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Review of Fog-Based Co-Operative and Secure Smart Healthcare System

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Abstract – The adoption of information and communication technologies is promoted by the rise of smart healthcare. However, intelligent sensing, processing, and analysis requires more computing and storage resources especially with the increasing demands of medical services in the proximity of medical users. Fog computing arises to empower in situ information preparing and administration arrangement for wellbeing in vicinity of clinical clients, taking advantage of countless limited scope servers. In this article, we audit fog empowered smart wellbeing toward agreeable and secure medical care administration arrangement. In particular, we initially present the general foundation and some encouraging applications and medical services notice. We also discuss significance and scope of the Healthcare system then we rive the wearable in our Healthcare system and the fog based Healthcare system followed by the conclusion of our entire paper.

Keywords – Fog Computing; Internet of Things (IoT); Cloud Computing; Smart Healthcare; Big Data

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1. INTRODUCTION

Health care sector had been widely benefitted with Current technology. Huge amount of patient's health records can be easily and quickly processed through Modern computers. Because of latest development in field of health care and Internet of Things, patient's information can be distributed in various areas. Due to which, solutions based on Cloud Computing have been suggested by scientists to take care about date of healthcare. But these solutions pose challenges with respect to large volumes of data, context-awareness and access latency. There lies probability of rise in transmission and processing errors that are takes place mainly as health data sets extends to larger volumes and more complicated. With regards to this, Fog Computing is presented as a substitute to decrease complexity in managing health data, leading to increase its reliability. Therefore, it is necessary in comprehending related challenges prior to defining an architecture for Fog Computing-based architecture to manage healthcare information.

The main notion of fog computing is to migrate the tasks of data centers to fog nodes situated at the edge of the network. "The significant rise in the senior population, which is connected to their age, necessitates the development of new technologies to assure this group's maximum living comfort. Fog computing [4] is a particularly profitable distributed computing scenario for smart health services because it makes use of dispersed network resources of low-level server nodes with minimal processing capacity (e.g., routers, servers, cloudlets, and gateways) located near to consumers. It guarantees that services are of high quality, have minimal latency, and are aware of their position, and for real-time applications, it also provides instant notification services [4- 6]. Although fog computing can effectively yield benefits for smart health service industries by meeting the requirements already mentioned medical service, such as harmonising local resources for infectious disease control and providing emergent healthcare service if elderly people become ill, fog computing can also effectively yield benefits for smart health service industries by meeting the requirements already mentioned medical service, such as harmonising local resources for infectious disease control and providing emergent healthcare service if elderly people become ill. Fog nodes, which act as local servers, leverage near proximity to quickly calculate health data and respond to service requests as and when they arise.Meanwhile, fog nodes activate identified health data aggregation and replication to preserve network resources in the intermediate layer between cloud servers and healthcare devices [7]. Furthermore, fog nodes can provide preliminary in situ health data processing to improve data analysis efficiency by extending the capacity of a cloud server that is centralised to the network edge [8]. Fog computing makes smart health capable of offering high-quality healthcare services to the public by utilising scattered network resources to cascade healthcare devices and cloud servers".

Computing using "fog technologies is increasingly being utilised in the field of healthcare, especially to improve tele-health and telemedicine infrastructure, which promises to address the expanding healthcare needs of the elderly and people with chronic conditions throughout the world. For example, fog computing in body sensor networks increases the standard for medical signal processing, energy efficiency, privacy, and security [9]." Because of freely accessible nature of network environment and personal health data privacy sensitivity, privacy and security issues in fog-enabled smart health must be discussed. Hackers can manipulate healthcare devices (wearable and bio-sensors devices) and transmit erroneous biometric information to fog nodes in such a way that it can influence detected health data or can even blackmail medical service subscriber that are installed with healthcare devices in system. As health information and instruction data sent amongst medical applicant and service providers might be misinformed or tampered, health care user's treatments may be get badly influenced, putting their lives in jeopardy.

In medical smart health fog-enabled, healthcare information can be sent to fog node in no time, thereby health response can achieve real time scenarios because of least latency. In such uses, for controlling their daily routines medical users are installed with devices of social and wearable healthcare appliances. If fog node accepts emergency signals from sensors or social networks platforms, like when an old person falls from stairs and poses risk of his life, fog node activates and coordinates with closest ambulance available on the vicinity with fastest route to provide urgent medical assistance, and ambulance carries patient to nearest resourceful hospital and can save patient's life from a catastrophic condition.

2. REVIEWOF WORKS

Model disposition in ECG presented in [10] a device of Electrocardiogram helping to provide high-definition traces in terms of alternating signals. For each 10 seconds of time, analysis of data takes place with help of a strings of algorithms and many generations of alerts. Alert thus created and traces both are kept in internal memory of health care devices for further references. Model which is designed prototype enables patients to share medical data to their family or close physicians, thus monitoring their health status independently and provides status to concerned authorities quickly in emergency time. For further analysis stored data with Historical information will also be accessible, for detecting patterns that may enhance medical diagnoses in foreseeable future.

By the help of ECG, a paper is presented [11] where data for Electrocardiogram are designed and developed in smart gateway along with many characteristic extraction procedures that includes P and T waves, heart rate with wavelet transform methodology. Outcomes assists in forecasting that fog computing helps in attaining higher than 89% of low latency and efficiency of bandwidth.

Ahmad et al. [12] put forth concept for medical care named as health where layer of fog is utilized as a buffer coating between end workers and cloud. Primarily writers emphasize improving and amenably controlling data confidentiality issues in healthcare systems.

A keen e-health access employment for applications in fog process coating is mainly focused [13]. They underlined and highlighted mostly on providing a bridge in between networks to such entries, both for clinical and home-based applications.

For securing health information from being disclosed, tampered and illegally accessed, it is mandatory for fog-enabled smart health care system to have data access control mechanism, data confidentiality and valid authentication access [14].

In [15], it contains details explanations about how Fog computing consist of and expands Cloud Computing and it scrutinize key features of Fog paradigm and determines few of rich applications cases scenarios such as smart traffic light systems and wind farm that encourages need for Fog, emphasizing its relevance to various spheres within Big data spaces and IoT (internet of things). It also shows a high-level description of Fog's software by high lighting various technical components needed to attain fog vision.

In smart health care system with "fog-enabled, cloud server, fog nodes and healthcare devices work at different strata of information computing for efficient healthcare service provision in a challenging environment. These devices execute basic data computing operations;however, they are too resource-restricted to perform analysis of complex data. Centralized cloud server, that is capable of remotely storing data, can give marvelous data analysis and processing analysis, however at the price of backhaul bottleneck limitations effecting operations. As it is at middle-layer, devices amongst cloud server and healthcare devices, fog nodes can perform and complement a part of storage task and processing for both of them. With an absence of any one entity, remaining two components can operate with difficulties for smart health efficiently in comprehensive services provision systems. Focusing on this goal, they should coordinate amongst each other through computation allocation and efficient data exchange [16].But, for a certain information computing job, which portion should be allocated to cloud server, fog nodes and healthcare devices for maximum output with minimum resources to maintain efficiency. When cooperation between fog nodes are concerns, then how to manage task execution, resource allocation and data exchange still remains a challenging job. Fog-enabled smart health includes vastly available edge network resources, between which storage resources, communication and computation, changes heterogeneously. To attain efficient service provision at various location and time interval, it should cater to ever changing medical needs in terms of differing demands of communication, storage resources and processing [17]".

Few compute-intensive jobs do not leverage information interchange but heavily rely on real-time processing resources for their requirement. Instead of exquisite processing resources few data communication jobs include communication ability with energy-efficient. Normally, information sent with a lone fog node is limited, and function processing done by a single fog node is generally restricted, in such a way that single fog node can perform biased and incomplete service provision. Moreover, jobs switching from a fog node to their neighboring fog nodes is needed if medical subscriber upends their health care needs in a mobile environment. Due to this, cooperation and coordination issues on selecting appropriate data exchange and task allocation between heterogeneous endpoints different medical needed must be taken into consideration for fog-enabled smart health systems.

Due to critical privacy sensitivity of information about personal health and easily accessible nature of network environment, privacy and security challenges in fog-enabled smart health must be discussed. Spammers may assault healthcare devices (e.g., wearableand bio-sensors equipment) and transmit inappropriate biometric information to fog nodes thereby influencing sensed health data or even blackmailing health care applicants which are equipped with medical gadgets. Moreover, medical information and instruction data sent between service provider and health care subscriber can eavesdrop or tamper, medical patient's treatments may get affected, leading to risk of their lives. Meanwhile service provision with information access and analysis, data of personal health can get disclosed to invalid users, such that secured and critical data of medical subscribers might be used for illegal money in black market [18].

To guard health care data from being disclosed, tampered and illegally accessed, it is compulsory for fog-enabled smart health care systems to have data access control techniques, proper authentication and data confidentiality [19].

Since it is available with abundant originally spread edge resources of network that are included as fog nodes in efficient service provision, security threats can consequently break around smart health systems because of ever rising users' interactions and high level of data exchange frequency [20]. Basically, health data might be relayed securely analyzed and processed by a fog node on one situation that fog node can be securely managed. But, when fog node itself is tampered or compromised adversaries, then information computing leads to rise in privacy leakage challenges and security risks. Meticulously, collusion of fog nodes that keeps and stores fragmented information can spill all of private health information and data. For discussing above mentioned issues, privacy and security schemes for fog-enabled smart health must be suggested.

3. SCOPE AND SIGNIFICANCEOF THE SYSTEM

As data centers are main components of cloud, the operation cost as well as energy consumption is high in cloud computing. In fog computing multiple fog devices are involved for the processing. Accordingly, the energy consumption and operation cost is low in comparison to cloud. Also Interaction in Real-time is impossible for cloud as it has high latency, but such issues can be resolved by Fog Processing. Rate of failure in t Fog is higher due to power failure, decentralized and wireless connectivity [21- 23]. Even though fog-enabled smart health can basically become advantageous in medical service provision, its success still depends on how we approach and address security issues and cooperation. To give fail proof and comprehensive medical services, fog-enabled smart health enquiries for urgent cooperation between fog nodes, healthcare devices and cloud server. But the issue is that how to distribute information computing tasks among highly heterogeneous processing entities infuses challenging problems in fog-enabled smart health systems. Eventually, at edge of a network, data sent along a single fog node is restricted to few, and computation done by a lone fog node is constrained, that causes it in making biased and incomplete health care decisions.

4. MOTIVATION

4.1 Wearable big data in healthcare

Big healthcare data are ceaselesslybeing augmented by information generated by intelligent edge devices like wearable sensors. "Wristbands, smart watches, smart fabrics, skin patches, smart shoes and socks, and even contact lenses are examples of wearables."They are offering data aboutpatient healthand transmittingthem directly toa network or through mobile devices to be available whenever and wherever they are needed. This in turn, gain greater visibility into the status of patient health permitting him to control his health outcomes over a period oftime and it makes decisions based on that. Following a wide variety of latest wearable sensors is presented. These wearables are usually used to manage specific conditions, like – diabetes, heart conditions, asthma and respiratory conditions, hyperthermia and hypothermia, menstrual cycle, etc.

These ever-growing number of wearable sensors are generating too much data constantly to be sent to the Cloud for storage and analysis. Thus, acquiring information from these complicated raw data becomes drawn-out and tedious. Right now, enormous information can require days, weeks, or even a very long time to head out from the edge to the cloud for investigation. Which is inadmissible for dealing with the patient wellbeing that requires a speedier methodology. Preferably, ongoing large information investigation could just require minutes, yet in the desperate circumstance, it might bring about calamitous outcomes [24 - 27]. Any postponement in notice of boundaries, for example, high tension or temperature might bring about irretrievable misfortunes. One more concern is the capacity to act progressively to approaching exchanges and working inside put down certain boundaries of data transmission. All things considered, traffic that is being created from huge number of clinical sensors and shipped off the cloud reaches data transmission limit [28]. The model of sending crude clinical information to the cloud for huge information investigation is becoming wasteful, tedious, and costly [29]. These size difficulties can be effectively managed by working at the edge. In other words, information ought to be followed up on nearer to the gadgets where it is delivered as opposed to steering everything over cloud cannels. Hence, allowing quicker information handling, further developed reaction time and downsizing the need of transmission capacity. This eventually prompted bringing down costs and upgrading effectiveness [31- 34]. This methodology is known as Fog computing. This iconicreplacement from cloud to fogmakes a lot of sense and holds the potential to revolutionize IoT-driven healthcare solutions.

4.2 Fog based smart Healthcare

"Smart healthcare businesses are increasingly focusing on fog computing rather than cloud computing. In reality, the goal of IoT-driven healthcare is to enable immediate connections between patients and providers, resulting in population-based value-based care. Fog computing is the underlying infrastructure for moving the healthcare IoT from novelty to reality, according to several academic contributions in various sectors of healthcare. Following are some instances of effective Fog computing applications in the healthcare area."

- Smart health
- Smart homes and hospitals
- Wearable Healthcare monitoring system
- Healthcare system privacy
- Diabetes
- Hypertension attack
- Active illnesses

5. CONCLUSION

System of Healthcare can be productive and capable through the expanding utilization of different IoT gadgets and sensors. The statement presented by these gadgets are by and large extremely intriguing however ought to be embraced cautiously, as there are as yet real concerns related to patient security, consistency, cost-viability, etc. Since the distributed computing isn't intended for the raising volume, assortment, and speed of wellbeing related information made by IoT gadgets. Carrying out a scaled down information preparing focuses, called Fog computing, that trade information as opposed to sending them to the Cloud has been viewed as a superior arrangement. Haze could tackle issues with dormancy, extensive measure of time and the data transfer capacity for a situation of cloud that are right now hindering the development use of IoT in medical services. In actuality, haze gives numerous advantages, including lowed inertness, decreased transmission capacity, heterogeneity, interoperability, adaptability, security and protection, constant preparing and activities. Nonetheless, the capacity of fog to store and handle large clinical information, contrasting with cloud, is restricted. Consolidating then mist and distributed computing is regularly advanced as a formula for achievement in different parts of the medical care area. In additional work, it is intriguing to utilize a haze registering office to propose a security model for protecting the protection of clinical large information in an IoT-based medical care cloud.

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