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Radical Health Monitoring System Using Body Sensor Network

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ABSTRACT: Wireless Body Sensor Network (WBSN) is a special purpose Wireless Sensor Network (WSN) which can observe the physiological behavior of the patient or human being. Sensors can collect the data and then send them to the central unit through the Metropolitan Area Network (MAN) or Local Area Network (LAN). Wireless Sensor Network is a collection of several transducers spread across the environment to monitor the various parameters such as blood pressure, heart rate, blood sugar, skin temperature, blood oxygen. The Biomedical Wireless Sensor (BWS) which are attached to the human body is capable of establishing wireless communication link. WBSN's can be known as the distributed system, where nodes are distributed on the human body. In this system, the cluster head node selection technique chooses the best node; the number of nodes is increased between the local nodes, Wireless Local Gateway (WLG) and the Hospital Gateway (HG) for the reliable and efficient communication. By implementing the automatic connection establishment, the time delay in the system can be improved. This method aims to provide instantaneous and remotely accessible monitoring system. The implementation is done using the Unified Technology Learning Platform (UTLP).

KEYWORDS: Biomedical Wireless Sensor (BWS), Cluster Head (CH), Unified Technology Learning Platform (UTLP), Wireless Body Sensor Networks (WBSN), Wireless Local Gateway (WLG).

I.INTRODUCTION

Body Sensor Network (BSN) ^[1] collects, displays, analyzes and streams data to a computing centralized server. Wireless sensor networks are offering the next evolution in biometrics and healthcare monitoring applications. Wireless Body Area Network (WBANs) ^[2] can be termed as a distributed system, where nodes are distributed on the human body. The deployed sensors are utilized to sense some physical quantities in human body such as heart beat rate and body temperature. By wireless body sensor network (WBSN) system, a hospital can monitor physiology signals (such as body temperature, electrocardiogram (ECG), ^[3] pulse oxygen saturation, blood pressure, blood glucose, etc. A typical Android smart phone is equipped with a cellular data network accessible chip, a Wi-Fi adapter, a Bluetooth transmitter and a Near Field Communication (NFC) ^[4] reader. Especially for ECG sensor data, a QRS ^[5] detection algorithm for the heart beat rate (HRB) calculation is implemented for the Android Smart phone system.

Power consumption in the Wireless Body Area Networks (WBANs) are categorized into sensing, communication and data processing. Biomedical Wireless Sensors (BWSs) ^[6] must be designed to manage its local supply of energy and maximize the total network lifetime. The cluster head failure and its recovery have an important condition for the correctness of the node recovery. The Routing Information Protocol (RIP) ^[7] property much has high probability.

The Sensors that collect the information of the human body and then transmit it to the Base Station. It is then connected by the means of Wireless Wide Area Network (WWAN) and the Wireless Local Area Network (WLAN). The information is then transmitted to the central server via Internet. The central server sends the data to the remote database or the physician for the further immediate processing in case of emergency.

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In further sections of this paper, Section II discusses about Physical Architecture, which describes the block diagram of the system. Section III discusses about Methodology that includes the node selection technique for the cluster nodes. Section IV shows the expected results and Section V contains the Conclusion.

II. PHYSICAL ARCHITECTURE

The sensor nodes collect the biomedical information and transmit it to the Cluster Head. The cluster head chooses the best node based on the detection technique. And the information is then transmitted to the WLG. From the local gateway the information is transmitted to the Hospital Gateway. The sensor nodes collect the information from the human body and the best node is selected from the group of nodes by the cluster head. This selection is carried out by CHNST by the software NS2. And the information is sent to the hospital gateway by Wireless Application Protocol (WAP) for the diagnosis.

In Fig 1 the local nodes are interconnected with the cluster head, the cluster heads are connected with each other. At the node level, CH is responsible for discovering faulty nodes. The faulty node is identified by the other neighboring CH'S in the network. All the Cluster Heads are connected to the main Wireless Local Gateway and this is connected to the Hospital Gateway (HG).^[8]

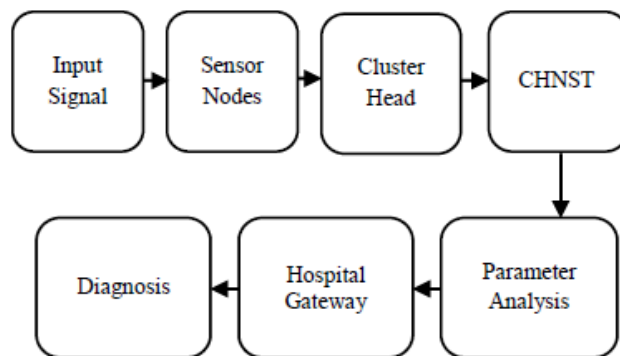


Figure 1 Network Architecture

- 1) **System layer.** This layer is a PC in the hospital, which consists of the control path and the data path for the WBSN system. The control path includes the function control and power control signals. The main actions of the system layer are sending commands to the application layer and receiving data from it.^[9]
- 2) **Application layer.** This layer includes several sensor groups, and controls all the sensor groups by sending commands and receiving data from them.
- 3) **Sensor group layer.** This layer includes several sensor nodes, and controls all the sensor nodes in the sensor group layer by sending commands and receiving data from them.
- 4) **Sensor layer.** This layer is just a single sensor node receiving commands from a sensor group and sending the detected data to the sensor group.^[10]

The four layers of software hierarchy system architecture help the WBSN in development and verification.

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III. METHODOLOGY

The Android smart phone is used to act as an iPCN, the Intelligent Personal Communication Node (iPCN) which includes the both signal processing and data transmission. In the existing system, a Bluetooth connection is established. It's a manual connection method. Only if two devices get paired each other the connection can be established. The Bluetooth protocol supports connections up to 7 different nodes. In the methodology of the paper Bluetooth Serial Port Profile (BSPP) is used to establish the connection between the Smartphone and the device. This is used in transmitting the data.

Apart from all this techniques the new methodology aims to connect many numbers of nodes with reliable and efficient data transfer. The QRS detection algorithm which finds the ECG signal waveforms and it represents the right and left ventricular depolarization of the heart abnormalities. The cardiac cycle is accurately measured using the RR intervals. The advantages of the iPCN system are that it is a low power consuming system and an energy efficient system. Multiple wireless protocols for the connection establishment includes the Bluetooth, Wi-Fi, Cellular data network and Near Field Communication. These systems are used to transmit the sensor data. The cluster heads are connected in the star topology. In this topological connection even if anyone cluster head is under faulty condition then the data transmission is not affected in between the other cluster heads.

CHNST

The Cluster Head Node Selection Technique (CHNST) selects the best node from the group of nodes based on the packet drop. The information from the adjacent nodes is transmitted between the nodes for the analysis of the recent data transmission. Consider the situation node 0, 1 and 2 are connected to the cluster head node 3, the collected data is transmitted from the nodes to the head node.

The best node is selected based on the node with minimum packet drop and reliable data transmission. Since the connection established is a wireless connection, there is a possibility of packet drop between the nodes. But the packet drop should be minimum for the health monitoring systems. The information from the best node is taken to the WLG for the diagnosis. The data base is predefined for the evaluation.

IV. EXPECTED RESULTS

The performance of the proposed Cluster Based Failure Detection and Recovery Technique (CBFDRT) for Wireless Body Area Networks is to be evaluated using NS2 Network Simulator. The performance is evaluated mainly, according to the following metrics:-

Performance Metrics

The performance of the Cluster Head Node Selection Technique (CHNST) for Wireless Body Sensor Networks is evaluated using NS2 Network Simulator. The packet latency, average packet delivery ratio and the energy consumption are evaluated for the simulated system

Performance Analysis

In the system implementation by using the network simulator 2, 13 nodes have been created with duplex link where it can send packets in either head or the tail portion of the node. The data rate transmitted is about maximum of 2Mb with time delay of maximum 60ms. In the node creation part 13 nodes have been created. In the UDP connection part the data packets have been transmitted with the connection oriented type. And the time delay and packet size has been varied.

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Packet Latency

Latency is a measure of time delay experienced in a system, the precise definition of which depends on the system and the time being measured. In communications, the lower limit of latency is determined by the medium being used for communications.

In simulation applications, 'latency' refers to the time delay, normally measured in milliseconds, between initial input and an output clearly discernible to the simulator trainee or simulator subject.

$$\frac{\sum \text{Individual data packet latency}}{\text{Total number of data packets delivered}} \quad (1)$$

Latency is another element that contributes to network speed. The term latency refers to any of several kinds of delays typically incurred in processing of network data.

Average packet delivery ratio

It is the ratio of actual packet delivered to total packets sent. It is the ratio of the number of packets received successfully and the total number of packets delivered successfully to the other end.

$$\frac{\sum \text{Number of packets received}}{\sum \text{Number of packets delivered}} \quad (2)$$

The greater value of packet delivery ratio means the better performance of the protocol. Packet delivery ratio is defined as the ratio of data packets received by the destinations to those generated by the sources.

Energy Consumption

Energy consumption is the consumption of energy or power. This measure the energy expended per delivered data packet. It is expressed as,

$$\frac{\sum \text{Energy consumed by each node}}{\text{Total number of packets delivered}} \quad (3)$$

Energy consumption and efficiency of the system will be based on different traffic growth and transmission of data packets. Schemes that reduce the energy consumption of networks are, first is based on putting network components to sleep during idle times, reducing energy consumed in the absence of packets..

V. RESULTS AND CONCLUSION

Simulation Results

Figure 2 shows the node formation of 13 nodes, node 0, 1 and 2 are connected to the node 3, node 4, 5 and 6 are connected to the node 7 and node 8, 9 and 10 are connected to the node 11, where nodes 3, 7 and 11 are the Cluster Heads (CH) for collecting information from the sub nodes.

A new agent UDP connection is established between the nodes for faster transmission. The nodes 3, 7 and 11 are connected to the node 12, which is the Hospital Gateway (HG). The node 12 is then connected to the node 13, where the further diagnosis will be carried.

Figure 3 explains the transmission of data packets from the nodes 3, 7 and 11 to the Gateway node 12 and this node transmits the information to the node 13. The node 13 acts as the diagnosis center for any emergency situation of the patient to be treated immediately.

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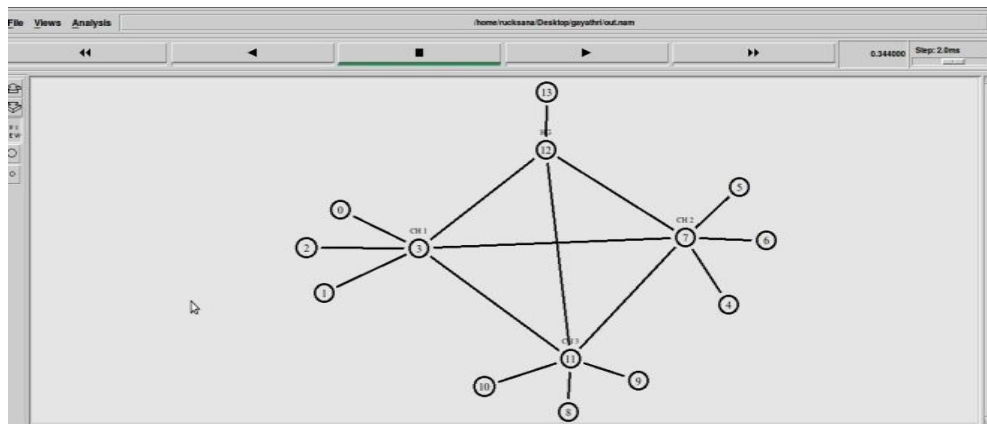


Figure 2 Node formation

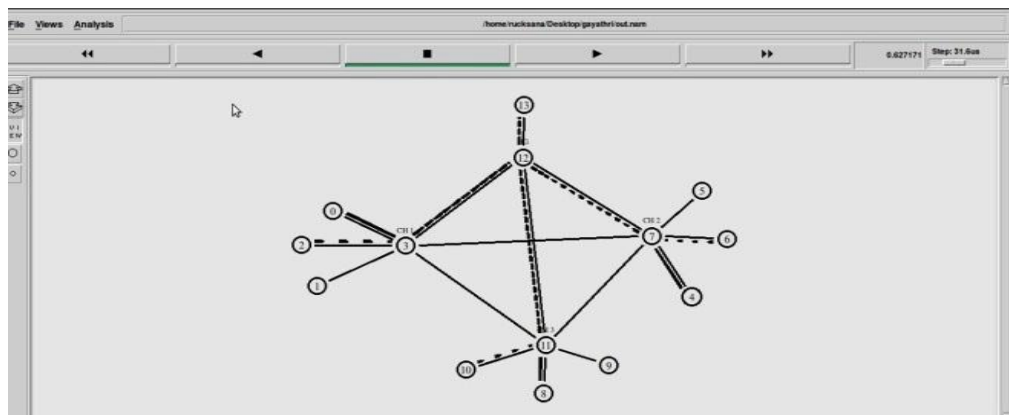


Figure 3 Transmission of packets from Cluster Heads

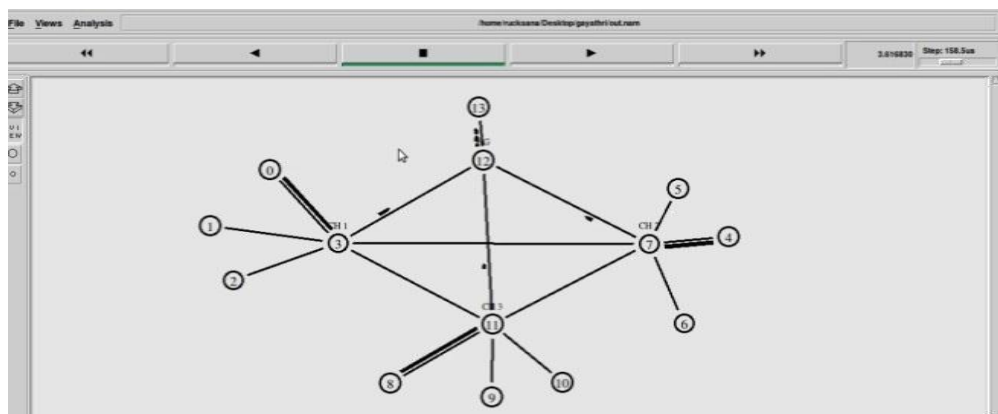


Figure 4 Selection of best nodes

Figure 4 displays the selection of best nodes from the group of nodes based up on the minimum packet drop. The information bits are then sent to the head node, then to the hospital gateway and then finally to the diagnosis center.

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Figure 5 illustrates the parameter packet latency; the Xgraph has been plotted for the individual packet latency to the total number of packets delivered.

Initially there is no delay and gradually it increases and it is maintained to a certain limit of packet transmission, then the packet latency gets reduced due to the reduction in the packet drop. Another axis shows the increased delivery of packets.

Figure 6 expresses the parameter average packet delivery ratio, the Xgraph has been drawn between numbers of successful packets received to the number of packets sent. The percentage of efficiency is increased about 20%.

Figure 7 demonstrates the parameter energy consumption; the Xgraph has been characterized between the energy consumed by each packet to the total packets delivered. The energy consumption is considerably reduced of about rate 1.5.

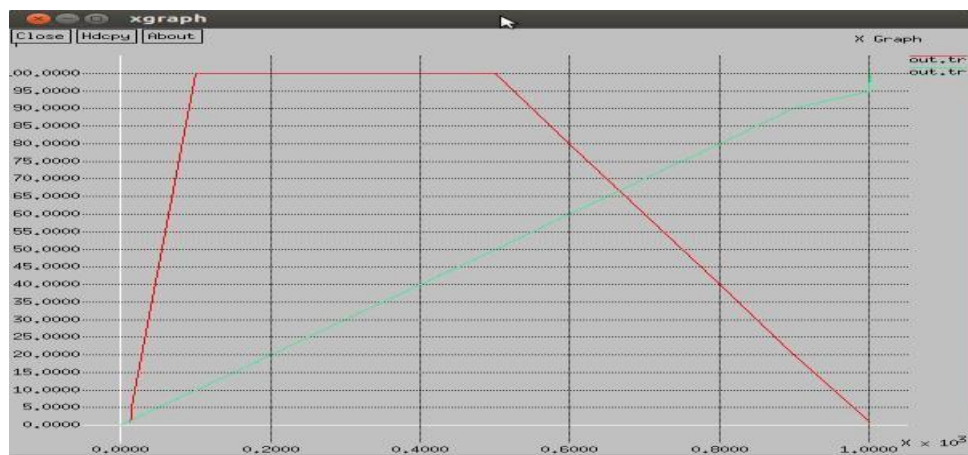


Figure 5 Packet latency

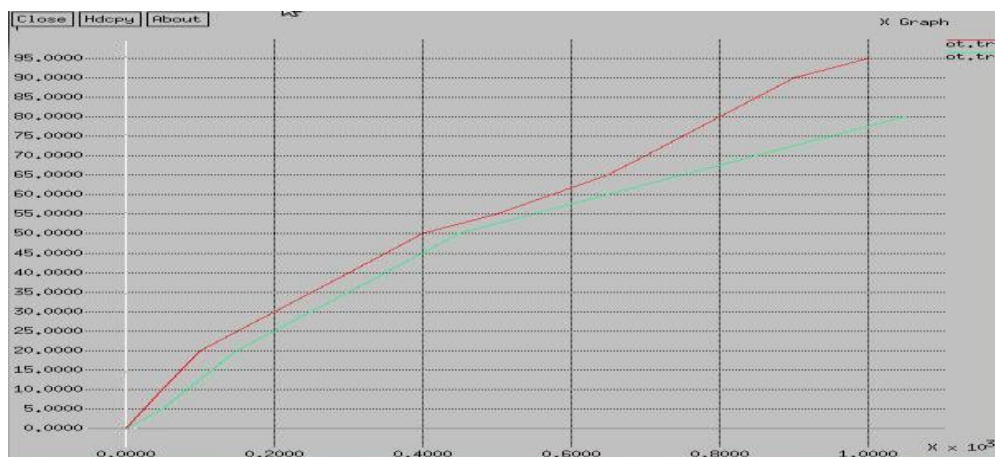


Figure 6 Average packet delivery ratio

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Figure 7 Energy consumption



Figure 8 (a) Patient abnormal



Figure 8 (b) Patient normal
Figure 8 Monitoring of patient condition

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Figure 8 shows the implementation of patient monitoring system using the Mission 10x system. The figure 8 (a) shows the patient is abnormal and the figure 8 (b) shows the patient is in normal condition.

Figure 9 shows the ULK control panel, the host is connected with the corresponding IP and the process for loading the program and enter the patient details to know the status.

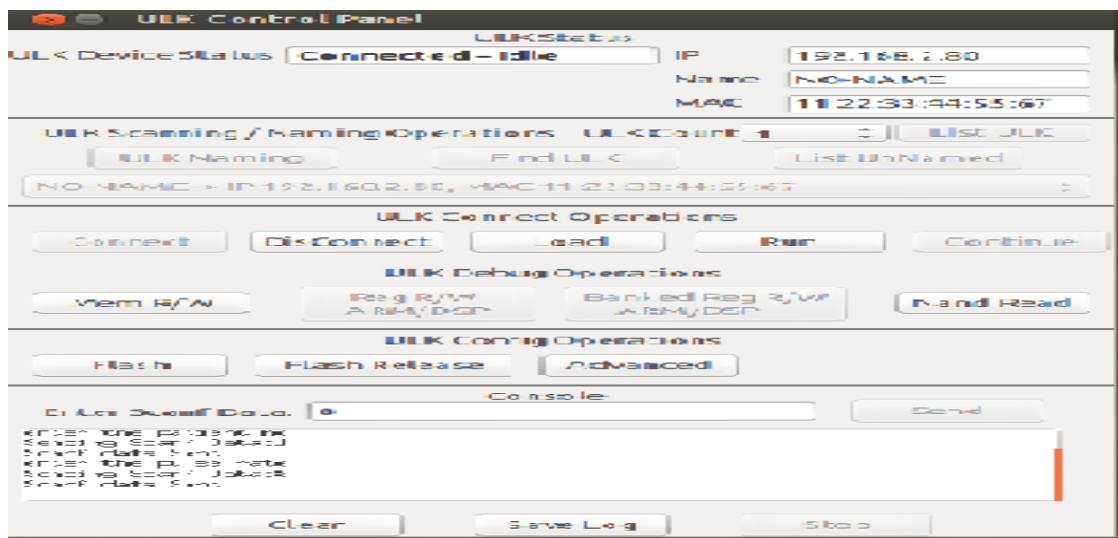


Figure 9 ULK Control panel

V. CONCLUSION

From the Simulation results and trace file, the X-graph depicts the amount of energy consumption, the increased number of nodes, the average packet delivery ratio and the packet latency. In this project, a system of Wireless Body Sensor Networks is to be introduced for choosing the best node. The number of nodes for the analysis of three different parameters has also been increased. The number of nodes is increased to 14. A better system which monitors a large location with better energy consumption is obtained. Each local sensor collects fault related information and stores in a fault tolerant table. CH compares F_{info} with three predefined threshold values. The efficiency of the simulated model is increased than the compared work. The results are shown as the indication of patient condition.

REFERENCES

- [1] Haghighi, M. Department of Computer Science, University of Bristol, UK, (2013) 'An end-to-end middleware solution with multiple concurrent applications support for wireless body area networks', Sixth International Workshop on Computational Intelligence & Applications (IWCIA), IEEE, ISSN. 1883-3977, pp. no. 201 – 206.
- [2] Javaid, Z. Abbas, M. S. Fareed, Z. A. Khan and N. Alrajeh, (2013) 'M-ATTEMPT: A New Energy-Efficient Routing Protocol for Wireless Body Area Sensor Networks', 4th International Conference on Ambient Systems, Networks and Technologies (ANT) Elsevier, Procedia Computer Science Vol.19, pp. no. 224 – 231.
- [3] Meena Abarna, and Venkatachalapathy, K. Department of Computer Science and Engineering, Faculty of Engineering and Technology, Annamalai University, India, (2014) 'Cluster Based Failure Detection and Recovery Technique for Wireless Body Area Networks', Research Journal of Applied Sciences, Engineering and Technology Vol.7, pp. no. 3458-3465.
- [4] Mohammadreza Balouchestani, Kaamran Raahemifar and Sridhar Krishnan, Electric and Computer Engineering Department, Ryerson University, Toronto, Canada, (2013) 'Increasing the Reliability of Wireless Body Area Networks Based on Compressed Sensing Theory', 26th IEEE Canadian Conference of Electrical and Computer Engineering (CCECE), ISSN. 0840-7789, pp.no. 1 – 5.
- [5] MohsinIftikhar and Iftikhar Ahmad, King Saud University, Riyadh, Saudi Arabia, (2014) 'A Novel Analytical Model for Provisioning QoS in Body Area Sensor Networks', (BASNet), Elsevier, Procedia Computer Science 32, pp.no. 900 – 907.
- [6] Nitya, Pushpam and Maninder Kaur, Keshav Memorial Institute of Technology, Hyderabad, India, (2013) 'An Advanced Wireless Sensor Network for Health Monitoring', International Journal of Advanced Research in Electrical, Electronics & Instrumentation Engineering, Vol.2, Issue2, ISSN: 2278 – 8875.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

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- [7] Orlando Pereira, R.E. Joao Caldeira, M.L.P. Lei Shu and Joel Rodrigues, J.P.C. (2014) 'An efficient and low cost Windows Mobile BSN monitoring system based on TinyOS', Springer Science, and Business Media New York, Vol. 55, Issue 1, pp.no. 115-124.
- [8] Pawan Baheti, K. Harinath Garudadri and Qualcomm Inc. San Diego, CA 92122, USA, (2009) 'An Ultra-Low Power Pulse Oximeter sensor based on Compressed Sensing', Computer Society, IEEE, DOI 10.1109/P3644.31, pp.no. 144 – 148.
- [9] Won-Jae Yi and Jafar Saniie, Department of Electrical and Computer Engineering Illinois Institute of Technology Chicago, Illinois, USA (2013) 'Smart Mobile System for Body Sensor Network', IEEE, ISSN: 2154-0357, pp. no.1 – 4.
- [10] Zhaoyang Zhang, Honggang Wang, Chonggang Wang, and Hua Fang (2013) 'Interference Mitigation for Cyber-Physical Wireless Body Area Network System Using Social Networks', IEEE transactions on Emerging topics in computing, ISSN : 2168-6750, pp.no.121 – 132.