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Patient Treatment Time Prediction

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Abstract

As population is growing now days and because of various environmental conditions, lifestyle and on the other multiple factors peoples getting more health problems due to which hospitals get over crowded. It becomes major problem for the hospital management system to maintain the patient queue system and to minimize the patient waiting time while getting treatments in hospitals. A patient has to wait until the entire patient queue before him or her to get treatment. Waiting for such a long time becomes really frustrating for patients and it also wastage of time. It will be more convenient and preferable if patient get to know the total waiting time through a system. It also becomes easy for the hospital management system to manage the queues. So, to manage the hospital queuing system and to reduce the patient waiting time while getting treatment in hospital we proposed and implemented a new approach called Patient Treatment Time Prediction (PTTP) technique to predict the waiting time for patient. To implement this technique, we used a historical patient's data. Depending on this large-scale dataset the waiting time is predicted for each treatment queue. We used this treatment time calculated by PTTP algorithm to calculate and to predict the efficient and suitable treatment plans for the patients by using Hospital Queuing-Recommendation technique. As the dataset on which we work is of very large scale therefore here we use a big data technology to handle such a large-scale data.

Keywords: Big data, cloud computing, hospital queuing recommendation, patient treatment time prediction.

INTRODUCTION

Due to tremendous growth in population in recent years, hospital gets overcrowded and it becomes very difficult for hospital management system to manage such huge crowd while patients getting treatment. Patient time prediction and queue

management system becomes the major challenge for the hospital management system. As a patient has to go through various treatment task while getting treatment depending on patient heath condition. Many times, doctor recommends two or more tests to identify and to analyze the condition of the patient and then after diagnosis the treatment starts. Thus, that patient has to go through all recommended tests. Sometimes it happens that the test which is to be performed is depending on some previous tasks. So, patient has to wait in queue for long but unpredictable time before treatment. Waiting for such a long time becomes really frustrating for patients and it also wastage of time.

In this paper, we present a technique to minimize the patient waiting time and helping hospital management system to achieve their action task and organizing proper queue system in expected time by recommending then the proper test order from given tests. For this system to accomplish proper queue system and predict proper treatment plan we have considered very large-scale data. This data consists of patient name, age, treatment tasks, doctor name, treatment start time and treatment end time. From this time prediction, we calculate the waiting time using our system. The time calculation prediction is based on different parameters such as age, gender, treatment start time and end time. The time calculation prediction is based on different parameters such as age, gender, treatment start time and end time. The waiting time for each task is predicted or calculated by the PTTP algorithm. Then this predicted time is used by the HQR system to recommend the proper treatment task sequence for patient to minimize the waiting time. As we work on large amount of real time data, difficulty and concurrent necessities we used big data and cloud computing model for flexibility and capability. In this system, we have also used an improved version of Random Forest Algorithm (RF) to train PTTP algorithm and to calculate the total waiting time. Then, HQR system is used to predict a well-organized and suitable action chart for every patient. From this time prediction, patient can view the real time waiting for their treatment task.

BACKGROUND

Many different algorithms and techniques are proposed till dates to increase the data efficiency. [1] Proposed a Random Forest technique for the detection of human body in high speed video. Detection of multiclass action in video is very difficult task because of messy backgrounds and the huge intra-class deviation in every form of actions. Therefore, to detect action instead of tracking each body they generated a sequence of video from spatial temporal interest point. By using this spatial point and Random Forest Algorithm generates a pre-matching system to provide a rank for each action type. Another Random Forest based robust matching system is proposed in [2]. In this method, they go through most existing and wildly used approach to find the features from the images and locating it is to generate the features and then used Random Forest Algorithm for matching process.

A Random Forest method is a good ensemble learning method. Because of its good classification and simplification ability, the random forest has accomplished success

in various domains. Though random forest algorithm generates a huge amount of noisy data while working on large scale data which some time generates a wrong decision. To avoid such situation [3] gives a weighted tree Random Forest Algorithm in which the problem is solved by weighting the trees according to their ability of classification. Service recommendation system is one of the most useful and essential services nowadays. Generally, service recommendation system works on the huge amount of data. Accessing such a huge data by traditional method gives the problem of accessibility and scalability. To avoid such problems [4] proposed a Keyword-Aware Service Recommendation method. Specific keywords are used to present the user's preferences and user-based collaborating filtering method to present appropriate recommendation. [5] gives a new recommendation technique for travel recommendation. In this method, instead of only mining the photo tags they also considered personal attributes such as age, sex traveling group type etc. and depending on this attribute they construct a personalized travel recommendation technique.

Bayesian-inference-based recommendation system is shown in [6] which is based on online social network. The recommendation is given based on historical mutual rating between two pair of users on social network. The big data consists of large amount of complex growing data which having multiple autonomous sources. [7] Represent a technique for data mining with big data called HACE theorem to categorize the features of big data and gives a Big Data processing model. An improved hybrid version of CRO method called HCRO is represented in [8] in which the old CRO method is used with a combination of novel heuristic approaches. A Gaussian random walk is used in this to search for optimal local user's solution. Map Reduce is one of the most preferable techniques for data intensive distribution for batch jobs. However, it suffers from number of disadvantages such as sequential processing while processing Map Reduce data, limits in data scalability, not supporting to flexible pricing and not supporting to streamed data processing. To eliminates all these drawbacks [10] proposed Cloud Map Reduce technique. They also proposed a new pipeline concept between Map and reduce phase to support stream data.

PROPOSED SYSTEM

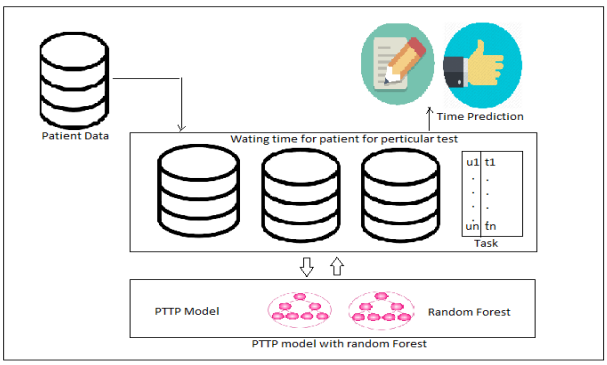

Fig. System Architecture.

The above fig shows the system architecture which includes patient historical data. This data is then sorted or arranged according to patient age, gender and time taken by patient to perform particulate task. To arrange the data according to age, gender and tasks we consider PTTP model with random forest algorithm. Random forest algorithm is used to group the patient historical data according to gender and different age group. PTTP is used to calculate the tasks waiting time according to sorted dataset stored in data base.

ALGORITHMS

Algorithm 1: Random Forest

Random forest is the supervised classification algorithm. As the name suggests it arrange or classify the given data to create forest like structure. In this proposed system, we have used random forest algorithm to arrange the historical patient data to calculate the time taken by the patient to complete that task. The pseudo code for Random Forest Algorithm on patient historical data is as follow:

Input:

Pd_{sorted} : Sorted Patient Historical Data.

Output:

h_i : Sorted dataset according to gender and age group.

1. For i=1 to N do //No. of Patient.
   Get group of treatment tasks T_t ⟵ Pd

2. For j=1 to N do // Group of Treatment Tasks.
   t ⟵ T_t //Single task from group of tasks.

3. For k=1 to N do //No. of patient in single task
   G_{gender} ⟵ t

4. if G_{gender} is equal “Male” then
   if A_{age}<=20 then
   age_{group}=”1 to 20”

   else if A_{age}>20 && A_{age}<=60 then
   age_{group}=”21 to 60”
   else age_{group}=”61 to 125”
   end if
   else
   if A_{age}<=20 then
   age_{group}=”1 to 20”
   else if A_{age}>20 && A_{age}<=60 then
   age_{group}=”21 to 60”
   else age_{group}=”61 to 125”
   end if

   end if

   end for

```
    end for
end for

append data to h_i
return h_i
```

Algorithm 2: PTTP based on RF.

PTTP i.e Patient Treatment Time Prediction algorithm is used to predict the waiting time for patient to get treatment. PTTP algorithm is based on RF algorithm. It uses dataset generated by RF algorithm to calculate the waiting time. The pseudo code for PTTP algorithm is as follow:

Input:

D_{train} : The Train data set
K : No. of tree generated by RF.
Pid: patient id
Tsk: Treatment Task of patient
Reg : Registered patient for different task

Output:

$PTTP_{out}$: Patient Treatment Time Prediction out put

1. Find no. of patient Nopb before pid for task Tsk.
   Nopb ⟵ Reg
2. for i=1 to Nopb do
3. find gender and age
   G_{gender} ⟵ Reg
   A_{age} ⟵ Reg
   Map to M
4. End for
5. for j=1 to K
   t ⟵ T_t
   if *t* is equal to Tsk then
   if M.gender equals to “Male” then
   if A_{age}<=20 then
   age_{group}=”1 to 20”
   else if A_{age}>20 && A_{age}<=60 then
   age_{group}=”21 to 60”
   else age_{group}=”61 to 125”
   end if
   else
   if A_{age}<=20 then
   age_{group}=”1 to 20”
   else if A_{age}>20 && A_{age}<=60 then
   age_{group}=”21 to 60”
   else age_{group}=”61 to 125”
   end if

   end if
   enf if

$$PTTP_{out} = \frac{\sum End_{time} - Start_{time} \longleftarrow age_{group}, M.gender, Tsk}{\sum No.\ of\ Patient}$$

6. end for
7. return $PTTP_{out}$

MATHEMATICAL EXPRESSIONS

$$T = \{D = \{p1, p2, p \ldots p\}\{T1, T2, \ldots Tn\}\{ti1, ti2 \ldots . . tin\}PTTP, P, train, Tc, Df\}$$

Where T is the time set

D = Dataset

$P = \{p1, p2 \ldots pn\} = The\ number\ of\ patien\ in\ the\ dataset$

$t = \{t1, t2, \ldots . tn\} = the\ tratment\ data\ of\ the\ patiens$

$ti = \{ti1, ti2, \ldots . tin\} = the\ time\ required\ fro\ tratment\ \ patiens$

Train = train(preprocessing) = $\{p1, p2, p \ldots p\}\ \{T1, T2, \ldots Tn\}\{ti1, ti2 \ldots . . tin\}$----------1

Df = Different parameters required for the time prediction

Df = $T \in P$ ----------2

P = time prediction

Tc = $PTTP(\frac{train+df}{Tc})$ ----------3

PTTP is the patient treatment time prediction

$P \approx Tc$----------4

A. DATASET EVALUTION

In this process to calculate the waiting time we used data from various hospitals having patient history according to their situation. A hospital dataset contains patient information their diesis type, age, gender, personal information doctor name, servicing staff, various test mentioned by doctor while treatment and starting and ending time of treatment.

Table 1. Example of treatment records.

Patient No.	Gen.	Age	Task Name	Dept. Name	Doctor Name	Start Time	End Time
0001	M	15	Checkup	Surgery	Dr.kale	10-10-2015 08:30 AM	10-10-2015 08:45AM
0001	M	15	Payment	Cashier-6	null	10-10-2015 09:05 AM	null
0001	M	15	Ct-scan	CT-5	Dr.Li	10-10-2015 08:50 AM	10-10-2015 09:00 AM
0002	F	36	Take Medicines	Pharmacy	null	10-10-2015 08:30 AM	10-10-2015 08:40 AM
0002	F	36	Payment	Cashier-6	null	10-10-2015 08:45 AM	null
0003	M	67	MR-scan	MR-7	Dr.Pal	10-10-2015 09:30 AM	10-10-2015 09:55 AM

Table 1 shows the format of treatment records of hospital dataset which consist of number of columns of different information. It shows that one patient can go through more than one test as recommend by doctors.

RESULTS

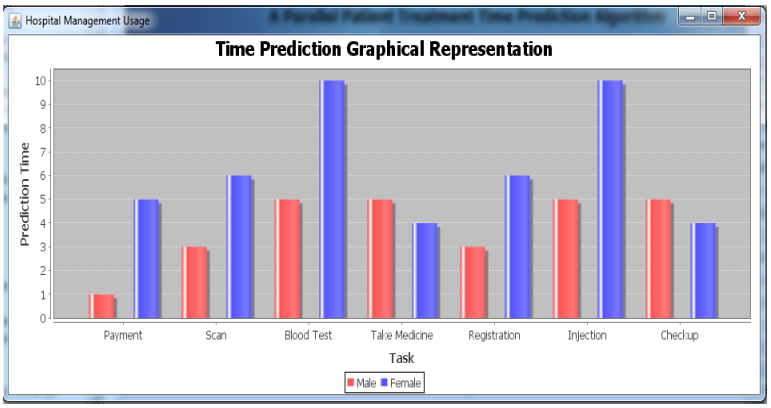

Figure 1: Time Prediction graphical representation

Above figure 1 shows the output of our system which includes different functionality for the admin process. The very first option is the admin train option by which admin can login into the admin section to load the patient historical data and perform different operations on it to make it clear for further use. Second option is the admin test, which is used for the patient's registration and login purpose to mark the treatment task and to get the waiting time for it.

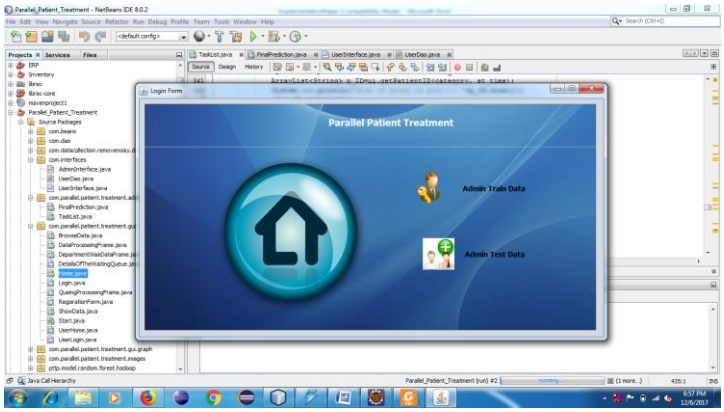

Figure 2: Home Screen

Figure 3: Patient Registration

Above figure 3 shows the patient registration window. If a new patient come then that patient gets enroled into the system by registering.

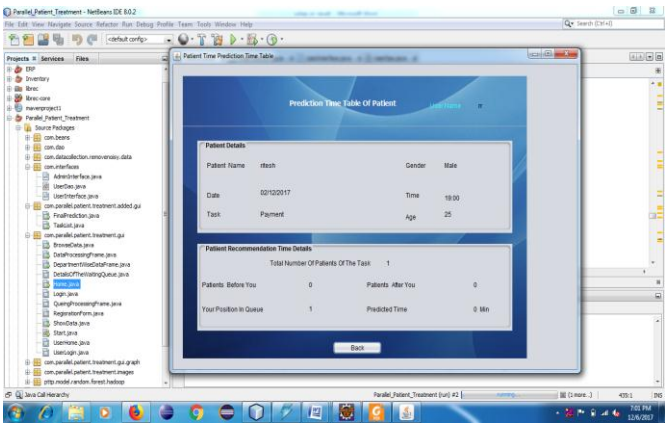

Figure 4: Waiting time for patient for the task

After consulting with doctor if doctor recommends some medical tests to be evaluated, then the patient can get the waiting time and the proper treatmrent plan to save the time.

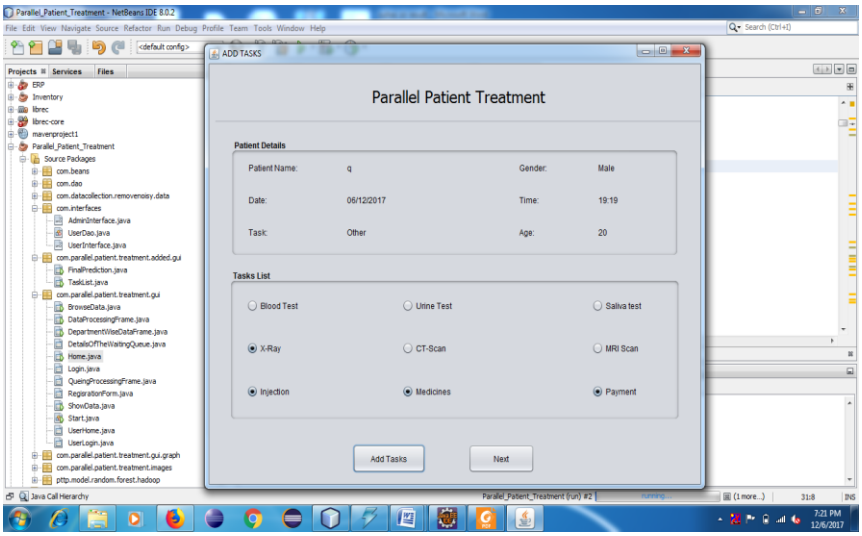

Figure 5: Tasks Window

Above figure 5 showa the window to add the tasks to be perform given by doctor. After selecting task by pressing Add Task button all the selected tasks are added to the database for that parient as shown in figure 5.

After tasks are added to system then by clicking on Next button it shows the waiting time for each task in waiting time section of window and next to it shows the recommanded plan to save the patient waiting time as shown in below figure 6.

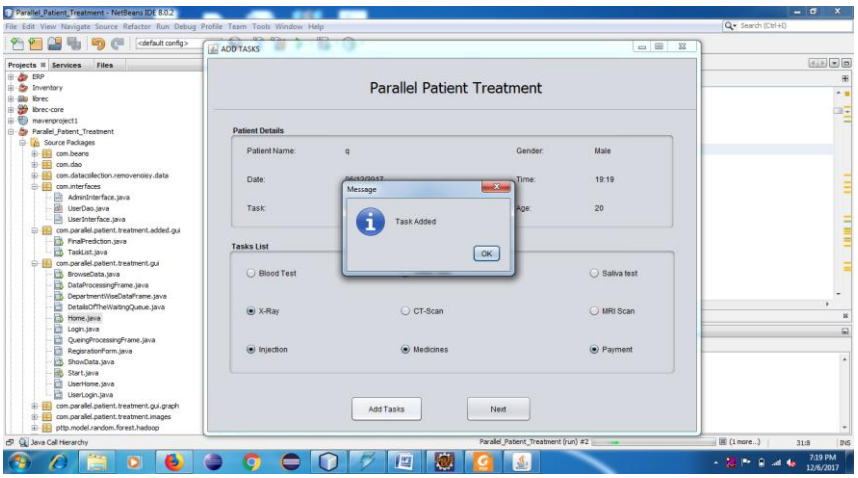

Figure 6. Tasks Added

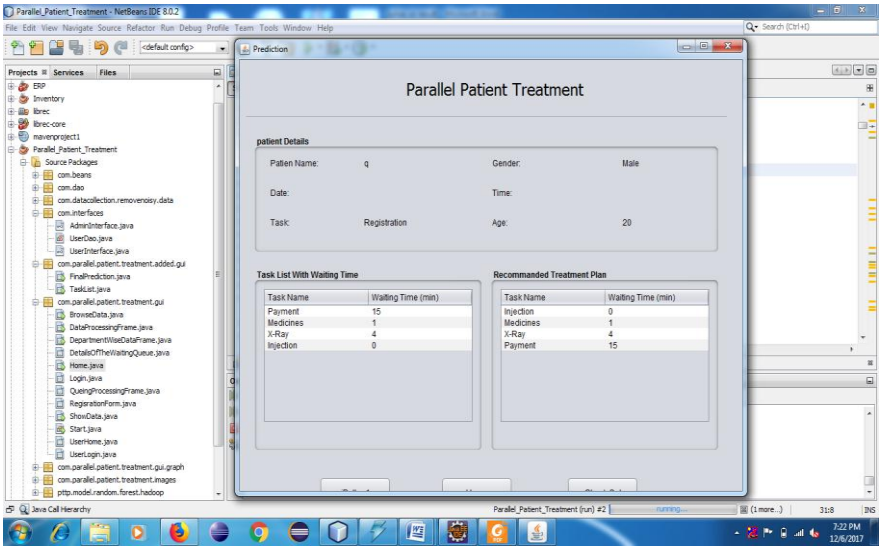

Figure 7: Waiting time containing recommended treatment plan

CONCLUSION

This gives the detail implementation of the PTTP technique on big data to reduce the patient waiting time in queue and also helps hospital management system to maintain the patient queue while taking treatment in hospital. A Random forest technique is used here to train the PTTP algorithm to calculate the exact waiting time according to patient's historical data and used this waiting time to recommend the appropriate treatment plans to reduce waiting time for the patients.

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