

It provides a good solution for IoT applications that are latency-sensitive [53]. To increase IoT system efficiency, most of the data generated by IoT objects/devices must be processed and analysed in real-time. The Fog computing will bring Cloud networking, computing, and storage capabilities down to the edge of the network, which will address the real-time issue of IoT devices and provide secure and efficient IoT applications [54].

Although the Integration of Fog computing with IoT will bring many benefits to different IoT applications, it also brings many challenges that need to be addressed. How to integrate Fog computing with IoT is a hot topic that needs more research studies to get all fog benefits to the IoT system.

8.5. Blockchain

Current IoT systems are built on centralized server/client model, which requires all devices to be connected and authenticated through the server. This model would not be able to provide the needs to outspread the IoT system in the future [55]. Therefore, moving the IoT system into the decentralized path may be the right decision. One of the popular decentralization platforms is blockchain.

A blockchain is a distributed database of records that contains all transactions that have been executed and shared among participating parties in the network. This distributed database is called distributed ledger [56].

Integrating IoT with blockchain will have many benefits. The decentralization model of the blockchain will have the ability to handle processing of billions of transactions between IoT devices, which will significantly reduce the costs associated with installing and maintaining large centralized data centres and will distribute computation and storage needs across the billions of devices that form IoT networks. In addition, working with the blockchain technology will eliminate the single point of failure associated with the centralized IoT architecture [57]. Integration IoT with blockchain needs more research to get the benefits of decentralization to the IoT field.

9. Conclusion

The IoT is considered as the next stage toward the evolution of the Internet. It has the capability to connect and communicate almost all real-world objects over the Internet to increase information sharing. With the help of sensors, the IoT has the ability to collect, analyses, and deploy a huge amount of data which in turn will be converted into meaningful information and knowledge that can be used to create new application and services that can improve our quality of life. This paper has provided a review of the IoT system. The state-of-the-art and layered architecture of the IoT are discussed. In

addition, IoT essential features and different communication technologies are presented. A comparison between common IoT communication technologies and IoT applications are also discussed. Finally, IoT challenges and future research directions are discussed.

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11. References

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