A REVIEW ON SMART E-HEALTH MONITORING USING IoT AND FOG COMPUTING

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ABSTRACT

CISCO company developed fog computing, which is an addition of cloud computing. By using different sensors, IoT produces an enormous amount of different types medical data which should be stored, analysed and processed at the cloud server. Here is where the use of fog computing is useful.The panel of fog computing stands as a conjunction between the end device and the conventional cloud.The normal IoT scenario sends a large volume of data to the storage for transformation and scrutiny and shortened to a large extent with fog processing. It cuts down the rush on cloud and is capable to sustain stuff within sources, which sharpens the quality of service (QoS) and security.With the help of fog, a confined volume of information is sent to cloud; and thus transmission capacity can be raised considerably with low latency and postponement along with low packet fall. This article presents a survey of different approaches used to monitor the health of patients using IoT and fog computing.

Keywords *: Internet of Things,Fog Computing, Edge computing, wearable sensors,medical IoT,Cloud Computing.*

INTRODUCTION

IoT can be defined as a network of different devices interacting with one another through machine to machine communication for collecting and exchanging data.In this new era, healthcare has an important place in everybody's life.But the steadily-increasing population and spread of different diseases require a new technology for reducing the pressure on healthcare applications by providing high quality care to the needy patients.

The Internet of Things has been formulated as an important solution to remove the constraints in healthcare applications, and it has been one of the most important topic of research. Internet of Things has been identified as the best solution for resolving significant strain in healthcare systems as compared to the applications of IoT in other areas.The IoT has awide range of applications like industry, healthcare, retail markets ,travel and tourism, logistics and so on. A vital application area in IoT is the healthcare sector. It is possible to track various parameters such as BP,blood glucose, body temperature and so on with the help of sensors.By using wearable devices, patients' health record can be monitored. Remote health monitoring can be used to monitor non-critical patients,reducing the load on hospital resources.Various sensor devices can be attached to the remote patient's body and all these data are monitored and analysed by the doctor at hospital itself.

IoT generates different patterns of data and supervising these medical big data at the cloud side leads to high latency, network traffic, and many other security complications.The sensor devices collect all data and send them to cloud which does the processing and the result is sent back to the patient. These processes save a lot of time which is a critical factor especially in the case of healthcare.

Fog computing aims to reduce these difficulties. The term fog computing is a distension of cloud processing. It functions as a joint by accompanying computing equipment and operational services linking data generation and their interpretation. Earlier, all data were sent to the cloud storage which took some time. Now with the fog technology, only a defined volume of information is sent to the cloud.

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LITERATURE REVIEW

According to Ali Omar [1]et al. 31% of healthcare sector is currently using cloud computing. Microsoft Healthvault and Google health platforms are some paradigms of application in medical assistance. Different users share and use sources within the cloud computing circumstances. Cloud computing users are at a high risk of privacy crack from external environment. Patient's sensitive health data are highly confidential and hence healthcare needs more stringent security parameters.

According to [2] traffic in the cloud can be reduced to a great extent by using foglets which send only relevant information to the cloud.Here they use multiple fog servers located in different places to evenly handle service requests. Data from the sensors are monitored by nearby fog servers and if any critical situation arises they will send the data to the cloud.Whenever the server faces heavy traffic, it will transmit the inquiry to nearby less-loaded server.Here they distribute loads equally among all servers so that the server that works a lot never breaks down.Resource-utilization can be increased and bandwidth be effectively utilised.

In accordance with [3], in many countries the reason for the highest mortality rate is Coronary Heart Disease (CHD) which is the most common cardiovascular disease. To anticipate and avoid the risk of CHD in its early stage can save a patient's life.Here they use ANFIS to analyse the risk category of CHD.

In [4] to maintain blood glucose level they suggest fog-assisted healthcare system which is energy efficient too. The J48Graft decision tree is used to anticipate the exposure level of diabetes with more distribution efficiency. By using fog computing, a necessity alarm is produced suddenly for immediate attention. Here they've applied J48Graft decision tree classifier to create an adequate forecasting on blood glucose. Native data storage, flexibility, extensibility, and interoperability are gained in remote diabetic patient monitoring by using fog computing as a mediator layer.

The authors in [5] propose a fog-based Smart Healthcare System named HealthFog for the automatic examination of heart defects using deep learning and IoT. HealthFog gives healthcare as a slight fog service and effectively maintains the information of heart patients that the various sensors keep producing. The fog-enabled cloud framework is known as Fogbus, which is used to check efficiency of bandwidth,jitter,power consumption, accuracy and latency. Here an android app known as Fastheartest is used at the edge device for collecting data.

In [6] they propose a fog-based healthcare structure for remote supervising and detection of diabetic patient with cardiovascular disease. In this system e-health data such as glucose level, ECG, body temperature as well as environmental data such as room temperature, humidity, and air quality can be monitored remotely.ECG extraction, local storage, security etc. can be achieved by using fog at the edge level. Here data-processing and analysis are done at fog layer which helps to reduce the burden on cloud and energy-efficient nodes can operate in an effective way. Frequent battery replacement is needed with wearable sensors.

In the case of [7] ,the system uses a window-based quality interpretation that is relevant for execution within an asymmetric multicore embedded processor that provides a committed core for hardware-oriented pattern matching. Here they claim that accuracy in the detection of abnormal events can be achieved and only the final result is transmitted and hence bandwidth can be enhanced.In this ,they attempt to make a hardware-oriented learning of machine learning methods to reduce the bandwidth issues.

In paper [8], authors propose stochastic performance models, combined with the stochastic availability models and original data in order to analyse how scope of fog devices and different geo-location of cloud instances impacts on performance parameters, such as throughput and service time.Here they claim that E-health monitoring system is more efficient by using fog device and cloud architecture.

According to Shi,Ding et al.[9], different properties of fog

computing and cloud in healthcare scenario can be characterised. Not all data are sent to cloud, instead only some relevant data are transferred for storage and processing. With the fog model only some non-time susceptible data sre sent to the cloud and time- sensitive data are directly dispatched to the fog node for processing and analysis.

By simulating the system with iFogsim tool in [10]they claim that latency, energy-consumption, network usage etc can be minimised with respect to the system that is only based on cloud. Here they use two modes, pulse rate (PR)model and ECG model. Machine learning algorithms are used to classify user's model. Here they advise that if Cardiovascular modules are placed more closely to the data source, latency can be minimised.

In [11], they suggest a systematic framework and a composite fuzzy-based support learning algorithm in an FC situation to cut down high suspension among healthcare IoTs and cloud. It uses the above-mentioned algorithm and neural network progression methods for data packet distribution and selection in IoT –FC paradigm..

Focus of [12] will be to use smart phone as sensor device and they have identified some problems in the existing scenarios.a)hackers can easily hack the password of medical devices thereby getting access to the devices.b)most of the medical devices are poorly patched and susceptible to malware or other attacks..c)since the capacity of the medical devices is limited,a large number of continuous requests can make a DOS attack. And d)attackers continuously monitor the network and since data are in encrypted form they can easily eavesdrop and steal passwords. The edge intelligence as explained in this paper offers many enhanced features in healthcare but it has some privacy issues because fog computing provides easy access to all data in the system.

Here [13] the authors have established a mobile application for the early disclosure and monitoring of some neurodegenerative disorders with virtual reality. An application developed in C# programming language and 3D environment for monitoring elderly people with neuro degenerative disorders is used in this approach.The images and 3D scenes are stored in edge device and processed locally and the information is sent to the nearby hospitals.The app shares the consolidated information through a distributed storage system. But the problem is that,the app which collects images and 3D scenes of patients require a huge storage facility.

Here [14], by using fog-cloud-IoT architecture student stress index for different actions at a specific time is predicted. Various health parameters are collected by sensors and these data sets are divided into different sections.a)visual datasets-blinking frequency, average eye closure speed, pupil diameter etc by using smart camera devices.b)physiological datasets-heart rate, temperature, EEG,sweating ,cool skin etc by using various wearable sensors and c)behavioural dataset-student body posture by using Kinect SD sensor. All these data are stored in cloud and are compared against the previous stress index values using TDBN model to make decisions.

Mosquito borne diseases are wide-spread and it is a serious issue for the authorities to disclose the outbreak of diseases at an early stage to prevent them from spreading fast. IN [15],Information regarding various symptoms like fever,headache, rashes,joint pain,fatigue etc are collected from the users through mobile or web application.Fuzzy K-nearest neighbour classifier is used in the dataset.

The following table shows various methods used in all papers.

Authors	Methods Used
Ali, Omar Shrestha et al.	Various cloud based health systems are reviewed and presented.
Khattak, Hasan AliArshad et al.	Used an IFogSim tool for finding fog server utilisation
Sandeep K. Sood, Isha Mahajan	ANFIS is used to classify user's risk category of CHD
Devarajan, Malathi Subramaniyaswamy et.al	J48graft decision tree to classify and predict Blood glucose levels
Tuli, Shreshth Basumatary et al.	It integrates deep learning at edge computing device
Nguyen, Tuan Ben et al.	QT length duration,fall detection and activity status detection algorithms for energy efficiency calculation.
Alessandro Scirè, Fabrizio Tropeano et al.	KNN algorithm for QRS identification and RNN for the arrhythmia classification purpose.
Da Silva Lisboa Tigre, Matheus Felipe Ferreira Santos et al.	Stochastic models by using SPN and RBD approaches.
Shi, Yingjuan Ding et al.	Various characterics of fog computing are compared.
Shehab, Ragaa A Taher, Mohamed Mohamed et al.	CVD application with PR and ECG mode of operation.
Shukla, Saurabh Hassan et al.	A novel hybrid machine learning algorithm using FIS and RL technique
George, A.Dhanasekaran et al.	Private Virtual Cloud for storing database.
García-Magariño, Iván Varela-Aldas et al.	Agent-based simulation method.
Verma, Prabal ,Sood et al.	TDBN model for predicting stress index.
Vijayakumar, V Malathi et al.	Fuzzy Knearest neighbour classifier.

CONCLUSION

This review was done with the aim of understanding the state and difficulties of fog computing in healthCare. From these reviews it is clear that cloud-based healthcare solutions generate delays that can point to the deficiency of the health systems. Thus, Fog Computing comes as complement to be blended with cloud technology to reduce the delay. Thus decision making can be easily done at fog layer if some critical situation arises. This paper has presented a summary of various papers in fog computing in healthcare.

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