A Brief Study On Pros And Cons Of Various Types Of Algorithms Involved In The Fog Computing

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Abstract- *Fog computing is a distributed computing paradigm that extends cloud computing to the edge of the network, enabling faster and more efficient processing of data. In fog computing, data is processed at the network edge, closer to the source of the data, instead of being transmitted to a remote cloud server for processing. Fog computing algorithms are designed to address the unique challenges of processing data in a distributed environment. Fifteen journals from various sources had been selected to analyze various algorithms' pros and cons in order to make a comparison of the system that provides maximum accuracy in the processing time. These algorithms include load balancing algorithms, resource optimization algorithms, fault tolerance algorithms, and security algorithms, among others. From this study we find out the most algorithm that will make the fog computing more efficient. This study makes the researchers to make an advanced research in the field of Fog Computing algorithms to obtain 100% better solution.*

Keywords- latency, Fog computing, edge devices, real-time processing

I. INTRODUCTION

Fog computing emerged as a response to the limitations of cloud computing in addressing the increasing demand for real-time processing and low- latency applications. While cloud computing offers significant benefits in terms of scalability, cost- effectiveness, and ease of deployment, it is limited by the distance between the cloud data center and the end- user. This distance results in higher latency and slower response times, which can be problematic for applications that require real-time processing, such as industrial automation, smart cities, and autonomous vehicles. Fog computing algorithms are necessary to optimize the performance of fog computing systems. Fog computing involves processing data at the network edge, which presents unique challenges compared to traditional centralized computing models. Fog computing algorithms are necessary to allocate resources efficiently across the fog computing network, optimizing the use of processing power, storage, and network bandwidth. Without Fog computing algorithms, it would be challenging to manage and scale. As the number of edge devices in the network increases, manual management of tasks and resources would become increasingly difficult, making it challenging to maintain the performance of the system. Fog computing algorithms are designed to address these challenges by optimizing the distribution of tasks across multiple edge devices, improving resource utilization, and reducing latency. The main purpose of these algorithms is to improve the performance of the system by distributing tasks and resources in an optimal way, enabling real-time processing of data, reducing latency, and improving the reliability of the system.

II. LITERATURE REVIEW

Table 1 provides a review of the research conducted in various years based on the algorithm used in the Fog Computing.

S.no	Year	Author	ProposedAlgorithm	Pros	Cons
1.	2019	X. Wang, W. Zhang,andZ.Gao	DeepReinforcement Learning[1]	TheproposedDRL-basedapproachis ableteachievehighertaskscheduling efficiency than traditional methods, such as the first-come-first-serve (FCFS) algorithm. This is because DRL can learn from past experiences and make more informed decisions abouttaskscheduling. TheDRL-based approach can improve resource utilization by making more efficient use of available resources, such as CPU and memory.	The proposed approach is evaluated on a small-scale fogcomputingtestbedwitha few fog nodes and tasks. The DRLmodel proposed in the paper is trained using a specificsetoffogcomputing scenarios and workload distributions. Therefore, the approach may require retrainingandfine-tuningfor each new scenario or workload.
2	2018	Xiaohui Liu, QinghuaWu,and Ho Li	Energy-EfficientTask OffloadingAlgorithm[2]	The algorithm is designed to minimize the energy consumption of fog nodes by balancing the workload across the fog nodes and minimizing the communication overhead. This canlead to significant energy savings, especiallyinlarge-scalefogcomputing environments. Thealgorithmsscalable and can handle large numbers of tasks and fog nodes.	The performance of algorithmsandtechniquesis often dependent on specific parametersandassumptions. Changesinthese parameters or assumptions can lead to different outcomes,the evaluation of proposed algorithmsandtechniquesis often limited to specific use cases and scenarios. The proposed algorithm only focuses on energy-efficient taskoffloading and doesnot considerotheraspectsoffog computing, such as reliability, security, or cost- effectiveness.
3	2020	Ysun Zhou, ZhongmingZhao, and Yusheng Ji	CongestionDetection Algorithm[3]	The algorithm is designed to detect trafficcongestioninreal-time,whichis crucial for managing traffic flow and preventing accidents. The algorithm uses machine learning techniques to analyze traffic data and identify congestion patterns. This approach is more effective than traditional rule- based algorithms, as it can adapt to changing traffic conditions. The algorithm is scalable, which means it can be easily adapted to differenttrafficscenariosandscaledupordown based on the volume of traffic.	The algorithm proposed in the paper may only work for specific types of traffic congestion scenarios andmay not generalize well to otherscenariosorcities. This limitationcouldbeduetothe differencesintrafficpatterns, infrastructure, and weather conditions that can affect traffic congestion. The paper may not have addressed how to evaluate the generalizability of the algorithm or how to adapt it to different scenarios.
4	2020	S.Sangeetha and R.Saravanan	Fuzzy Logic-Based ResourceManagement Algorithm[4]	The fuzzy logic-based algorithm can optimize the use of resources by dynamicallyallocatingresourcesbased on the current workload and demand. Thiscan help ensure that resourcesare used efficiently, reducing wasted	Fuzzylogic-basedalgorithms deal with imprecise and uncertain data, which can make them less reliable than deterministic algorithms.Fuzzylogic-based

				resources and lowering costs.The algorithm can be applied to fog computing environments of varying sizes,makingitapotentiallyscalable solution for resource management in fog computing.	algorithms can be more complex than traditional algorithms, requiring more resources to execute and leadingtolongerprocessing times.
5	2018	XiaohangWang Feng Xia Zhenfu Cao	SecureDataStorage Scheme[5]	The proposed scheme provides enhanced security by encrypting the data before it is transmitted to the fog nodes.Thefognodesarelocatedcloser tothedevicesandcanprocessthedata locally, thereby reducing the distance that the data has to travel.	The proposed scheme involves multiple layers of encryption and decryption, whichcouldmakeitdifficult to implement and maintain. Data isprocessed and stored in multiple fog nodes, there may be some latency involved in accessing and retrieving data.
6	2018	Shuiguang Deng, KechengLiu,and Xiaohong Jiang	DistributedMachine LearningAlgorithm[6]	The use of fog nodes allows for faster processing of machine learning tasks, as the data can be processed locally without the need for it to be sent to the cloudfor processing.machinelearning taskscanimproveprivacyandsecurity, as sensitive data can be processed locally without the need for it to besent to the cloud.	The paper provides experimental evaluation of the proposed algorithm, the evaluation is limited to a single dataset and a single fogcomputingenvironment.
7	2019	Yan Guo, JianxiongZhang, and Jianqing Li	ParticleSwarm Optimization [7]	The PSO algorithm used in the proposed algorithm has fast convergence,whichmeansthatitcan quickly find optimal solutions. The proposedalgorithmaimstominimize theenergyconsumptionoffognodes during data transmission.	While particle swarm optimization (PSO) is a powerful optimization technique, the proposed algorithmfaccuracymaybe limited by the quality of the initial population and the search space.the proposed algorithm would scale up in complex fog computing systems, and how it would perform under high traffic loads.
8	2019	Xuoxu Ma, TingtingCui,and Hui Tian	NovelTaskScheduling Algorithm[8]	The proposed algorithm can efficiently utilize the resources available in a heterogeneous fog computing system.It takes into account the processing capabilities of different devices and allocates tasks accordingly. It can handle a large number of tasks and devices without compromising on performance. Theproposedalgorithmis fault-tolerant and can handle device failures or network disruptions.	The algorithm may only be applicable to a specific type of heterogeneous fog computing system or a particular set of parameters. Thismaylimititsusefulness in other scenarios or environments.Thealgorithm may require significant computational resources, such as processing power, memory, or storage.
9	2019	Fang-Yie Leuand Chia-Mei Chen	Game- Theoretic ApproachtoResource Allocation[9]	Theproposedgame-theoreticapproach allowsfor efficientresource allocation infogcomputingenvironments,where computing resources are distributed across various devices in a network.The game-theoretic approach isscalable,andcan beappliedto large- scale fog computing environments. It canhandlealargenumberofusersand devices and can allocate resources efficiently even in complex and dynamic networks.	Theproposedgame-theoretic model assumes that all fog nodes have the same capability, which is not always true in real-world scenarios. Some fog nodes mayhavemore resourcesor higherprocessingpowerthan others, which may result in unfair resource allocation.Some fog nodes may behave selfishly and prioritize their own interests over the interests of the system. In such cases, the proposed approach may not work as expected and may lead to inefficient resource allocation.
10	2019	WeiLi,LiLi,and Peng Liu	HybridEnergy-Aware Algorithm[10]	The algorithm is designed to optimize energyconsumptioninFogComputing systems,ItachievesthisbyconsideringthE energy status of IoT devices, the computing capabilities of fog nodes, and the communication cost between them.Thealgorithm takesinto account thecomputingcapabilitiesoffognodes and their proximity to IoT devices. By prioritizing fog nodes that are closer to IoTdevicesandhavehighercomputing capabilities, the algorithm reduces latency in data processing andimproves response times.	The proposed algorithm is only applicable to fog computing in the context of the Internet of Things (IoT). Hence, its applicability to other domains may be limited.Itisunclearhowwell thealgorithmwouldperform asthenumberofIoTdevices and fog nodes increases.
11	2017	QiSun,Jianjun Yang, andYan Zhang.	Efficient Resource AllocationAlgorithm [11]	Thealgorithmoptimizestheallocation of computing resources by taking into accountheprocessingcapacityoffog nodes, the processing requirements of tasks, and the communication costs between nodes. The algorithm considers the energy consumption of fog nodesand tries to allocate tasks to nodes that have a lower energy consumption rate. This reduces the overall energy consumption of the system and increases its energy efficiency.	The paper focuses only on resource allocation for fog computing in 5G networks, anditdoesnotconsiderother important factors such as security, privacy, and fault tolerance. The paper makes several assumptions and simplifications, such as assuming that all fog nodes have the same processing capabilities and ignoring the impact of network delay, which may limit the generalizability of the proposed algorithm.
12	2019	Junjie Liu, YuzhengLin,and GuangxingWang	AQoS-AwareResource AllocationAlgorithm[12]	The algorithm optimizes resource allocationinawaythatminimizesthe overall resource usage while meeting the QoS requirements of all applications.	Fognodesmaybevulnerable to cyber-attacks, and sensitive data may be compromised if appropriate security measures are not in place.
13	2019	QianqianFeng, YuyingHu,and Shuo Feng	Dynamic Resource AllocationAlgorithm [13]	By allocating resources dynamically basedonthenee dsoftheapplication, the proposed algorithm can improve application performance, reduce latency, and increase throughput.Resources are used efficientlyandeffectively,whichcan lead to improved application performance and reduced resource	The proposed algorithm involves frequent communication between edge devices and the Fog, which could result in increasednetworkoverhead and latency.
14	2020	JieXu,KaiWang, Xiuhua Li	TaskOffloading Algorithm[14]	The proposed algorithm reduces the communication overhead between the edge devices and the cloud.it can handle large numbers of edge devices and fog nodes without significantly impacting system performance.It can adaptbychangingconditionsandlearn from past experiences.	The proposed algorithm relies on several simplified assumptions about the fog computing environment,suchashavinghomoge neous fog nodesand taskexecution times that follow specific distributions. the algorithm may not be suitable or optimal for more complex fogcomputingenvironments.
15	2020	JieXu,KaiWanag, Xiuhua Li	LoadBalancing Algorithm[15]	Thealgorithm balancesthe load across fog nodes by redistributing tasks from overloaded nodes to underutilizednodes. This prevents any single node frombecomingoverloadedandensures that all nodes are utilized efficiently.The algorithm reduces the response time of IoT devices by dynamicallyadjustingtheallocationof computing resources	The proposed algorithm is designed for use in small-scaleIoTenvironments,and may not be suitable for larger, more complex systems.Thiscouldlimitits usefulness in certain applications.

III. CONCLUSION

Analyzation of various journal papers in detecting the pros and cons of various Fog computing algorithms and techniques is the main purpose of this proposed work. This investigation will be very much helpful for the beginners and new researchers to make a new revolution in Fog Computing technique

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