IOT Survey: The Phase Changer in Healthcare Industry

Gurpreet Kaur[1*], Manreet Sohal[2]

[1*]Department of computer engineering and technology, Guru Nanak Dev University, Amritsar, India
[2]Department of computer engineering and technology, Guru Nanak Dev University, Amritsar, India

Abstract— where the addicted use of internet is highly affecting the health life of today's generation, internet of things (IOT) is appearing as blessings for smart healthcare. The IOT's realism let us welcome nearly infinite chances and connections. The internet of things (IOT) is flattering the rising conversation of the concept which has potential to penetrate our living standard as well as our work surroundings. Internet of Things implies the future law that whatever is connected, will be connected. Healthcare symbolizes one of the essential monetary and societal challenges being dealt by the countries all over the world. It is offering a gateway for advance social and economical Healthcare era. This paper presents the significant survey of amalgamation of IOT and healthcare techniques based on health problems, diagnosis and services using optimized techniques. Moreover, the survey has shown how IOT is becoming far more proactive technology for chronic syndromes and patient's comfort using IOT's Smart-Healthcare Services.

Keywords— Big data with IOT, smart rehabilitation, sugar level sensing using m-IOT, Silicon bio-sensors, smart medicine Kit., Smart-ICU using Kinects, VIRTUS middleware, smart wheelchair.

I. INTRODUCTION

The Internet of things (IOT) is flattering the rising conversation of the concept that has the potential to impact our living standard as well as our work surroundings. Extensive accessibility of Broadband , falling price of links, Wi-Fi competency is producing bulk of devices along with built-in sensors, reducing technology expenditure, and invasion of Smartphone is shooting up to the sky. Everything crafts a "great squall" in favor of the IOT. The IOT is a huge relationship of "things" connecting people to people, people to things, and things to things. Any machine/device/tool such as cellular phones, coffee-machines, washing machines, earphones, lanterns, wearable devices and many more we consider can be linked to a toggle to the Internet [1]. The forecaster corporation Gartner (Gartner, Inc. provides information technology, research and consulting services) estimates over 26 billion connected devices by 2020. Impact of IOT, say, during going for the meeting by four-wheeler; vehicle could have access to acquire the finest path, Four-wheeler might inform the second person via message of being late in case of intense traffic. How will you feel when your timer gets you up morning at 5 and inform the coffee-machine to prepare coffee for you? , workplace devices already know the low-supply timings and robotically reorganize further?. The IOT's realism let us welcome nearly infinite chances and connections.

The paper is organized as: Section II includes the amalgamation of IOT and healthcare industry. Related work

has been discussed in Section III. We have also discussed the deficient conventional health services as well as IOT driven significant survey of optimized techniques with benefits precisely in Section IV. Section V involves the conclusion.

II. AMALGAMATION OF IOT AND HEALTHCARE INDUSTRY

Large functions of new technology in healthcare are providing the growth of medical information system. Healthcare symbolizes one of the essential monetary and societal challenges being dealt by the countries all over the world. Moreover, healthcare governance is dealing with escalating burden so that they can regulate the developing hopes of civic and classified zone as well.

Swelling price tags of health checkup, even highest in chronic syndrome cases has most important impact on the quality of the life of people [2]. Constant increase of aged ones compels the public service and fitness service [3], healthcare industry progress demands a rigorous attempt to exploit the information authority and interactive equipments to generate extra capable, successful, and protected data distribution, wide-ranging data processing, as well as successful connections. [4] proposed a huge number of device connections notably developed healthcare rescue where wireless sensors are used for data collection and cloud oriented software for data analysis. From the last 10-15 years, healthcare service providers, dealers, and rescue teams, hospital authority are connected with the use of cellular

phones, laptops, smart-phones, Wi-Fi technology, and interactive tools [5] and facilitates to turn out to be new proactive regarding Healthcare deliverance.

III.   RELATED WORK

A.   Role of Big data in e-health

The Objectives of Big data are firstly to develop the health zone management as well as progress in chronic patient's cases that require constant observation and its data storage. Objectives also involve receiving numerous parameters with the help of invasive or non-invasive devices for patient's welfare and control assurance. Apparatus improvement with the technologies, however, have lots of data collection by using measures and stores the vital sign information. Also, procedure followed through the medical squad (amount of medicine, team and the rest), patient's locality with radio-frequency card, using controlled devices, their position, conditions and maintenance, locality of the staff and medical supply, along with parallel progress in savings and fine use plays vital role in e-health.

- In date investigation, the prime rewards of this technology are the medical devices connected with patient and with medicinal squad, subsequently, cost testing, investigating the division (medical apparatus, research, insurance and organization.

- In diagnosis, this technology helps to access to all health zones for every patient apart from the location where test was conducted. Furthermore, real time tests storage, permit instant decision- makings.

B.   IOT's VIRTUS middleware

VIRTUS IOT middleware gives a suitable choice to present IOT's way out for growing population and healthcare. VIRTUS forces an XMPP (Instant Messaging protocol) to promise a nearly real-time, protected and trustworthy guide amongst varied devices, combines the data provided from lots of varied sources (in favor of hardware, software structural design as well as the use of communication procedure). Here, structural design layer is known as "middleware". Units of XMPP find whether the messages are sent to the target even in the case of absence of a sender i.e. no internet. XMPP, initially recognized as Jabber, is a XML based, open, real-time messaging set of rules. Being entirely decentralized where each server handles their personal system, it can also be accessible from the open network [6].

C.   Smart Medicine Kit

Smart medication sachet (sMedSachet) performs dwelling healthcare doorway. IOT devices (e.g., wearable sensors, smart medication kit (sMedKit)) are flawlessly linked to the sMedSachet via a heterogeneous or mixed set of connections well-matched with numerous wireless principles. The Bio-Patch that can be wear, trace and gather real-time biological indication to the sMedSachet. RFID link helps to link the

sMedKit and the sMedSachet provides the approved medicated system.   In the meanwhile, the sMedSachet performs on stage of dwelling healthcare. The ideal sMedKit throws home information in return such as identification number of kit, numerous medication untie holes, numerous unbroken holes, and proceed accordingly e.g. to unlock particular medication holes.

D.   WBMSD

Wearable bio-medical sensing devices (WBMSD) such as Electrocardiogram (ECG) and electroencephalograms (EEG), the most frequently bio-indicators imperatively observe and examine the status and detection of patient's syndrome [7]. Collective use of sMedKit and WBMSD makes digitization of ECG where body temperature broadcast to the sMedSachet then collects the information of patient's heart-beat then analysis and detect heart-beat daily hence record based ECG signals are given by WBMSD Bio-Patch. The sMedSachet activates an alarm in case of heart-beat that shows constant abnormality. The sMedSachet without human intervention sends message to the physician if the situation is not under control within, say, 8-10 minutes. AV (audio-video) interface is obtainable as well between both parties via sMedKit.

E.   SICU (Smart Intensive Care Unit)

This is general healthcare scheme for patient examination in danger in smart Intensive Care Units. Traditional observatory tasks are: heart-rate and heart-beat , breathe-rate and saturation point of oxygen, blood-pressure, body Heat [8]. For preventive measures and observation, Microsoft's XBOX Kinect^{TM} generates a smart ambience to analyze the patient's status in danger in ICU. This gadget is capable to notice actions or things done by the patient, features identification and speech recognition via sensors. Proficient side is the 20 points of joint helps to spot head, hands, feet, shoulders, knees. The most attractive feature of the Kinect^{TM} is that patient don't need to have wearable sensors or wearable gadgets.

F.   m-IOT

m-health known as mobile health is nothing than portability, medicated sensors, and interactive tools for healthcare services. Noticeably further, general services and protocols for IOT outline needs little changes in service of warning, asset distribution, internetworking, transmission set of rules for mixed or heterogeneous devices, and connection protocols. Theoretically, m-IOT lets you know about the brand-new healthcare interface replica which connect the 6LoWPAN (6 layer wireless personal area network) having 4G network for next generation m-health services, where now m-IOT characteristically shows the IOT's healthcare service [9].

- Sugar-level sensing using m-IOT: Metabolic syndromes like diabetes-extended sugar levels, high blood-glucose examination assists meal-planning,

movement, and time of medicines interactive gadgets such as a sugar device to collect blood-glucose, a mobile or CPU [10].

▪ Body heat observation using m-IOT: Body temperature is a powerful imperative indication to repair the homeostasis [11]. The m-IOT theory of body temperature deviations presents the successful process [12].

G. IOT-SRS (Smart Rehabilitation System)

The potential of IOT improves rehabilitation systems by means of increase in elder inhabitants and the lack of health professionals. An ontology-based automating design method for IOT-based smart rehab-systems is proposed in [13] IOT methods is capable of valuable communications that maintain successful remote surveillance of wide-ranging rehab-systems [14], IOT-based jail rehab-systems [15], the therapy guidance of hemiplegic patients [16], a smart city medical rehab-system [17].

H. Smart Wheelchair Management

Smart Wheelchair based on IOT technology is presented in [18]. The proposed design came up with WBANs incorporated sensors adaptable operations to IOT constraints, A medical support system is the remarkable case of IOT-based smart wheelchair development connected designed by Intel's IOT department used by Dr. Stephen Hawking [19], such kind of technological expansion ultimately shows involvement of normal "things" into data driven linked mechanism. Smart wheelchair is capable to analyze the important indications of the personal sitting in the chair. Data gathering is also done on the basis of patient's ambiance helps to rate the ease of access rate.

I. Smart-phone and IOT

The emergence and highlights of the rise of smart-phones as a driver of the IOT has been witnessed by latest years. Smart-phones is proficient in performing the healthcare analysis as follows: the asthma diagnosis, chronic disruptive pulmonary syndrome, cystic brosis, cough infections, allergic syndromes, ENT warning signs as well as of the respiratory tract, the heart-rate, Blood-Pressure, sugar saturation levels, and advanced growth and investigation of injury in diabetes patients [20] [21]. Some of a good but incomplete survey of smart-phone applications giving healthcare solutions has been presented in [22].

J. IOT-RFID and IOT-GPS

These techniques have been proposed as sensor-integrated and data repository schema that could successfully add and Stores the heterogeneous IOT data sources such as radio frequency identification (RFID: within e-health this could be used as patient's ID, to diminish mishaps, wrong medicine or dose, or for wrong recognition of the child to where the children are put in the wrong cradle). Safety administration of fresh food (RFID, GPS) had been extended from manufacturing to clearance in the food industry [23]. For an instance, food superiority examination by the use of real-time sensor and maintain different functional goods, decision makings by capturing the data even during climate changes. Moreover, if the billions of tags and sensors could be linked through the Internet networking then it can be possible to generate an extraordinary number of connections, data capacity as well [24], [25]. An automobile industrialized tracking system; for instance, need to store hundreds of Giga byte data merely to mange 30 units of a solitary motor-vehicle manufacture row. Now, Mongo-DB: the mostly accepted, developed by 10th gen, is a document oriented NoSQL database that recommends elevated routine and scalability. Mongo-DB uses a flexible scale-out plan for hardware growth, and support auto-sharing. Hence automatic distribution of data becomes handy over numerous servers [26].

K. IOT based WBAN

The 5G (fifth generation) of network holds the IOT technology as a supportive mechanism in various healthcare applications, offers hundred times superior wireless bandwidth along with power saving and utmost storage consumption using big data analytics. A wireless network accurate spectrum, allowed by FCC, could be worked to examine the data of patient with the healthcare potential of the MBAN devices in the 2360–2400 MHz band [27]. The IOT based wireless body area network (WBAN) [28] wearable or as in-body sensors are implanted under the skin that work upon wireless network. Constant capturing and sending essential indications such as BP, Heat, sugar-level, humidity and heart activities, collected data transmits to a main controller or straightforwardly transmitted via Bluetooth or ZigBee (less power consumption and small batteries provides much longer life-span) [29], detailed architecture of WBAN system is given in [30].

IV. DEFICIENT HEALTH SERVICES AND OPTIMIZED TECHNIQUES WITH IOT

Major shortcomings based on traditional health services and technologies have shown in table 1. Significant survey of optimized techniques with IOT along with the benefits has shown in table 2 as follows:

TABLE I. SHORTCOMING OF CONVENTIONAL HEALTH SERVICES AND TECHNOLOGY

S. NO.	HEALTH DIAGNOSIS, SERVICES, PARAMETERS	SHORTCOMINGS
1.	Medicinal research, data investigation, diagnosis.	Less storage, costly treatment, unable to process the bulky stored data with less amount of time, cannot store the different test-cases in real time, unable to access common health zones increases waiting time of diagnose results.
2.	Heterogeneous sources or devices for data mixing in electronic health applications.	Mobility intrusion causes Irregular communication which proposes unpredictability.
3.	Traditional ICU observation	Presently, patient monitoring by personnel medical team causes unavoidable human errors.
4.	Universal ageing and dominance of chronic syndrome in traditional HIS (Healthcare Information System)	Most of the countries are undergoing major problem of rising number of old-age patients and shortage of hospital beds, hard regular check-up, economic load, incomplete hospital-centric assets in emergency care.
5.	Holter System, wearable sensor nodes for ECG , EEG etc	This type of obtrusive observation system has Physical margins, huge size, rapid enclose, warped wires, sensor band node have to forcefully pushed against user's upper body which is painful for long term use, pricey, large power use.
6.	Sugar-level examination	It might be possible if failure of Traditional clinical devices in true conditions, chances of errors can impact the quality, hundreds machines, thousands workers, dozens of sites gives faulty devices, ecological contact, patient intrusion.
7.	Lack of health experts	Mitigation problems linked with bodily impaired or disabled person.
8.	Body heat observation	Lengthy measurement time, less precision, not easy to determine the patient's body with accuracy.
9.	Mobile phone health apps	Provides only general static information based on different diseases , healthy and ill personal's medication
10.	Wheelchair supervision	Semi-automated traditional wheelchair gives normal ease but patient has to go for daily check-ups.
11.	Food quality examination	Hard to get the accurate Information of stale items, difficult to track constant food supply chains.
12.	Wired monitoring system	Hindrance in patient's movement and growth of errors, infections in health-zone ambience, hard to constant monitoring by the team, costly.

TABLE II SIGNIFICANT IOT BASED SURVEY IN HEALTHCARE INDUSTRY

S. NO.	OPTIMIZED TECHNIQUES USING IOT	ADVANTAGES
1.	Big data with IOT	Storage and processing times are spectacularly trimmed down with the reuse of previously collected data and medical ,devices afterward values testing, cost effectively investigate the whole division such as medical apparatus, research, insurance and organization, common access to all health zones, and every patient's information stores in real time and instant decisions on test basis
2.	IOT's VIRTUS Middleware using XMPP	Distant inspection, able to fetch healthcare to the patient's home, dynamic XMPP helps to address the heterogeneous sources or devices despite of their location, built-in three unlike copies of system always upgrades simultaneously.
3.	S-ICU monitoring using XBOX Kinect	Microsoft's XBOX kinect works using sensors in that case where sensor device itself stop measuring the contact resistance even if the patient has been eliminated from sensing devices, wire or at false alarm, kinect uses concurrently mainly six skeleton and collect various data about joints , location etc
4.	Smart Mediation Kit using Smart medication Sachet	Timely reminder of medication, exact control over the quantity of advised medicine, avoid medication misuse, clinical prescription is stored inside, sMedSachet alarm, SMS to clinical professionals, alarming abnormal heart rate.
5.	Unobtrusive Bio-sensors with Flexible WBMSD (Bio-patch)	Silicon-on-Flex technique provides bendy, slim, easy, less power used, reasonable price, digitization of WBMSD with sMedKit, wireless data broadcasting, sMedSachet senses various Bio-indicators such as ECG, EEG, temperature sensor.
6.	Sugar-level sensing using m-IOT	Real-time noninvasive glucose sensing by m-IOT, patient's senses are connected by IPV6 to the supplier, broadcasts the collected data on IOT system and examine the glucose-level reports
7.	Smart rehabilitation system (IOT's SRS) using ontology based automatic propose way	Signifies important branch of medicine, worthwhile infrastructure to useful isolated consultancy in complete re-hab for prisons, exercise of hemiplegic patients, verbal communication exercise for early day autism.

8.	m-IOT using home-gateway	Sensors get the different timely little evaluations, speedy, automatically accurate. Home-gateway broadcasts the temperature with infrared exposure.
9.	Smart-phones as drivers of IOT	Ability of Ubiquitous deployment and provides the availability of low cost solutions, asthma diagnosis, chronic disruptive pulmonary syndrome, cystic brosis, cough infections, allergic syndromes, ENT warning signs as well as of the respiratory tract, the heart-rate, Blood-Pressure, sugar saturation levels, and advanced growth and investigation of injury in diabetes patients.
10.	Smart wheelchair using IOT (WBAN)	Fully automated, chair vibration control helps to find the condition of patient on wheelchair, determine vitals and gather data on the ambiance, provides ranking of a site to ease of access.
11.	IOT based RFID and GPS	Maintain numerous operational logistic choice creations; accomplish Green, less carbon power saving needs.
12.	IOT based WBAN	Affordable wireless body area network provides Data gathering of blood pressure, temperature, sugar level, moisture level and heart behavior then broadcast main signals to the doctor's site for real time analysis in case of critical situation

V.   CONCLUSION

The penetration of IOT in the health management and Industry is, undoubtedly, rising day by day. Successful IOT driven technologies such as, big data gives the cost effective ways to get rid of the huge data storage limitations, where affordable wireless technologies such as digitized WBAN, RFID, flexible bio-sensors helps to transfer the patient's emergency data from remote areas. A cherry on top of the cake is smart healthcare mechanism. Low cost advance investigation of heart rate, blood pressure as well as asthma syndrome given by IOT driven Smart-phones. Smart ICU's provides contact resistant sensors (Kinect), instant treatment, emergency alarms as well as more comfortable support system for patients specially children and aged ones. Communication protocol connects the patient's senses and broadcast the real time examined data to the supplier for further reports. In this way, the magic blending of IOT and current technologies with better understanding has been surveyed in this paper as a phase Changer of healthcare industry.

REFERENCES

[1]. F. Wortmann, and K. Flüchter. "*Internet of things*." International Journal of Business & Information Systems Engineering, Springer, vol. 57, Issue.3, pp. 221-224, 2015.

[2]. O. Geman, S. Sanei, I. Chiuchisan, A. Prochazka, and O. Vysata, "*Towards an Inclusive Parkinson's Screening System*", In the proceedings of the IEEE 18th International Conference on System Theory, Control and Computing ICSTCC, Romania, pp. 470-475, 2014.

[3]. C. Turcu, C. Turcu, D. Tiliuṭe, "*The Potential of Internet of Things to Improve the Quality of Healthcare Delivery*", Journal of Applied Computer Science & Mathematics, Vol. 6, Issue.13, pp. 73-78, 2012.

[4]. J. Tan, "*E-Health Care Information Systems*", John Wiley & Sons, 2005.

[5]. J. Gubbi, R. Buyya, "*Internet of things (IoT): A Vision, Architectural elements, Future directions*", journal of Future Generation Computer Systems, Elsevier, Vol. 29, Issue. 7, 2013.

[6]. M. Bazzani , D. Conzon D, A. Scalera , M.A Spirito, C.I. Trainito, "*Enabling the IoT paradigm in e-health solutions through the VIRTUS middleware*." In Trust, Security and Privacy in Computing and Communications, 2012 IEEE 11th International Conference, pp. 1954-1959, 2012.

[7]. Y.M. Chi, T.P. Jung, and G. Cauwenberghs, "*Dry-Contact and Noncontact Biopotential Electrodes: Methodological Review,*" Journal of IEEE Reviews in Biomedical Engineering, vol.3, pp.106-119, 2010.

[8]. F.A. Drews, "*Patient Monitors in Critical Care: Lessons for Improvement*," Patient monitors in critical care: Lessons for improvement, Agency for Healthcare Research and Quality (US), 2008.

[9]. R.S.H. Istepanian, E. Jovanov, and Y. T. Zhang, "*Guest editorial introduction to the special section on m-health: Beyond seamless mobility and global wireless health-care connectivity''*, Journal of IEEE Transactions and information Technology in Biomedicines, vol. 8, Issue. 4, pp. 405 414, 2004.

[10]. R. Dimova, et al, "*Risk factors for autonomic and somatic nerve dysfunction in different stages of glucose tolerance*", Journal of Diabetes and Its Complications, Elsevier, Vol. 31, Issue. 3, pp. 537-543, 2017.

[11]. M. N. Ruiz, J. M. García, and B. M. Fernández, "*Body temperature and its importance as a vital constant*", National Journal of Revista Enfermeria, Spain, vol. 32, Issue.9, pp. 44-52, 2009..

[12]. R.S.H. Istepanian, S. Hu, N. Y. Philip, and A. Sungoor, "The potential of Internet of m-health Things 'm-IoT' for non-invasive glucose level sensing" In the proceedings of *IEEE Annual International Conference of Engineering in Medicine Biology Society (EMBC)*, Boston, U.S.A**,** pp. 5264-5266, 2011.

[13]. Y.J. Fan, Y. H. Yin, L. D. Xu, Y. Zeng, and F. Wu, "*IoT-based smart rehabilitation system*", Journal of IEEE Transaction on Industrial Informatics., vol. 10, Issue.2, pp.1568- 1577, 2014.

[14]. B. Tan and O. Tian, "*Short paper: Using BSN for tele-health application in upper limb rehabilitation*," In the proceedings of the IEEE World Forum on Internet of Things (WF-IoT), South Korea, pp. 169 -170, 2014..

[15]. B. Singh, et al., "*A review on internet of things and its applications in healthcare*", Journal of Chemical and Pharmaceutical Sciences, Vol. 10, Issue. 1, 2017..

[16]. J. Krupinski, J.J. Secades, R.K. Shiraliyeva, "*Towards Effective Neurorehabilitation for Stroke Patients*", International Journal of Physical Medicine and Rehabilitation, Vol. 2, pp. 2, 2014.

[17]. P. Elanthiraiyan, S. Babu, "*Smart Medicine and Physical Health System Using IoT*", International Journal of Computer Science and Mobile Computing, Vol. 4, Issue. 3, pp. 333–338, 2015.

[18]. L. Yang, Y. Ge, W. Li, W. Rao, and W. Shen, "*A home mobile healthcare system for wheelchair users*" in Proceedings of IEEE

International Conference Computing Supported Cooperative Work Design, pp. 609- 614, 2014.

[19]. K.M. Larsen*, "Stephen Hawkings: a Biography",* Greenwood publishing group, U.S, pp. 105-130, 2005.

[20]. E.C. Larson, M. Goel, G. Boriello, S. Heltshe, M. Rosenfeld, and S. N. Patel, "Spiro Smart*: Using a microphone to measure lung function on a mobile phone*", in proceedings of *ACM* International Conference Ubiquitous Computing, Pennsylvania ,USA, pp. 280-289, 2012, ISBN: 978-1-4503-1224-0.

[21]. E.C. Larson, T. Lee, S. Liu, M. Rosenfeld, and S. N. Patel, "*Accurate and privacy preserving cough sensing using a low-cost microphone*", in the Proceedings of the ACM 13th International Conference Ubiquitous Computing, Beijing, China, pp. 375- 384, 2011, ISBN: 978-1-4503-0630-0.

[22]. E. Agu *et al.*, "*The smartphone as a medical device: Assessing enablers, benefits and challenges",* in the Proceedings of the 2013 10th Annual IEEE Communications Society Conference on Sensor, Mesh and Ad Hoc Communications and Networks, New Orleans, USA, pp. 76-80, 2013.

[23]. Y.S. Kang, H. Jin, O. Ryou, and Y.H. Lee, "*A simulation approach for optimal design of RFID sensor tag-based cold chain systems,*" Journal of Food Engineering, Elsevier, vol. 113, Issue.1, pp. 1–10, 2012.

[24]. L. Jiang, L.D. Xu, H. Cai, Z. Jiang, F. Bu, and B. Xu, "*An IoT-oriented data storage framework in cloud computing platform*", IEEE Transactions on Industrial Informatics, vol. 10, Issue. 2, pp. 1443–1451, 2014.

[25]. D.E. O'Leary, "*Big data', the 'Internet of Things' and the 'Internet of Signs*", Intelligent Systems in Accounting, Finance and Management, vol. 20, Issue.1, pp. 53–65, 2013.

[26]. K. Banker, *MongoDB in Action*, Manning Publications Co., Shelter Island, NY, USA, pp. 267-270, 2011.

[27]. J.M Cano-Garcia, E. Gonzalez-Parada, & E. Casilari, , "*Experimental analysis and characterization of packet delay in UMTS networks*", International Conference on Next Generation Wired/Wireless Networking NEW2AN 2006: Next Generation Tele traffic and Wired/Wireless Advanced Networking, Springer, Berlin, Heidelberg pp. 396-407, 2006, online ISBN 978-3-540-34430-8.

[28]. J. Prokkola, et al, "*Measuring WCDMA and HSDPA delay characteristics with QoSMeT*", Communications, 2007. ICC '07. IEEE International Conference on, Glasgow, UK, pp. 492-498, 2007.

[29]. N. Chhabra, "*Comparative Analysis of Different Wireless Technologies*", International Journal of Scientific Research in Network Security and communication, Vol. 1, Issue. 5, pp. 13–17, 2013.

[30]. L. Fuentes, N. Gamez, P. Sanchez, "*Managing variability of ambient intelligence middleware*", International Journal of Ambient Computing and Intelligence, Vol. 1, Issue.1, pp. 64–74, 2009.

Authors Profile

Gurpreet Kaur has graduated with B.Tech (CSE) from Punjab Technical University, Jalandhar, in 2013 and M.Tech (CSE) from Guru Nanak Dev University, Amritsar in year 2015. She is currently working as Assistant Professor in Department of Computer Engineering and Technology, Guru Nanak Dev University, Amritsar.

Manreet Sohal has passed out her B.Tech (CSE) in year 2013and M.Tech (CSE) in a year 2015 from Guru Nanak Dev University. She is a research scholar, pursuing PhD at Department of Computer Engineering & Technology, Guru Nanak Dev University Amritsar. Her main area of interest is Cloud Computing.