15.6. IEEE 802.15.6 is the best and latest standard which offers reliability, security, mobility, etc characteristics [8].

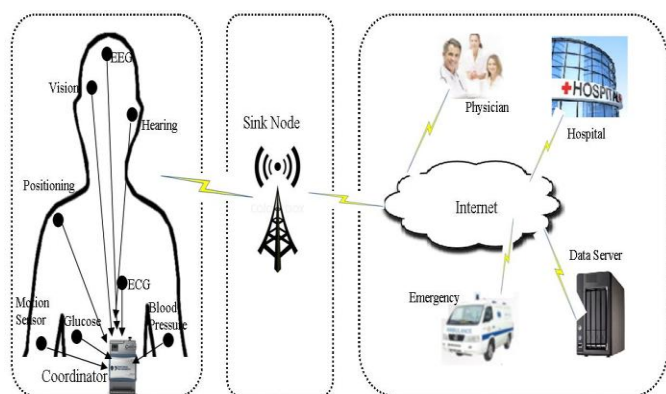


Figure 4 Architecture of WBAN

Optimized Routing is that routing in which the best route is chosen from various possible paths by keeping in mind to eliminate all the problems of WBAN. By employing optimized routing, no dropping of packets, packet on-time delivery, less time consumption of battery nodes are being reduced by employing several optimization mechanisms utilized i.e. Ant-Colony Optimization (ASO), Particle Swarm Optimization (PSO), Shuffled Frog Leaping (SFL), Genetic Algorithm (GA), Mimetic Algorithm (MA), among which GA is best because it is natural heuristic optimization mechanism. GA is the evolutionary algorithm in which mutation, inheritance, crossover and selection is performed to produce solutions to optimized routing. GA is suitable in fields i.e. chemistry, engineering, physics, mathematics, science, pharmacometrics, phylogenetic, and bioinformatics and in other fields too [11].

A WBAN has In-Body and On-Body nodes which monitor's patient condition for diagnosis [4]. On-Body node can be used for multimedia and other applications. A WBAN uses mics bands for data transmission, WMTS for medical applications etc. Only authorized doctors can use WMTS band. ISM band, UWB are some other alternative. A WBAN is divided into 3 categories on-demand, emergency and normal traffic. On demand traffic is used for diagnostic purpose, emergency traffic initiated by the nodes when they exceed a predefined threshold. Normal traffic is a data traffic, this includes routine health treatment of many disease like cancer, neurological disorder etc. The normal data are collected by a coordinator with the help of wake up circuit, a main radio and a bridging function which are connected with data interface. Wake up circuit is used to accommodate on demand and emergency traffic while bridging function establish a connection between different nodes working on different frequency bands [12].

II. LITERATURE SURVEY

Mohammad Abdur Razzaque et. Al. [1]: Here authors improve Quality of software in Body Sensor network using adaptive network coding technique. For simulation purpose author has takes MATLAB as a simulation tool. In their work author proposed a unique network coding that based on error recovery mechanism that improve Qos at very low energy, memory and hardware cost. In their contest it utilize application level and network level information to make it adaptive. After the simulation result they conclude that the proposed mechanism reduce retransmission and energy consumption and NC relay adaptive [12].

Gill R. Tsouri et. al. [2]: In this paper authors improving life time of BAN using energy consumption balancing and routing. For the performance evaluation the authors has taken ns2 tool for the simulation purpose. In their proposed algorithm record channels attenuation is procured that providing high quality of service. The proposed algorithm was evaluated through real time implementation in dynamic environment using real channel data. After the simulation result they conclude that the A>P network architecture energy consumption decreases average 40%.

Javed Iqbal Bangash et. al. [3]: Here authors survey the routing protocols in Wireless Body Sensor Networks. This paper identifies various issues and challenges in pursuit of effective routing in WBSNs. The authors provided a comprehensive review of existing routing protocols specifically designed for WBSNs. Based on their nature and structure, the routing protocols have been classified as QoS-aware routing protocols, temperature aware routing protocols, cluster based routing protocols, postural-movement based routing protocols and cross layered routing protocols. After that the authors critically analyzed each routing protocol by comparing its relative performance against other state-of-the-art schemes and have identified the relative strengths and weaknesses of each routing protocols.

Sidrah et.al.[4] Here authors analyses incremental, Co-operative, communication for Wireless Body Area Network with different number of relays. In this propose scheme three stage relaying was used for compare single and two stage relaying schemes. This simulation result shows that the purpose three stage relaying gives high throughput an eliminate data redundancy problem.

N. Javaid et.al.[5]. In this paper author reviews various aspects of Wireless Body Area Network that provide solution for emergency applications in body antenna designing, low power MAC protocol designing for WBAN. Author also discuss new power efficient solution for On-Body and In-Body sensors network with micro electro mechanical system technology and integrated circuits.

III. PROBLEM FORMULATION

Based on Literature Survey, sufficient work has been done in WBAN. As WBAN has the capability to forward and obtain data by sensors which are equipped on the patient's body such as sensors communicate with one other (for example Laptop, mobile phones). Nodes (sensors) gather vital signs from the body or environmental factor and examine them. Network performance, decreased energy consumption, hence increasing the network lifetime is the primary issue in BANs on which various researchers performed their research. Many studies show that multi-hop for BANs helps for obtaining network performance, decreasing energy consumption and increasing network lifetime. Many algorithms in WBAN for routing are made to decrease power consumption and improve lifetime, here in the suggested project, a new mechanism for WBAN locating for optimized routing by employing GA can be employed so that network performance can be enhanced and low power consumption. As by employing GA which is easy and fast as compared to other optimization mechanisms we can discover the best route so that sensors can intercommunicate fast [11].

IV. PROPOSED WORK

To implement best routing in WBAN, many modelers have been employed to present the network behavior i.e. computing the interaction among nodes in WBAN employing many mathematical formulas and presents graphically normal residual energy of nodes or node's packet delivery ratio. There are various modelers which are being employed in WBAN i.e. NS3, MATLAB. The technology being employed for the suggested work is done by using the GA and by utilizing best route can be selected so that nodes can intercommunicate with one other and the results of the suggested work will be measured employing MATLAB 2014 modeler.

Objectives:-

1. GA (Genetic algorithm) initialization and implementation for optimized positioning.
2. Concluding several results and plotting with various scenarios.

Nodes which are positioned over body communicate with one other and all the data gets saved at sink node (ankle/waist).

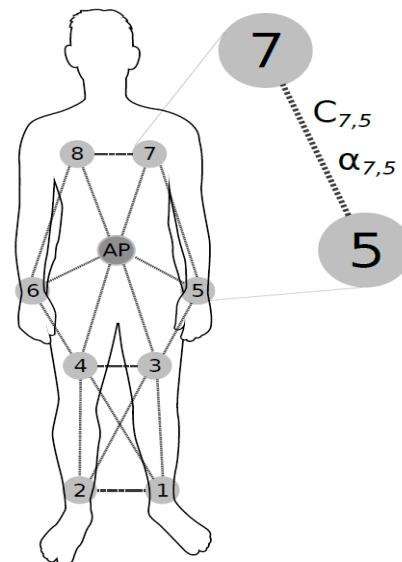


Fig 7 Found Best possible routes by using Genetic Algorithm having sink node at ankle as well as at waist.

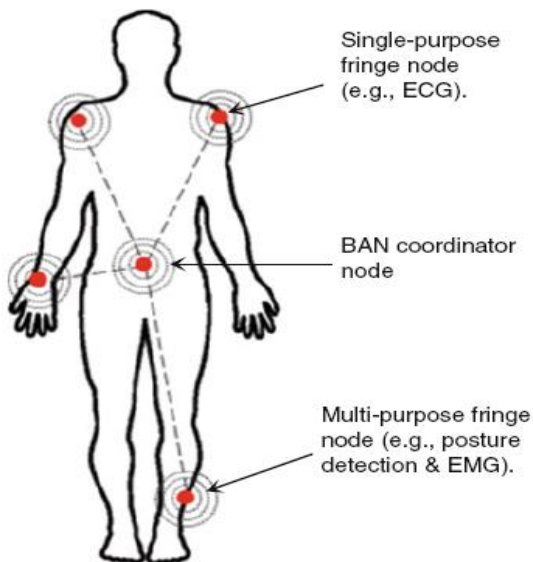


Figure 5. Position of nodes on different places

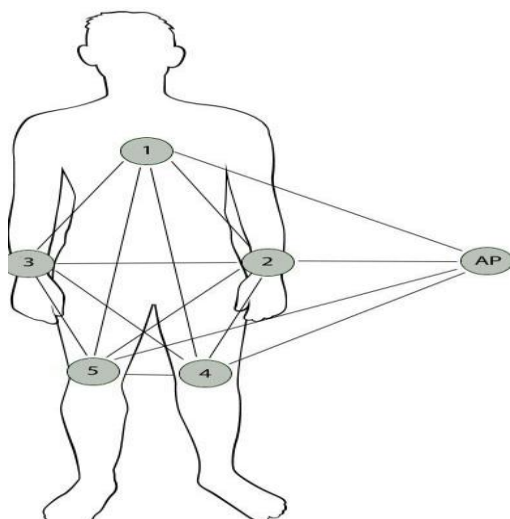


Figure 6: Different possible number of routes

V. NETWORK LIFETIME

Figure 8 presents the network lifetime results by utilizing bar graph for the four parameters (SPT, Fuzzy logic, proposed and RSSI) and for sink positions (sink at ankle and sink at waist). Nodes which are positioned over body are assumed dead after taking 2J energy. By employing Genetic Algorithm network lifetime enhances by following load balancing in the network nodes. Shortest route is chosen by the Genetic Algorithm so that battery life of the positioned nodes enhances. In the above figure 8, results are better as compared to previous results.

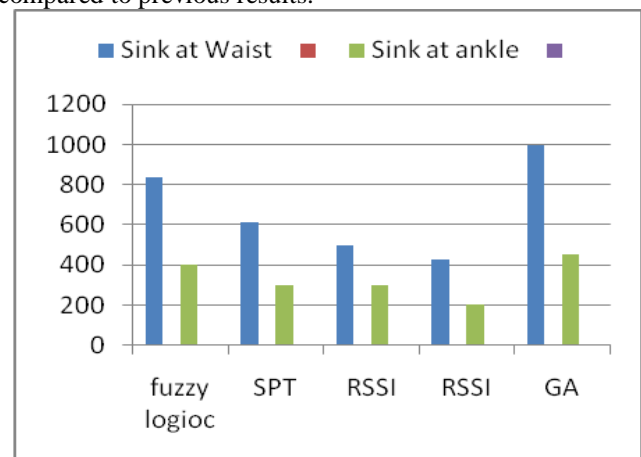


Fig 8: Network lifetime

VI. RESULTS AND DISCUSSION

As in the mentioned work, Fuzzy logic is utilized to choose the best path among many possible paths. But by employing Genetic Algorithm which is a natural optimization mechanism, results which are produced are far more enhanced as compared to previous. Depending on fitness function, chromosomes are chosen. By employing Genetic Algorithm, best possible path is discovered so that network life time enhances, packet delivered to its destination node in lesser time as compared to previous, low battery consumed by nodes during communication.

CONCLUSION

WBAN is a most wide area for research in which distributed nodes are established over human body to evaluate various body signals. Major challenges i.e. battery consumption, security, packet delivery ratio etc are essential to be eliminated so that patients do not achieve any difficulty when they make usage of WBAN in their daily life. WBAN system is equipped in hospitals and the system is a three tier architecture which is composed of Medical Server, Personal Server, Sensor nodes and all tiers have its own services to complete the WBAN process. Doctors employing their personal devices with the help of internet can examine their patients and even the patients who are being equipped with sensors also require internet connectivity in their personal device i.e. PDA, mobile phones, etc. In the previous work, Fuzzy logic was being utilized employing methodology MATLAB. Mamdani model were utilized in which rules are adjusted utilizing and /or. Fuzzy logic also presents good result but in the suggested work, best optimization mechanism i.e. GA which is depending on the natural evolution in which based on fitness function, chromosomes are chosen. For 100 generations, employing looping best possible path is chosen among several possible paths in a shortest span of time by enhancing Packet delivery ratio, Rest energy consumed by nodes, network life-time enhances. Shortest route is used by GA to arrive the packet or data to its destination node in the WBAN in the shortest period of time. In the suggested work, results are far better as compared to previous one for eliminating the problems of WBAN system. For handicapped patient, elderly people this technology has advantages because as it is known that the old age patients cannot travel too much so they cannot move to doctor too much, so they are using this best technology, patients are equipped with sensors or nodes and then remotely from any place doctors can examine their patients and suggest them medicines. Patients who are sitting in one country can achieve the advantage of the best doctor who is sitting in other country; doctor can examine him remotely by employing Personal devices if and only if the patient is established with sensors. Handicapped patient who are blind equipped with sensors in their retina so that they also obtain advantage to view this beautiful world.

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