

Predictive Health Analytic Model in Federated Cloud



A.Karunamurthy, M.Aramudhan

Abstract: Predictive Health Analytic is a challenging discipline in healthcare industry where knowledge can be transferred into action. The basic steps in predictive modeling are to define the problem, gather the initial necessary data and evaluate several different algorithm approaches. Later his process to be refined by selecting best performing models, testing with bench mark data sets and real world setting. Predictive analytics helps to extract useful knowledge and support in making decisions. In this paper, federated health providers are interconnected by using brokers, gather information and helps in decision making related to the issues of health. Each provider has provided the awareness about the distinct diseases, predict the possible level of diseases affected and the mode of treatment. Simulation result reveals that the proposed architecture is essential for the present needs of human life.

Keywords: Health analytics; predictive ; federated cloud; fuzzy models; regression models; bench mark data; decision making;

I. INTRODUCTION

Detecting disease at an early stage increases the survival rates of patients and also increases the life time. Data analytics is a new trend of technology designed to handle big data and essential tool for medical organization to provide effective health services at affordable cost. The failure rate of IT projects in healthcare is high when compared to other industries . The challenges in the predictive model related to medical applications is how to train , understand, interpret and use the result of the approach. In this paper, federated health service architecture best health service provider (HSP) for the treatment. This architecture uses brokers for collecting the information such as doctor, patient, equipment's, past treatment status and cost and updated in the broker manger registry.

SLA Management describes the status of the patient, requirement of patient and need of treatment. This type of SLA information plays a vital role in selection process of HSP. Prediction model selection the available and suitable

HSP based on the requirement of users, ranking model helps to select the best HSP among the shortlisted HSPS in the prediction model suppose, there is a failure when no HSP is shortlist is invoked it suggests the conclusions of two or more HSPS are the best for the treatment.

In this paper, a dynamic provider ranking algorithm is proposed to select the HSP for the user with shortlisted HSPS in the prediction model. In prediction model the future health condition of the patient is tentatively observed using hybrid PSO and K-means based in that HSPS are shortlisted.

II. LITERATURE SURVEY:

Zibin Zheng., et al;[1] proposed Qos ranking frame work to study the ranking prediction accuracy and compared with other competing ranking algorithms. A fuzzy based model is recommended[2] for Qos violation detection and predication for ensuring continuous service availability[2] rajarajeswari[3] proposed SLA management approach by distinguishing the incoming request either as SLA based or non-SLA and address the starvation by introducing distributed loose priority based scheduling.

Yaxg ., et al [4] introduced a frame work which measures the quality and selects the service providers based on service measurement Index (SMI) metrics suggested CCSMI and ranks the providers using Analytical Hierarchy process (AHP). Regression tree based ranking model[5] suggested by mourougan computed the trust of the providers, past behaviors and performance of the providers, based on that, regression tree is formulated and most suitable provider assigned to the service.

Asma Al Falasi., et al: [6] proposed multi-levels SLA A solution to mitigates the cascading effect due to monitory and report of violations communicated to concerned model depends on a coordination to manage consumers' Qos definition where agents handle mapping of multiple requirement need by the consumer into one aggregated SLA document. SLA resource allocator handles interaction between users and resources by examing requested Qos and controlling admission of requests to available resources.

In this paper[8], adaptive SLA mechanisms is introduced which type with dynamic underlying changes of SLAs and relationships, dynamic SLA validation and deployment methods in federated cloud . contracts based mechanism for resource sharing between CSPS is proposed[9] that maximizes the local profits of the CSPS and achieves good performance better than the traditional model in terms of cost and success rate Authors[10] in this paper, developed resource prediction models to understand the load flections and designing resource provisioning scheme that waves on data centers and clusters.

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Prasan kumar saho et al .,[11]designed SLA based healthcare big data analytic architecture to allocated resources with minimum inter- network latency and processing time . predict the health condition of the user. Authors in this paper[12] ,introduced a VM'S optimization model using PPSO algorithms to improve the healthcare applications.

III. FEDERATED HEALTH SERVICE PROVIDERS ARCHITECTURE (FHFA).

In FHFA two or more healthcare provides are interconnected using brokers, all brokers are interconnected with broker manager. Broker communicates with specific health service provider (HSP), updates the information in the brokers registry (BR). In FHFA, resource management is a challenging task which covers discovery, section, monitoring and allocation. The responsibility of brokers manger is to find the resources and services for the service request submitted by the user and ensuring its quality.

In this proposal, selecting the provider for the service by using two phase approaches. In the first phase, providers are shortlisted that met all the requirements of the service request and user. In the second phase, ranking mechanism is applied to select the best provider. Health service providers selection mechanism should consider the SLA requirements of the user and application. The architecture of federated health service providers is shown in Figure1.1.

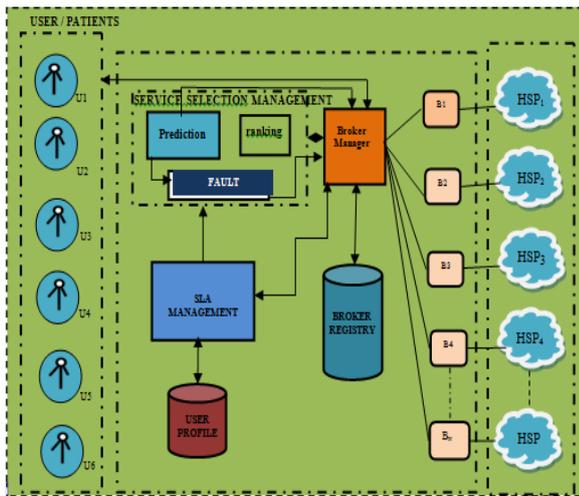


Fig.1.1Federated health service providers architecture (FHFA)

Service level agreements (SLA) is defined as a means to establish a common understanding of expectations and obligations of health providers and their users. In this proposal the assigning of health provider to the specific user based on the value of SLA and considered Service Measurement Index (SMI) attributes. Brokers manager seeks SLA related information for the user from SLA Management. Prediction model observes the status of the patient based on the data given by the user. Let us consider a Health Service Provider is integrated with different users such as doctors, nurses, infrastructures such as MRI scan and patients.

The priority of the patient is decided by considering the SLA, current health condition (cc), disease severity(ds), and any emergency. In health care domain, doctors depend on the value of clinical outcomes of the health parameters as the evidence of the disease[]. In this proposal, patients are falling on three different categories such as High, Medium, Low. The priority for the patient is high, if and only if current health

condition is serious, disease severity and emergency factor is high.

3.1 Prediction Model:

In this model, two possible tasks are carried out, based on the input, first classify the type and priority of the disease and secondly, shortlist the possible HSPs. A clustering method based on the combination of the particle swarm optimization (PSO) and K-mean is suggested to identify the type and priority of the disease. At the beginning stage, the whole space is searched for the best solution. When the PSO algorithm reaches to the solution roughly close to the best, switch to the K-means and finish the process faster and more accurately.

The PSO fitness function direct to switch the K-mean at proper stage of the processing. The summary of PSO-K-M algorithm is described.

Step1: Initialize the position and velocity of particles randomly. Each particle is a centroid of clusters. Hence, i^{th} particle is initialized as

$$X^{(0)} = (Z_{i1}, Z_{i2}, \dots, Z_{ik}).$$

Where Z_{ik} refers to the K^{th} cluster centroid suggested in the i^{th} particle.

Step2: Evaluate the fitness for each provider based on clustering criteria. The fitness of particle i in swarm is defined as below.

$$F(i) = \sum_{j=1}^K \frac{\sum_{p \in C_j} (Y_p - Z_{ij})^2}{N_p}$$

When

N_p is the number of data points as inputs to clustering process. By minimizing the fitness function, the clusters are to be minimized.

Step3: If the number of iterations exceeds a predefined level go to step7, otherwise go to step4.

Step4: The position of best particle among the particles in swarm is stored. Then the position of all the particles are updated according to Equations (1) and (2), if a particle flies beyond the boundary $[X_{min}, X_{max}]$, (the range of possible solutions) then the position of particle is set to the X_{min} or X_{max} similarly if a new velocity is beyond and the boundary $[V_{min}, V_{max}]$ the new velocity will be set to V_{min} or V_{max} . Step5: Reduce the inertia weight, W , according to the strategy described in section2.

Step6: if the global best of particles, G , remains unchanged for a number of iterations (ten in our implementations), go to step 7; otherwise go to step3,

Step7: use the K-means algorithm to finished clustering task. The clustering terminates when one of conditions stated in section3 reaches.

After this model completed, the type of organs such as eye, heart, brain, the classification of severity say high, medium and low is to be displayed. Based on this, broker manger shortlists the HSPs and ranking algorithm is to computed.

3.2 Ranking:

Ranking mechanism helps the user to find most reliable HSP that satisfy its SLA and its business needs. Brokers manger can act as a middleware between user and HSP. Apply dynamic provider ranking algorithm to select the best HSP is given as below.

Input : shortlisted HSPS based on SLA, type of disease and severity.

Output : Best HSP among shortlisted.

Step 1 : Rank the shortlisted health service providers based on the observed Qos values prescribed in Service Measurement Index (SMI).

Step 2 : For each HSP , calculate the sum of preference values of that services by

$$P(i) = \sum_{j \in I}^K Q(i, j)$$

Where $Q(i, j) = q_i - q_j$. $Q(i, j)$ refers the comparing Qos values of HSP i and HSP j.

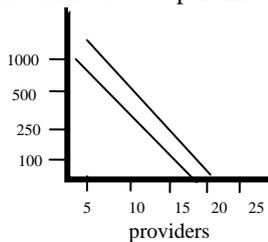
K denotes the number of HSPS shortlisted

Step3 : HSPS are ranked from the highest position to the lowest position by picking the service X that Has the maximum $P(x)$ value.

Step 4: If HSPx is unavailable , the next Provider may be selected and so on.

4. Simulations and discussion's:

To evaluate the performance of the proposed algorithms, simulations work is implemented in cloud simulation average response time and throughput are considered as metrics. To evaluate the performance of the proposed system. The numbers of requests, number of providers, deadline of tasks are considered as parameters.



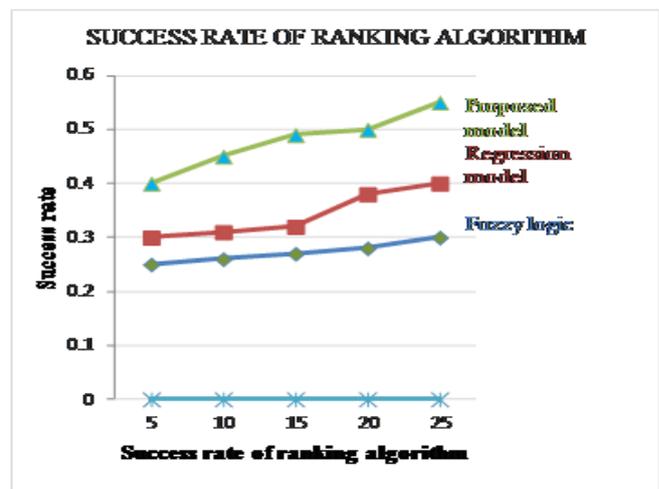
The execution time for each task is considered between 0.1ms and 0.5ms. The numbers of requests generated at a time are varied from 100,250,500,1000. The numbers of providers in the federated cloud is 5,10,15,20,25. Every cloud service providers has 50 hosts and VM scheduler . cloud brokers comprises of 256 MB of memory, 1GB of storage and cloudlet scheduler.

Table 1: Regression Average Response

Method	No of request	No of providers	Average response (m s)
Regression model	100	10	8
	250	10	18
	500	10	24
Regression model	1000	10	36
	100	15	6
	500	15	20
	250	15	12
	1000	15	31

Table 3 : proposed model average time:

Method	No of request	Providers	Average time (m s)
Proposed model	100	10	6
	250	10	13
	500	10	20
Proposed model	1000	10	31
	100	15	4
	250	15	9
	500	15	16
	1000	15	28



Graph1 : success rate of ranking algorithm:

The success rate is defined as the number of requests are completed the tasks successfully. In graph1 generally the number of providers increases the success rate also increased. The performance of the proposed ranking model providers better success rate because the existing models are not suited in uncertainty and un predictable conditions model is incorporate the suitability checking of providers. Hence, the proposed model yields better results compared to the existing techniques considered.

IV. CONCLUSION AND FUTURE WORK :

The broker based prediction and dynamic ranking cloud selection frame work federated model is proposed and the functionalities of all components are discussed in section 3.2. prediction model evaluates the availability of resources, identify the condition is either safe a unsafe using banker's algorithms. The shortlisted providers are considered for ranking, the most suited provider is assigned for the tasks. The simulation results shown that the proposed ranking model is better compared to the existing approached such as regression and fuzzy logic set.



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