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# Patient Treatment Time Prediction in Hospital Queuing Management

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## ABSTRACT

Hospitals patient queue and its management to lower patient waits delays daily is considered as challenging tasks. Time wasting waits for long period results in to poor service and also lowers the hospitals reputation. Patient waiting for the treatment task to be completed need to wait for all the other patients who are appointed before him. This all the factors can be avoided if patient receive the updates about the queue, required time he need to wait for on his mobile phone. Understanding these problems faced by the hospitals, I proposed an individual Parallel Treatment Time Prediction (PTTP) system which will be responsible for analyzing the waiting period for every treatment activity for a patient. Here the realistic patient data from hospitals will be analyzed to calculate estimated patient treatment time for every task. The system will be responsible for getting the updates regarding huge and realtime data-set, the treatments time taken by each and patient among the list of present queue of every task is analyzed. With the successful recognition about the time taken by patient and waiting time, the Hospital Queuing Recommendation (HQR) system is implemented. HQR responsible for the suggestion about the time efficient treatment tasks for the individual. The models thus helps us to overcome the problems faced by hospitals with the help of HQRs time efficiency.

**Keywords:** Treatment time, Hospital queuing recommendation, Patient treatment time prediction, Hospital waiting's, Patient queue, Hospital queue portal.

## I. INTRODUCTION

Most of the hospitals are rushed with long queues of the patients. Patient thus suffering with one or more diseases need to wait for long period. Most of the patients need to approach to hospitals for their tests suggested like an X-ray scan, checkup, assorted tests, e. g., sugar level or blood test, or CT scan or some regular checkup. Considering the paper I consider these treatment tests as tasks. As the patient enters for the treatment the waiting patients cannot predict how long the patient will be taking to get its treatment completed. Patient for some of the diseases need to undergo multiple procedures for the test. Some of the patient also need to undergo dependent task which he has to wait for more than one queue, as a result patient with dependent tasks has to wait for those patient which are present in the number of queue the assigned task is given to the particular patient. Our paper thus suggest that the patients will be able to complete their treatment tasks in a very sure time which will be taken care by PTTP system and suggest the treatment required by using HQR system. This will be serving to hospitals to plan each treatment task line up and avoid overcrowded and ineffective queues. The real time data from hospitals will be used to formulate a patient treatment time model. The realistic patient treatment time are analyzed and strictly supported necessary parameters, like patient treatment commence time, end time, patient age. This will results in the determination and calculates waiting time for various patients supported their conditions and activities performed throughout treatment.

TABLE I
PATIENT TREATMENT RECORDS

| Patient No. | Gender | Age | Task Name | Dept Name | Doctor Name | Start Time | End Time |
|---|---|---|---|---|---|---|---|
| 0001 | Male | 15 | Checkup | Surgery | Dr. Paul | 2017-10-10 08:30:00 | 2017-10-10 09:00:00 |
| 0001 | Male | 15 | CT Scan | CT-5 | Dr. Chen | 2017-10-10 09:39:00 | 2017-10-10 10:25:58 |
| 0001 | Male | 15 | MR Scan | MR-8 | Dr. Martin | 2017-10-10 10:39:00 | 2017-10-10 10:59:00 |
| 0001 | Male | 15 | Take Medicine | TCM | Dr. John | 2017-10-10 11:05:00 | 2017-10-10 11:18:00 |

## II. BACKGROUND

The moto is to finish the treatments of the patients present in the queue and to avoid unnecessary delays would be the challenging task for the hospitals. The patients data will be use to predict the time required by the patient for the treatment with the help of Patient Treatment Time Prediction(PTTP) Algorithm.

- **Problem Definition :**

Prediction analysis and procedure for massive patient information from diverse hospitals is actually a difficult task .A lot of the information in private hospitals are considerable, unstructured, and high dimensional. Private hospitals that contain an outstanding package of information, like patient data, medical activity data, time, treatment section, and specific information of task as shown in table I. The manual procedure and varied occurrences throughout treatments, a huge quantity of inconsistent information seems, such as an insufficient patient gender and age group data, time inconsistencies induced by zone configurations of medical machines from manufacturers, and treatment details with only a start time but no end time.

## III. NEED OF PATIET TREATMENT TIME

As we observe there are long queue of waiting patients in hospitals, waiting for their turn to come for the treatment. In this there also some of the patients who need to get the multiple treatment and dependency tasks to get completed. So my PTTP algorithm will be trained based on the patients real-time data for recommend the alternate queue for the treatment. The patients data is first processed. For data preprocessing, patients treatment data of the hospital is referred. Number of patients visiting to the hospital be S, a set of and registered patient be with his information would be $S_i$. We can consider that there are N patients in S:

$$S = \{s_1, s_2, s_3, \ldots\ldots s_N\},$$

The required parameters are unchanged will be used for our analysis. There could be other patients with more than one treatment task to perform. So $X|s_i$ will be the set of treatment tasks for patient during specific visit,

$$X|s_i = \{x_1, x_2, x_3, \ldots\ldots x_K\},$$

The treatment records $x_i$ will contain multiple tasks like $Y$, task name, task location, department, start time, end time, doctor, and attending staff.

$$Y|x_i = \{y_1, y_2, y_3, \ldots\ldots Y_M\},$$

Thus $y_j$ will be the feature variable for tasks $x_i$.

The real time patient data will be analyzed, like patient no., gender, age, task name, department name, doctor name, start time, end time. With the patient conditions the treatment time will be analyzed. The basic model attributes of the task to be fulfill is shown in table I.

- **Improving Accuracy of PTTP Algorithm :**

For improving accuracy of the PTTP data, the RF algorithm is used to construct the PTTP model. *k* training subsets are sampled from the original training dataset *S* in a bootstrap sampling process. *N* samples are selected from *S* by a random sampling and replacement method in each sampling period. After the current step, k training subsets are constructed as a collection of $S_{Train}$:

$$S_{train} = \{S_{train1}, S_{train2}, S_{train3}........strain_k\}$$

The data which is not required in each sampling considered as out-of-bag (OOB) dataset. k OOB sets are constructed as a collection of $S_{OOB}$:

$$S_{OOB} = \{S_{OOB1}, S_{OOB2}, ......S_{OOBk}\},$$

Where $K << N$, $Strain \in S$, and $S_{OOB} \in S$

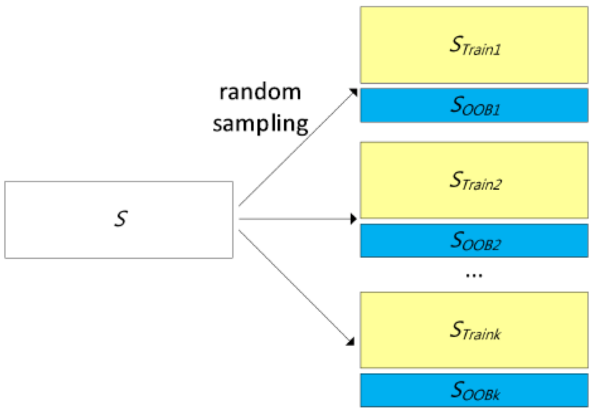


Figure 1. Training Dataset For Improving PTTP Accuracy.

## IV. RELATED WORK

A. **Paper Title: A Parallel Patient Treatment Time Prediction Algorithm And Its Applications In Hospital Queuing- Recommendation In A Big Data Environment.**

*Author Names: Jiangua Chen, Kenli Li, Zhuo Tang, Kashif, Bilal, Keqin Li.*

**Abstract**:

Todays reputed hospitals, I observed that many patients are approaching to get the treatment done for the diseases they are suffering. Many patients have to wait for long queue which results in their frustration by the patients and causes the reputation of the hospitals goes down. Every patient have to wait for those number of patients which are present in front of him in the queue. Some of the patients also gets multiple checkups for the treatment which results for waiting for more than one queue. This patients queue management some times also require resources to manage the queue because sometimes other patient may also enter between the queue or can break the queue as well. All these cases can also be managed if patient gets the updates about his queue on his smart device or mobile. The patient treatment time can be calculated by Parallel Treatment Time Prediction (PTTP) algorithm, which will be responsible to give the updates of how much time will be required for patients turn to come. Thus in the mean while patient also get recommendation that if patient is having multiple check-ups to be done, the Hospital Queuing Recommendation(HQR) system will suggest to approach the queue where the treatment require privilege before the other like plaster cant be done before X-ray scan etc. The real-time data the patients like its symptoms, name, age etc is also been verified to manage the queue for the treatment to get completed. Thus with huge amount of hospitals data the PTTP and HQR system performs better for patients data processing [1].

B. **Paper Title: Self-Adaptive Induction Of Regression Trees**

*Author Name: Raul Fidalgo-Merino and Marlon Nunez*

**Abstract:**

An algorithm named SAIRT is researched in which rule for progressive construction of binary regression trees is conferred. SAIRT responsible for capturing the elicited model once facing knowledge streams involving unknown dynamics, like sudden and rough operate drift, manipulation in bound regions of the operate, inconsistent data, and virtual drift. Moreover it also handles each symbolic and numeric attributes. The algorithmic rule will be mechanically captures its internal parameters and model structure to get new patterns, reckoning on the present dynamics of the info stream. SAIRT will also be responsible to monitor the utility of nodes and can also ignores examples from elite regions, storing the remaining ones in native windows associated to the leaves of the tree. On these conditions, current regression strategies want a careful configuration reckoning on the dynamics of the matter. Experimentation also suggests that the planned algorithmic rule obtains higher results than current algorithms once addressing data streams that involve changes with completely different speeds, noise levels, sampling distribution of examples, and partial or complete changes of the underlying operate [2].

C. **Paper Title: Parallel Boosted Regression Trees for Web Search Ranking**

*Author Name: Stephen Tyree, Kilian Q.Weinberger, Kunal Agrawal.*

**Abstract:**

The web users has increase in large number, which processes huge amount of data over the internet. Gradient Boosted Regression Trees (GBRT) are the present progressive learning paradigm for machine learned web search ranking a site disreputable for terribly massive data sets. The approach gives us a tendency to propose an ultimate technique for parallelizing the learning of GBRT. The approach also used the development of the individual regression trees and operates mistreatment the master-worker paradigm parallel. The content or data is divided among the users. At every cycle, the user summarizes its data-partition in the form of histograms. To create one layer of a regression tree the master processes uses the histograms, also sends this layer to the users, permitting the users to create histograms for following layer. The algorithmic approach rigorously arranges overlap between communication and computation to realize smart performance.

Since this approach relies on knowledge partitioning, and needs a little quantity of communication, it generalizes to distributed and shared memory machines, similarly as clouds. I have a also observed that experimental results on each shared memory machines and clusters for 2 massive scale net search ranking data sets. I have also demonstrated that the loss in accuracy elicited owing to the bar graph approximation within the regression tree creation is paid for through slightly deeper trees [3].

D. **Paper Title: KASR: A Keyword-Aware Service Recommendation Method On Mapreduce For Big Data Applications**

*Author Name: S. Meng, W. Dou, X. Zhang, and J. Chen.*

**Abstract:**

Keyword-Aware Service Recommendation method, named KASR, to address the challenges of scalability and inefficiency problems when processing or analyzing such large-scale data.. It aims at presenting a personalized service recommendation list and recommending the most appropriate services to the users effectively. Specifically, keywords are used to indicate users' preferences, and generate appropriate recommendations. With the success of the Web 2.0, more and more companies capture large-scale information about their customers, providers, and operations. The rapid growth of the number of customers, services and other online information yields service recommender systems in various environment, which poses critical challenges for service recommender systems. Moreover, in most existing service recommender systems, such as hotel reservation systems and restaurant guides, the ratings of services and the service recommendation lists presented to users are the same. They have not considered users' different preferences, without meeting users' personalized requirements. In KASR, keywords are used to indicate users' preferences, to generate appropriate recommendations. More specifically, a keyword candidate list and domain thesaurus are provided to help obtain users' preferences. The active user gives his/her preferences by selecting the keywords from the keyword candidate list, and the preferences of the previous users can be extracted from their reviews for services according to the keyword-candidate list and domain thesaurus. This paper aims at presenting a personalized service recommendation list and recommending the most appropriate service(s) to the users [4].

E. **Paper Title: A New Framework for Distributed Boosting Algorithm.**

*Author Name: Nguyen Thi Van Uyen, Tae Choong Chung.*

**Abstract:**

The paper gives the approach for proposing new framework for building boosting classifier on distributed databases. The most plan of our methodology is to utilize the correspondence of distributed databases. The formulas every turn the, every site processes its own information domestically, and calculates all required information data. A middle website can collect info from all sites and build the world classifier that is then a classifier within the ensemble. This international classifier is additionally employed by every distributed website to compute needed info for the next round. By continuation this method, can observe are going to have an ensemble of classifier from distributed information that's virtually a dead ringer for the one designed on the total information. The experiment results show that the accuracy of our projected methodology is sort of capable the accuracy once applying boosting formula to the total dataset [5].

F. **Paper Title: Fast Action Detection via Discriminative Random Forest vote and Top-K Sub volume Search.**

*Author Name: Gang Yu,Norberto A. Goussies, Junsong Yuan and Zicheng Liu*

**Abstract:**

Multiclass action detection in advanced scenes may be a difficult drawback as a result of cluttered backgrounds and therefore the massive intra-class variations in every variety of actions. To attain economical and strong action detection, we have a tendency to characterize a video as a set of spatiotemporal interest points, and find actions via finding spatiotemporal video sub volumes of the best mutual information score towards every action category. The algorithm named Random Forest is analyzed with efficiency to generate discriminative votes from individual interest points, and a quick top-K sub volume search formula is developed to find all action instances in a very single round of search. Top-K search are performed on down-sampled score volumes for a lot of efficient localization but not touching the considerably degrading the performance. Experiments on a difficult MSR Action Dataset II validate the effectiveness of our projected multiclass action detection methodology. The detection speed is many orders of magnitude quicker than existing strategies [6].

## V. PROBLEM STATEMENT

Prediction analysis and procedure for massive patient information from diverse hospitals is actually a difficult task. The huge amount of information in private hospitals are considerable, non-structured, and sometimes high dimensional. Private hospitals that contain an outstanding package of information, like patient's personal data, medical treatment activity data, time taken by patient, treatment section, and specific information of task. The manual procedure and varied .occurrences throughout treatments, a huge quantity of inconsistent information seems, such as an insufficient patient's sex and age group data, time anomaly induced by geographical locations configurations of devices in hospitals, and check-up lists with time of start cannot predict time ended.

## VI. SYSTEM ARCHITECTURE

In my system architecture, as patients will approach to the hospital, they will be registered with their attributes and the symptoms they are facing. All this details will be saved in the databases. Based on this data collected by the patients, the time will be predicted using PTTP algorithm for the various treatments they need to undergo. Also the HQR system will recommend the patients for the dependency tasks or if multiple task required will suggest the queue to be joined. Thus patients will get real time updates on their smart phones for the time required for the queues and recommendation for the dependency tasks or multiple tasks if assigned information seems, such as an insufficient information about type of sex of patient and group for age data, mismatch of time induced by geographical locations configurations of hospital devices of assembler, and treatment details missing data.

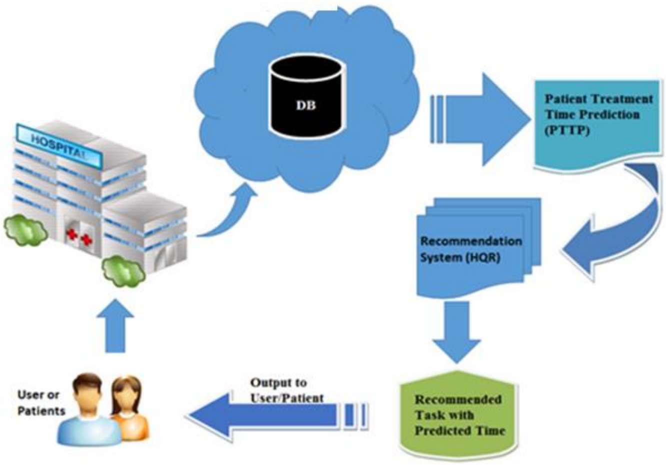


Fig. System Architecture

## VII. METHODOLOGIES AND ALGORITHM

Depending on the random forest algorithm on decision tree useful for data mining approach of big data. The applications can be fast action detection, robust and accurate shape model matching using random forest regression voting, Top-K sub volume ,and big data analytic framework for peer-to-peer botnet detection using random forests. The finding gives effectiveness and where the RF algorithm can be possible to apply given results in these papers can demonstrate. Mostly changing training system which may manage the performance of RF algorithm is proposed by Bernard. A random forest system relied on weighted trees demonstrated for data with more dimension is demonstrated. The direct voting procedure is still used by the original RF algorithm. In thus instances, this will lead to inconsistent decision tree will lead to anomaly

data.

### 1. PTTP ALGORITHM

Input:

S Train: training datasets;

k: the number of Classification and regression technique

in the HQR model.

Output:

PTTP: The HQR system based on PTTP model

Procedure

Step1: for i ← 1 to k do

Step 2: generate the subset with trained strain ← sampling (STrain);

Step 3: generate OOB subset sOOBi ←(STrain - straini);

Step 4: generate the tree CART as empty hi;

Step 5: every variable which is independent yj in straini do

Step 6: calculate points spill vs - yj;

Step 7: for each vp in vs do

Step 8: Measure best split point (yj ; vp) arg min xRL (yi

- cL)2+ xRR (yicR)2];

Step 9: end for

Step 10: add node Node (yj,vp) to hi;

Step 11: divide data to left branch RL(yj,vp) ← x—yjvp;

Step 12: divide data to right branch RR(yj,vp) ←
xjyj<=
vp; Step 13: for each data R in RL(yj;vp); RR(yj;vp) do
Step 14: calculate 8(vpLjyj) maxi 8(vi);
Step 15: if ((vp(L)yj) (vp|yj)) then
Step 16: append sub node Node(yj,vp(L)) to
node(yj,vp)
as more than one branch;
Step 17: divide data into two forks RL(yj,vpL ) and
RR(yj,vpR);
Step 18: else
Step 19: get fresh info to leaf node Dleaf ← (IL yj OL);
Step20: Find mean value for leaf node c 1/K Dleaf ;
Step21: end if
Step22: end for
Step23: remove yj from straini;
Step24: end for
Step25: Calculate accuracy
CAi←I(hi(x)=y)/I(hi(x )=y)+ I(hi(x)=z) for by testing
sOOBi;
Step26: end for
Step27: PTTP H(X,j) ←1/kiK ← [CAi hi];
Step28: return PTTP.

**2. HQR ALGORITHM**

Input:
X: task data of the patient;
PTTP RF:
On basis of RF algorithm the PTTP
model.
Output:
Ts(X): there suggested tasks with desired waiting
time. Procedure
Step1: generate map Ts(X)←Hash Map←string;
double;
Step2: for each Task I in X do
Step3: make array Ui←patients in queue of Task i;
Step4: for each patient Uikin Ui do
Step5: predict time consumption Tik←PTTPRF;
Step6: end for
Step7: calculate predicted waiting
timeTi←1/Wimk=1Tik;
Step8: append waiting time Ts(X)←¡Taski;Ti¿;
Step9: end for
Step10: separate map Ts(X) in ascending order;
Step11: for each i Task i;Ti in Ts(X)do
Step12: if (Task I has treatment which is dependent)
then
Step13: put records of the dependent tasks before
Task i;
Step14: end if
Step15: end for
Step16: return Ts(X).

## VIII. MATHEMATICAL MODEL

Let W be the whole system which consists:

**W= {IP, PRO, OP}.**
Where,
IP is the input of the system.

**A) IP= {P, D, DD, PD, U, PTTP, HQR, RF}.**

1. P is the number of patients in the system.
2. D is the set of number of department in the system.
3. DD is the set of number of doctors department in the system.
4. PD is the patient's database system which consists of number of databases.
5. U is the set of number of user in the systems that are accessing the data from patient's database server.
6. PTTP Patient Treatment Time Prediction used for to predict the waiting time for every treatment task for a patient.
7. HQR Hospital Queuing Recommendation used for calculates Associate in Nursing predicts an economical and convenient treatment set up suggested for the patient.

**B) PRO is the procedure of our proposed system:**

Step 1: At first the wireless medical network which capture the patient's data and transmits the patient data to a patient database system.

Step 2: A patient database system which stores the patient data from medical network and provides querying services to users (e.g., physicians and medical professionals);
Step 3: A patient data access control system which is used by the user (e.g., physician) to access the patient data and monitor the patient;
Step 4: PTTP algorithm to predict the waiting time for every treatment task for a patient. The expected waiting time of every treatment task is obtained by the PTTP model, is that the total of all patients' probable treatment times within the current queue.
Step 5: HQR system is planned supported the expected waiting time. A treatment recommendation with associate degree economical and convenient treatment set up and therefore the least waiting time is suggested for every patient.
Step 6: A patient data analysis system which is used by the user (e.g., medical researcher) to query the patient database system and analyze the patient data statistically.

### C) OP is the output of the system:

The system provides the proposed model to recommend
an effective treatment plan for patients to minimize their
wait times in hospitals.

## IX. PERFORMANCE ANALYSIS

- Performance Measure HQR:

To evaluate the efficiency of our HQR system, various experiments about average waiting time for patients in the with-HQR case with that in the without-HQR case are performed. Each case is under the treatment data with 5000 patients and 20,000 treatment records. Here i accounted and compared the average waiting time of patients in the With HQR case with that in the without-HQR case. The results of comparison are presented in figure, if patient is equal to 2, the average waiting time of each patient is approximately 15 min in the without-HQR case (the original case), while 12 min in the with-HQR case. When there are 6 treatment tasks required for each patient, the average waiting time is approximately 118 min in the former case, while 63 min in the latter case.

| Parameters | Without HQR | With HQR |
|---|---|---|
| 1 | 10 | 6 |
| 2 | 10 | 3 |
| 3 | 08 | 3 |
| 4 | 10 | 6 |
| 5 | 08 | 5 |

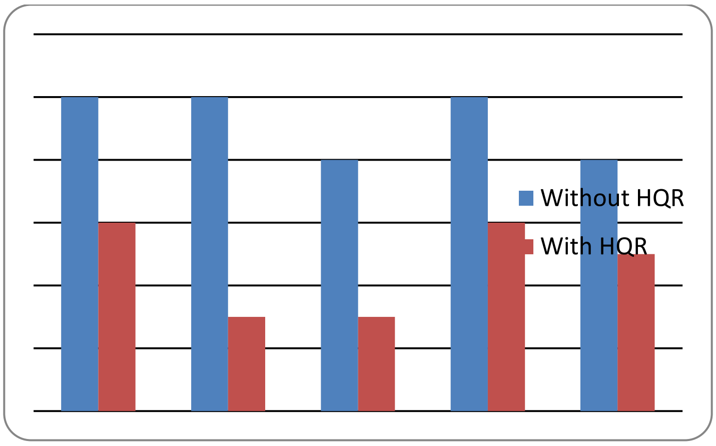


Fig. Result analysis performance for HQR

## X. CONCLUSION

The survey conclude the need of management of the patient queue in hospitals which is a PTTP algorithm supported huge information of the hospitals. The queue waiting time of every treatment task is trained by PTTP model with set of treatment tasks as *X/si* and multiple tasks with records xi as *Y/xi*. Thus further the HQR system will be also responsible to find the patients with multiple tasks which will be able to recommend the best treatment in mean while or to find the dependency tasks which will help to complete the patients tasks within the required time.

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