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Fog Computing Based IoT System: A Review

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Abstract:
Due to the rapid accelerated development of IoT technologies, the traditional generation cloud computing model is faced with a range of problems, including high latency, low bandwidth, and network problems. Fog computing is a new promising feature that enables legitimate cloud application services will be provided close to something like the physical IoT device at the edge devices rather than in the cloud. It's a layer that lies between the cloud and the Iot. computers that enables unified internet-based computing. How about sending IoT information to the cloud, the fog processes and stores it remotely at IoT computers. The fog in comparison to the cloud, offers resources that are more sensitive and of higher quality. As a result, fog computing could be the best option for enabling the IoT to deliver effective and reliable services to a huge number of IoT clients. After that, we'll go over some of the literature and outline the findings.

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1. Introduction

The (IoT) is increasingly evolving as a central enabler of disruptive developments in our culture that are primed to modify our views of devices and the atmosphere (Ashton, 2009). The (IoT), data collection, quantum computing, cloud computing, SDN, and the creation of more powerful and successful edge nodes are all coming together such as switches, routers, mobile terminals, etc. have resulting in an acceleration of linked devices and data over internet networks, as well as connections between computers and the humanistic approach (Keti & Askar, 2015; Qadir & Askar, 2021; Atzori et al., 2010). The Internet of Things is going to hit a point when all of the objects in our world would be able to access the Internet and interact with one another without the need for human interaction (Atlam et al., 2017). Initially, the Internet of Things was designed to eliminate human data entry activities by using multiple types of devices to capture information about the environment and simplify the collection and analysis of that data (Schrecker et al., 2016). The (IoT) and the cloud are a powerful mix that provides multiple benefits to various IoT applications. Nevertheless, since there are so many IoT devices for different platforms, creating new IoT implementations is a challenging challenge (Voss, 2010; Ahmed & Askar, 2021; Mohammed & Askar, 2021). Since IoT applications produce enormous quantities of data through sensors and other instruments, this is now the case. Following that, the big data is processed in order to make decisions on different actions (Ai et al., 2018). To transfer all of this data to the server, you'll need a lot of bandwidth utilization. Fog computing is used to address these problems. Fog computing is a relatively recent technology that has a variety of applications, especially in the IoT (Askar, 2017; Fizi & Askar, 2016; Askar, 2016; Ai et al., 2018). Fog computing, like the cloud, delivers data collection and storage facilities to IoT customers (Ali & Askar, 2021; Hamad & Askar, 2021). The basis of the fog is to include data processing.

More computation operations before being completed at the channel's edge transferred to the main network or clustered clouds thanks to fog computing (Yi et al., 2015). Rather than being sent and obtained from clouds, decisions would be taken by edge computers. This results in more reliable processes and the ability to respond to incidents more effectively (Dang and Hoang, 2017). The fog-computing has evolved to meet the needs of Iot technologies that are currently unfilled by current solutions. Various initiatives have been suggested to encourage fog growth, and much analysis has been undertaken to enhance those elements (Rahmani et al., 2017). Conversely, a thorough examination of the various options is also needed, including details about how they can be implemented and adapted to satisfy particular specifications (Bellavista et al., 2019).

This paper's material will be arranged as follows: part 2 gives a quick summary of info about fog computing, part 3 presents the fog computing architecture, part 4 gives the fog computing different from edge computing, part 5 gives the advantage and disadvantage of fog computing, and finally, part 6 gives a description and ideas for possible directions for research.

2. Background

The fog computing is a decentralized model of computation that functions as a bridge among cloud computing environment and Iot apps and sensors (Husain & Askar, 2021; Samann et al, 2021). That enables Fog support by offering device, communication, and storage services. to be immediately linked to IoT sensing devices (Dastjerdi and Buyya, 2016). Cisco presented the idea of fog computing in 2012 to solve the complexities of IoT implementations of traditional Cloud computing (Dastjerdi et al., 2016). IoT devices or sensors, as well as real time and latency service specifications, are widely spread at the channel's edge. Because cloud computing services are globally centralized, these frequently struggle to meet the computational and communication needs of millions of location IoT devices and sensors. As a consequence, there is a crowded network, large frequency in delivery of services, and low (QoS) (Sarkar and Misra, 2016). Heterogeneous network components like as routers, cable boxes, cache servers, Access Points, and others make up a Fog computing platform, which can be positioned similar to Smart objects. These modules have a broad variety of computation, memory, communication, and other features and can run user interfaces. As a result, Fog computing will generate vast relative importance of Cloud-based resources thanks to the hosts connected. Fog computing also helps with position recognition, flexibility, real-time communications, scalability, and compatibility (Bonomi et al., 2012). Fog computing will thus suitable performance of service quality, resource usage, bandwidth utilization, cost of the proposed, content delivery, and so on. In this way, Fog computing, in contrast to exclusively using cloud, best satisfies the criteria for IoT systems (Sarkar et al., 2015).

3. Architecture of Fog Computing

The fog-computing is a method of moving any of a data center's processes to the network's boundary. The fog distributes minimal processing, memory, and communication services among edge nodes and standard datacenters for cloud computing in a dispersed environment (Tang et al., 2015). As seen in Figure 1, the ultimate focus of fog computing is to have high or very low bandwidth for time-sensitive IoT systems.

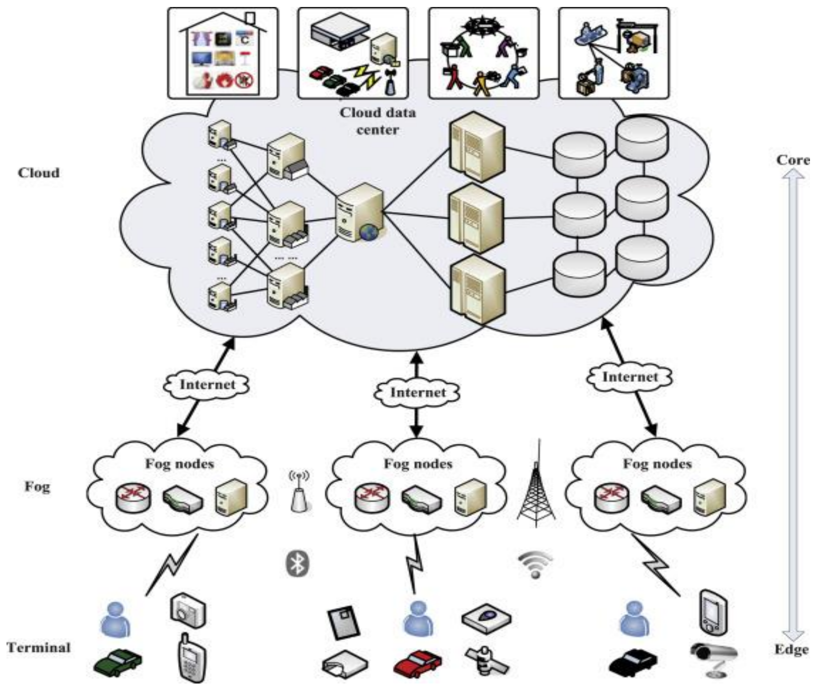

Figure 1 Architecture of fog computing

3.1 IoT devices

When enabled, IoT can sense the world, gather data, and warn of findings, convert, and transfer actual info, based on the size and function. These can be used to complete tasks that require real-time flexibility considering their minimal computing capacity. They're also used to send information to the next step of the hierarchy. Mobile sensing elements for detecting environmental circumstances, virtual converters, data storage systems for storing data, networking modules for ensuring network functions, and a power unit for powering the system make up IoT gadgets. Any authentication mechanisms are built into IoT nodes (Gia et al., 2015a). Protection is important for assisting the processor in executing a safe boot and ensuring that the key is running the code that it was intended to run. Any IoT would be used to protect property by marking counterpart IoTs that behave oddly. The IoT's are responsible for the IoT's front end, fog, and cloud (Goh et al., 2006).

3.2 Fog Nodes

In the Iot, fog, cloud arrangement, the fog sits among the cloud and IoT computers. The fog handles encoding, storage, and security for IoT applications, as well as providing cloud service (Sulaiman & Askar, 2015; Fares & Askar, 2016). The conduct transfers optimization, which can include statistical analysis, feature extraction, and automated data handover to the server for storage when assisted. The fog delivers awareness to the technology that IoT devices cannot supply due to a shortage of computing capacity. They can develop intellectual capabilities that enable them to track and manage Iot nodes, execute traffic replication when traffic converges framework for the server, and manage server throughput. The fog makes the middle tier of the IoT_fog_cloud (Gia et al., 2015a).

3.3 The cloud

IoT_fog_cloud architecture depends on the cloud for secure resources. Via the Internet, these facilities can be reached from everywhere all the time. They assist between IoT and Fog nodes as needed, particularly for activities that require a lot of material that aren't accessible at the reduced ranks of the architecture. The cloud has storage, framework, and digital services. Amazon EC2 for virtual IT, Google App Engine for idea put, Apple iCloud for network computing, and so on are examples of cloud providers (Gia et al., 2015b).

Table1. The comparison among the fog and cloud computing:

Attribute	Cloud-Computing	Fog-Computing
Distribution	Centralized	Transmission
Deployment	Hard and costly	Simple and low-cost
Data analytics	Data transmission and decision-making in the cloud.	Received data is performed partly at cumulative locations and the remainder is done in the cloud, with a simple judgment coming from the fog node.
Latency	High	Low

4. Fog Computing and Edge Computing similarities and differences

Fog computation is a full-spectrum approach hierarchical design that allocates computation, memory, power, and communication functions closer to consumers. The term "edge" may have a variety of connotations. Edge routers, access points, and home gateways are typical examples of devices used on the edge node, as contrasted to the network infrastructure (Chiang et al., 2017). There are some distinctions between fog and edge in this regard:

Cloud, heart, subway, edge, customers, and stuff are all included in Fog. To support end to end systems and resources, the fog infrastructure can allow merging, arranging, controlling, and protecting the capabilities spread in the cloud, everywhere along the Iot devices spectrum, and on the objects. Instead of approaching network edges as discrete computing nodes, Fog aims to provide a continuous from of the cloud to the objects, a wide variety of computational tools that are available. The fog imagines a decentralized network that will support popular fog computing features for a variety of sectors and application environments, including conventional telco networks, but not exclusively. Mobile device is a major component of edge computing, though fog computing infrastructure would be adaptable enough to run over both wired and wireless networks.

5. Fog Computing Services

This part gives you a quick description of a subsection of fog layer services as well as the benefits that support IoT. These facilities are divided into three categories: compute, storage, and networking.

5.1 Services in computing

Implementation of distributed processing methods has been prompted by the computational capacity constraints of systems in the perception layer. Loading at the Fog level is driven not only by operating power constraints at edge devices, but also by the need to better fulfill device specifications and improve energy consumption (Datta et al., 2015). The computing can be actually moved to the fog level for more regional computation and quick speed. In that same respect, there may have been a variety of implementations for spreading computational among the multiple levels of load in an IoT system, and processing specifications can vary depending on the actual job. For example, In the case of a machine that processes data to understand a model, the process should be spread such that regional structures could be found in the fog level while generic structures are only visible in the cloud (Hu et al., 2016). The fog level can accommodate incidents in relation to data administration Due to its location, this level is an excellent candidate for handling incidents in order to respond in real time and improve device stability. Furthermore, many virtualization applications make use of the fog level to control physical nodes through aggregation, based on agents control, and virtualization software.

5.2 Storage Services

The (IoT) systems have the ability to produce a vast volume of data, and there are millions of these different sensors in use. Given the pace at which data is generated, the capacity available in cognition level devices is frequently insufficient to store only a simple day's terabytes of information. As previously mentioned, moving all data to the cloud is not sufficient, particularly when data is obsolete or redundant. Filtering and perceptually storing the data in the indirect fog layer would be a prudent solution in such situations (Rahmani et al., 2015). The processed data can be sorted, interpreted, and optimized for effective transfer or for learning local knowledge about the device activity when coupled with the computing service. Storage facilities help improve the system's stability by ensuring correct system behavior for client nodes in situations where connectivity isn't always reliable (Sarkar and Misra, 2016).

5.3 Communication Services

Wireless devices control connectivity in the Internet of Things. These wireless components are developed for low power service, limited reception, or a greater duration of propagation due to resource limitations in the awareness layer. A large number of alternate procedures are currently obtainable on the market (Sheng et al., 2013). The fog level is strategically placed to coordinate and create a unified these disparate wireless protocols' connectivity with the Cloud layer (Chen et al., 2016). This aids in the management of sub-networks of embedded systems, as well as providing stability, channeling messages between systems, and increasing system efficiency. Moreover, through describing and reading the proposed modeling, this layer will provide compatibility of disparate protocols. Besides that, the Fog layer allows non-IP-based applications to be visible and available over the Internet (Rahmani et al., 2015).

6. Benefits and Detriments of Fog Computing

Understanding the connection among fog and could and assessing the effect of the fog on (IoT) service latency and service quality is critical in an IoT setting. The fog computing model has many characteristics that create it perfect for Iot enabled systems (Negash et al., 2016). Fault tolerance related to fog providers' similarity to the edge devices, communication bandwidth efficiency due to the limited and data exchange with plugins, and improved response time due to a smaller specific container between the dataset and the fog level compared to the cloud are among them (Aleisa et al., 2020). Since fog and cloud computing provide several of almost the same capabilities (web development, technology, and bandwidth) with some similar structures and characteristics like parallelization and many contracts, the fog computing has a number of advantages for Iot nodes (Atlam et al., 2017). All advantages can be summed up as follows:

Greater market mobility: Fog computing systems can be built and implemented easily with the right software. Furthermore, these programs will configure the system to run in accordance with the needs of the user (Cisco, 2015).

Lower Data Quantity: The installation of fog nodes decreases the burden on the central server or cloud. The fog devices process the data that decreases the impact of effort the cloud needs to do as well as the volume of network traffic it receives (Ahmed et al., 2020).

Low latency: The fog is capable of providing real time utilities such as gaming and video streaming (Askar et al., 2011; Al Majeed et al, 2014; Peralta et al., 2017).

Regional and huge usage: Fog computing could provide massive and broadly dispersed applications with dispersed processing and storage services (Peralta et al., 2017).

Lower running costs: By accessing data locally rather than uploading it to the cloud for review, you can save network bandwidth (Ahmed et al., 2020).

Versatility and heterogeneity: Fog computing enables various services to collaborate across diverse geographic areas and systems (Bonomi et al., 2014).

Scalability: Since the fog computing is so like to node devices, it allows the number of devices connected and resources to grow.

Network bandwidth conservation: Fog computing decreases the amount of bandwidth needed for connectivity between sensors and the cloud. This has an immediate effect on IoT results. Edited or chosen data was submitted to the server for further processing to conserve network bandwidth and increase server capacity (Ahmed et al., 2020).

The real time data processing: Fog computation allows for actual data analysis. Real time utilization of fog includes personal medical research, refinery tracking in the petroleum industry, and train line control (Dahiya and Dalal, 2018).

Bandwidth conservation: regular terabytes of processes have been developed by numerous sources such as social media, ecommerce, and financial transactions, among others. In just thirty min, passenger airliners will produce 10 TB of data. It is inefficient to transfer any of the data from the sensors to the cloud. That will also increase the total running cost. The fog model reduces bandwidth utilization (Dahiya and Dalal, 2018).

Fog computing is not without its drawbacks, which would include the following:

Physical location: Since fog computing is connected to a physical area, it invalidates all of the other cloud computing's "whenever and wherever" advantages.

Potential security problems: The fog-computing may be vulnerable to security problems including such IP address spoofing and man-in-the-middle attacks in the right conditions (Abdulkahleq & Askar, 2021; Khalid & Askar, 2021).

Startup costs: The fog-computing is a deal that creates the use of both node and cloud services, even though there are hardware costs involved.

Ambiguous concept: Despite the fact that fog computing has been around for many years, there is still some confusion about its concept, with multiple suppliers describing fog computing in different ways (Firdhous et al., 2014).

7. Fog computing Applications

The fog computing framework can be used for a number of purposes. In this part, we'll focus at a few of the interesting applications that fog computing can help with, as showed in Figure 2.

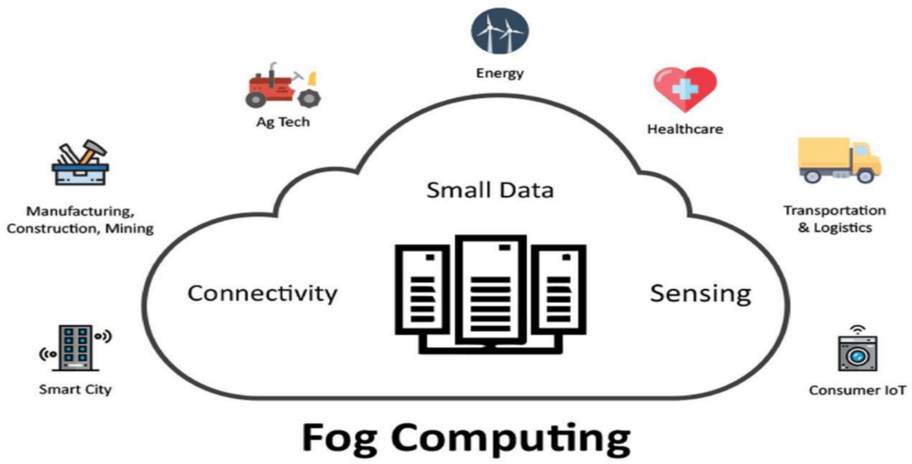

Figure 2 fog computing applications

7.1 Health care

Healthcare fog computing has been mentioned in a few similar articles. As an instance, Mukherjee et al. (2018) to show the feasibility and usefulness of fog computing in health surveillance, researchers used a real-world ubiquitous health monitoring program. In dementia patients, slips are a significant risk factor for mortality. As a result, identifying slips immediately and in a timely way is important for stroke prevention in everyday life. They created new fall classification algorithm and developed and introduced a down detection in actual environments method based on the fog computing model, in which the detection role is divided between edge devices and the server. Decentralized monitoring and edge knowledge, backed by the fog computing model, are very interesting applications for comprehensive health surveillance, according to findings obtained (Mukherjee et al., 2018). In addition, Shi et al. (2015) the fog computing can offer in the healthcare system were mentioned. The fog-computing, which is built on the foundation of edge servers, is regarded as a revolutionary technology that distributes small computer technology, storing, and communication resources among edge and conventional cloud computing datacenters. It transforms data for Data Centers and delivers logical information to edge devices (Shi et al., 2015). Gia et al. (2015) they improved this health management system by using fog computing at knowledge comes, which included advanced techniques and resources such as integrated data analysis, scalability, and warning service at the network's edge. Electrocardiogram (ECG) function extraction was selected in particular. Smart gateways evaluate ECG signals and retrieve functionality such as heart rate and a versatile model based on a lightweight optical flow mechanism. Their findings show that fog computing aids bandwidth utilization while still providing low-latency legitimate answer at the edge of the network (Gia et al., 2015a). In addition, in (2015) Cao et al. described a fog computing categorization based on the problems and characteristics of the fog and it is discussed how similar computing paradigms, such as end edge computing and cloud computing on the move, vary from fog. They have looked at fog node setup with networking equipment, as well as different fog computing parameters. However, There is no provision for service allocation, network optimization, or comprehensive performance monitoring dependent on latency, energy usage, resource sharing, and caching (Cao et al., 2015). In addition, in (2018), Paul et al. recommended that fog computing be used to better track medications so that data can be gathered and analyzed quickly. The biggest challenge will be to filter out only perspective data that is important to the patient's welfare. A basic detector system is no longer feasible, and that's where a fog computing layer occurs. This improves the overall system's reliability because which not only decreases the volume of data sent back and forth across the cloud and the devices, but it also avoids the chance of a data center outage (Paul et al., 2018).

7.2 Vehicular

Yu et al. in (2018) discussed about effective implementation and layout of Fog computing enabled vehicle technology for AD is investigated. They introduced two distinct design types, coupling and decoupling, and formulated the system into multiple Parameter Estimation formulas with the goal of reducing implementation costs. The decoupling method is much more cost-effective and scalable than the coupling mode, according to numerical data (Yu et al., 2018). Another author, Tang et al. in (2018) to enhance parking system in real time, fog computing based parking guidance architecture was proposed. Parking lot fog nodes that communicate with one another allow real time reconfiguration of parking data and delivery of parking queries. Through implementing optimum solution on parking demand distribution, the cloud core will boost smart parking capacity even more. As compared to other parking tactics, the results showed a higher quality. Fog computing smart parking, as introduced, would decrease total parking costs while simultaneously reducing fuel pollution and vehicle exhaust emissions (Tang et al., 2018). Fog computing for smart urban, Chiang and Zhang (2016) provide the results of the fog's integration with IoT. They began by addressing emerging problems in IoT networks, as well as how hard it is to address these problems using existing computing and networking technologies. The study then goes on to address the need for an environment for digital computation, processing, and communications, and also how this technology may be used to increase the profitability. They have explored the advantages and disadvantages of this fog architecture, as well as solutions to certain IoT problems (Chiang and Zhang, 2016).

7.3 Smart cities

For smart City Fog Computing and Iot Managed Service, Changhao Zhang (2020) examined the benefits of the fog and proposed Iot architecture based on fog that efficiently addresses issues of large data collection and cognitive task. The Iot and fog computing will be used to make it possible to create smart cities. On this foundation, a structured fog computing system structure is designed to further organize the city's operations, via numerous intelligent experiences, knowledge collection, and network transmission means, effective and peaceful (Zhang, 2020). In addition, also for smart city Wang et al. in (2019) implemented a fog-computing paradigm and modify the Hungarian method to handle the combining resource to achieve effective and reliable resources with a shorter delay. The fog computing platform serves as a buffer and operator between the CPS level and the cloud layer, allowing malicious attacks to be handled while also allowing highly sustainable applications to be built. Our approach can minimize coupled computing and increases economic usage to make systems more efficient (Wang et al., 2019). Also Mohamed in (2019) addressed the concept of fog service stability and low latency for smart cities based on Iot. They looked at a couple of variables in order to reach a high level of latency for the fog-computing systems in smart cities. Furthermore, load balancing virtualization services for fog computing is suggested to support in the resolution of latency and limit state problems. These utilities will make it easier to run IoT-based smart city applications in a more stable environment (Mohamed et al., 2019). In addition, in (2020) Sinha et al. developed fog for smart traffic; they suggested surveillance system is intended for traffic light control and condition monitoring. It can also be programmed to identify traffic accidents that necessitate additional care during periods of congested traffic. A fog server is a small device on a device that collects real time data from different geographic sources and provides it to the cloud for storing and analysis in this system. The findings illustrate the fog organization's success in enhancing the cloud system's quality in terms of reaction time reduction and bandwidth expansion (Sinha et al., 2020). Also Haj Qasem in (2020) the idea of fog computing is used to suggest a smart city with a scalable hierarchy. With allowed real-time applications, the suggested solution greatly reduces computing and management latency, delivers required task over end technology to reduce data processing costs, and enables shared data sharing among smart cities (Qasem et al., 2020).

7.4 Other applications

A variety of similar papers have been provided fog framework for real time applications, Peter (2015) Implementations in actual environments have been debated. He demonstrates that fog computing can accommodate large volumes of data produced by Iot nodes. Moreover, it also demonstrated that fog would help with convergence and latency problems. The fog was also shown to support an intelligent framework for handling the fragmented and actual environments design of evolving Iot architected and creating innovative services at the end edge, resulting in the development of new products and possibilities for operators of facilities (Peter, 2015). In addition, LI et al. (2019) in wireless IoT networks, researchers studied the issue of job management and heterogeneous resource utilization for multiple computers. IoT systems that gather vast volumes of data must make reasonable offloading decisions in order to deliver the information to the fog devices. In addition, to be capable of binding a millions of computers when transferring a large volume of data with minimal latency and resources to decrease the system's power usage, the issue of efficiency is solved as a mixed convection variable optimization problems. Since the issue is NP-hard, they devised (IGA) algorithm to obtain it. According to the scientific experiment findings, the suggested methodology performs well in terms of throughput, delay, outage chance, and energy demand (Li et al., 2019). In (2020) Wang et al. In the Iot devices, the four-layer architecture for integrating fog computation and organizational modal analysis is suggested. Fog computing is introduced in this four-layer architecture to address resources that cloud computing cannot perform in actual environment. In addition, A finite storage generates recurrent highly correlated operational modal evaluation dependent on testing technique is suggested in order to save time and storage sophistication algorithm for organizational modal analysis and help the actual time efficiency of fog-computing. The non-stationary arbitrary reaction signals of a beam structure whose intensity changes slowly produce time varying operational modal recognition, indicating that the results in relational proposed method organizational modal analysis methodology used in loss generates requires less storage and latency and has a good efficiency and recognition effect. (Wang et al., 2020).

Table2. A set of similar works that looked at fog computing and Iot devices

Model	Author(s)	Year	Objective(s)	Result(s)
	Gia et al. (Gia et al., 2015a)	2015	Through using the principle of fog-computing at smart gateways, such a health management scheme can be improved.	Low bandwidth utilization and providing actual solution with low delay at the channel's edge.
	Cao et al. (Cao et al., 2015)	2015	There is no provision for information obtained resource optimization, or detailed performance monitoring.	dependent on latency, energy utilization,
	Shi et al. (Shi et al., 2015)	2015	Fog computing's features and the services it can deliver in the healthcare sector. It processes specifically for Data Facilities and delivers logical information to end devices.	Transfer data for Data Centers and delivers logical information to edge devices, effectively with low latency.
Health care	Mukherjee et al. (Mukherjee et al., 2018)	2018	To show the feasibility and usefulness of the fog model in healthcare apps, a real world systemic healthcare monitoring framework was developed.	Decentralized monitoring and edge knowledge.

	(Paul et al., 2018)	2018	Use the fog-computing to aid in the monitoring of medicate beneficiaries so that data can be gathered and analyzed quickly.	The system's reliability and decreases the volume of data sent back.
Smart city	Wang et al. (Wang et al., 2019)	2019	To handle the combining resource to achieve effective and reliable resources with a shorter delay.	Increases economic usage to make systems more efficient.
	Mohamed (Mohamed et al., 2019)	2019	The concept of fog service stability and low latency for smart city technologies built on the Iot devices	Make it easier to run Iot based smart city applications with low latency.
	Sinha et al. (Sinha et al., 2020)	2020	Surveillance system is intended for traffic light control and condition monitoring.	Reaction time reduction and bandwidth expansion.
	Changhao Zhang (Zhang, 2020)	2020	Addresses the issues of hug data analysis and network optimization.	Knowledge collection and network transmission means, effective and peaceful.
		2020	To minimize the waste of data management and to enable collective data sharing across smart cities	Improves user access performance and reliability while significantly sacrificing time, expense, or network utilization
Vehicular	Chiang and Zhang	2016	Fog computing for smart urban, to address the need for an environment for digital computation, processing, and communications.	Increase the performance.
	Yu et al. (Yu et al., 2018)	2018	implementation and layout of Fog computing enabled vehicle technology for AD	More cost effective and scalable
	Tang et al. (Tang et al., 2018)	2018	To enhance parking system in real time.	Result showed a higher quality.
Other app.	Peter (Peter, 2015)	2015	The fog was used to show how an intelligent network can be used to handle the decentralized and real-time design of evolving IoT.	An intelligent framework for handling the fragmented and actual environments with low latency.
	Li et al. (Li et al., 2019)	2019	To make reasonable load balancing in order to deliver the data to fog computing points.	The findings show that throughput, delay, outage chance, and energy usage.
	Wang et al. (Wang et al., 2020)	2020	Four layer architecture for integrating fog computation and organizational modal analysis is developed.	The storage and latency requirements are reduced, and the reliability and identification effect are enhanced.

8. Conclusion

IoT devices are fundamentally complex, with minimal storage and computing capacity. The standard centralized cloud, on the other hand, has a range of flaws, including network mobility and network problems. And solve these concerns; the fog was built as a cloud extension that is closer to IoT computers, where fog nodes do all computations, minimizing delay, particularly for time to sensitive applications. Fog computing's incorporation with the Internet of Things would support a number of Iot software. The fog-computing allows edge and cloud services to work together seamlessly. It facilitates the automatic identification processing of vast quantities of data generated by IoT sensors deployed for seamless associated with cloud computing integration. The discussion also centered on various IoT technologies that would benefit from fog computing. To successfully execute fog computing applications, multiple use cases such as health care, virtual reality, smart environments, and IoT are discussed. In summary, the aim of this paper was to include an overview of recent research studies on fog computing, the IoT devices, and their applications in our society.

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