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A Comparative Study on Edge Computing & Cloud Computing

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***Abstract* –** *With the technological development of advanced technologies and the use of the Internet of Things (IoT), the number of connected devices is increasing in manufacturing processes. As devices become more and more incorporated using more processing power, the big data is generated. However, increasing the generation of big data leads to problems related to processing and analysis. The current tendency of solving the problems of processing and analysis is via Cloud Computing technologies. However, more attention is dedicated of performing computations as close to the device as possible, relying on Edge Computing technologies..*

Keywords- Cloud Computing; Edge Computing; Edge vs Cloud Computing

I- INTRODUCTION

Edge computing creates a replacement concept within the computing landscape. It brings the service and advantage of cloud computing closer to the tip user and is characterized by fast processing and rapid application response time. The currently developed internet-enabled applications like wearable devices, smart retail, video game, and smart appliance monitoring require fast processing and rapid time interval. The cloud computing issues are often done by a number of three Edge computing models Cloudlets, Fog computing and Mobile Edge computing.

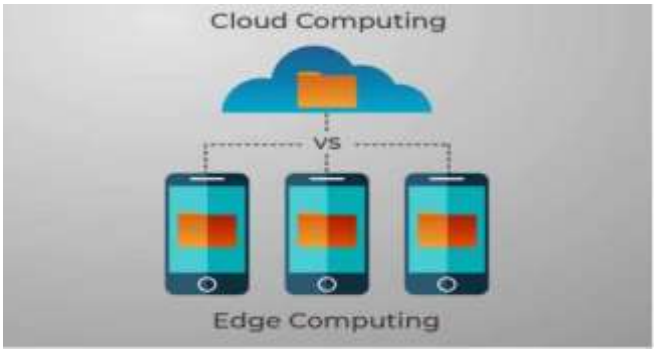

Fig 1: Edge Computing & Cloud Computing

Edge computing enables data to be processed closer to where it's developed, reducing the necessity to transfer data back and forth between the cloud.

Edge computing computer science services will effectively reduce loads on data centres, and also edge computing with the net of things field are developed new opportunities by enabling smart homes, smart hospitals, smart cities, wearable devices, smart supply chain and style of other smart environments.[1]

II- METHODOLOGY

The results presented in this section have been obtained according to specific criteria. Manuscripts were filtered based on the presence or absence of keywords in the title of the document. Keywords of interest were: Cloud

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computing, Edge computing, IEEE Xplore Digital Library (DL) and ACM Digital Library (DL) have been used as data sources. The reason behind these choices is that we aim at giving an idea of research trends related to specific keywords, rather than providing a comprehensive and detailed statistical analysis of the literature. Thus, we assume that the results highlighted from the analysis of the aforementioned main databases reasonably reflect common trends of the scientific community about recent computing paradigms [2].

III- APPLICATIONS DOMAIN

A. TRANSPORTATION: Autonomous vehicles are one in all the feasible applications of edge computing. Self-driving vehicles for its smooth operation, they're heavily given every type of sensors The inertial measurement unit (IMU) sensors can provide exact analytics on what motion happened in driving a car-i.e.,hard brakes, sudden lane changes, GPS, etc. Data from IMU sensors doesn't reply why the motive force acted in that manner. For that, we've many Cameras, the video stream from these cameras will only go locally to the edge server and process them locally and provides directions, before sending it to cloud, which lead to low visibility.

B. HEALTH CARE: People became increasingly convenient wearing fitness trackers. the important time data sending to the network is extremely big resulting in many megabytes for one patient. and lots of of such cases sending data synchronously will lead to network congestion. The doctor reaction to emergencies is late due to the increased response latency. Edge computing may be a solution to the current. Accumulate the info from the patient like ECG, Heart rate, EEG, etc. and send it to any smart edge device, where data get processed easily and understand patient condition. Thus, decreasing the quantity of information to be send to the server. Doctors would be able to offer faster better care to patients while also adding a further layer of security to the patient furthered health data.

C. SMART HOME: Some products like smart TV, smart light, google assistant are available in market now a days. These all are due to the influence of latest technology Internet of Things in people life. In smart home environment, the devices are connected and might be ruled by a sensible device, or by a sensible phone. Besides that, a large amount of information being produced and it should be transmitted over network.

Edge computing is taken into account to be ideal for building smart home. the info is being analysed and processed where it's constructed. With the sting gateway running in a grip software (edge OS), the things is simply connected and being easily managed. the info are being prepared locally and there by releases the burdens for internet bandwidth and high privacy and high security is given to the information [1].

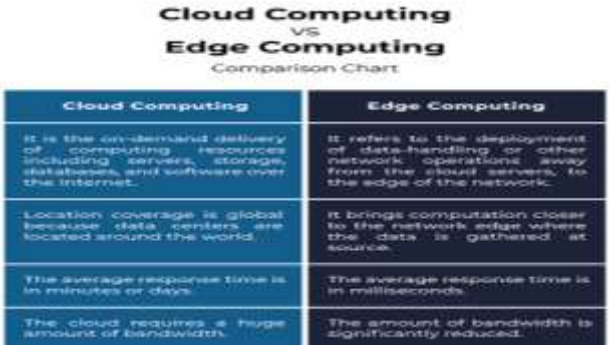

Fig 2: Cloud vs Edge

IV-CLOUD COMPUTING

Cloud Computing, as a combination of centralized, distributed and parallel system, includes virtualized and arranged computers that are dynamically supplied and set or an outsized number of existing computing resources creates a service at the level of the connected device. Cloud Computing shares the majority of the Internet work computer resources instead of software or storage on local computers. To distribute their work, computer resources are placed in many locations where these computer parts are run simultaneously in a computer group. This method is used for creating analytics that runs more rapidly and is capable of performing the time consuming and power-consuming data processing [5]. Cloud Computing represents a computing technology providing services of storage, sharing and processing of knowledge through visualized and scalable resources over the networks.

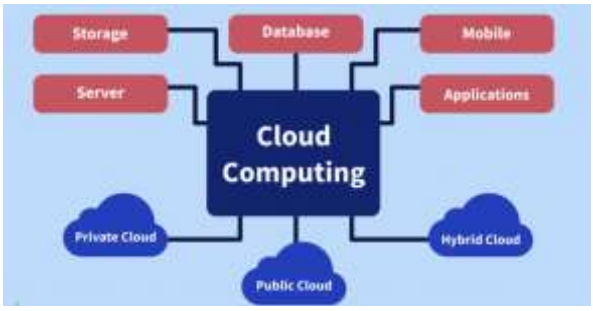

Fig 3-Cloud Computing

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With the advantage of flexibility, storage, sharing and simple accessibility, Cloud Computing encompasses a big role in Data Analytics process with the accent on Big Data, namely Big Data Analytics (BDA), because it offers access-based computing infrastructure oriented to subscription, data, and application services.[2]

V-ADVANTAGES OF CLOUD COMPUTING

- Efficiency / Cost Reduction: No must spend huge amount of cash on purchasing and maintaining equipment.
- Unlimited storage capacity: Cloud supports an enormous storage capacity to store any quite files.
- Mobility: Cloud allows sharing of knowledge via smart phones and devices.
- Disaster Recovery: It provides data recovery from natural disasters to power outages.

- Issues in Cloud Storage: Although there are many advantages, still cloud computing faces some issues like.
- Data Loss: Intruders may hack the client's applications on the cloud, and thus access sensitive data. Cloud computing faces a high risk on security because of malicious program or powerlessness. Servers can in addition suffer from data loss.
- Connection Problem: Sometimes the cloud service might not ready to connect thanks to errors and system crashes.
- Latency Issue: Since, accessing the cloud frequently, the interval also increases, thus arises a latency problem.
- Security: When transmitting the info within the smart phone, it's going to also contain private data. When such data are transferred to the cloud storage will results in security problem.
- Energy Consumption: As increase within the number of smart appliances the facility consumption of information centerish increased drastically. As an answer, a replacement computing technology called edge computing booms.

VI-EDGE COMPUTING:

The Edge Computing, unlike Cloud Computing, represents the decentralized computing service for storage, processing and applications. It takes place on the network edge and acting as a middle layer between user and cloud data centers therein way introduces distance that data must travel on the network while producing minimal delays.

The sting Computing is perceived because the easiest method of optimizing the Cloud Computing by performing Data Analytics as near the information sources as possible.

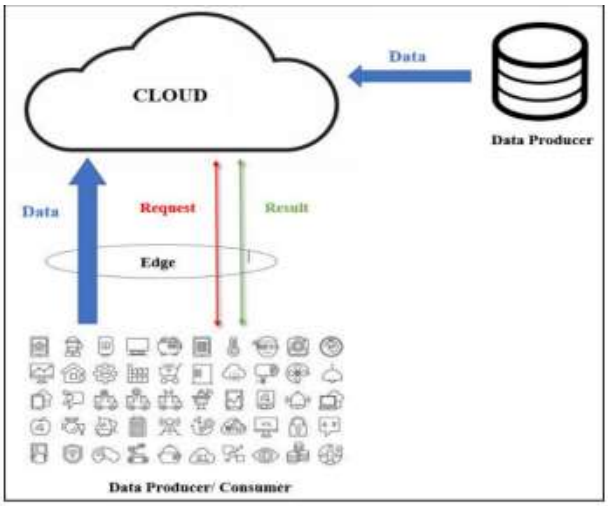

Fig 4- Edge Computing

Many researches find that Edge Computing is synonym for Fog Computing. As Shi et al.and Mukherjee et al. agree, Edge Computing is additionally interchangeable with Fog Computing, with the minor difference that Edge Computing is targeted more toward the items side, while Fog Computing is concentrated more on the infrastructure side, while both of those technologies are the identical regarding the information Analytics perspective.

The multi-layer Edge and Fog Computing architecture is ready to support quick response, providing high computing performance used for processing the information along Data Analytics technology.

The knowledge processing is distributed between edge devices, while the information processing tasks, which might not be handled well by edge systems, are taken to the cloud. As a result, the scalability and efficiency is improved significantly because of undeniable fact that computing and routing burdens

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are decreased. This also benefits for lowers network traffic[2].

VII-ADVANTAGES OF EDGE COMPUTING

By edge computing you can solve the low latency problem. Edge computing on devices ensures that only non-critical data can be acted upon exactly. B. Edge computing reduces the bandwidth by its decentralized approach.

When data are collected, at every second data processing begins and only those data that need to store are sent to the cloud. This makes edge computing more scalable, efficient and also decrease the load on the network.

Edge computing can say that there us an additional layer of security too, because most of the data from IoT devices doesn't traverse through the network. Instead at the point of design itself, it is processed.[1]

VIII- KEY ADVANTAGES OF EDGE COMPUTING

- Low latency.
- Decrease in server resource use and associated cost.
- Further functionality [1]

IX-DRAWBACKS

A. A drawback of edge computing is that the addition of wider 'smart' devices into the edge servers and IoT devices that have robust built-in computers, there are new range of options for malicious actors to compromise these devices.

B. Another drawback is that it requires most local hardware components. It would require a many more sophisticated computers with additional processing power and thereby increasing the cost [1].

X- EDGES vs. CLOUD COMPUTING

When the two terms are compared, the main difference arises over the data processing techniques. In cloud computing architecture, all the data captured and generated by the existing IoTs are processed in the cloud by the series centralized servers.

While edge computing differs in way as it follows the phenomena of moving processes away from the cloud and bring them near to the end devices, which are closer to the source of origin. By now in 2020 about 45% of the worldwide data which is stored and managed in the network's edge.

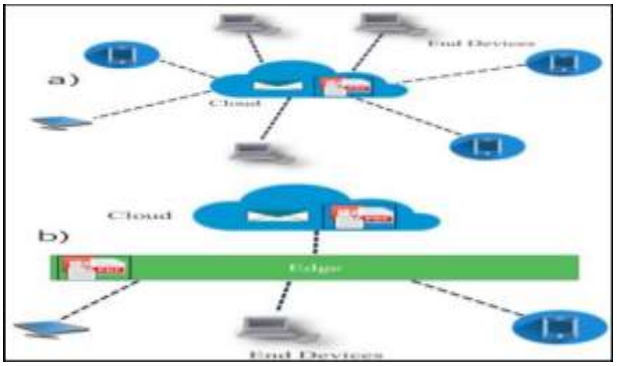

Fig 5- Edge computing vs Cloud Computing

The major drawback that the cloud faces over the edge is the amount of data processed per second is not passably supported by the cloud. Other than the issue of latency, the cloud faces the issues of wastage of resources as well. Also, when data is piled up and transferred to the cloud, it overloads the network and results in latency and high bandwidth usage.

It rises challenges for the cloud-based data processing system. In the case of edge computing, the device nodes process out the data and utilize the underlying hardware of the device only, which does make use of all available resources without need of extra ones.

Edge Computing not only helps in minimizing the data dependency over the app or any service, but also helps in speeding up of the processing. The various different features amid edge computing and traditional cloud computing are given Since, edge computing is still in the growing period, whereas the cloud environment is a developed one.

The theoretical comparative study provides the blurry differences among both the environments, due to which it becomes a bit difficult to get a concrete picture of both paradigms. Both the technologies are complementary to each other, instead of the substitution. One is supporting other and similarly getting the benefits out of it.[3]

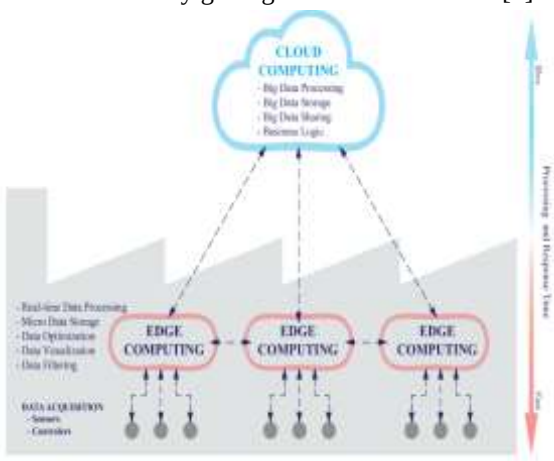

Fig 6-Edge vs Cloud

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XI- FUTURE WORK

In this new era of computing, every electrical equipment is integrated with IoTs and sensors with more advanced features of artificial intelligence.

Edge computing clearly proposes a number of benefits that cannot be easily achieved in traditional cloud computing, but also outsides a lot of technical and non-technical challenges as mentioned previously. The current study lacks the standardization in terms of the actual implementation of edge computing.

For example, with the real-time data of clean energy in the community and ES, the heating system can produce hydro- gen programmatically via the electrolysis of water[4].

The algorithm and software contrivance of the edge and IoT requires collective control of cloudlets. The features mentioned in comparison could be taken towards the analytical observation by implementing both in required scenario.

On the technical side, the quantitative data can be collected and compared by analysing the various factors, like performance, latency, data accuracy & loss, amount of data storage & processing capability, level of data security offered, deployment complications, expense occurrence of both the edge and traditional cloud computing environment.

The analytical comparative study could help identify the technology being more useful and effective, providing maximum benefit out of it.

For the collection of such data, edge computing and cloud computing services can be implemented in different scenarios. For example, the application of both the technologies can be implemented on the healthcare department, where data and readings are very critical. Also, the use of edge devices is growing immensely in the sector. In such case, it will become easier to calculate the efficiency and better productivity out of both technologies.

The one with less latency, less data loss, more accuracy, better productivity and other factors can determine the best implementation among the both and would be more clear on the feature and implementation of edge nodes. Another imperative area of study will be the improvement of contrivances which can compensate for the weaker perimeter security of the IoT and cloudlets, as compared to the traditional cloud computing environment.[3]

XII- CONCLUSION

Edge computing with its advanced features related to IoT, smart & mobile connected devices, etc. are bringing processing power as close as possible to the tip devices, which is enabling low latency, data processing, enhancing mobility, quality of service, and acting as a skinny line between the cloud and also the devices tier the varied models enabling edge computing on the three-level architecture simplifies the sting implementation and processing. Edge differs from the standard cloud in terms of mobility, and distributed architecture.

In future work, we will implement edge computing into power grids to support applications in reality [6].

Although edge provides the benefits, but the issues that confines the cloud computing model currently remain because the lead of the generated data that continues to extend. The technology of edge computing still needs development and further studies which could help in making a transparent line to differentiate among the effectiveness of the cloud and edge computing paradigm, as the current study lacks the calibration of 1 technology over the other on the precise implementation field. The orchestration of edge services become more difficult as edge node will be mobile and rapid changes can cause connectivity failure and bandwidth fluctuation.[3]

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