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Challenge of Handling Big Data in Smart Cities with Fog Computing

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Abstract

The smart cities are concentrated on supervisory available resources safe and sound, defensible, and efficiently to develop the economy and social results. People, organizations, and things in the cities are producing huge amount of data daily. Thus, big data created from several resources is supposed to be the most scalable quality of a smart city. In the current decade Managing Big data generated by vital connected devices are difficult to handle, for handling this difficulty "big data" an efficient computing platform "fog computing" has been proposed. It is standard that is extending the cloud computing services to the edge of the network and is used for reducing the latency of dynamic decision making and improving the real-time performance.as internet of hinges of things consists of minute and the resource restraint device that are connected to the internet.

Keywords: Big Data; Smart Cities; Fog Computing; Cloud Computing; Data

Introduction

Diverse sorts of information makes it trying to distribute, oversees, decide, translate, syndicate, look at, and devour. Certainly, measure of information is huge and it is created from different conditions, for example, water, vitality, traffic, and structures. "Multi-dimensional" and "multidisciplinary settings" for example "Computerized reasoning" (Machine Learning, Semantic Web), "Database", "Information Mining", and Distributed Systems social orders are seen to be the most ideal method for tending to a lot of difficulties for Big Data in keen urban communities.

The core objectives of smart cities are to develop the comfort of its inhabitants and encourage commercial development while maintaining and sustaining. Smart cities can develop a number of services containing healthcare, education, transportation and agriculture among others. Smart cities are centered on the ICT agenda including the Internet of Things (IoT) technology. These technologies produce large amount of heterogeneous data, which is usually referred to as big data. Big data can be extracted and demonstrated through the analytics procedures to get better understanding and to increase functions of smart cities.

Basically internet of things (IoT) are used to perform some specific functionalities without any need to perform complex and resource consuming tasks. This result shows that most of the data transmitted in the cloud without any preprocessing or else analysis and this reason causing in the increasing of data even more rapidly. It is certain that cloud computing are being renowned as a success reason for IoT for providing efficiency, consistency, scalability and for high –performance [33]. though cloud computing based application of IoT fails which need expected latency and that require fast mobile and large scale distributed control systems since it is geographically centralized and its communication implications.to tackle this low latency and geographical distribution needed by IoT devices a promising and reliable technology has been introduced which is fog computing [34].

The growth of huge information and the headway of Internet of Things (IoT) advancements have assumed a critical job in the practicability of brilliant city undertakings. Enormous information recommends the potential for urban areas to get profitable dreams from an immense measure of information gathered from different sources, and the IoT licenses the incorporation of sensors, radio-recurrence recognizable proof, and Bluetooth in the genuine condition by incomprehensibly arranged administrations. The blend of the IoT and huge information is an unmapped research zone that has conveyed new and intriguing difficulties for accomplishing the objective of future shrewd urban areas. These new difficulties focus chiefly on challenges related to business and innovation that enable urban communities to speak to the vision, standards, and prerequisites of the utilizations of shrewd urban communities by perceiving the principle keen condition attributes.

Problems faced by smart cities

Cloud computing of big data problem is the key solution of health scenarios toward the full development of IOT and especially they looks as No SQL DBs and how to shift toward the Web of Things to investigate. Abstraction on find the problem on seeing data representation and they concepts to analyzed of adjacency, containment or proximity. And they introduce in different dynamics of data representation contexts. The global model should have accomplished of dynamic interoperability disregarding and decision makers to process if large amount of data not such a problem because that is not clear of practically addressed. Big data issues in smart environment provides data access to heterogeneous data sources present solution of cloud storage.

The data abstraction is related to overcome of data manger to the heterogeneity of data. Data storage issues specially to integrate, monitoring environment in the cloud of end user to exposed data and propose new solution of manage data and organized. Linear prediction is the simple and flexible the ARIMA is widely used in model but it has poor performance for nonlinear problem. Basic function of handles to overcome of nonlinear problem relations and combination of both methods forecast and water of demand of models used. But the problem is the distribution follows of data assumes the methods which is not case for high dimension data and methods are computationally complex problem and also approached for cluster based for anomaly detection. The restoration problem become very complex problem of combination of switching operations and increase in system's components when taking into consideration the large numbers increase exponentially. Multiple control units divide the problem „Designing the smart grid in a hierarchical model „within its regions or scope charge of restoring power. Now the time needed to enhance the process of data and speed up the restoration process.

The hierarchical smart grid infrastructure can be solved different levels of DSM problems to preserve consumer's privacy and generate effective scheduling plan level solved but they do not benefit consumers but also the utility company. Energy sources manage research effective and different strategies and optimization solutions have been developed within smart grid. Due to nature how much data is available no matter of cities and complexity managed and planners so called wicked problem are too many variables can affect outcome or state. The advent of large scale data collections problems of warehouses the information system so called data rich. And allow the company to manage the data most benefits with other frames of each path of lands and helps of the solutions. Big data and agriculture corporates and providing solutions across value of chain and infrastructure and sensors of the software manage and streams of data from across the farm. Another problems of quality data is availability before can you make use of it and lack of integration, anonymity of data cannot be tracked of individual companies of problem include open governmental data never designed underlying systems that contains many inconsistent and incompatible data of cloud computing.

Software engineering problems conduct context survey. in this paper to analyze the effect of problem satisfactions on learning and on customers. Internal validity it's not far-fetched assumed problems can facility learning with struggling encounters can decreased the customer's satisfactions and acknowledged such an amount of efforts spent workings certain activity can affect both problems of learning the amount of struggling. Furthermore, problems do not decrease customer satisfaction related to quality requirements are educational encounters them. Some major problems with task management developers encounters and decrease customers satisfactions and they don't have educational value are conflicting goals. IN the era of big data, smart city is exposed to analysis of individual and information which is a condition that concerns to give rise sharing and misuse about profiling and stealing.

Cyber security concerns and requires attention in a large number of smart cities such as data communication, graph matching and evaluation of privacy preserving services. Big data problem is the key of security and one of concern for the enterprises. Most of malicious data it's become very difficult. Data research problem related to fields of cloud computing, grid computing, parallel computing, granular computing is the software defined storage. No SQL is the database solution for all problem are the additional track of relational database management system(RDBMS) they does not meet the requirement of highly quality performance of large amount of data of expandability and scalability problem of open source, cost effective, is the lack of maturity and consistency related to performance and do not deal with analytics. Design efficient data requires algorithms from large amount data is highly practical and solve many big data problems of cloud computing.

Background

Over few years big data has been in context for the researchers. It contributes immensely in cloud and helpful for all the areas that conquer cloud. This table explains how it helps in different fields.

Government Sector

It helps government sector to improve government systems and also help to control government activities.

Traffic systems

It helps to control the traffic signals and traffic flow. Give a proper traffic system in a smart city. The risks of accidents are reduced.

Health care

It helps to keep all the records of the patients and data regarding them and helps to keep it managed and secure.

Farming

It helps the farmers to keep the record of all the crops and helps to keep in the record of all minor details.

Education Sector

Also help in education sector. Help teachers and management to control all educational activities.

Banking Sector

In banking sector make a revolution change. It helps customers and as well as management to manage their information in easy and safe way.

Enormous information is been useful in the previous couple of years and it is shown by numerous analysts. The brilliant city part is still in the „I know it when I see it" stage, without an all-around concurred definition". As it were, a common meaning of a shrewd city isn't yet offered, and it has been hard to detach a standard worldwide importance. Information is being created from a few sources noteworthy in the structure of what is as of now known as large information [4].

What's more, the inward city development and conjecture could be advanced amid a Smart Digital City. Consequently, in general IoT skills can be ordered into a grouping of crash regions (Jiong., *et al.* 2014). It might be an effect on the national wellbeing and security (Rathore., et al. 2016), transportation (Rathore., *et al*. 2017), road condition (Rathore., *et al.* 2017), the positive result as a rule versatility and contamination because of transportation framework, etc. so forward. Various plans for cyclist observing, vehicles versatility, open vehicle leaving examination, and so on. are begun by utilizing sensors administrations to gather information for a specific city administrations. Evidently, numerous other administration applications are unsurprising that misuse IoT inner structure of the Smart City for air contamination, natural checking and clamor control (Geng., *et al*. 2017), vehicle developments (Soufiene., *et al*. 2015), and security and reconnaissance framework (Goyal., *et al.* 2017).

Big data in smart cities

Enormous information is the thing that will drive shrewd urban communities. It will be the power that guarantees they turn into a reality. In any case, conventional information preparing programming can't adapt to these galactic dimensions of information, 80% of the world's information has just been made inside the most recent couple of years, and by 2020 an expected 1.7 megabytes of new data will be made every second for each human on the planet, causing issues for information stockpiling, investigation, exchange and sharing.

This issue is especially observed while exchanging information, as the information gravity will pull in associations to start interfacing their administrations to cloud-based frameworks. Once collecting enough „mass", these cloud-based frameworks will be essentially difficult to move. With the development of the social web, enabling us to screen and share every single component of our lives from our area, to wellness levels and with each gadget in a city associated with these cloud-based frameworks, in what manner will we have the capacity to deal with the data that is being transferred?

Furthermore, more organizations are being associated over the world every single day, which means more information exchange between video conferencing, messages and web empowered texting frameworks because of the development of globalization. In this way, brilliant urban communities need frameworks that will most likely procedure elevated amounts of information at extraordinary rates to guarantee the city is running as productively as could be allowed.

Using big data analytics to contend with the interoperability in internet of things

Field of Internet of things IoT is growing rapidly and provides a great business potential in the direction of new period of smart cities as it provides preferable facilities connecting several regulations such as smart parking, smart transportation, smart environment healthcare etc. Continuous increasing of the versatile smart cities is comprehensively challenged by real –time smart decision capabilities and processing of data. Smart city architecture based on big data analytics and consists of three modules 1)data acquisition and aggregation module collects varied and diverse data interrelated of the city services.2)data computation and processing module performs normalization, processing and data analysis and filtration3)decision module and applications formulate initiates and decision events. This architecture is used or the smart cities planning and variety of datasets are analyzed for validation. This proposed architecture provides reliable datasets which are verifiable on hadoop server (threshold limit value) and offer valuable addition into the community development systems for getting better and efficient architecture in smart (urban) cities.

Challenges and issues of smart cities planning with iot

Converting from traditional mode of services to the smart and well –groomed mode is challengeable due to there is no straightforward perception to formulate in a flourishing smart city. Internet of things (IoT) provides a platform for the smart cities through the assistance of diverse sensors, smart meters, cameras and smart environments by using big data analytics technique and user driven eco system or analyzing large amount of data provides by smart city environments. The technique big data analysis is applied in huge datasets for revealing the unseen patterns and correlations in making efficient decisions. Big data analytics provides number of phases which includes data analysis, acquisition, data cleaning, data recording, data integration, data querying, data aggregation and data representation in which major issues are highlighted as normalization, timeliness, incompleteness, data format, data queuing and data value [32].

Fog computing

Distributed computing isn't profitable for some web of-things applications, fog registering is frequently utilized. Fog registering

decreases the transfer speed required and lessens the forward and backward correspondence among sensors and the cloud, which can contrarily influence IoT execution. Fog registering bringing insight and handling nearer to where the information is made. In a fog domain, knowledge is at the neighborhood. Information is transmitted from end focuses to an entryway where it is then transmitted to hotspots for preparing and returns transmission. Fog figuring is making utilization of decentralized servers in the middle of system center and system edge for information handling and to serve the quick prerequisites of the end frameworks.

Fog figuring is non-paltry augmentation of Cloud registering worldview to the edge of the system. System edge: applications and hosts, switches near end frameworks in the web; Network center: interconnected switches in the web, system of systems fog hubs can be sent anyplace with a system association: on a manufacturing plant floor, over a power post, nearby a railroad track, in a vehicle, or on an oil rig. Any gadget with figuring, stockpiling, and system availability can be a fog hub. Models incorporate modern controllers, switches, switches, inserted servers, and video observation cameras.

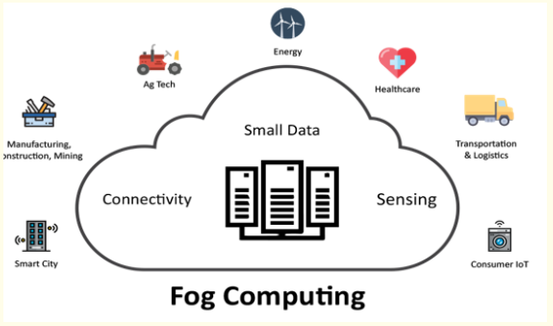

Figure 1: Fog computing architecture.

Computing paradigms original main frames assessed time-sharing, centralized machines to multiple users through remote terminals. Local areas networks and world web network access client-server models about content on individual servers processing cloud computing computations in centralized data centers, server's farms and hosting single servers consumed and complementary phenomena decades‟ peer to peer (p2p) system disturbed across internet to tackle bandwidth limitations. Cloud computing and p2p signaled of big data age, emphasis on scientific and web database, media content process on large scale. Computing model hosting thousands of virtual machine (VMs) platforms broadband and cellular network communication combined smart phones and general-purpose of computing. IOT and smart phones marks both advent Edge computing or mobile and cloud computing. These resources host VMs to relative to cloud data centers. Fog computing generalized the network latency expanded for cloud interactive application was coined by cisco, on computer architecture. Fog computing with many clients of mobile or consumer devices used interactively by humans or devices for machine 2 machine interactions. There are two contemporary models of client at the edge of internet, analytics that use data form, generate content and control application.

Fog computing inevitable due to gaps and these common two approaches, network latency, network bandwidth if internet. Edge computing avoiding issues of network times, operations devices that have limited battery. Fog computing serves computing layer in network topology and typically uptime on internet connectivity. Fog computing involving model of computing, topology architecture, resource capacity, reliable, available and fog deployment models these have implications on the operational cost of fog computing resources. IOT deployment traditional web clients‟ services of WWW and the growth of content distribution network (CDN) have low latency and data comes as observational streams or time series data from distribution sensors.

The application of fog computing to deployment of requirement latency processes in span virtual and argument reality (VR/VM) applications and gaming, smart cities, healthcare, mobility of fog computing. And research directions attention more topics of fog computing, fog architecture, data management, programing models and platforms, security, privacy, and trust in deployment of cloud and fog computing.

Smart societies through mobile: big data, fogs and clouds

Smart societies generate mobility platforms and applications requires in life. Mobile computing system enhance big data through information technologies fog and cloud and system include cloud based big data analysis system and mobile applications platform using in fog computing and more important relevant information provided to the user in multimedia format including text, video and voice. Automated system in IOT include field of life also part of sensors and device attached to homes, offices, business and roads on operation system automated. In smart cities provider the end user of all information and current situations to cloud update surroundings. In this paper we proposed architecture layer involve in cloud and user application and fog layer acts as end user application and data storage backend the analytic engine on clouds. Big data refers to designed extract values and emerging technologies form data have four types: volume, variety, velocity, and veracity.

Fog figuring characterize as a situation where an immense number if heterogeneous universal and decentralized gadget impart and conceivably work together among them and with the system to perform capacity and handling undertakings without the mediation of outsiders. Huge information in versatile application, distributed computing are by and large broadly utilized in days and empowered to shrewd social orders of universally useful system of huge information advancements are exclude fog and cloud. And furthermore cloud layer manages information and yield information created by applications gathered in various sources.

IOT produced big source of cloud device and other sensors and important source of input using processing tools, Hadoop and sparks. Fog network considered heterogeneous devices can also help store date to use infrastructure provided user devices to fast assess on data requirements. All type of data to proposed application of functions to illustrate. Furthermore, big data focus on implementations and analysis of these include data management, using artificial intelligences and scalability of the system size user based multimedia communication and we will use machine learning to enhance the scalability and quality of information provided user to big data fog and cloud computing.

Fog-based storage technology to fight with cyber threat

Cloud computing depending on powerful storage capability on traditional scheme a lot of change in typical application which take advantages of huge capacity of cloud computing, many internet GOOGLE, IBM on cloud storage. There are advantage and disadvantage growing development of cloud technology, cyber threats, such as data loss, malicious modification etc. Traditional computing model for cyber security users requirement model cannot satisfy so fog computing and edge computing appears in sights of artificial computing model. Furthermore main purpose of fog computing to solve problem in traditional cloud storage field to manage data in cloud server provider (CSP) so user do not actually control physical storage of data separation.

CSP information cannot useful without data server on fog and mechanism ensure integrity, confidentially of user data. Security in cyber space main threats include data loss, leakage of data, client trust of cloud computing accessing data in high jacking session. System architecture and mechanism QOS includes reliability, which depends on the CSP‟s service quality.

Fog computing security a current applications and security solution for big data

Cloud stage show is stretched out by another worldview which is fog registering, upgraded by giving processing assets on the finishes of a system. It is cloud-like stage which has comparative information administrations of, calculation, stockpiling and applications, yet is it is principally unique since it is decentralized. Fog frameworks can deal with a lot of information locally, perform activities on proof, and are completely convenient, and can be introduced on various sorts of equipment. These qualities of fog stage make it uncommonly appropriate for time and area touchy applications. For instance, gadgets of Internet of Things (IoT) needs to process extensive measure of information rapidly. These much checked usefulness driven applications misrepresents numerous security issues with respect to information, virtualization, and its segregation its systems administration, its malware investigation and observing.

Points of interest of distributed computing are accessible to numerous people and associations offered by exceptionally accessible and productive figuring assets with sensible rates. A few cloud administrations are open in present day benefit making arrangements, yet they are not fitting for underdevelopment nations, compactness and area touchy applications like IoT, wearable registering, keen frameworks and programming characterized systems.

Fog computing

Fog figuring is a decentralized registering engineering whereby information is prepared and put away between the wellspring of source and a cloud framework [1]. Fog framework has the accompanying attributes:

- It will be situated at the edge of system with rich and heterogeneous end-client support;
- Provides backing to a wide scope of mechanical applications because of moment reaction ability;
- It has its very own figuring, stockpiling, and systems administration administrations;
- It will work locally (single bounce from gadget to Fog hub);
- It is profoundly a virtualized stage; and Offers reasonable, adaptable and compact organization as far as both equipment and programming.

Comparison of fog computing and cloud computing

Fog is an extension of the cloud; hence it is inexpensive and easy to manage. Through the literature review we come to the conclusion that fog computing is helpful in every field but it is playing a stupendous role in the smart cities.

Cloud Computing	Fog Computing
High Latency	Low Latency
Servers Within Internet	Servers On Edge Of Network
No User-Defined Security	User-Defined Security
Prone To Attack	Safe From Attack
Multiple Hops	Single Hop
No Location Awareness	Location Awareness

Table 1

Fog computing based mobile applications

Software applications which are supported by smart mobiles and tablets are getting more attention which causes replacement of traditional laptop computers and PC but on the other hand, they need more processing, computational and storage space. Cloud computing solutions are infeasible in smart mobile applications due to the limited bandwidth and high latency. however fog computing provide a platform for these devices to choose a preferable a fast, reliable, efficient computing standard for offloading their computational work [34].

Challenges for integrating the fog computing in the internet of thing (iot) system

1. **Reliability** Fog computing reliability is crucial just like cloud computing due to the difficulty in the analysis and huge size of the network. Due to the unique properties and

the model used for testing former networks cannot be used for fog computing [34]. however failure method detections which are used nowadays are not mature enough all of these make the fog computing reliability most important but complex task.

2. Privacy Decryption of data cannot be done in fog computing from smart meter as the devices transmit the information to the other gateways which may leak the information of users.
3. Security Most of the devices in the fog computing use the temporary power supplies batteries and most of the nodes are not powerful and have limited computational and storage resources.as a result development of low power security standards with adequate level of security is very crucial and challenging.in fog computing users data stored remotely and users have concerns that where their data will be stored, who will use it and what are the reasons for they use their data.

Conclusion

Cloud platform model is extended by a new paradigm which is fog computing, enhanced by on condition that computing resources on ends of the network. It is cloud-like platform which have similar data services of, computation, storage and applications, but is it is primarily different because it is decentralized. Fog systems can handle large amounts of data locally, perform operations on evidence, and are fully portable, and can be installed on different types of hardware. These features of Fog platform make it extremely appropriate for time and location-sensitive applications. For example, devices of Internet of Things (IoT) required to process large amount of data quickly. These highly scoped functionalities driven applications exaggerates many security issues regarding data, virtualization, its discrimination its networking, its malware analysis and monitoring [1-34].

Advantages of cloud computing are available to many individuals and organizations offered by highly available and efficient computing resources with reasonable rates. Several cloud services are accessible in modern profit-making solutions, but they are not appropriate for underdevelopment countries, portability and location-sensitive applications like IOT, wearable computing, smart grids and software defined networks.

Bibliography

1. C a. Balanis Antenna Theory: Analysis and Design 28.3 (2012).
2. D Petcu. "IJACSA Editorial from the Desk of Managing Editor…". (2010).
3. L Tian., *et al*. "Video big data in smart city: Background construction and optimization for surveillance video processing". *Future Generation Computing Systems* (2018): 1371-1382.
4. VC_Muthu_Transaction_R2_final.pdf.
5. VC_FGCS_stor_per_cloud_BD_accepted.pdf.
6. TheRoleofBigDatainSmartCity-Finalversion.pdf.
7. AT Hashem., *et al*. "The rise of „big data" on cloud computing: Review and open research issues". *Information Systems* 47 (2015): 98-115.
8. "Modeling and Processing for Next Generation Big Data Technologies". (2015).
9. M Fazio., *et al*. "Big data storage in the cloud for smart environment monitoring". *Procedia Computer Science* 52. 1 (2015): 500-506.
10. AT Hashem., *et al*. "The role of big data in smart city". *International Journal of Information Management* 36.5 (2016): 748-758.
11. K Ben Ahmed., *et al*. "Age of Big Data and Smart Cities: Privacy Trade- Off". *International Journal for Trends in Engineering and Technology* 16.6 (2014): 298-304.
12. "RK-Real-time-City.pdf".
13. PK Senyo., *et al*. "Cloud computing research: A review of research themes, frameworks, methods and future research directions". *International Journal of Information Management* 38. 1 (2018): 128-139.
14. L Mayangsari and S Novani. "Multi-stakeholder co-creation Analysis in Smart city Management: An Experience from Bandung, Indonesia". *Procedia Manufacturing* (2015): 315-321.
15. M Jaradat., *et al*. "The internet of energy: Smart sensor networks and big data management for smart grid". *Procedia Computer Science* 56. 1 (2015): 592-597.
16. E Al Nuaimi., *et al*. "Applications of big data to smart cities". *Journal of Internet Services and Applications* 6.1 (2015): 1-15.
17. C Lin. "A Novel Green Cloud Computing Framework for Improving System Efficiency". *Physics Procedia* 24 (2012): 2326-2333.
18. "google_predicting_the_present.pdf".
19. P Vijai and PB Sivakumar. "Design of IoT Systems and Analytics in the Context of Smart City Initiatives in India". *Procedia Computer Science* 92 (2016): 583-588.
20. Deloitte. "Smart Cities Big Data". 7 (2015).
21. Daneshyari.com_1025531.pdf".
22. CLUS_Comp_Aisha_VC_accepted.pdf.
23. CCAF_VC_openstack_accepted.pdf.
24. c3c6bcf156c3fb2e6dfdabd6365062ce264b.pdf.

25. SE Bibri. "The IoT for smart sustainable cities of the future: An analytical framework for sensor-based big data applications for environmental sustainability". *Sustainable Cities and Society* 38 (2018): 230-253.

26. S Wolfert L., *et al*. "Big Data in Smart Farming – A review". *Agricultural Systems* 53 (2017): 69-80.

27. DR Li., *et al*. "Big data in smart cities". *Science China Information Sciences* 58. 10 (2015): 1-12.

28. MM Rathore., *et al*. "Exploiting IoT and Big Data Analytics: Defining Smart Digital City using Real-Time Urban Data". *Sustainable Cities and Society* (2017).

29. 00001323_144780 pdf.

30. 10.1186%2Fs13174-015-0041-5 pdf.

31. Y-P Huang., *et al*. "The Effectiveness of Integrating Somatosensory Technology into Nuclear Energy Education Learning". *Procedia Social and Behavioral Sciences* 176 (2015): 476-482.

32. M Babar and F Arif. "Smart urban planning using Big Data analytics to contend with the interoperability in Internet of Things". *Future Generation Computing Systems* 77 (2017): 65-76.

33. S Korea. "2014 IEEE World Forum on Internet of Things (WF-IoT) Program". (2014): 265-270.

34. F Bonomi., *et al*. "Big Data and Internet of Things: A Roadmap for Smart Environments". 546 (2014): 169-186.