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Salient Applications and Obstacles in IOT Edge Computing

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***Abstract:** The Internet of Things (IoT) is a new technology that has emerged in recent years as a result of the exponential rise of linked gadgets. The IoT benefits from cloud computing. Applications to store the data and carry the calculations, that the enormous volume of data produced by these IoT devices may be managed and controlled. However, fulfilling the demands of numerous Internet of Things, real-time applications remains the main problem in cloud computing. On the other hand, Edge or Fog computing is a computing architecture that facilitates data management, processing, storing, and communication while providing a prompt response.*

By putting these functions closer to the end consumers, this is made possible. For many applications, edge and cloud computing are complementary technologies that work independently of one another. The overview of IoT and communication technologies and IoT protocols, as well as data transit in IoT. We look into cloud services for processing, storing, and analysing the data produced by Internet of Things devices.
***Keywords:** Cloud computing, Edge computing, Fog computing, Internet of Things.*

I. INTRODUCTION

The Internet of Things, or "IoT," is a new field that is being used in many different fields in the digital age. It uses sophisticated communication technologies, protocols, and quick, intelligent data analysis software to enable computing services by utilizing edge and cloud architecture based on user requirements and service quality for various application types.

By enabling Radio-frequency identification (RFID), actuators, and sensors for intelligent decision making based on the user context to improve lives, the Internet of Things (IoT) makes things or devices communicate with each other in turn to enable machine to machine communication.

IoT has been applied over time in many different fields, including the medical, industrial, and transportation sectors [1].

Architectural standardization makes it possible to offer people high-quality services, enhance their quality of life, and grow the global economy.

Since the number of connected devices is growing at an exponential rate, enormous volumes of data are generated. This has led to the development of data analytics on the cloud, which in turn has made cloud computing a developing technology with applications across numerous industries. IoT applications requiring high availability, processing power, and large amounts of storage are deployed with cloud computing [2].

The enhanced potential of IoT allows for data gathering, storing, and analysis at the user level, making it appropriate for time-sensitive real-time applications. Since sustaining Quality of Service (QoS) even with a larger number of devices is crucial, real-time applications must enable real-time interactions with very little delay [3] and very quick reaction times. Often used as a solution, the edge computing paradigm in many applications.

By removing the need to transfer data to the cloud or from the cloud to nearby end devices, the edge computing paradigm enhances Internet of Things applications [4]. The proliferation of wireless sensor nodes, communication technologies, and manufacturing advancements in conjunction with the development of smartphones has resulted in a significant surge in edge computing.

This study aims to offer an understanding of the Internet of Things, specifically combining edge and cloud computing. Benefits, difficulties, and the distinctions between edge and cloud computing were covered. The remainder of this essay is structured as follows: IoT specifics are covered in Section II, cloud computing is briefly discussed in Section III, and edge computing is covered in Section IV.

II. NOVEL VIEWPOINTS ON IOT

The concept known as the Internet of Things (IoT) enables several computing devices to connect and exchange data via wired or wireless networks. By integrating sensors, objects, or gadgets become intelligent.

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This can be done with or without human-to-human or human-to-computer contact. Sensors are used to collect data and analyze it. Internet of Things (IoT): the capacity to link numerous physical objects, including wearables and street lights, and use those connections to share the data, communicate, and take action.

This increased the potential of IoT use in a number of IoT applications, including smart wearables for medical purposes, smart appliances, smart meters, smart cities, smart traffic monitoring, and weather condition monitoring devices.

Components of IoT

The four parts of an Internet of Things system is illustrated in **Figure 1.** These are actual hardware components that include sensors, network connectivity, data processing, and an application user interface built in.

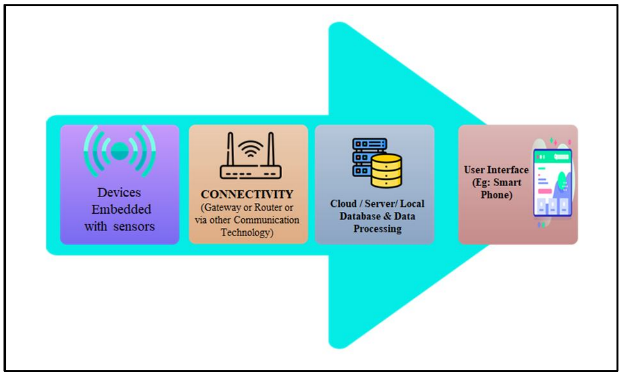

Figure 1: Components of IOT

By integrating several sensors, electronic devices can become smarter by gathering context-based data from their surroundings, including temperature, signal, audio, and video. This process produces a massive amount of data.The massive volume, value, and range of forms that contribute to rapidity, veracity, and variety are some of the features of the data generated by IoT devices.

These gadgets are linked to the cloud through Internet of Things protocols to the adjacent edge gateway through a variety of data protocols like HyperText Transfer Protocol, Message Queuing Telemetry Transport, and client-server models with Web transfer protocols. They are also connected via data communication protocols like Mosquitto, Extensible Messaging and Presence Protocol, Lightweight Machine to Machine, and Simple Sensor Interface Protocol via communication technologies[5,6,7] like Wi-Fi, Bluetooth, Cellular networks, Ethernet, Zigbee, etc. Wearable technology frequently uses Bluetooth, a short-range communication technology, to send and receive data.

Smart devices can be set up to send data across a wired network to the cloud or to a local database locally.

Figure 2 illustrates how the smart devices are set up to transmit data over a wireless router and subsequently to the cloud via any available communication method. The cellular network is typically used by smart devices to transmit data to the cloud. Depending on the needs, price, power, bandwidth, and coverage area, there are various ways we can transmit data to the cloud service.

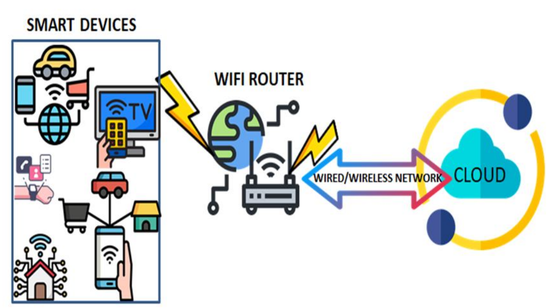

Figure 2: Data transfer in IoT

After data is gathered in the cloud, it is processed by data analyzing software, which then extracts useful information and makes it available to the user. When compared to local database technologies like DBMS and RDBMS, cloud computing offers advantages like massive data storage and data analytics.

To extract useful information from data, analytical tools or artificial intelligence algorithms process data on the cloud. Application programming interfaces can be used to provide this data to the end user.

A. Internet Of Things Benefits And Challenges

The Internet of Things is used to improve human lives by streamlining and facilitating a variety of industries, including agriculture and medicine [8]. Figure 3.lists a few advantages of the Internet of Things.

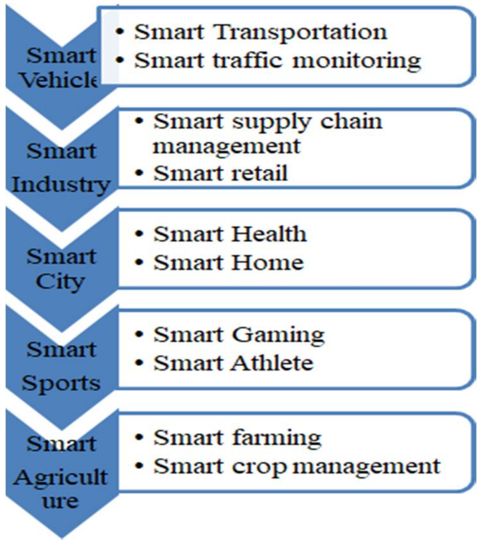

Figure 3: Applications of IoT

1) The Internet of Things is a rapidly developing technology that has many applications across numerous industries. The Internet of Things will expand and become more accessible. chances for more risks and difficulties. Not all of them are listed.
2) Data produced by IoT devices will be diverse. Given the variety of data types created by IoT devices, including text, audio, video, pictures, signal, noise, and more, analyzing this data and providing the owner with useful information is challenging.
3) Retention policies for data, including as alerts, surveillance, aircraft, and application data, that specify how long data is kept on file—days, months, years, or even decades.
4) Cyberattacks on IoT data and virus vulnerability are potential risks associated with IoT devices because they are networked to the internet. One of the biggest challenges in IoT data security and privacy is ensuring privacy.

III. CLOUD COMPUTING'S OBSTACLES

Cloud computing is used globally in various applications to store massive amounts of data, process and analyze them for statistical analysis, or to extract useful insights from the data to create value. IoT is producing increasingly complex devices for a wide range of uses, which generates enormous amounts of data that must be exchanged, stored, and transported around. Cloud services are utilized to complete all of the aforementioned tasks and give users greater flexibility and efficiency. For corporate purposes, these cloud-based services are quite beneficial. Depending on their needs, they will use the public, private, and enterprise clouds offered by cloud services [9].

Many applications that generate large amounts of data and can tolerate delays use cloud computing extensively. Although cloud services are employed in many different fields, only a small number of applications demand real-time data analytics and urgent access to insightful information. We are unable to use the cloud for these kinds of applications for the reasons listed below:

1) A lot of applications these days require extremely fast reaction times and very little end-to-end delay[10].
2) Reliable connections [11] are scarce and frequently unreliable on networks; nonetheless, cloud computing requires strong connections in order to send and receive data to and from the cloud.
3) There is an increase in network latency since data is processed, stored, and retrieved from the cloud.
4) Sensor-generated data travels via many networking channels via the internet to the cloud.

Data security and privacy are reduced since there are more opportunities for data hacking.

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IV. EDGE COMPUTING ARCHITECTURE

The edge computing paradigm has gained prominence due to the exponential rise of IoT applications [12, 13]. The architecture of edge computing is comparable to that of cloud computing, but it is more effective at processing and storing data closer to the source, saving bandwidth and response time.

The architecture of edge computing, as seen in Figure 4, offers the foundation for the hardware and software deployment framework.

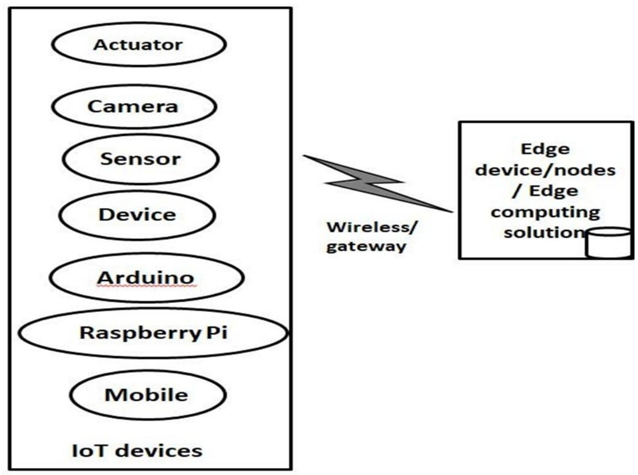


Figure 4: General IoT Edge computing architecture

The core of an IoT system is the massive amounts of data produced by IoT devices. The edge node or edge device will gather, store, and analyze this data. Depending on the context at the edge device, the data will be handled right away. In order to optimize network bandwidth and shorten reaction times for results, edge computing systems are located close to end users or Internet of Things devices.

The following tasks will be performed via edge computing:

1) Hands-free onboarding of devices;
2) controlling IoT devices and data collection;
3) strong security[14] for data from sensor to gateway;
4) ingesting, gathering, storing, and analyzing data at the edge.

A. Challenges in Edge Computing

As Figure 5 illustrates, edge computing is becoming more and more popular, but it also faces several obstacles [15, 16, 17].

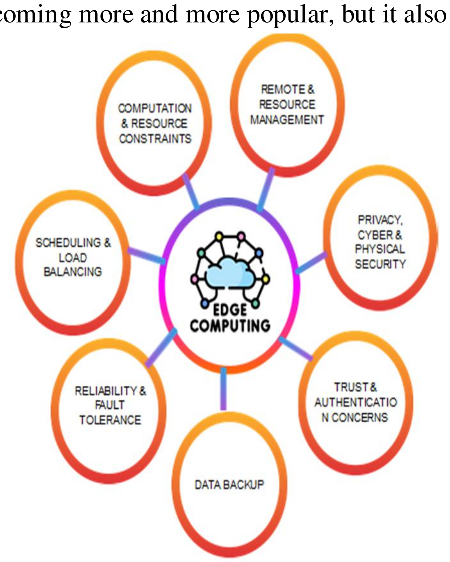


Figure 5: Challenges in Edge computing

B. Edge vs. Cloud Computing

Although edge computing cannot completely replace cloud computing, it can be advantageous for many very large-scale Internet of Things applications [18]. The differences between edge and cloud computing are covered in Table 1 [10].No matter how much data is generated, cloud computing offers a wide range of services, has fast processing, strong network connectivity, and is already widely employed in many applications. Edge computing is useful for real-time applications even if it offers few services.

C. Benefits of Edge Computing

Edge computing is a rapidly developing paradigm in computing, where computation-intensive and latency-critical operations are carried out by storing and processing data in Edge devices.

TABLE I. Edge Vs. Cloud computing

FEATURES	EDGE COMPUTING	CLOUD COMPUTING
• Location	Distributed nodes and systems but near to end-user	It can be in any remote Location
• Response Time	Low	High
• Dynamic Mobility	High	Low
• Processing And Decision Making	At Local edge device	Remote cloud
• Communication	Real-time interaction	Constraints with bandwidth and network
• Size Of Storage	small	Huge in size
• Context Awareness	yes	No
• Operational Environment	Decided by the customer	Controlled by cloud operator.
• Device Heterogeneity	Highly supported	Limited support
• Computing Capability	Medium	High
• Cost of development	Low	High
• Applications	Suitable for realtime critical applications	Supports most of the application
• Deployment	Does not require much careful planning	Requires careful planning
• Bandwidth	Can operate without much network connectivity.	Requires good network connectivity

Figure 6 enumerates the advantages of the edge computing paradigm [19, 20]. Because edge computing allows real-time data processing close to the source, it offers extremely fast reaction times while using less network capacity.

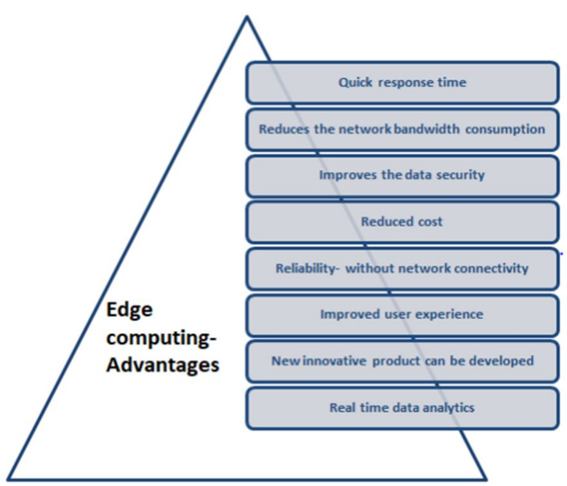


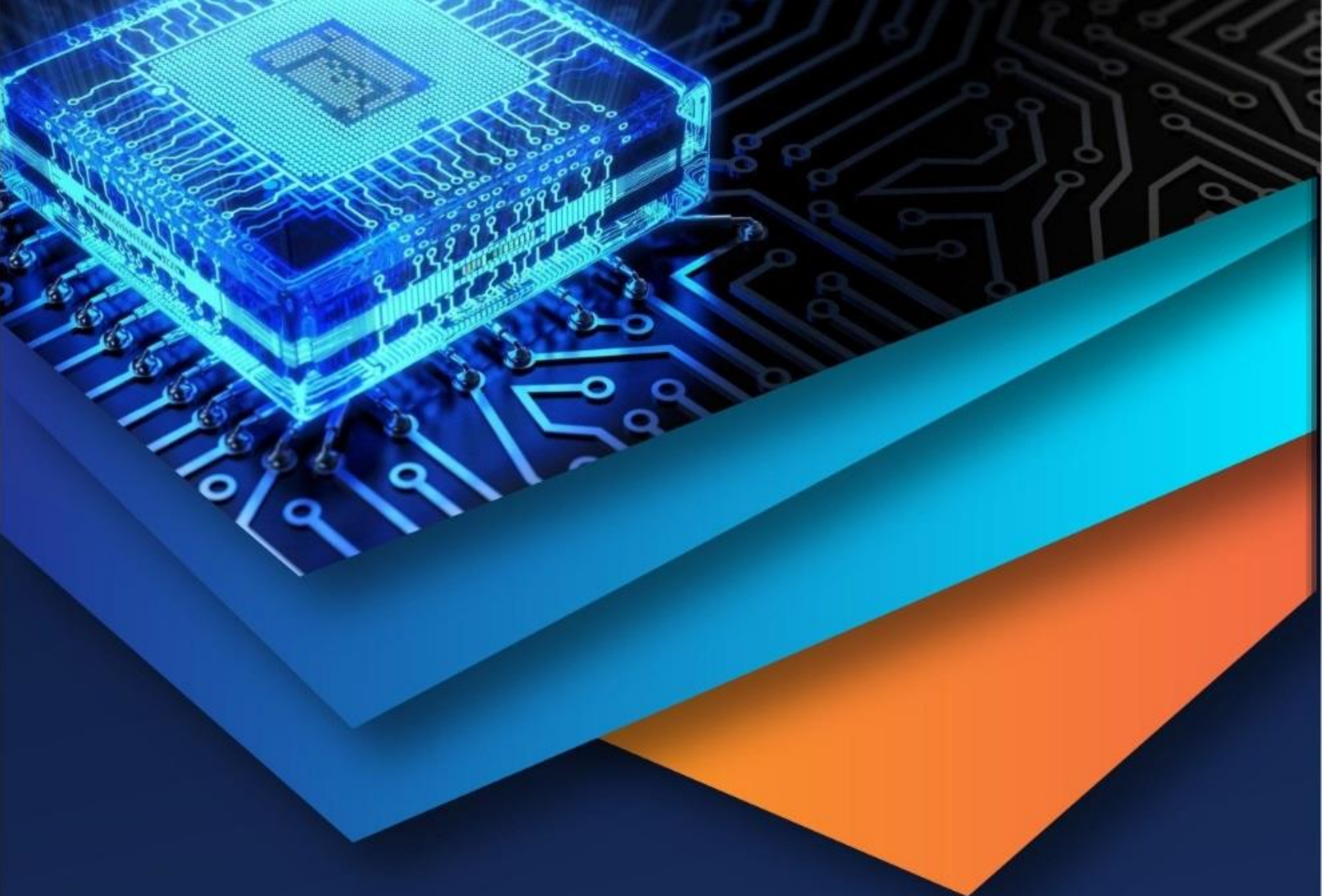
Figure 6: Benefits of Edge computing

V. CONCLUSION

Internet of Things apps and improved services are both made possible by the widespread use of computing paradigms. Cloud computing is an emerging paradigm for computing that allows for the analysis and storing of enormous amounts of data. When reliable network bandwidth and Internet services are widely available, cloud computing is the perfect answer. Technologies are changing and numerous advancements are made possible by Edge computing. Important technologies, difficulties, and advantages are covered in this study. A promising strategy for faster service response, less bandwidth use, and data privacy protection is edge computing. Applications with strict timing requirements can benefit from edge computing.

REFERENCES

[1] Shree Krishna Sharma, Xianbin Wang, “Live Data Analytics With Collaborative Edge and Cloud Processing in Wireless IoT Networks”, IEEE Access, vol. 5, pp.4621-4635, March 2017
[2] Volkan Gezer, Jumyung Um, Martin Ruskowski, “An Extensible Edge Computing Architecture: Definition, Requirements and Enablers”, International Conference on Mobile Ubiquitous Computing, Systems, Services and Technolgies(IARIA), 2017
[3] Yousefpour, Ashkan, Genya Ishigaki, and Jason P. Jue. "Fog computing: Towards minimizing delay in the internet of things." In 2017 IEEE international conference on edge computing (EDGE), pp. 17-24. IEEE, 2017.
[4] Hang Liu, Fahima Eldarrat , Hanen Alqahtani, Alex Reznik, Xavier de Foy, Yanyong Zhang,” Mobile Edge Cloud System: Architecture Challenges, and Approaches”, IEEE Systems Journal, Vol.12, no.3, pp.2495-2508,, September 2018
[5] Yang Liu, Jonathan E. Fieldsend, Geyong Min, “A framework of Fog Computing: Architecture, Challenges and Optimization”, IEEE Access, Vol.5, pp.25445-25454,October 2017
[6] Capra, Maurizio, Riccardo Peloso, Guido Masera, Massimo Ruo Roch, and Maurizio Martina. "Edge computing: A survey on the hardware requirements in the internet of things world." Future Internet 11, no. 4 (2019): 100.
[7] Plakhteyev, Anatoly, Artem Perepelitsyn, and Vyacheslav Frolov. "Edge computing for IoT: An educational case study." In 2018 IEEE 9th International Conference on Dependable Systems, Services and Technologies (DESSERT),pp. 130-133. IEEE, 2018.
[8] Pandian, A. P. (2019). ENHANCED EDGE MODEL FOR BIG DATA IN THE INTERNET OF THINGS BASEDAPPLICATIONS. Journal of trends in Computer Science and Smart technology (TCSST), 1(01), 63-73.
[9] Salman Raza, Shangguang Wang, Manzoor Ahmed, Muhammad Rizwan Anwar, “A survey on vehicular Edge computing: Architecture, Applications, Technical Issues and future Directions”, Wireless Communications and Mobile Computing, Volume 2019, Article ID 3159762, 19 pages,Wiley , Feb 2019
[10] Mung Chiang, Tao Zhang, “Fog and IoT: An Overview of Research Opportunities”, IEEE Internet of Things Journal, Vol.3, no.6, pp.854-864, December 2016
[11] Soumyalatha, N., Rakesh Kumar Ambhati, and Manjunath R. Kounte. "Performance evaluation of ip wireless networks using two way active measurement protocol." In 2013 International Conference on Advances in Computing, Communications and Informatics (ICACCI), pp. 1896-1901. IEEE, 2013.
[12] Datta, Soumya Kanti, and Christian Bonnet. "An edge computing architecture integrating virtual iot devices." In 2017 IEEE 6th Global Conference on Consumer Electronics (GCCE), pp. 1-3. IEEE, 2017.
[13] Syed Noorulhassan Shirazi, Antonios Gouglidis, Arsham Farshad, David Hutchison, “The Extended Cloud: Review and Analysis of Mobile Edge Computing and Fog From a security and Resilience Perspective”, IEEE Journal on selected areas in communications, vol.35, no.11,pp.2586- 2595, November 2017
[14] Naveen, Soumyalatha, and Manjunath R. Kounte. "In Search of the Future Technologies: Fusion of Machine Learning, Fog and Edge Computing in the Internet of Things." In International conference on Computer Networks, Big data and IoT, pp. 278-285. Springer, Cham, 2018.
[15] Grover, Jitendcr, and Rama Murthy Garimella. "Reliable and Fault-Tolerant IoT-Edge Architecture." In 2018 IEEE SENSORS, pp. 1-4. IEEE, 2018.
[16] Cristian Martin, Manuel Diaz, Bartolome Rubio, “An edge computing architecture in the Internet of Things”, IEEE International Symposium on Real-Time Distributed Computing(ISORC), July 2018
[17] Singh, Sachchidanand. "Optimize cloud computations using edge computing." In 2017 International Conference on Big Data, IoT and Data Science (BID), pp. 49-53. IEEE, 2017.
[18] Jianbing Ni, Kuan Zhang, Xiaodong Lin, Xuemin (Sherman) Shen, “Securing Fog Computing for Internet of Things Applications: Challenges and Solutions”, IEEE Communication Surveys & Tutorials, Vol.20. no.1, pp.601- 628, October 2018
[19] Enzo Baccarelli, Paola G. Vinueza Naranjo, Michehe Scarpiniti, Mohammad Shojafar, Jemal H. Abhwajy, “Fog of Everything: Energy-Efficient Networked Computing Architectures, Research Challenges and a Case Study”, IEEE Access, vol.5, pp.9882-9910, June ,2017
[20] Hesham EI-Sayed, Sharmi Sankar, Mukesh Prasad, Deepak Puthal, Akshansh Gupta, Mnoranjan Mohanty, Chin-Teng Lin, “Edge of Things: The Big Picture on the Integration of Edge, IoT and the Cloud in a distributed computing Environment”, IEEE Access, vol.6, pp.1706-1717, December 2017.



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