Analysis on Cooperative communication in Wireless Body Area Networks

G.HEMALATHA, P.VENKATESH

Sree Dattha Institute of Engineering and Science Hyderabad Telangana

Abstract— Wireless Body Area Networks (WBANs) can be used to monitor medical, sporting, or training-related activities (WBAN). Placed either inside or around a person's body, these sensors are used to collect health data via wireless transmission while they are engaged in a specific activity (IEEE standard 802.15.6). An effect device is connected to sensors via these nodes. During this paper, we have a tendency to detail a handful of integral diseases and its subordinate diagnostic tests in normal, moderate, critical condition mode, protocols of a WBAN and cooperative communication in WBAN. These will provide the fundamental plan regarding WBAN. Compared with basic or simple network communication, the cooperative communication in WBAN the facility of the signal and quality of the signal is hyperbolic and it provide secured network between the companions and therefore the simplicity of the exchange of the information. For efficient transmission or reception, a sufficient number of cooperative nodes is selected based on channel conditions and transmitted distance.

Cooperative communication in WBAN is employed for to monitor the patient health condition with the assistance of relays for single or dual patient health monitoring or for multi patient health monitoring in indoor or outdoor and accustomed to improve the system performance and making monitoring efficient. These we can implement by using Lab view, NS, MATLAB to get simulative results

Keywords— WBAN, IEEE 802.15.6, PHY and MAC layers, Cooperative communication in WBAN, MATLAB.

I. INTRODUCTION

During a specific activity, such as a medical procedure or a sporting event, small wireless sensors are placed on or around a person's body to collect vital health information. These sensors are used by WBAN to collect physiological data (It comes under IEEE standard 802.15.6). Between the sensors and the bearing device, a network of these nodes is formed [1].

Figure1 shows the essential infrastructure of WBAN for medical and non-medical applications. Sensors square measure inserted in within or around the patient body to gather the physiological signals like Electroencephalogram (EEG), Electrocardiogram (ECG), Pulse Plethysmography (PPG), Electromyography (EMG), Pulse rate...etc, that square measure wants to comprehend the patient condition. WBAN will justify in three important steps are 1) Sensor node which comes underneath tier-1, 2) Access point (AP) which comes underneath tier-2, and 3). Medical user or doctor or user application that comes under tier-3, these tiers are shown in figure.2. From figure 1 and figure 2 sensors are inserted inside or around the person's body to capture the medical signals by victimization appropriate sensors, this information we will transmit to access point from personal networks like mobile through virtual antennas and this happens in communication tier1[5].

In communication tier 2, from the access point, we will transmit person medical information to medical server or info to grasp the case of the patient. During this tier, the medical instructor will save the patient information to grasp concerning the condition of the patient and medical instructor will send the information to a specialized doctor for the better treatment of the person. The doctor will receive the patient data through the server, once receiving this data doctor will bear the medical report and doctor will counsel the appropriate or higher treatment for the patient via remote transmission and educated to the medical instructor for the improvement of patient health.

In communication, tier-3[1] has accommodated the anamnesis and specific profile of the user and this suggests that the design basically needs to be specific to associate the application; patients could also be alerted to associate emergency state of affairs via the net or through short message service (SMS). Additionally, tier-3 permits for the restoration of necessary patient information which is able to be crucial to line up for acceptable treatment. Tier-1 and tier-3 are directly connecting with the assistance of GPRS/3G/4G whereas not the need of access point, relying upon the applying.

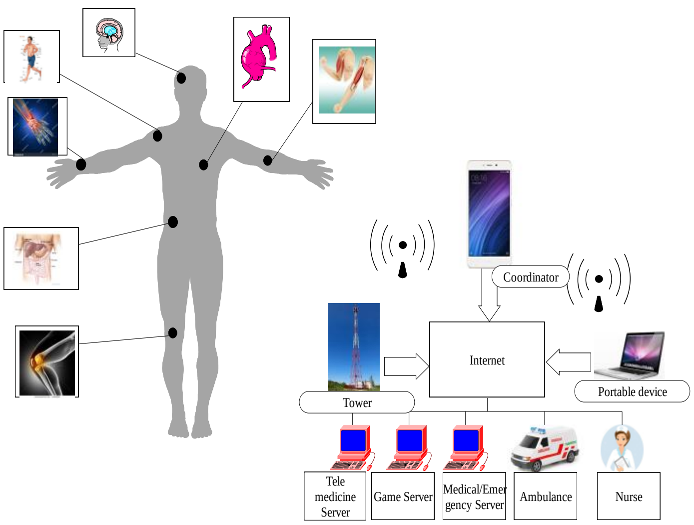

Fig1.1: WBAN Infrastructure for medical and non-medical applications

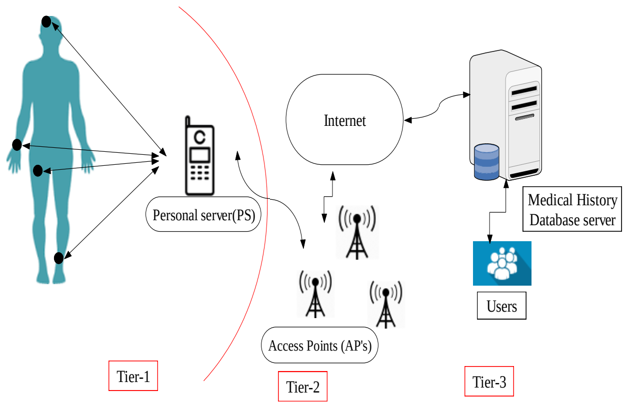

Fig 1.2: Communication tiers in WBAN

In this handout we describes in section one is about basics of wireless body area networks, section II is approximately literature read on diseases and its ancillary diagnostic tests, section III gives ephemeral information practically cooperative communication and cooperative communication in WBAN, section IV is about IEEE standard 802.15.6 including MAC and PHY layers, section V is approximately proposed theses work about single/dual and multi patient health monitoring by using cooperative communication techniques in WBAN followed by conclusion.

II. LITERATURE SURVEY

In this section we offer a survey of the diseases and its identification takes a look at necessities. Supported these take a look at doctor will counsel the potential treatment to the patient. Whilst a person suffering from the illness, he/she has the tour to go to the clinic for the primary remedy and the diagnosis check to be finished by means of the diagnostic centre. By way of seeing the prognosis of the suffering individual health practitioner could be accomplished the remedy that we will be mentioned within the underneath desk.

Survey on link failure detection in WBAN networks

Anurag Tiwari et al. (2016), are extremely important for people suffering from ailments such as heart disease, irrationally angry patients, pregnant women, and so on, as they require constant perception to function. Every one of these exercises requires more security as a result of the web connection. In other words, this paper discusses issues relating to security and protection.

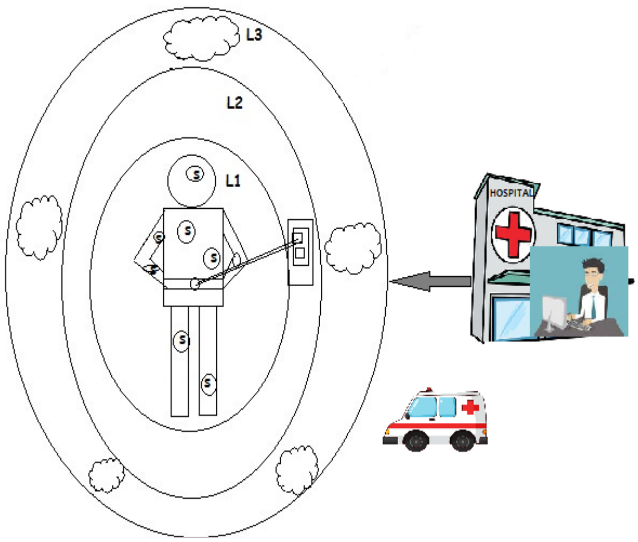

Fig 2.1 Functional Layer-based architecture of WBAN

Fig.2 is shown above. There are many sensors (s) attached to a user (human being) in layer L1. There is a personal server/gateway device that collects data from sensors in L1 in layer L2. Clouds and services based on the Internet can be found at layer L3. It also connects the user to a healthcare-based cloud in this L3 layer.

Humans have a moral obligation to improve the lives of all people, regardless of their age, gender, or location, in the current era of technological advancement. There's no doubt that health and wealth go hand in hand. Sickness sensitive people must be taken care of without disrupting their daily routines. Wired media was the only form of communication available in the pre-digital age. It lacked mobility and required a lot of money for cable maintenance. In today's wireless world, everything from communication to healthcare is wireless, as well.

AdwanAlanaziet al. (2016), In order to anticipate link failures in WBAN networks, various quality-of-service (QoS) routing strategies have been proposed that target changing throughput and end-to-end delays in remote Sensor systems (WSNs). WMSNs, the next generation of remote mixed media sensor systems, allow for a better distribution of data between high-quality data packets and low-latency, time-sensitive data packets. In these cases, hub advancement and load balancing can improve QoS.

Therefore, balancing long system life with quality of service (QoS) has been a critical consideration. The Optimized Node Selection Process (ONSP) method was presented in this paper to ensure robust multipath QoS directing in WMSNs.

Reza Khalilianet al. (2016), introduced a new strategy that improves the security of WBANs by increasing the encryption level. For the purpose of this paper, the goal was to reduce the number of memory control parcels required while also controlling the cradle-over-stream and controlling the current harm. AES-256 was used to improve security in this study.

Muhammad MoidSahndhuet al. (2015), Medical and non-medical applications are attracting increasing attention to Wireless Body Area Networks (WBANs). Keeping WBAN operational for a long period of time necessitates efficient energy use. There is a new routing protocol proposed in this paper for WBANs with BEC (Balanced Energy Consumption). Relay nodes are selected in BEC by using a cost function. Data is sent to the sink by way of relay nodes located close by. It has been proposed to detect link failures in WBANs using a steering convention for the Balanced Energy Consumption algorithm (BEC). BEC hand-off hubs are preferred due to their lower overall system cost. To get to the sink, hubs send their data to the nearest hand-off hubs. When hubs are closer together, they send more data to the sink. The hubs also only transmit the bare minimum of information if their vitality turns out to be less than optimal. Each round, hand-off hubs are rotated with an eye toward disseminating the heap consistently while taking into account a cost capacity. Using the re-enactment method, it can be shown that BEC achieves a 49 percent longer system lifetime than OINL.

Ilkyu Ha (2015), shown that WBAN has ecological characteristics that are distinct from those of existing WSNs. WSN advancements were not linked to WBAN because remote sensors in BAN are connected to various body parts and operate in a completely different system environment from existing remote sensor systems. ' Because the wireless sensors in a BAN transmit through the human body, the network environment for an aWBAN is very different from that of a sensor network that uses open space. There are a number of different areas of research that are unique to WBANs because they take into account the human body's unique characteristics. We look into how a WBAN differs from conventional sensor networks in terms of its environmental characteristics, as well as the areas that academia has studied in order to create WBANs that are even more efficient. Systematic Literature Review (SLR) techniques were used to investigate WBAN research trends since the concept of WBANs was first introduced in 2001. Investigations include categorising research and researching fields in accordance with the content of a given study. Survey results are also presented, as well as an outlook for future research.

III. COOPERATIVE COMMUNICATION IN WBAN

Mobiles with single antennas can extend their antennas and create a 'virtual' multiple-antenna system using cooperative communications [2].

In a traditional communication system, we tend to use two nodes are transmission and receiver for signal transmission through a channel however in cooperative communication we tend to use three nodes for signal transmission. The three nodes are transmitter, relay and receiver as shown in figure 3.

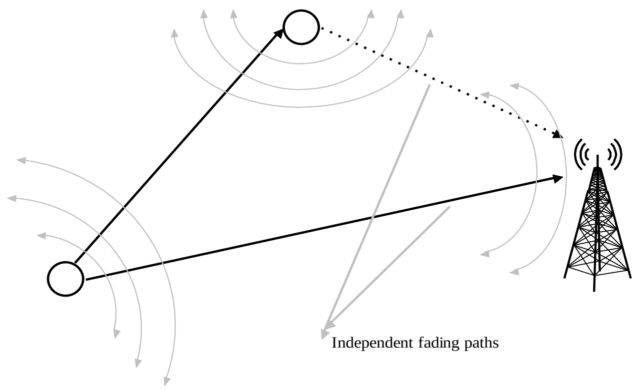

Fig3.1: Cooperative communication

Interference in the network, loss of rate to the coop mobile due to co-op activities and cooperative assignment are a few of the cooperative issues that need to be addressed. Wireless agents that can improve their effective quality of service measured at the physical layer by bit error rates, block error rates, and, outage probability via cooperation tend to be targeted in cellular or ad-hoc networks. We assume that each wireless user will transmit data and act like an agent for another mobile in coop. Power and information measure of mobiles result in important gains in system performance. Different kinds of relaying techniques are discussed in next.

i. *Fixed Relaying:*

Allowing relays to decode, reencode, and retransmit messages is permitted as long as the relays are limited in power. There are four primary cooperative wireless communication techniques: Detect and forward, Decode and forward, amplify and forward, and coded cooperation

ii. *Detect and forward:*

Using the traditional relay method, user tries to pick up on the partner's bits and then retransmit them The base station may assign the partners to each other or use other methods to do so.

iii. *Amplify and forward:*

It is possible for two people to communicate in a noisy manner. Is used to amplify and then retransmit the noise. The simple method involved in amplify and forward is sample, amplifying and retransmitting of a signal from base to destination via relay. Using the information sent by both the user and the partner, the Base station decides whether or not to transmit a particular bit. Although cooperation increases noise, the base station receives two independently faded versions of the signal and is better able to make decisions with the data. High SNR is the ideal result of amplify and forward.

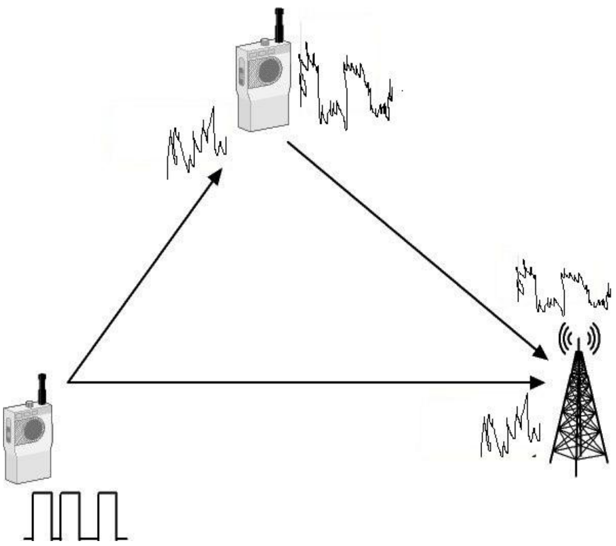

Fig3.2: Amplify and forward

iv. Decode and Forward:

It is a simple implementation of Code Division Multiple Access (CDMA) (CDMA). Using this model, two people work together. Bits are transmitted by each user at two different times during the signalling period, which are the first and second intervals. The second bit is then detected by each user. Second bits from each user are multiplied by the appropriate spreading code and transmitted in a linear combination to each other in the third interval. For the first, second, and third intervals, the transmit power can be varied, and by optimising the relative transmit powers based on channel conditions, this method provides adaptability to channel conditions.

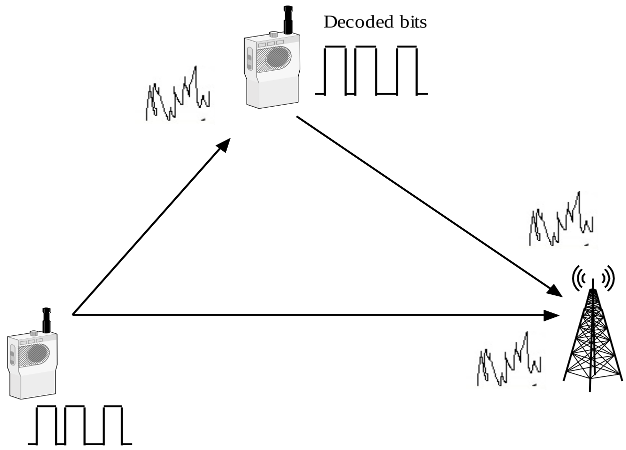

Fig3.3: Decode and Forward

v. Coded Cooperation:

Cooperative channels can be encoded using the coded cooperation method [4, 5]. Each part of the user's code word is sent as an independent code word. Redundancy can be transmitted incrementally by each user to its peers. CRC, RCPC, RPPC, and other coding techniques are used by the user code to separate their source data into individual blocks.

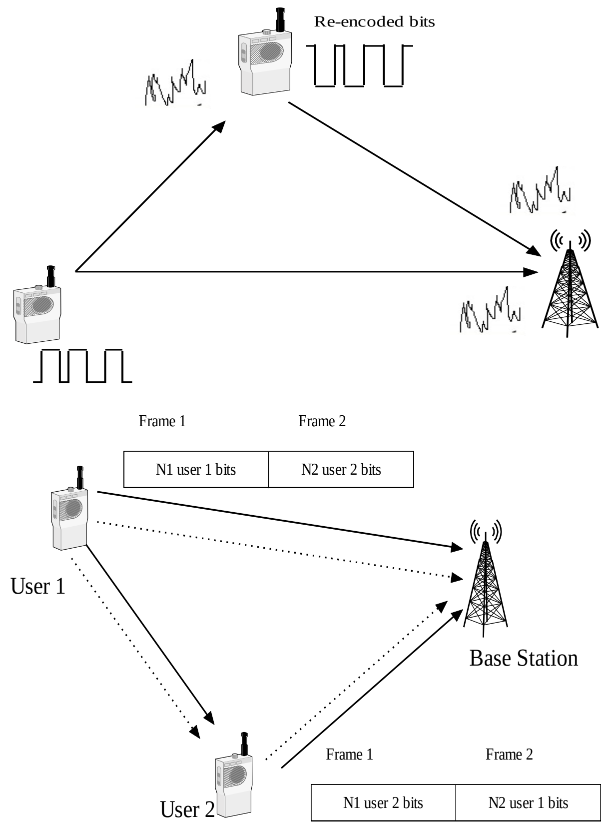

Fig3.4: Coded cooperation

vi. Selection relaying

Using selection relaying, transmitting terminals can choose a cooperative (or non-cooperative) action based on the measured signal-to-noise ratio (SNR).

vii. Incremental relaying

It is possible to benefit from incremental relaying in both fixed and sectional relaying because it uses limited feedback from the destination and relays only when necessary.

IV. COOPERATIVE DIVERSITY TECHNIQUES

Primarily, the idea behind Primary goal is to minimise small-scale fades and make sure the same data is delivered to receivers via channels that are statistically unrelated.

- *Types of Diversity*

To achieve spatial or antenna diversity, cellular or base station receivers typically employ multiple antennas. In order for a signal to be constructive or destructive, it must be separated from other signals → by a small amount of distance ($\propto \lambda$). Polarization, frequency, and time diversity are all other types of diversity.

- *Microscopic diversity*

In the fight against small-scale fading, microscopic diversity is most commonly employed (fading created by interference effects). It Use multiple antennas separated in space at a mobile, signals are independent if separation > $\lambda / 2$ but it is not practical to have a mobile with multiple antennas separated by $\lambda / 2$ (7.5cm apart at 2 GHz)

For microscopic diversity, it is possible to use multiple receiving antennas at base stations, but the separation between them must be on the order of ten wavelengths (1 to five meters). As a result of reflections occurring near the receiver, independent signals opened up tonnes before they reached the bottom station. 120-degree sectoring antennas typically use this configuration. On all four sides, two different receiving antennas complement the transmit antenna in each sector. A robust signal can be found on a different radio path if the signal on the primary radio path is weak, and the SNRs at the receiver can also be improved if one path is frequently selected.

- *Microscopic diversity Techniques*

Microscopic diversity includes spatial, temporal, frequency, angular, and polarisation variations, and it can be used in a variety of contexts, including cellular networks, WiFi, and Bluetooth (multiple antennas receiving different polarizations).

- *Macroscopic diversity*

In Macroscopic diversity, the Combat large-scale fading (fading created by shadowing effects), Frequency diversity/Polarization Diversity/Spatial Diversity/ Temporal Diversity isn't suitable here. It doesn't matter if the BS or MS has a hill between the transmitter and receiver antennas. Macro-diversity is created by using a separate BS and building an enormous distance between base stations1 and2. Using repeaters on the frequency (receive the signal and retransmit the amplified version). Even though synchronisation eliminates some of the complexity, the overall delay and dispersion are increased.
It's possible that broadcast applications such as digital television could benefit from using Simulcast (the simultaneous transmission of the same signal from multiple BSs.). Because so much signalling, synchronisation, and transmission data must be sent to base stations via landlines when using simulcast, this is a drawback of the technology.

- *Signal Combining*

Combining of signals is The best SNR can be achieved by selecting the best path or combining multiple paths to improve overall SNR. All other copies of the signal are discarded and only the 'Best' copy is processed (demodulated and decoded).
In Combining Diversity All signal copies are combined and combined signal is decoded. Combining diversity results in better performance but Rx complexity above Selection Diversity, and therefore the gain of Multiple Antennas are Diversity Gain and Beam forming Gain. Differential gain, Equal gain, and Equal gain diversity are the four types of space diversity.

- *Selection diversity Technique*

It's easy and inexpensive to select a wide range of options. This branch has the best instantaneous signal-to-noise ratio (SNR). In order for the system to stay with the current signal until it is likely that the signal has faded, a new selection must be made at a time equal to the fading rate.

- *Maximal Ratio Combiner (MRC) Diversity*

In MRC diversity, the amplitudes of the signals are weighted according to each SNR and then added together in phase. Since battery power isn't an issue in the base station receiver, modern digital signal processing (DSP) has made this the most difficult type to implement.

- *Equal Gain Combining (EGC) Diversity*

A single signal is created by using the EGC diversity technique. If G is set to 1, the phase will always be shifted to the right. Co-phased vectors add in phase to each branch's signal. Selection diversity has a lower success rate than this method.

- *Transmit Diversity*

At a single link, multiple antennas are used for transmit diversity (usually at BS). Received diversity branches are used in the uplink transmission from the base station. The transmitter is where the downlink diversity branches off. Send Diversity both with and without channel state data.

- *Time Diversity*

Time Diversity is the practise of re-transmitting the same information at different intervals of time. Signals can be considered independent if their coherence time is longer than the time interval between their arrival and departure. BW efficiency has been significantly reduced, which means that the signal is transmitted only once, requiring an increase in bandwidth in order to receive the same amount of data (data rate). If the data stream is repeated twice, the bandwidth required to receive the same amount of received data is either doubled or cut in half, depending on how many repetitions are performed.

- *Time Diversity - RAKE Receiver*

In DS systems, CDMA provides a powerful means of time diversity. Propagation delays in the MRC allow for multiple transmissions of the same signal at different times. Uncorrelated multipath signals are often characterised as having a time delay greater than the spreading sequence's chip period (independent). A basic system ignores these delayed signals because they've been delayed for a long time and appear as noise. To reduce noise, we can delay one signal from the rest and then receive it separately from the others. This can be accomplished by multiplying chip code by time shift. Correlation receivers are provided for each of the multipath signals in order to gather time-shifted versions of the first signal. Thus, the RAKE receiver may be a time-diversity receiver that collects time-shifted versions of the original transmissions.

The RAKE receiver affects multipath on a high-frequency transcontinental link with a selection spectrum Typically, it is assumed that each integer multiple of a chip time has a multipath component. As a result, the time delay between branches of the spreading code is Tc. For example, the RAKE receiver uses the spreading code to induce path diversity in the transmitted signal, which helps to resolve independent multipath components separated by several chips. Selection combining (SC), equal-gain combining (EGC), and maximum ratio combining (MRC) are all methods for combining ranges. In the RAKE, each branch/finger represents a portion of the signal that is at least one contribute time behind the other.

X. CONCLUSION

Low-power wireless communication protocols currently available for use in WBAN systems are reviewed in this paper. Additional specifically, provides the human diseases and its relative diagnostic tests in normal and abnormal mode. During this review, WBANs square measure accustomed modify health care professionals to incessantly monitor the single or multi patients and senior folks in indoor and outdoor environments. During this approach, abnormal conditions may be detected early which ends up in major enhancements within the quality of patients' lives and also enumerated about communication strategies, error correction and error detection coding techniques, synchronization methods. This paper investigates the longer-term prospects of health care systems that embrace the benefits, challenges and also the quickest areas of growth within the close to future by using cooperative communication techniques, IoT, D2D, M2M technologies.

XI. REFERENCES

[1] Weilin Zang, Shengli Zhang, Member, IEEE, and Ye Li, Member, IEEE ” An Accelerometer-Assisted Transmission Power control solution for energy efficient communications in WBAN” IEEE Journal on selected areas in communications, vol.34,no.12December 2016.

[2] Xiaohu Ge, Linghui Pan, Qiang Li, Guoqiang Mao, Song Tu, “Multipath Cooperative Communications Networks for Augmented and Virtual Reality Transmission”, IEEE Transactions on Multimedia, Vol. 19, No. 10,pp. 2345- 2357, October 2017.

[3] Aria Nosratinia, Todd E. Hunter, Ahmadreza Hedayat, University of Texas, “Cooperative Communication in Wireless Networks”, IEEE Communications Magazine, October 2004.

[4] Sriram Lakshmanan, “Cooperative Communication in Wireless Networks: Algorithms, Protocols and Systems”, Georgia Institute of Technology, August 2011.

[5] Mehmet R.Yuce, Jamil Y. Khan “ Wireless body area networks-Technology, Implementation, and Applications” © 2012 by Taylor & Francis Group, LLC CRC Press is an imprint of Taylor & Francis Group.

[6] Li Wang, Huaqing Wu, Zhu Han, Ping Zhang, H. Vincent Poor ”Multi-hop Cooperative Caching in Social IoT Using Matching Theory” 1536-1276 (c) 2017 IEEE.

[7] Abdur Rahim Mohammad Forkan, Ibrahim Khalil ” A clinical decision-making mechanism for context-aware and patient-specific remote monitoring systems using the correlations of multiple vital signs” computer methods and programs in biomedicine-2017 published in Elsevier.

[8] Media Aminian and Hamid Reza Naji “A Hospital Healthcare Monitoring System Using Wireless Sensor Networks” ISSN: 2157-7420 JHMI, an open access journal

[9] Himadri Nath Saha, Shreyaasha Chaudhury, Ruptirtha Mukherjee ” Internet of Thing Based HealthCare Monitoring System” 978-1-5386-3371-7/17/$31.00 ©2017 IEEE.

[10] Nosratinia, T. E. Hunter, and A. Hedayat, ``Cooperative communication in wireless networks," IEEE Commun. Mag., vol. 42, no. 10, pp. 74_80, Oct. 2004.