LUPINE PUBLISHERS

Current Trends in Computer Sciences & Applications

DOI: 10.32474/CTCSA.2023.02.000142

ISSN: 2643-6744

Review article

Review of Recent Applications in 6G Communication Networks: A Descriptive Case

Abdullah M Al Ansi[1]* and Ahmed Al Ansi[2]

[1]*Department of Education, Thamar University, Yemen*

[2]*Faculty of Info-communication Networks and Systems, The Bonch-Bruevich Saint-Petersburg State University of Telecommunication, Russia*

***Corresponding author:** Abdullah M Al Ansi, Department of Education, Thamar University, Yemen

Received: January 30, 2022 **Published:** March 02, 2023

Abstract

The world is on the cusp of a new communications revolution. The next generation of communication networks, known as 6G, will enable a wide range of new applications and services that are not possible with current 4G or 5G networks. In this descriptive case, we will review some of the most promising applications of 6G technology. Some of the key applications that are being developed for 6G communication networks include Digital Twin (DT), Holograms, Robot Avatar, High Density (IoT), and AR & VR. The use of these applications in 6G communication networks is not a new concept. These applications have been around for some time now and have seen various improvements over the years. However, with the advent of 6G communication networks, the use of AR and VR is expected to see a drastic change.

Keywords: Digital Twin (DT); holograms, robot avatar; high density (IoT); AR & VR; 6G

Digital Twin (DT)

Digital Twin is a virtual representation of a physical object or system used to monitor, analyze, and optimize performance [1]. It is becoming increasingly popular in a variety of industries and is expected to continue to grow. It can be used to reduce the cost of service migration, make 6G networks more secure, and create a secure, immutable, and transparent digital representation of physical objects. Challenges include the cost of implementation, complexity of data, and accuracy and reliability [2]. 6G networks use DT technology to create a virtual replica of physical objects or systems, allowing them to detect any unauthorized access or changes and take appropriate action to protect them from malicious activity [3]. This technology also makes the network more secure. For example, if a sensor detects a temperature change in a machine, the digital twin can be used to adjust the temperature to ensure optimal operation. Digital Twin in 6G is a complex system that combines the physical and digital worlds. It is composed of hardware, software, and data that creates a digital representation of a physical object or system [4]. This representation is created using data from sensors, cameras, and other sources, and is used to monitor, analyze, and control the physical object or system. The data is then stored and analyzed on a cloud-based platform, which can be used to create predictive models to anticipate future events and take proactive action. Digital twins and blockchain technology can be used together to create a secure, immutable, and transparent digital representation of physical objects [5]. This digital representation can be used to track the performance of the physical object, store and share data related to the object, and create smart contracts that are stored on a blockchain and automatically executed when certain conditions are met [6]. This can help to reduce costs and increase efficiency. Digital Twin technology is a powerful tool, but it comes with a few challenges [7]. These include the cost of implementation and maintenance, the complexity of

data collection and analysis, and accuracy and reliability issues [6]. All of these require significant resources and expertise to address. Furthermore, Digital twin technology is a complex process that requires a lot of expertise and resources to collect and analyze data accurately [8]. Despite its potential, there are still issues with accuracy and reliability, and it can be difficult to keep the digital twin up to date. Additionally, the digital twin must be kept up to date in order to remain useful, which can be a challenge.

Holograms

Holograms are a 3D imaging technology used to create realistic images of objects and people [9]. It is now being used to create a more immersive experience for customers, such as allowing them to interact with a customer service representative in a virtual environment [10]. This could be especially useful for customers in remote areas or who have difficulty traveling to a physical location. Furthermore, Holographic Nondestructive Testing (HNDT) is a type of non-destructive testing (NDT) that uses holography to detect flaws in materials [11]. It is used to inspect a wide variety of materials, including metals, plastics, composites, and ceramics, and is used in industries such as aerospace, automotive, and medical. HNDT is a powerful tool for detecting flaws that could lead to failure or malfunction, as well as corrosion, fatigue, and other types of damage [12]. It is an important tool for ensuring the safety and reliability of components and materials. Additionally, Hologauze is a revolutionary new technology that allows for the projection of large scale 3D holograms [13]. It is a lightweight, transparent fabric made up of tiny, reflective particles that create a 3D image when light is shone through it. It is versatile, cost effective, and easy to set up and use, making it a great choice for those on a budget or with limited technical knowledge [14]. Holograms are a new technology with a number of challenges that must be overcome before they can become mainstream. These include the cost of specialized equipment and materials, lack of standardization and compatibility, complexity of the technology, low resolution, and difficulty of interaction [15].

Robot Avatar

Robot avatars are computer-generated characters that can be used to represent a person in a virtual world [16]. They can be used for a variety of purposes, from providing a virtual presence to providing a more realistic representation of a person. They can be programmed to perform tasks such as navigating a virtual world, playing games, or providing assistance to other avatars, allowing for a more realistic interaction between people in the virtual world [17]. The use of robot avatars in 6G for service migration presents numerous challenges, such as creating a realistic avatar that can interact with humans, integrating the avatar into existing services, ensuring security and reliability, and providing a high-quality user experience [18]. These challenges require extensive research and development, technical expertise, security measures, and user testing and feedback [19]. Robot avatars and blockchain technology are two of the most promising advancements in 6G technology, with the potential to revolutionize how we interact with the world. AI-powered robot avatars can understand and respond to human commands, while blockchain technology can securely store and transfer data [20]. This combination could lead to more efficient and cost-effective services, as well as more secure and transparent transactions.

High Density (IoT)

The Internet of Things (IoT) is a rapidly expanding network of connected devices that can communicate with each other and other networks. High-density IoT solutions are designed to provide a secure, energy efficient mesh network architecture for efficient data transmission between multiple devices [21]. These solutions are ideal for applications that require a large number of connected devices in a limited space, such as smart cities, industrial automation, and healthcare. 6G promises to bring immense potential benefits, such as faster data transmission speeds, more secure data transmission, and more efficient use of spectrum [22]. It will also enable new applications and services, such as smart cities, autonomous vehicles, and the Internet of Things (IoT), to connect millions of devices in a single area for more efficient data collection and analysis [23]. IoT devices are becoming increasingly popular and are being used to provide a variety of services [24]. By integrating these devices with blockchain technology, service providers can create a secure, distributed, and automated system for delivering services, which can provide a number of benefits such as increased security and reliability [25]. The integration of IoT and blockchain in service migration can provide a more efficient, cost-effective, and transparent system for delivering services [26]. Blockchain technology can automate the process of delivering services, reducing time and cost, and ensure that all data related to the service is visible and accessible. Integrating IoT and blockchain technology presents a number of challenges, such as scalability, security, and interoperability [27]. Scalability is a major challenge due to the large amount of data generated by IoT devices, and security is a concern as IoT devices are vulnerable to attack [28]. Interoperability is also a challenge, as IoT devices must be able to communicate with each other and with the blockchain network [29]. To address these challenges, a secure and resilient blockchain network is needed that is able to support multiple protocols and standards.

AR & VR

6G promises to be a faster, more reliable, and more secure wireless technology than ever before, allowing AR and VR applications to take advantage of its increased speed and reliability to provide users with an even more immersive experience. AR and VR have already been used in a variety of applications, from gaming to education to healthcare [30]. 6G networks provide users with a more immersive experience due to increased speed and reliability. This allows for more realistic graphics and smoother gameplay in gaming, virtual classrooms and teachers in real-time in education, and more accurate diagnosis and treatment of patients in healthcare [31]. 6G networks offer increased speed, reliability, and security compared to previous generations, making them ideal

for AR/VR applications [32]. The combination of 6G and blockchain technology can enable secure, distributed applications with real-time, immersive experiences [33]. This could be used in a variety of contexts, such as gaming, education, and healthcare, to protect user data and privacy. The potential of 6G and blockchain technology when combined in the AR/VR space is immense [34-37]. This combination can create a powerful platform for applications, as well as new business models and secure, distributed networks for data sharing and collaboration [38]. This could enable developers to monetize their applications and create new revenue streams, as well as leverage the collective intelligence of the network.

Conclusion

In this essay, we reviewed the existing under-developed applications in 6G communication network that have a huge advantages in next years in different area including education, healthcare, technology, economic and businesses. These applications are digital twins, holograms, robot avatar, high density IoT and AR & VR in 6G networks. Furthermore, the characteristics, advantages and possible challenges were included as part of this essay.

References

1. Jones D, Snider C, Nassehi, A, Yon J, Hicks B (2020) Characterising the Digital Twin: A systematic literature review. CIRP Journal of Manufacturing Science and Technology 29(1): 36-52.
2. Lu Y, Maharjan S, Zhang Y (2021) Adaptive edge association for wireless digital twin networks in 6G. IEEE Internet of Things Journal 8(22): 16219-16230.
3. Ahmadi H, Nag A, Khar Z, Sayrafian K, Rahardja S (2021) Networked twins and twins of networks: An overview on the relationship between digital twins and 6G. IEEE Communications Standards Magazine 5(4): 154-160.
4. Kuruvatti N P, Habibi M A, Partani S, Han B, Fellan A, Schotten H D (2022) Empowering 6G Communication Systems With Digital Twin Technology: A Comprehensive Survey. IEEE Access 10(1): 112158- 112186-112190.
5. Ozdogan Mehmet Ozgen, Levent Carkacioglu, Berk Canberk (2022) Digital twin driven blockchain based reliable and efficient 6G edge network. 2022 18th International Conference on Distributed Computing in Sensor Systems (DCOSS).
6. Allam Z, Jones D S (2021) Future (post-COVID) digital, smart and sustainable cities in the wake of 6G: Digital twins, immersive realities and new urban economies. Land use policy 101(1): 105201-105201.
7. Masaracchia A, Sharma V, Canberk B, Dobre O A, Duong T Q (2022) Digital Twin for 6G: Taxonomy, Research Challenges, and the Road Ahead. IEEE Open Journal of the Communications Society 99(1): 1-14.
8. Abdullah M Al Ansi, Indah Fatmawati (2023) Integration of ICT in higher education during Covid-19 pandemic: a case study International Journal of Learning and Change 15(2): 1-10.
9. Elzanaty A, Guerra A, Guidi F, Dardari D, Alouini M S (2021) Towards 6G holographic localization: Enabling technologies and perspectives p. 1-7.
10. Long W, Chen R, Moretti M, Zhang W, Li J (2021) A promising technology for 6G wireless networks: Intelligent reflecting surface. Journal of Communications and Information Networks 6(1): 1-16.
11. Zhang X, Chang T, Wang Z, Cui H L (2020) Three-dimensional terahertz continuous wave imaging radar for nondestructive testing. IEEE Access 8(1): 144259-144276.
12. Kemper B, Bauwens A, Bettenworth D, Götte M, Greve B, Kastl L, et al. (2019) Label-free quantitative in vitro live cell imaging with digital holographic microscopy. Label-Free Monitoring of Cells *In vitro* 2(1): 219-272.
13. Kurniawan C (2016) Pengembangan Model Pembelajaran 3D Display System Berbasis Holografi. Sinteks: Jurnal Teknik 5(2): 1-9.
14. Huang C, Hu S, Alexandropoulos GC, Zappone A, Yuen C, et al. (2020) Holographic MIMO surfaces for 6G wireless networks: Opportunities, challenges, and trends. IEEE Wireless Communications 27(5): 118-125.
15. Elmeadawy S, Shubair RM (2019) 6G wireless communications: Future technologies and research challenges. In 2019 international conference on electrical and computing technologies and applications (ICECTA) p. 1-5.
16. Beniiche A, Rostami S, Maier M (2022) Society 5.0: Internet as if People Mattered. IEEE Wireless Communications 29(6): 160-168.
17. Maier M (2021) 6G as if people mattered: From industry 4.0 toward society 5.0. In 2021 International Conference on Computer Communications and Networks (ICCCN) pp. 1-10.
18. Maier M, Ebrahimzadeh A, Rostami S, Beniiche A (2020) The Internet of No Things: Making the Internet Disappear and" See the Invisible. IEEE Communications Magazine 58(11): 76-82.
19. Yaacoub E (2022) Synergy between 6G and AI: Open Future Horizons and Impending Security Risks. pp. 1-27
20. Al Ansi AM (2022) Reinforcement of student-centered learning through social e-learning and e-assessment. SN Social Sciences 2(9): 1-19.
21. Chen N, Okada M (2020) Toward 6G internet of things and the convergence with RoF system. IEEE Internet of Things Journal 8(11): 8719-8733.
22. Vaigandla K K (2022) Communication Technologies and Challenges on 6G Networks for the Internet: Internet of Things (IoT) Based Analysis. In 2022 2nd International Conference on Innovative Practices in Technology and Management (ICIPTM)
23. Chowdhury M Z, Shahjalal M, Hasan M K, Jang Y M (2019) The role of optical wireless communication technologies in 5G/6G and IoT solutions: Prospects, directions, and challenges. Applied Sciences 9(20): 4367.
24. Shahraki A, Abbasi M, Piran M, Taherkordi A (2021) A comprehensive survey on 6G networks: Applications, core services, enabling technologies, and future challenges.
25. Pajooh HH, Demidenko S, Aslam S, Harris M (2022) Blockchain and 6G-Enabled IoT. Inventions 7(4): 109-112.
26. Hu S, Liang Y C, Xiong Z, Niyato D (2021) Blockchain and artificial intelligence for dynamic resource sharing in 6G and beyond. IEEE Wireless Communications 28(4): 145-151.
27. Lu Y, Zheng X (2020) 6G: A survey on technologies, scenarios, challenges, and the related issues. Journal of Industrial Information Integration 19(1): 100158-100158.
28. Peng H, Chen PC, Chen PH, Yang YS, Hsia CC, et al. (2022) 6G toward Metaverse: Technologies, Applications, and Challenges. In 2022 IEEE VTS Asia Pacific Wireless Communications Symposium (APWCS) pp. 6-10.
29. Kharche S, Dere P (2022) Interoperability Issues and Challenges in 6G Networks. Journal of Mobile Multimedia 18(5): 1445-1470.
30. Kim J H (2021) 6G and Internet of Things: a survey. Journal of Management Analytics 8(2): 316-332.
31. Al Ansi A (2022) Investigating Characteristics of Learning Environments During the COVID-19 Pandemic: A Systematic Review. Canadian Journal of Learning and Technology 48(1): 1-28

32. Liao S, Wu J, Li J, Konstantin K (2020) Information-centric massive IoT-based ubiquitous connected VR/AR in 6G: A proposed caching consensus approach. IEEE Internet of Things Journal 8(7): 5172-5184.

33. Bhattacharya P, Saraswat D, Dave A, Acharya M, Tanwar S, Sharma G, Davidson I E (2021) Coalition of 6G and blockchain in AR/VR space: Challenges and future directions. IEEE Access 9(1): 168455-168484.

34. Allam Z, Jones D S (2021) Future (post-COVID) digital, smart and sustainable cities in the wake of 6G: Digital twins, immersive realities and new urban economies. Land use policy 101(1): 105201-105201.

35. Jain P, Gupta A, Kumar N (2022) A vision towards integrated 6G communication networks: Promising technologies, architecture, and use-cases. Physical Communication 55(1): 101917-101917.

36. Huang C, Hu S, Alexandropoulos GC, Zappone A, Yuen C, et al. (2020) Holographic MIMO surfaces for 6G wireless networks: Opportunities, challenges, and trends. IEEE Wireless Communications 27(5): 118-125.

37. Maier M, Amin Ebrahimzadeh (2021) Toward 6G: A new era of convergence. In Optical Fiber Communication Conference. Optica Publishing Group, USA pp. F4H-1.

38. Peng H, Chen P C, Chen PH, Yang YS, Hsia CC, et al. (2022) 6G toward Metaverse: Technologies, Applications, and Challenges. In 2022 IEEE VTS Asia Pacific Wireless Communications Symposium (APWCS) pp. 6-10.

DOI: 10.32474/CTCSA.2023.02.000142