Cloud-based Dashboard for Medical Data Center

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Abstract*: - Introduction of technology to aid medical field is one of the revolutionary changes in modern information era. Digitizing or storing medical data in to centralized storage has helped greatly in maintaining medical records and improving the hospital treatment facilities. The data may be collected as raw textual records, spread sheets, images and, videos, also the data is many a time real time data that is retrieved from sensors or IoT devices in case of Telemedicine data center. The research carried out proposes an efficient storage approach for medical data centers especially with respect to Telemedicine Scenario with help a Cloud based Dashboard or API. The proposed data categorization algorithm clusters the data in to varies categories and store them in to different partitions in Cloud data center. Partitioning of Cloud data center helps in retrieving the data as well as processing or analyzing the data in a later stage. Implementation is carried out with the help of Fire base cloud storage and KNN classifier for categorizing the data and partitions are created with the help of ingestion time and data category identified by the proposed categorization algorithm. The results obtained by testing with various data shows that the proposed Cloud storage with the dashboard is efficient in terms of retrieval time and memory utilization than many other public cloud platforms.

***Index Terms*: medical; cloud; categorization; KNN; dashboard;**

I. INTRODUCTION

Information technology and computation systems have come back as an aid for supporting the medical diagnostics and analysis. This has resulted in the creation of Telemedicine approach[1], breaking the barrier in providing health care support. It has helped in establishing communication between a patient and a doctor remotely and enabled them to transmit information as multimedia format data. Medical data vary from diagnostic images, human vital values and disease registers. Disease registries are clinical information systems that track a narrow range of key data for certain chronic conditions such as Alzheimer's Disease, cancer, diabetes, heart disease, and asthma. Registries often provide critical information for managing patient conditions.

Medical data are classified into different data type such as Electronic Health Record it will be the purest method of electronic clinical data which will be gathered at the point of care at a medical facility such as hospital, clinic or practice center. Often known as the electronic medical record (EMR). The EMR is not available to outside researchers because of the privacy protection policies of the medical data centers. EMR data includes administrative, demography information, diagnosis, treatment, prescription drugs, laboratory test, physiologic monitoring data, hospitalization, patient's insurance, etc. hospital or health care system may provide this information to its internal staff. Second type of data is Administrative Data which is frequently related with electronic health records, there are mainly hospital discharge reported to a government agency like AHRQ. Patient/Disease registries are another type of medical data. Disease registries are clinical data systems that track a slender vary of key knowledge certainly chronic conditions like Alzheimer's malady, cancer, diabetes, heart condition, and asthma. Registries usually give important data for managing patient conditions. Telemedicine plays a significant role in providing health help to remote areas wherever correct hospitals or aid centers are unobtainable or scarce[2][3]. Doctors and aid specialists from all round the world are ready to discuss and are available up with optimum solutions to troublesome problems Another space within which telemedicine aids is sending the bio-signals like ECG, Pulse Rate, SpO2, etc.[4] This helps a doctor in identification patients even before they get to the hospital, that is in cases may facilitate in saving lives. once it involves villages, most of them won't be having advanced aid facilities. So, once a patient desires higher medical experience and facilities, they're transferred over to different hospitals that may offer the adequate facilities. it's necessary to separate and judge the hospital that has all the specified facilities. this will be finished the assistance of a smartphone application secured with an information with the relevant knowledge. The software package also can be equipped with the options for gathering patient vital organ and transmit over to the doctor once the destination hospital has been set. The planned system models a smartphone application with multiple instances for various types of users and may gather bio-signals from a patient and deliver it to the doctor. For communication functions,[5] the applying uses net property. For implementation, experimentation and testing functions, latest mechanical man platform is being employed. Pulse oximetry is one among the common measurements wide employed in a clinical setting. an individual's eye will solely acknowledge hypoxemia once the chemical element (O2) saturation is below eightieth.

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however, in keeping with research done by state capital et al., O2 saturation <90% were ascertained for a minimum of five min length summary for mechanical man primarily based Interface for
Multiparameter primarily based aid Analytics in twenty-six of the patients. So, it's important to find acute hypoxemia that is tough to find with human eyes. during this system, we tend to employ a pulse measuring instrument device for obtaining the bio-signals (SpO2) from someone.

II. LITERATURE SURVEY

The literature survey conducted on regarding topics can be summarized as:

In 2003, Roberto J Rodrigues et al[6] came up with a review regarding the healthcare and the influence of ICT (Information and Communication Technologies) in introducing eHealth technologies in Latin America.

The Caribbean. Similar research conducted by Ricardo Cardoso et al[7] introducing specialized ICT in favor of telemedicine and healthcare systems in regions like the villages of Amazon. They have proposed actions that can be followed for the faster development of eHealth technologies in the region, like increasing number of stakeholders, identifying the frequent tasks related to costs. They suggested a nation wise action plan with six priority areas for regulation. The authors conclude that the region is currently not prepared for adopting the ICT.

A Martinez et al[8] in their approach, in January 2001 and May 2002 for calculating the effect of telemedicine systems and healthcare analytics, which were implemented in 39 sites along the banks of Amazon. The consultation rate was increased from by 3 person and emergency transfers were numbered to 205.

R Wootton[9], had a different approach addressing the usage and real-time implementation aspects of telemedicine technology, considered and reviewed the major conferences and journals in depth, and looked for reports on the telemedicine projects. The author proposes and discusses some classification criteria for design issues, based on the lessons learned in this research area

Another work of U.K. Prodhan et al[10], conducts a survey in Bangladesh for the possibility to implement telemedicine services. The survey questionnaires were developed to collect primary data from different areas of Bangladesh. The questions were developed based on the discussions with patients, doctors and pharmacy owners. The results were collected in form of spreadsheets and they were analyzed to obtain the survey result.

C. Gremu et al[11], proposes the facilitations necessary for implementing telemedicine using ICT in underprivileged regions. This paper discusses an e-Health service that facilitates dissemination of health information to people living in poor areas and that is subsequently used to generate revenue to support deployment and development of ICT in the areas. The tool was developed within the context of the Siyakhula Living Lab (SLL), a multi-stakeholder operation that promotes ICT for Development in the Eastern Cape Province of South Africa.

P.Alafaireet et al[12] discuss about the importance of graphical user interface in medical field. Although several imaging services are already in use, there is a need for graphing and comparing every vital measured from the patients. The study also indicates that the physicians prefer a customized user interface rather than the GUI provided by medical imaging tools.

M Sarma et al proposes KNN algorithm for improvising quality of service and security in a cloud architecture. They also discuss on various trust models and safety architectures Improvement to information classification, is extended to the proposed method in[13], which ensure security and performance. Amazon EC2 cloud has been used to evaluate the proposed model and results are captured as part of this paper.

K Zkik et al[14] discuss about mobile cloud computing platforms. The authors propose a way to improve the efficiency and performance of mobile loud platform without compromising the security. The propose efficient schemes for uploading and downloading data with the help of algorithms. The proposed system offers sharing and encryption of data.

In this proposed paper Behrouz Minaei-Bidgoli et al[15] has discussed about the web-based education technologies and research method to study which approach of learning help in achieving. This helps in in collecting the huge amount of data of users and also use data mining method for database. This paper represents the approach to classify student in sequence of forecasting their final grade with feature extraction method from present data in education web-based system. Jeffrey Horner et al[16] had represented the use of imbedding R within the Apache web service. It also represented the how R users utilizes the embedded r interpreter to make efficient application and also compared with other R projects involved in network interface to R.

In October 8-13 Brian Burg et al[17] came up with the project which represent the time-lapse, an application for immediate fast recording, reproducing and debugging interactive behaving in web application. Time-lapses can be utilized by developers to browse, visualized and seek with in recorded program, it also uses popular debugging tool such as breaking points and logging. In the paper Pascal Soucy et al[18] came up with a proposed system of text categorization which means text classification. In this paper used a simple non-weighted features KNN 0algorithm for text categorization. In this proposed paper Zhou Yong et al[19] cane with modification of traditional KNN text classification algorithm used all training sample for classification which leads to huge number of training samples and huge complexity of calculation . So, they have improved the problem mentioned above by KNN text classification algorithm based on clustering center in this proposed paper.

In this paper Quansheng Kuang et al[20] described about a partial GPU based K Nearest Neighbor algorithm implemented by CUDA. In this proposed system the algorithm which implements the data Segmentation method has introduced in the distance calculation step to obtain CUDA thread needed and memory hierarchy. It also increases high performance compared to ordinary CPU version.

In this paper Wen-Tyi et al[21] describe about a new fast KNN classification algorithm is represented for texture and pattern recognition .the algorithm identifies the first K closest vectors in the design set of KNN classifies for each vector input by performing the partial distance search in the wavelet domain.

Eyhab Al-Masri and Qusay H. Mahmoud et al[17] in their work conducted a survey on the plurality of web services interface that exist on web today. Using their web service Crawler Engine (WSCE). They called meta data services info on retrieved interface threw accessible UBR's, services portals and search engine with the help of this data they determine the current status of web service based on size, type of technologies employed and number of function services.

III. TOOLS AND TESTING

There are many cloud computing technologies used to store data, for example Amazon E2C is the Amazon Elastic Compute Cloud (EC2). It is one of the main or important part of the amazon.com's. Amazon Web Services like allowing client to rent virtual Computer on which to run their own computer application. EC2 encourages scalable deployment of application by providing a web service through which user can boot an Amazon Machine Image to configure a virtual machine. On April 2018, Amazon charged about $0.0058/hr.

($4.176/month) for the smallest "Nano Instance "(t2. Nano) virtual machine operating on Linux/Windows $4.992/hr. will be the rate of storage optimized instances.

Firebase is another service provider data base. It is real time data base which was founded James Tamplin and Andrew Lee in 2011. Its specialty was data modification and retrieval of data or information will be very quick perhaps they used this for send application data it wasn't like chat application. Developers were using Evolve to sync application data such as game state in real time across their users. In mite 2016, base expanded their services to become a unified platform for mobile developers. The service distributes application developer's an API that grants application data to r accompany across client and stores on firebase cloud. Firebase provides client libraries that enables integration with Android, IOS, Java Script, Java, Objective-C, swift And Node JS application.

Firebase is also known as Google cloud message (GCM), Firebase Cloud messaging (FCM) is a cross platform solution for message and notification, for android, IOS and web app, which can be used at free of cost.

Microsoft AZURE is another example of cloud computing service. It is cloud computing services developed by Microsoft for testing, building, deployment and managing app's and services with Microsoft managed data centers. It dispenses software, platform, infrastructure as a service and support many different programming languages. Microsoft Azure also provides Mobile services like collecting of real-time analytics that highlights client's behavior and also gives facilities like push notifications to mobile devices. It provides storage services like REST and SDK API's for storing and accessing data on the cloud. Queue services is also provided in this service by queues.

In this proposed system firebase is used as a main database because it is a cross platform solution for message and notification. It is also known as real time database. Most important Firebase is providing quickest data retrieval and storing in database with free of cost.

IV. ARCHITECTURE

The proposed system helps in retrieving data which is stored in the real time data base. The case study used to test the cloud-based storage is a Telemedicine scenario where in a patient will be carried through an ambulance to the hospital. Ambulance will be having a paramedic inside the ambulance who will register the patient details in the database using an android application. Paramedic have to register patient's name, patient's SPO2, BP, ECG, Images and videos and information on the body part which got injured in case of accidents. The information will be sent to the cloud and hospital finding application integrated to it will help in finding nearby hospital which is capable of treating the patient. Hospital management system is a web application which help in retrieval of patient data from cloud data center and adding, editing the hospital details like hospital name, id, emergency bed, number of pathologists, no. of immunologists, no. of anthologists, no. of cardiologists, no. of ENT specialist, no. of MRI scanner, CT scanner, X-ray's.

In this proposed system a data categorization algorithm with unsupervised learning helps in dividing the data which will be stored in partitions in Cloud based hospital data center. This proposed approach plays a vital role in emergency medicine as the data needs to be retrieved, processed or analyzed for medical decision support or as an aid support the doctor in treatment or diagnosis. The data partition or categorization algorithm is supported with the help of KNN Classifier which classifies data in to varies types based on the size and upload time or arrival rate. The classified data for example video, text, photos and audio will be separated and stored in different portions.

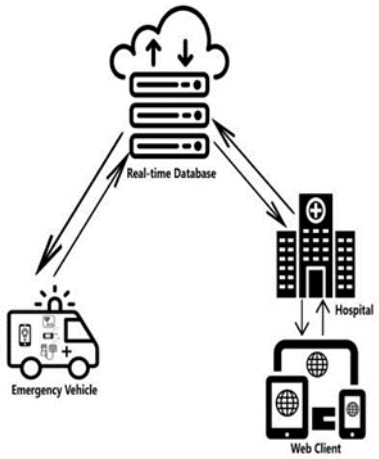

Figure 1: Proposed architecture of Cloud based datacenter for tele medicine.

The architecture in Figure 1 represents the various interconnected components in the telemedicine data storage like the ambulance carrying the patient with various sensors mounted in to collect vital information of the patient, the cloud based real time database storing the medical records which is in turn connected to hospital management system, and at the end is the web-based interface for doctors and hospital admin with a provision of viewing the real time data. The proposed algorithm works in the API connected to the Could data center the unsupervised algorithm classifies the data into various types based on the size and arrival rate at which the data is loaded in to the cloud the algorithm is depicted in the next subsection of the paper.

V. DATA CATEGORIZATION ALGORITHM

The Cloud data centers in the proposed research is enhanced in storage with the help of the unsupervised classifier K Nearest Neighbor (KNN)[22][23]. K Nearest Neighbors method. K Nearest Neighbors is an effective and efficient method in which is used for storing all available classes and classifies new categories according to similarities. KNN has been employed in applied mathematics estimation and pattern recognition already in the early 1970's as a non-parametric technique [24]. The Cloud Dashboard uses the KNN algorithm to classify the photos, data or videos uploaded by the paramedic and then to store it into different partition tables in the data base and then the web application has to categorized according to the photo or data size and store it to the data base and displaying the proper result to the doctors on the web-based interface [25][26]. Proposed KNN algorithm helps in grouping of data or information according to its size, bandwidth or arrival rate

CP- Cloud Partition
D- Data
C-Classes

Step 1: Load the data D into Cloud through the dashboard
Step 2: retrieve parameters specific to D, arrival rate is measured as A and data size is measures as S.

Step 3: Train the KNN classifier with existing dataset of containing information about medical data, choose K according to the Training data available. Obtain the C values.

Step 4: Make cloud partitions in the firebase depending in number of classes C. And Map each C value to Cloud Partition CP.

Step 5: Feed 'A 'and 'S' in to KNN algorithm for Classification

Step 6: Obtain the class value C from output of KNN.

Step 7: Store the data D in to cloud partition CP based on the matching C value,

The algorithm helps in storing the data that arrives from the paramedic in ambulance into various Cloud partitions in the data center, this helps to great extend in retrieving, processing and analyzing real time data. The observations and result obtained from the Fire base Cloud medical data center while processing the data collected from a telemedicine application is detailed in the next subsection of the paper[27].

VI. RESULTS AND OBSERVATIONS

The experimentation for the research is carried out with the help of Firebase Cloud data center and Web based dashboard integrated to the telemedicine system in an ambulance. The paramedic inside the ambulance may load various type of data like image, audio, video and raw textual data. The data is received in to the Cloud API and the API extracts features of the data such as arrival rate and size of the file. The Cloud dashboard then calls the data categorization algorithm proposed to classify the data. The result of the data categorization done by the algorithm is depicted in the Table 1

Table 1: Data categorization by the proposed algorithm

Arrival rate	Size	Category
20 seconds	18.5 KB	Text
122 seconds	11000 KB	Video
103 seconds	5500 KB	Audio
24 seconds	20 KB	Text
39 seconds	2300 KB	Image
450 seconds	54000 KB	Video
95 seconds	4300 KB	Audio

The data ones categorized are mapped in to the cloud partition. Partition tables are created by using query in stored procedure to create tables based on the category and ingestion time. The partition stores the data mapped according the category value. The Big Query editor integrated to the dashboard helps in maintaining and updating the partitions of Firebase data center.

The results obtained from the Firebase that is the retrieval time of the data from the Cloud to the end user interface is depicted in Table 2. table also shows the results of the data retrieval time that had taken form various databases like Windows AZURE, firebase, AmazonEC2. the result of Table 2 clearly shows that Firebase with data categorization algorithm has the least retrieval time.

Table 2: Comparison of retrieval time of various data types in different Cloud datastores.

No	Data No.	Data Type	Output time by Windows AZURE	Output time by Firebase with Data categorization on algorithm	Output time by Amazon EC2
1	1001	Text	89 sec	30 sec	72 sec
2	1005	Photo	87 sec	35 sec	78 sec
3	1056	Video	92 sec	37 sec	80 sec
4	1059	Audio	90 sec	41 sec	84 sec

Figure 2 depicts the graphical representation of comparison of retrieval time of various data types in different cloud data stores like Windows Azure, Firebase with proposed algorithm and Amazon EC2. The graph depicts that proposed algorithm has the least retrieval time for different type of data.

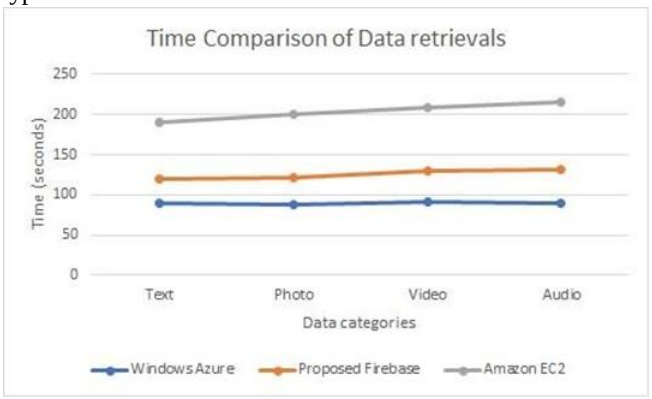

Figure 2: Time comparison of Data retrieval

The system thus provides a fast and efficient retrieval mechanism for various data because the data are categorized, partitioned and stored. Thus, the proposed system is an ideal solution for data storage for real time applications like Telemedicine.

VII. CONCLUSION

The research carried out on medical data is suitable for the real-life scenarios like hospital management system. The results obtained by testing with various data shows that the proposed Cloud storage with the dashboard is efficient in terms of retrieval time and memory utilization than many other public cloud platforms. The research provides a smart solution for storing telemedicine or hospital records. The challenges involved in storing medical data are numerous in number because of the heterogeneity in the type of data getting collected. The major role of the cloud API used here lies in categorizing the medical data based on data size or time taken to upload data with the help of unsupervised learning algorithm.

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