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Cloud Based Healthcare Framework for Criticality Level Analysis

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Abstract: ***In a Cloud based development Amazon Web Service(AWS) is a platform which secures the cloud services, offers database storage, content delivery, computer power and also provides other functionality to help business scale and grow. This proposed work aims that medical healthcare inputs from various sensors have been automatically retrieved and directly loaded into the cloud. Once the data has been loaded creating the inference engine, setting up a big data cloud environment and store the data into a cloud based dataset. Medical data is calculated using machine learning algorithms such as K-Nearest Neighbor (KNN), Naïve Bayes and Support Vector Machine (SVM) through R shiny web application. The cloud system stores the health care data and transmitted to practitioners through the web service network. Based on these medical data the score value of a patient is calculated and displays criticality of patient.***

Keywords: ***Amazon Web service(AWS), K-Nearest Neighbor(KNN), Naïve Bayes(NB), Support Vector Machine(SVM).***

I. INTRODUCTION

Healthcare cloud is a cloud computing service which can be used to store and maintain the patient data. In the case of healthcare framework, the Big data processing engine is set over a cloud. So Hadoop is set over a cloud and it collects the loaded data in the cloud and it works in a parallel processing system, multiple machines. HDFS stores the clinical data, MapReduce will execute the data. Once it takes the data it does Mapping. Map reduce process will fetch a similar value into key value, after that it can be sorted according to a key value. Then it will be reduced and putting into a single attribute. Inference engine receives the healthcare input data and applies some logical rules, based on that data it gives the result. Initially the data coming from different hospitals are loaded into the database, that data will be filtered using preprocessing technique. While filtering the data unwanted, null values will be removed using some R-based packages. A cloud based machine learning supports for prediction of data. Certain packages are klaR, require e107, caret, MASS, etc. After the preprocessing data is ready, that data will be sent to a cloud based environment. So we are using AWS to store healthcare data. In this framework the data has been taken and map the values into a particular key. The 3 phases of reordering are Mapping, Sorting and Ready. Then that data will be feeded into the inference engine. Inference engine collects the data based on the type of human vitals like, if it is BP it suggests a particular machine learning algorithm for that, likewise for pulse rate.

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All the data can be collected and put together into a common entry for a patient inside the cloud. Based on that common entry, score value will be calculated for a patient like how much its criticality or what is the present health level of the patient. Finally, each levels like high level, low level, normal are to be taken into a particular frame the type of disease patient has. It results that if the patient has high BP and high Pulse rate, these things will be considered and concluded that he is having heart attack. AWS also supports for VPC (Virtual Private Cloud) for hosting services on a private network, which can also communicate the resources in the same network. Amazon Elastic Compute Cloud (EC2) provides a virtual server are compute capacity instances. Amazon EC2 configure security, networking and also used for storage. Virtual machine connects over a network through that Remote Desktop(RDP) has been host. RDP provides a user graphical interface to connect with an another system over an internet.

II. RELATED WORK

Cloud computing offers a shared access of resources. Basically Information Technology [1] services in cloud provides a major healthcare benefits, for health care organization cloud computing delivers a services to highlight it. This work concludes that the people who knows well about the Healthcare organization IT activities have some idea about Concrete Cloud Computing for healthcare organization. For many hospitals they more prefer Software as a Service. In a Big data environment, it emerges a massive datasets of clinical data into a data storage and analysis. Map reduce works with two tasks: Map and Reduce [2]. MapReduce does processing of data framework; Hadoop works in cloud framework for an implementation of specific nodes or clusters. The main advantages of MapReduce and Hadoop are: the storage of fault tolerance results to a reliable data processing and Hadoop File System (HDFS) provides a high throughput of data processing framework, Data stored in HDFS are given to a slave node. The usage of healthcare data in a MapReduce and Hadoop results a utilization of data and emerges new opportunities. When there is a loss of data, Distributed File System provides a data replication for computing nodes. High Performance Computing (HPC) system mainly contains the distributes, grid, processing and file systems. Clinical data follows the advantages of Descriptive and predictive analysis. Predictive data shares the computing nodes and used in framework. Cloud computing is leading to a wide range for a business infrastructure [3] to a consumers and experts, also it gives a high quality of outcomes for patient.
To secure healthcare data the industry is opting for outsourcing. Cloud computing can support clinical EHR, prescriptions, and patient results.

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Amazon's S3 cloud service provides implementation of clinical data [4]. Several characteristics of cloud computing are a computing time for a server storage, through network main resources are available, Pool of resources, quick access of resources. Cloud infrastructure interface maintains user account by providing services in the form of queue. Amazon provides numerous web interface for maintaining data and accessing. AWS offers the security of database on SaaS [5]. Via internet a patient healthcare record can be accessed at any time. Cloud providers are OpenStack for deployment of cloud. For the transmission of data wireless technologies [6] have been incorporated to check patient's condition. Patient vital signs are blood pressure, pulse rate and more, machine-to-machine communication for healthcare sensors cloud system offers a real time application. The pervasive healthcare data leads to access shared resources and cloud infrastructure. The infrastructure of healthcare organizations aims at a standard IT application [7] to update a result for healthcare services. For maintenance of patient records low cost IT systems having large capability is used. E-Medical Record (EMR) application model, needs a cloud computing environment in the single application and database. EMR results in the integration of international healthcare standards. In the case of cloud environment, the human health-data is stored and transmitted to the practitioners from everywhere and through web service network the response can be given back to patients. This work presents the Medical Cloud Computing [8] result through the web service of healthcare. Thus, Mobile and Cloud Computing offer to use remote healthcare domain for the necessary functionalities. Big data healthcare analytics uses Hadoop [9] for the implementation of computing framework. This makes an unstructured data into a structured data and the healthcare frameworks are real-time analytics for data prediction. For disease prediction genomic data gives a better result. Hadoop-HBase architecture provides an efficient query management and also for batch storage facilities. Analyzing EMR [10] on cloud is to propose Map reduce programming for Hadoop, also used Hive and Sqoop for medical data records. Recently most of the healthcare organizations are sending to cloud architecture to store and process the enormous amount of medical data. In this work EMR of unstructured data have been taken and to import the data into Hadoop, it uses Hive then it processes the data and for further analysis it exported to external databases on cloud.

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III. PROPOSED WORK

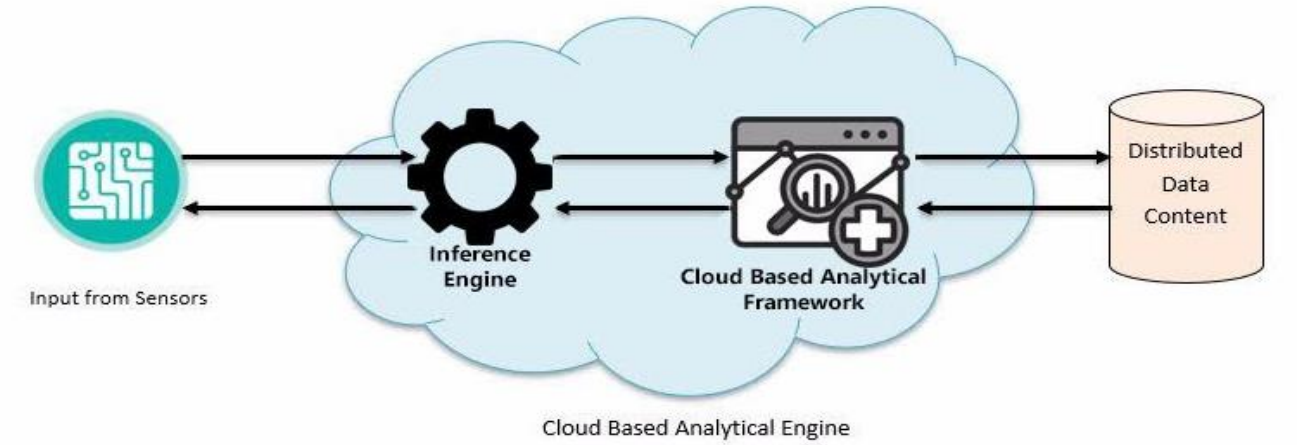

Figure 1-Proposed work architecture

Figure 1 depicts that the patient inputs have been stored in a various sensor, that is automatically retrieved and which is taken form the cloud. These clinical inputs are directly loaded into the cloud. Initially creating the inference engine, setting the Big data cloud environment that is AWS cloud. Storing it to a cloud based dataset, may be it is distributed in nature, private or public cloud environment. The datasets can be working using various machine learning algorithms, for that we are applying R language. EC2 instance supports a virtual machine on AWS cloud. By considering a Hadoop based environment in the inference engine the patient output will be generated as a report. Combining human vitals of BP and ECG, the cloud environment has been set up. Certain machine learning algorithms are applied for implementing a cloud based healthcare data to find out the prediction and accuracy. Based on the accuracy patient score value will be calculated, which predicts the criticality of patient and store that data in the database and that data is useful to refer practitioners.

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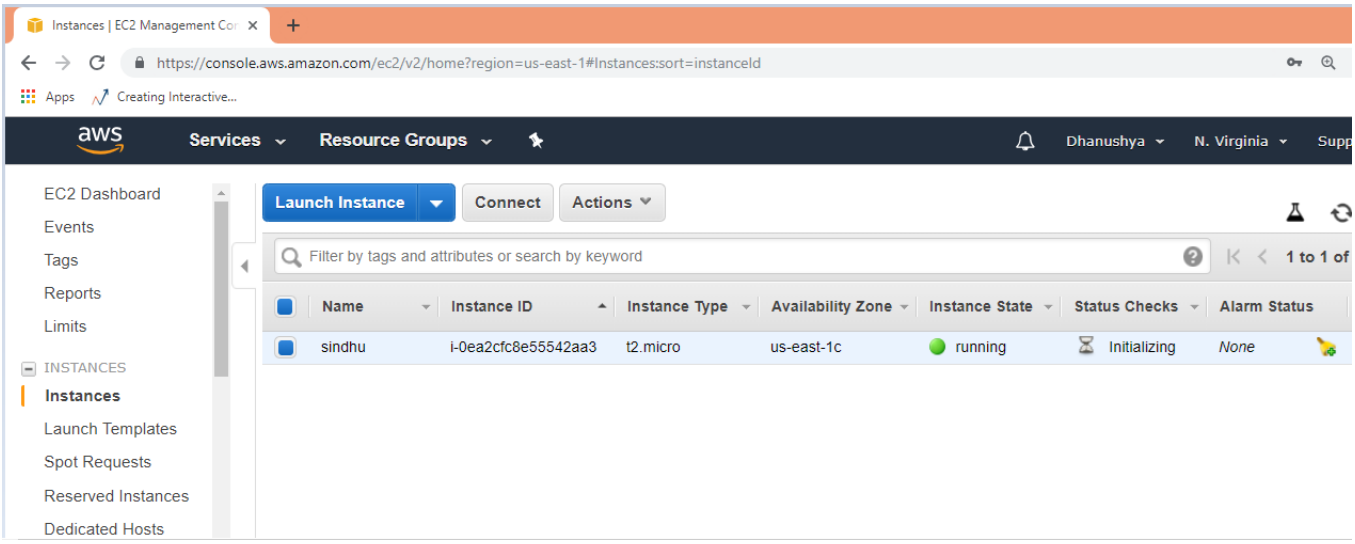


Figure 2- Launching Amazon EC2 instance

In the cloud platform, mainly Amazon EC2 is a popular commercial cloud, that is evaluated for behavior, performance, constancy and homogeneousness of little instances on EC2. For storing, managing and networking Amazon EC2is a best type to run the application. It can also be remotely manageable for the configuration of EC2 instances, Virtual Machines and servers in hybrid cloud environment.

Once the connection has been published, cloud will launch EC2 instances then connects to the remote desktop having Administration password to decrypt the key. Remote desktop only works on the cloud with specified credentials, upon that remote desktop R studio has been installed with some packages. Shiny web application is launched within R studio for structuring the medical data framework.

Shiny app web application:

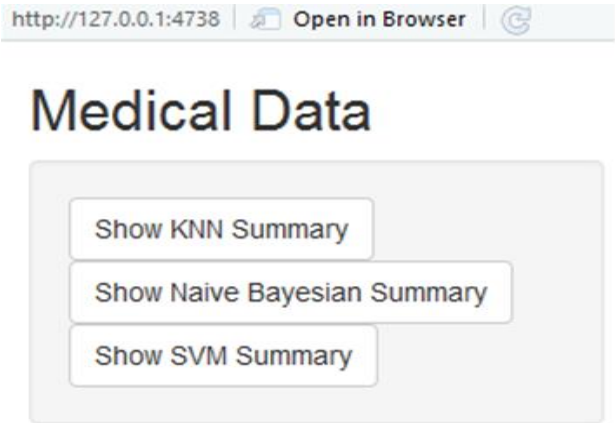
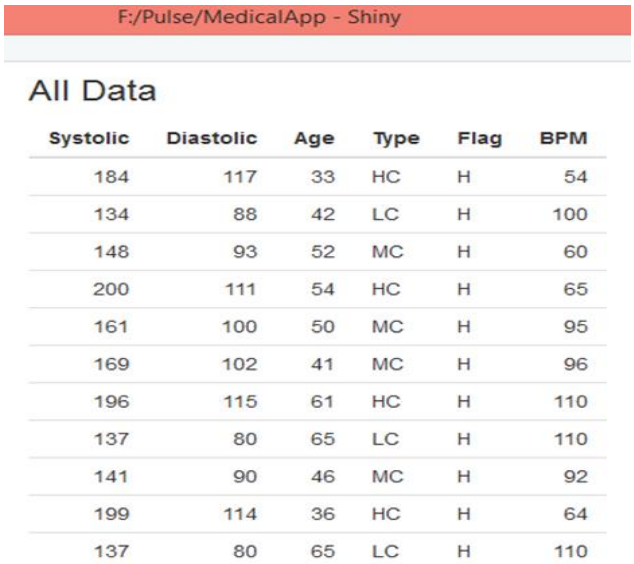


Figure 3- Medical dataset app in shiny server

For creating web application in R language it uses a Shiny server to set up Shiny to the web, also it uses a shiny server to host. Shiny is an R package open source system that offers most powerful framework for structuring web applications. Using shiny the data analysis can be done and it is seen by everyone in the web browser.

Figure 3 shows that the medical data which has been predicted using machine learning algorithms such as K-Nearest Neighbor(KNN), Naïve Bayesian and Support Vector Machine(SVM).



Systolic	Diastolic	Age	Type	Flag	BPM
184	117	33	HC	H	54
134	88	42	LC	H	100
148	93	52	MC	H	60
200	111	54	HC	H	65
161	100	50	MC	H	95
169	102	41	MC	H	96
196	115	61	HC	H	110
137	80	65	LC	H	110
141	90	46	MC	H	92
199	114	36	HC	H	64
137	80	65	LC	H	110

Figure 4- Medical datasets displayed in Shiny app

Patient healthcare medical datasets have collected from UCI public repository, initially it has been uploaded in R studio and the datasets are displayed in shiny app.

Summary of Naive Bayesian

```
    Systolic       Diastolic          Age        Type    Flag        BP
M
 Min.   :100.0   Min.   : 60.00   Min.   :29.00   HC:23   H:92   Min.
: 54.00
 1st Qu.:121.8   1st Qu.: 80.75   1st Qu.:41.00   LC:33   N:24   1st Qu.
: 65.00
 Median :139.5   Median : 89.50   Median :50.00   MC:36          Median
: 95.00
 Mean   :146.9   Mean   : 92.37   Mean   :50.04   N :24          Mean
: 88.86
 3rd Qu.:173.2   3rd Qu.:106.25   3rd Qu.:59.25                  3rd Qu.
:110.00
 Max.   :200.0   Max.   :132.00   Max.   :68.00                  Max.
:118.00
```

Figure 5- Summary of medical dataset

Each and every attribute that is Systolic, diastolic, age, type, flag, BPM displays the minimum, 1st quadrant, median, mean, 3rd quadrant, maximum value has been calculated.

IV. RESULT

Time efficiency in shiny app has been compared with three algorithm using medical dataset. Time efficiency of KNN algorithm is 19.33 seconds with 88.88 accuracy, time efficiency of NB is 24.22 seconds with 87.3 accuracy, time efficiency of SVM is 9.52 seconds with 92.4 accuracy. In this comparative algorithm in shiny app results SVM is best algorithm.

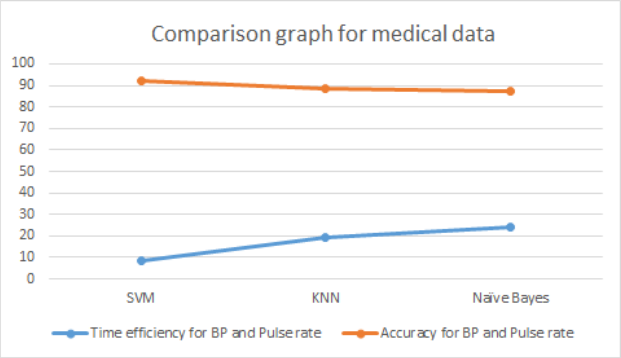


Figure 6- Time efficiency for classification algorithm

V. CONCLUSION

The aim of this research work is to set up a cloud EC2 instance through an AWS and connecting it with a specific instance id. Upon EC2 remote desktop has been launched and installed with R studio. In that R studio healthcare datasets are calculated by different classifiers mainly SVM, Naïve Bayes and KNN for calculating time efficiency and accuracy. These all done with the shiny app with R packages of powerful framework to show the web application. The result shows that SVM provides best time efficiency of 9.52 seconds and 92.4 accuracy.

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