Review of 6G Communication in HapticTechnology

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ABSTRACT

The sixth-generation (6G) wireless communication network is projected to incorporate the surface-dwelling, airborne, and naval communications into a strong network which would be more consistent, dissolute, and can provide a enormous number of devices with ultra-low potential requirements. Block chain, NOMA(non-orthogonal multiple access),quantum Machine learning(QML),edge Computing, small cells communication etc., are the highlighted technologies in the situation of beyond 5G(B5G) and 6G communication. Entire health sector will be dominated by 6G communication Technology in the upcoming era. Apart from health sectors diversified sectors are predominately occupy by 6G communication Technology. Perception of human Lifestyle are revolutionized by Artificial Intelligence based 6G communication Technology. In this paper Artificial Intelligent based 6G smart healthcare,haptic communication are briefly discussed. The key resistance of present healthcare system is time and space which is totally exhaust by implementing 6G communication technology interlinked with Internet of Things. Transportation of Patient from remote to Intensive care is facilitated by ambulance which can be serviced by normal vehicle also. Besides the hospitality for elderly peoples are very unsatisfactory most of them are died while transporting without having a proper communication. Real time date of a patient monitoring and accident detection system are lagging in the present scenario which is totally overcome by implementing AI-6G Integrated IoT based smart health care system. . Furthermore, Epidemic and Pandemic outbreaks, for instance, COVID-19, cannot be controlled due to lack of advanced infrastructure. A similar kind of virus will again arise in future. Thus, it is utmost important to develop 6G with smart Healthcare, haptic communication.

Keywords: 6G communication, Haptic, Artificial Intelligence, Machine Learning

INTRODUCTION

6G communication technology plays a vital role due to its specialised features, many researchers has studied a detailed work in these fields. Perception of multi domain applications will be revolutionised by 6G technology from 2030 onwards. Also the integration of tellurion, atmospheric data and coastal communication can be achieved by the implementation of 6G Technology.

Forthcoming technology in communication field targets to accomplish high spectral, power expansion and enormous networking system through the development of IoT devices. Such IoT enabled devices will develop advanced system like automatic traffic control, nature conditional monitoring, agricultural surveillance, e-health, telepresence haptic systems in integrated drones and robots. By the year 2030 IoT enabled devices are predictable to reach 30billions and hence it is the competitive task for the prevailing system to compensate huge devices. Next generation mobile network (NGMN) white paper suggesting the development of digital data transmission for society and across industry with multiple accessibility and associated requirements. Initially, it elaborates the 6G driver and essential guidelines for upcoming technologies to the compatibility of end users, Societies and MNO. In this chapter 6G communication for haptic technology is outlined which enables multiple services with enhanced market opportunities and innovations. Also, the chapter discuss the number of fundamental principles, inclusion of recent development and method, that requires to be included in design and development. Inspite of the 5G communication, performance higher than that of prevailing networks are being developed.5G network has the capacity to handle more than 50K IoT's and/or narrow band IoT(NB-IoT) devices. By this a huge clustered network can be developed by implementing 6G communication protocol.

LITERATURE REVIEW

Presently there is a less resource of 6G is available. By the year 2030,it is estimated that the international standardisation bodies will figure out the standards of 6G and by 2035, research centres will find out the human computational capabilities of 6G.across the world the researchers have initiated studies about Next Generation Network protocol. Approximative time period for 5G, B5G and 6G implementation is 10 year.

In 2015 the requirements of International mobile telecommunication 2020(IMT-2020) for 5G network standard was issued by International telecommunication Union Recommendation sector(ITUR), during the same period R13 for 6G was promoted by 3GPP. By the year 2030 it is forecast that 6G standardisation (ITU-R-IMT-2030) will complete by ITU whereas its protocol in R23. Research group nominated by ITU for the development of B5G/6G systems in July 2018. In 2018, the flagship programme named as 6Genesis was established by the Academy of Finland. It was initiated by the developed countries like China, United States of America, Russia, South Korea, Japan.

Research activities of 5G has moved to 6G networks for next generation communication system. Competitive analysis, Product benchmarking, Market trends, Product development are some of the report scope of next generation communication.[1-4] shows the forecasting communication, wide usage of 6G.Authors in [5-9] presents the perception of 6G application, its capabilities and customization. Realisation of millimetre microwave technology in satellite communication was described in the article [10] David etal.,[11] pointed out the potential usage of 6G in wireless charging and high data rates. Also he shows the socio ethics situations of 6G communication. Healthcare, societal problem and business application of 6Gcommunication was proposed by Nayak and Patgiri [12]. It shows the demanding challenges in 6G communication.

Haptic technologies is defined as physical sensation while touching with real environment. Interaction with human is performed through a distant mode like teleoperation and it is monitored using a computer system. The development of haptic communication is increased in this past years, haptic device development is based on the integration of multi disciplinary actions such as programming the algorithm, electro-mechanical operation, human factors. Haptic device performs in a closed loop manner where the user interact with computer control devices and create the sense of reality. The working of haptic devices is accomplished by the actuators mechanism also called haptic feedback.

Perception of haptic device application include entertainment industry, health sectors, navigation sectors, advanced warning system such as Lane departure in cars etc., Presently it involves the application in centralised Jurisdiction for face recognition, Scleral and limbus reflection for eye analysis procedures. The principles of haptic device is based on clusteringof force & vibration which uses a closed feedback loop to stimulate the user.

All customized device would be familiar about the accessing points, properties and quality of services, need of interconnected equipment in their domain. And to improve the overall efficiency time domain transmit beam forming can be used. It must have faster CPU to handle and toggle the resources (Bandwidth, Time, Power) The huge interconnected customized devices and the data is processed by the baseband units. It gives the important units in the 6G architecture which will pave the way for the structure of next gen 6G development. The Air interpretation is the major block that enhances wireless communicationorthogonal frequency division multiplexing plays a vital role in 4G development, whereas code division multiple access in the case of 3G.In the design of 6G architecture the air interface will play a important role.

In addition interfacing AI and ML algorithm is a vital component in guiding wide organization, self-healing, self-configuration of 6G communication. To adopt spectral communication spectrum congestion has been considered as an active component. 6G will cover multi device network ranging from IoT devices to high level devices, So 6G is designed to be coherent with all traditional technologies. For this requirement a Flexible and multi radio access technology system is introduced in the architecture.

Table 1: The predicted growth of global mobile connectivity

Issue	2010	2020	2030	Unit
Mobile subscription	5.32	10.7	17.1	Billion
Smartphone subscriptions	0.645	1.3	5.0	Billion
M2M subscriptions	0.213	7.0	97	Billion
Traffic volume	7.462	62	5016	EB/month
M2M traffic volume	0.256	5	622	EB/month
Traffic per subscriber	1.35	10.3	257.1	GB/month
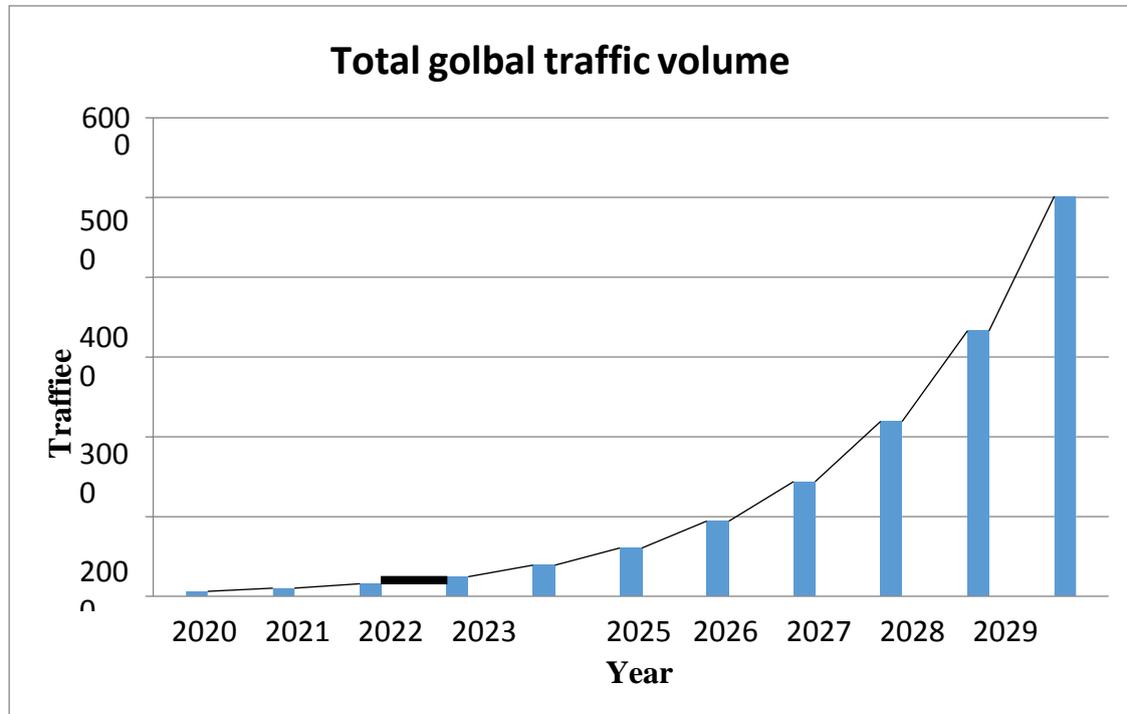
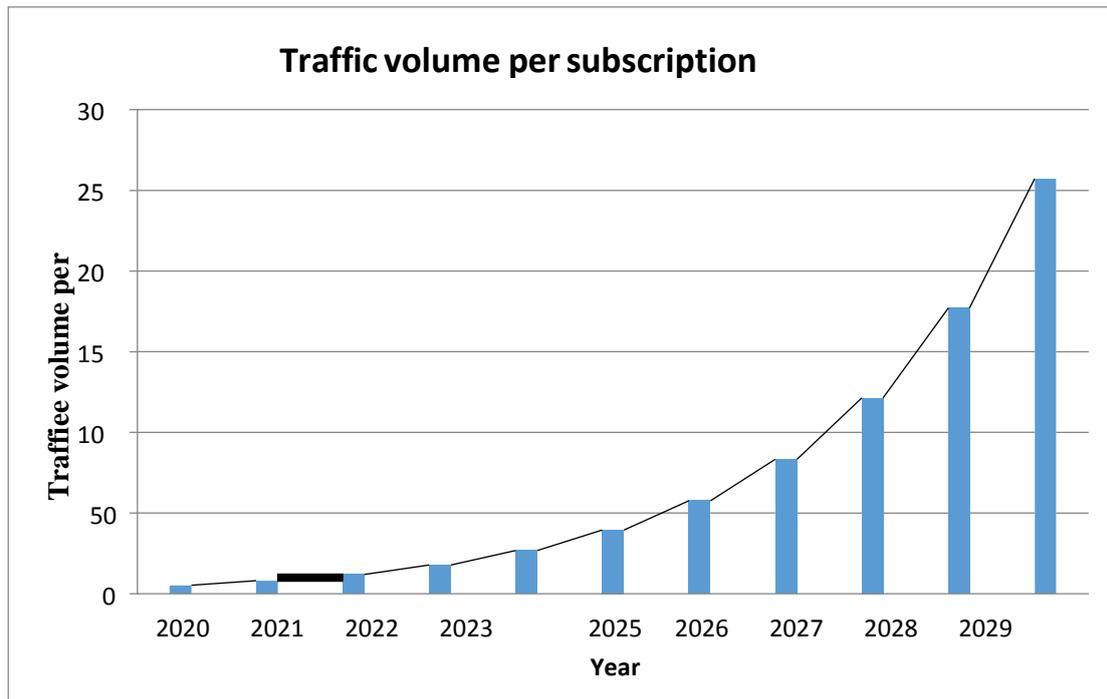**Figure 1:** Total global traffic volume

Figure 2: Traffic volume per subscription

AIR INTERFACE

The main aim of next generation communication is to handle teraherz frequency with enlarged channel. To enhance wide coverage inspite of spectrally optimization there is an availability of incredible bandwidth which in turn improves the effectiveness, operation and spectral inclusion. In the development of new air interface where more considerations focus on a separate carrier system. Because of the prevailing of cyclic prefix the orthogonal frequency division multiplexing(OFDM) scheme would be analyzed for the narrow frequency ranges. The design of power amplifier is more complex and costly due to high peak to average power ratio(P-APR).

Researchers in [13-15] cited that non orthogonal multiple access as a new solution for B5G/B6G.The simultaneous network sharing is can be done using non orthogonal multiple access. Rather than advanced spectral technologies and recent simultaneous communications and device detection it is expected that AI/ML plays a vital role in 6G development which enhances design deployment and operational phases(4).The following are the factors that impact of Artificial intelligence to a priority level like sluing, QoS mobility management, spectral sharing etc. Most of the 5G networked devices are accessed devices using 5G RAN and now there is a path that AI and ML plays a significant role in the design of 6G communication.AI is an innovative technology for the development of 6G which doesn't playany role in 4G also a limited interpretation in 5G. These applications of ML creates high intelligent networking devices which simplifies high complexity task, it reduces the time decaying ratio during data transfer in order to improve the overall efficiency. Normally the delay is

due to handover and selectivity is highly reduced .Also AI incorporates a major part in machine-machine, machine-human and HMI.
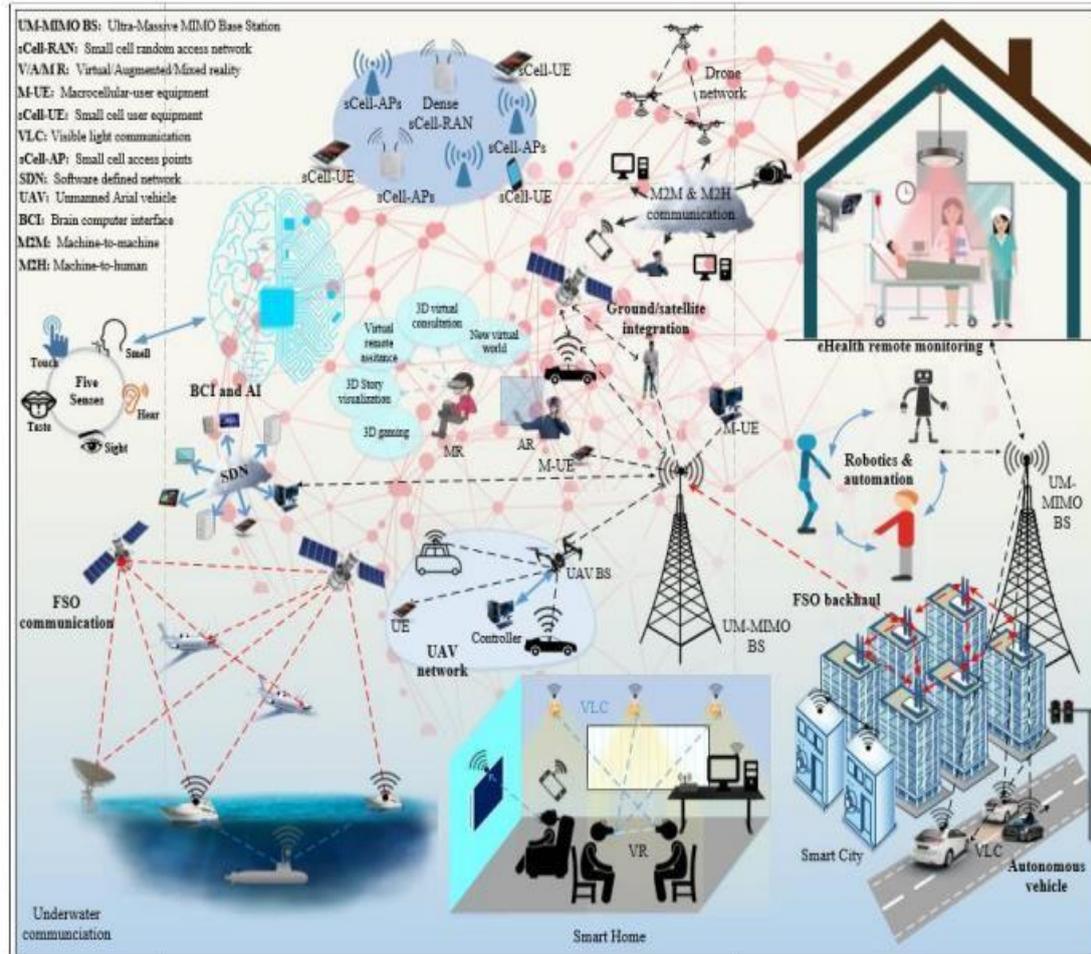

Figure 3: Architecture of Haptic technologyIntegration of sensing and Communication

The key responsibility of integrated wireless communication is the capacity to acquire the real time data of networked devices continuously and transfer the data from device to device respectively. In 6G the data acquisition will be highly monitored with interconnected devices.

Dynamic network slicing:

It allows the end user to access the dedicated critical network to guide the data transfer between different devices, machines and manufacturing units. It is the sole responsible of any industry to monitor the interconnected device data transfer and interoperable condition in 5G communication network.

Artificial Intelligence/Machine learning

Next Generation 6G network offering data security, wide area coverage and instant access for end users and in digital era. Automated vehicle systems and voice recognition will be the recent development by implementing machine learning algorithm ,By the usage of ML the difficulties occurred in B5G/6G network such as device complexity, error handling and network accessing can be resolved, also it enhances decision making method for preserving a level of KPI(Key Performance Indicator).Implementation of Artificial Intelligence in a wireless fidelity supports the operation of Random access network (RAN) for 6G.

Network Dimension

It plays a vital role in B6G, the network updating is required with respect to surroundings. In order to decrease latency, some of the features like self tuning, self regulation, self adaptation is achieved by interpreting Coding, virtualization, and data slicing.

Cloudification/Fog/Edge

There are n-number of devices are interchanged their data across industries and domestic applications. Huge data's are received from such devices which in turn stored system, data's are offloaded to end users devices. The latency or dead time for data transfer is reduced by shifting the process closer to end user devices in view of cloud/fog. Hence locating the workload nearer to the edge for better QoS.

Softwarization

Internal adaptability,self regulation, data outline, coding ability, flexibility are considered as amajor innovation while shifting from B5G/6G network.

Haptic devices for micromanipulation

Micro interaction system performs operation such as detecting, manipulating, stiffness and conductivity testing which can be used in electronics, medical treatment, biology and materialscience fields [16].Master-slave manipulator in these system is performed by using multi DOF piezo actuated device with haptic feedback. This devices includes planar 3PRR mechanism and 1DOF which can be used for the design of micro electromechanical application or micro teleoperated with biological cells[17].In [18] cited that Linear variable displacement transducer integrated with haptic negative feedback is applied for bilateral cell injection devices. Some of the teleoperated robots are listed below:

1. Mitsubishi RV-1a(Mitsubishi Electric Corp.Tokyo, Japan)
2. Micro(DLR,Koln,Gernany)-7DOF

3.   KUKA KR 6/2(KUKA AG,Augsburg,Germany)-6DOF

4.   PUMA (Unimation Inc.)-6DOF

5.   Mitsubishi MELFA 6Sl-DOF

6.   Mitsubishi PA-10-7DOF

7.   Mitsubishi MELFA RV-E2-6DOF

8.   Mitsubishi PA10-6DOF

9.   Mitsubishi PA10-7DOF

10. Rockwell Samsung AS2-6DOF

The advancement of 6G network will aid the operational functionality of haptic devices end users will access the on-board data in real time [19]. Haptic communication is monitored by the facility of 6G specialized functions.

Smart health care : 6G system will also support the medical field since new technology such as Augmented reality/ Virtual reality, Holographic tele-presentation, Artificial Intelligence etc., is implemented in a real time data accessing system[20]. Real time health monitoring system is controlled by the implementation of 6G network in addition to that remote surgical assessment is possible. In medical transcription a huge volume of data is to be stored and retrieved frequently, such operation is fulfilled 6G communication, sensational data's from human body is transferred without any distraction to the end users where BCI technology is implemented . A project title as breath communication is idle to communicate a human biological data's, using exhalation, also there is a chance of human physiological data communication through inhalation[21]. Such technology enhances its application for diagnosing of disease, emotional identification, segregation of biological data's and remote access of human body. Interdisciplinary studies will focus for mimicking human organ senses, which result in hybrid communication where human data's are received and send the signals to remote area through a proper communication.

Conclusion

Every invention will play a vital role in the generation of innovative and new features in the adaptability of network communication. Till 2021, 5G introduces an enormous changes worldwide in aspects of communication. For upcoming development such as Artificial Intelligence, Sensor networking 5G will not be able to fully guide the system, hence 6G will be rolled out. Researches in 6G communication is under progress among scientist for fully supporting the recent device development. In this study, we pointed out the possible applications and the technologies to be deployed for 6G communication.

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