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OPTIMIZATION OF RAILWAY TRACK OCCUPANCY USING SCHEDULING ALGORITHM

A. S. Vijay Kumar, Sri G. Rajeswara Rao

***Abstract*— Optimization of railway track occupancy is to reduce the waiting time of trains at the outskirts of the city. It was observed that the bottleneck tracks make trains to wait at the outskirts even though they are in-time to reach the destination. This makes increase in the journey time than that of the usual time and causes immense inconvenience to the passengers in those trains. In addition to this, tracks of the railway station are not being effectively utilized by the trains.**

By real time optimizing the usage of the bottleneck tracks in the vicinity of the railway stations, trains can be placed on the tracks of railway station with reduced waiting time at the outskirts. To this effect, both the tracks of railway station and bottleneck tracks can be optimized for time by using scheduling algorithm and implementing in the real time situation.

First Come First Serve (FCFS) scheduling algorithm has been used to schedule the tracks at railway station for the allotment of trains. Code::blocks software has been used for the implementation of present work.

***Index Terms*— Track occupancy, FCFS scheduling algorithm, bottleneck tracks, reduced waiting time**

I. INTRODUCTION

Railway transport is one of the major and cheap modes of transport for passengers and goods throughout the country. Usually trains get delayed due to various reasons. Whenever a train is scheduled to reach its specified destination, it may have to pass a good number of intermediate stations before reaching its destination station. In many cases, trains have to wait at the outskirts of their destination station due to reasons such as

1. Non availability of free tracks for arriving trains at the station.

2. Many trains may have to use the same bottleneck track at the end of the railway station.

This makes increase in the journey time than that of the usual time and causes great inconvenience to the passengers in those trains. Such waiting of the trains can be reduced by effectively utilizing the tracks in the station and the bottleneck tracks at the end of station.

II. CONSIDERATIONS TAKEN TO ALLOCATE RAILWAY TRACKS

Conditions must be taken in to consideration for 'n' tracks to be allocated properly for both arriving and departing trains in a railway station. Among the 'n' tracks, not all the tracks may serve the trains for halt. Because some trains just pass through the station, they will not stop even just for a while. So for these trains, some tracks must be allotted and these are known as buffer tracks, as these will not be connected directly to any platform. These tracks even serve for engine reversal at some times. Such buffer tracks are left and the remaining tracks which are used at the platforms are considered to be allocated properly.

In this paper, a Railway station having 8 Tracks like Visakhapatnam railway station has been considered. Each Track has its certain specification and any train that meets the corresponding track specification will be allotted to that track.

In general, trains which serve passengers are classified as follows

i. Passenger Trains.
ii. Express Trains.
iii. Super Fast Trains.

In addition to this, there are 2 more categories. They are

i. Start/End Trains: Trains that start from the present station or end at the present station comes under this category.
   Trains those start from the present station (starting trains) will be kept in the station 30 minutes before their actual scheduled departure time. And trains whose final destination station is the present station will stay in the station for around 20 minutes and sent to their respective LOCO sheds.
ii. Continuous Trains: Trains which passes through the present station. These trains will wait in the station for around 2 to 20 minutes as per their requirements and leaves the station.

Each track has a specification considered for the allotment of trains on to tracks, which has been shown below:

Tracks 1 and 8 are allotted with Express/Super fast start/end trains. Tracks 2, 3 and 4 are allotted with Express/Super fast pass through trains. Tracks 5 and 6 are allotted with passenger pass through trains. Track 7 is allotted with passenger start/end train.

In order to reduce the complexity of allotting the arriving trains to tracks, grouping concept is introduced for distinguishing the already filled trains from the available number of tracks.

The following are the results of grouping:

i. When 2 tracks are filled, no. of combinations gets reduced from 28 to 9.
ii. When 3 tracks are filled, no. of combinations gets reduced from 56 to 14.
iii. When 4 tracks are filled, no. of combinations gets reduced from 70 to 16.
iv. When 5 tracks are filled, no. of combinations gets reduced from 56 to 14.
v. When 6 tracks are filled, no. of combinations gets reduced from 28 to 9.
vi. When 7 tracks are filled, no. of combinations gets reduced from 8 to 4.

III. PROPOSED WORK

In this proposed work, an algorithm is developed to schedule the tracks by minimizing the waiting time of the trains by properly assigning the tracks to the arriving and departing trains. The tracks are assigned by adopting a scheduling algorithm called First Come First Served algorithm (FCFS).

A. FCFS scheduling algorithm

Scheduling is the method by which work specified by some means is assigned to resources that complete the work. The resources may be virtual computation elements such as threads, processes or data flows, which are in turn scheduled on to hardware resources such as processors, network links or expansion cards. A scheduler is what carries out the scheduling activity. Schedulers are often implemented so they keep all compute resources busy and allow multiple users to share system resources effectively, or to achieve a target quality of service. FCFS scheduling, a method for organizing and manipulating a data buffer, where the oldest (first) entry, or head of the queue is processed first.

B. Simplified algorithm

The proposed algorithm has been developed by considering that inputs are given at every step by a user.
Allocation and de-allocation procedure is done in comparison with the system clock.

1. Initially, details about non-vacant tracks including their specifications and positions are given.
2. Details regarding the arrival and departure trains are provided at that time.
3. These timing details are continuously compared with the real time clock and track scheduling is done based on FCFS scheduling algorithm.

IV. RESULTS-I

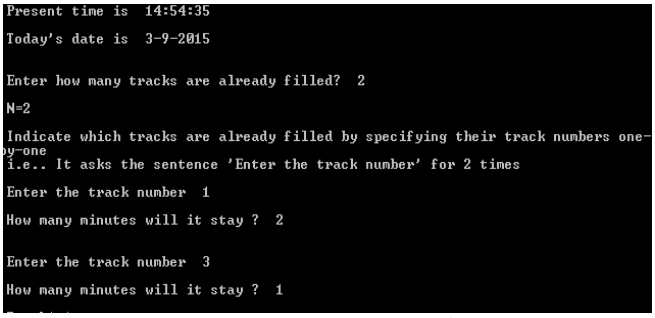

Figure 1. Acquiring details about the already filled tracks

Initially it procures the date and time at that instant. Details about the non-vacant tracks are provided. From the fig. 1, it is seen that tracks 1 and 3 are given as already filled track and their halt duration is 2 and 1 minutes respectively.

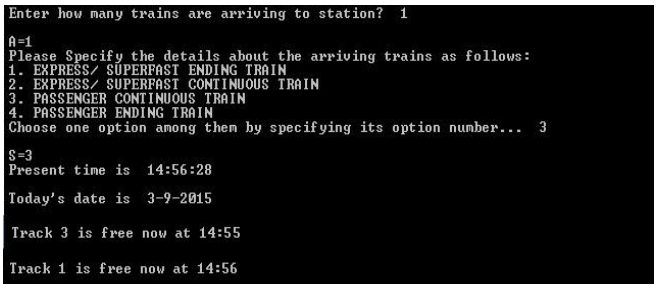

Figure 2. Acquiring details about the arriving trains

Fig. 2 shows that the user gave input as Passenger Continuous train is arriving to the station.

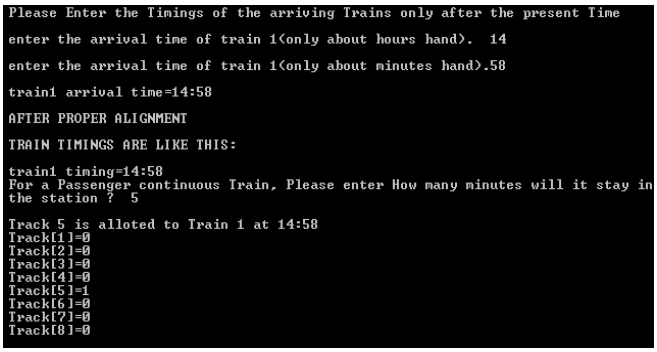

Figure 3. Allotment of train and displaying the track statuses

Arrival train timings and its halt duration are mentioned in the fig. 3. Among all the tracks in the station, tracks 5 and 6 are considered to passenger pass through trains (as previously mentioned). Now, at this instant both are ready to get occupied and it is shown in the figure that track 5 is allotted for that train.

Here it is shown from the above figures that details about one arriving train is used. It can be easily expanded when 2 or more number of trains arrives at a time.

V.RESULTS-II

All the required details such as already filled tracks, number of arriving trains and their specifications etc. are required to be given by the user during run time which makes human intervention very important and delay in the details given by the user makes the entire system to work improperly and also makes the system non-useful.

So, including data base regarding the train details makes the system much more efficient as there will be no input taken

from the user. Details in the data base is nothing but all the arriving and departure train details considering that all the trains arrive or leave the station as per the schedule.

A. *Modified Algorithm*

1. Create a data base of all the train timings including arrival, departure timings and halt duration along with train service numbers for the complete week i.e. from 00:00 of Sunday to 23:59 of Saturday.
2. All the train information is sorted as per time i.e. Train timings in an ascending order.
3. The real time clock will continuously compare with these scheduled timings.
4. Whenever the real time clock match with any of the scheduled arrival train timings, then the corresponding train will be allotted to a track.
5. Whenever the scheduled halt time for a train completes, the real time clock compares with the scheduled departing train timings. If it matches, the corresponding train will be sent from that track.
6. For a train starting from that station, a track has to be allotted just before 30 minutes from its actual departure time.
7. Such train timings are also compared with the real time clock continuously and whenever the timings matches, tracks are allotted for those trains 30 minutes before the departure time and will be sent from the station at their departure time.
8. This comparison of scheduled timings from the data base with real time clock is done and corresponding allotment or relieving of trains is done continuously.

B. *Train timings taken on Wednesday*

Below table shows the train timings on Wednesday for Visakhapatnam railway station between 07:50 and 08:15

TABLE 1. TRAIN TIMINGS ON WEDNESDAY FOR VISAKHAPATNAM STATION

Train No.	Arriving Time	Departure Time
18517	07:50	08:05
57264	08:00	08:15
57229	08:00	08:15

These train timings are just taken as an example to show the allocation and de-allocation procedure after including the train details in to data base.

```
Present Time is 07:50:5
Today's date is 25-8-2015
Today is Tuesday

Initially all the tracks are free... which can be indicated by representing the
track values as zeros
Track 1 value = 0
Track 2 value = 0
Track 3 value = 0
Track 4 value = 0
Track 5 value = 0
Track 6 value = 0
Track 7 value = 0
Track 8 value = 0
```

Figure 4. Displaying the status of tracks in the railway station

Fig. 4 shows that all the tracks are ready to get occupied which has been indicated by displaying their statuses.

```
Enter how many tracks are already filled ?
1
N=1
Indicate which tracks are already filled by specifying their track numbers one-
by-one
i.e. It asks the sentence 'Enter the track number' for 1 times
Enter the track number
1
How many minutes will it stay?
10
Track1=1
Track2=0
Track3=0
Track4=0
Track5=0
Track6=0
Track7=0
Track8=0
```

Figure 5. Acquiring the details about the track status

All the already filled track details are taken from the user which has been shown from the figure 5.

```
Present Time is 07:50
As Track 8 is free now.

Train arriving at 07:50 will be allotted to Track No. 8
Train No. 18517
Track 1 value =1
Track 2 value =0
Track 3 value =0
Track 4 value =0
Track 5 value =0
Track 6 value =0
Track 7 value =0
Track 8 value =1

Present Time is 08:00

Train from Track 1 is leaving now at 08:00
Track 1 value =0
Track 2 value =0
Track 3 value =0
Track 4 value =0
Track 5 value =0
Track 6 value =0
Track 7 value =0
Track 8 value =1
```

Figure 6. Allotting track no. 8 and relieving track no. 1

Allotting track 8 to train arriving at 07:50 has been shown in fig. 6. Also train from track 1 has been relieved at 08:00.

```
Present Time is 08:00
As Track 7 is free now.

Train arriving at 08:00 will be allotted to Track No. 7
Train No. 57264
Track 1 value =0
Track 2 value =0
Track 3 value =0
Track 4 value =0
Track 5 value =0
Track 6 value =0
Track 7 value =1
Track 8 value =1

Present Time is 08:00
As Track 5 is free now.

Train arriving at 08:00 will be allotted to Track No. 5
Train No. 57229
Track 1 value =0
Track 2 value =0
Track 3 value =0
Track 4 value =0
Track 5 value =1
Track 6 value =0
Track 7 value =1
Track 8 value =1
```

Figure 7. Relieving trains from track 7 and track 5

Relieving of trains from tracks 5 and 7 has been shown in fig. 7.

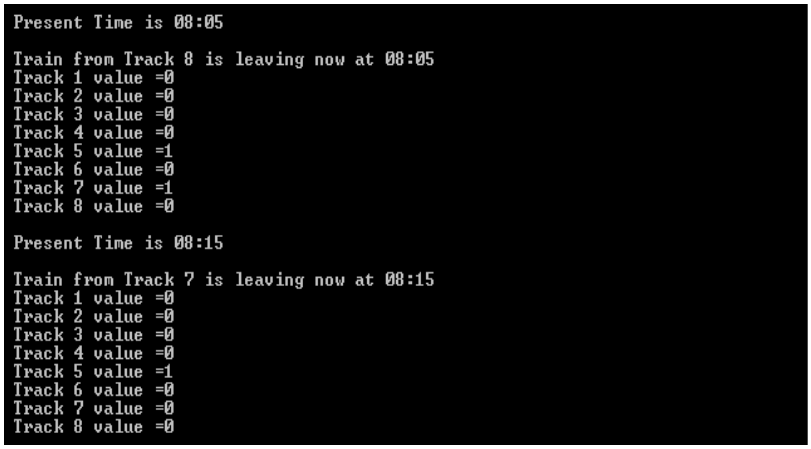

Figure 8. Relieving trains from track 8 and track 7

Trains from 7 and 8 tracks have been relieved shown from fig.8.

C. CONCLUSION

This work can be further improved by incorporating the delay timings to the actual train timings schedule and providing provision to add additional train information in the data base. Other algorithms such as priority based algorithms can be used in such cases. Effective utilization of bottle neck tracks along with the scheduling of tracks at railway station optimizes the present system, which when implemented in real time reduces the trains to wait at the outskirts of station.

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 **A.S. Vijay Kumar,** M. Tech. student (Embedded Systems and VLSI Design) in G.V.P. College of Engineering (A), member of IETE.

 **G. Rajeswara Rao,** M. Tech. M.I.E. Worked on Aircraft Radars, Weapon systems, Ground Radars and Communication Equipments for 20 years in Indian Air Force and 2 Years Experience in Satellite Earth station. Currently working as Assistant professor in G.V.P college of Engineering(A) from the last 12 years. Presented a paper in National Conference. Published 2 papers titled “Design of Satellite Control” and “Electromagnetic Pollution Modeling and Indexing in Mobile Communication”.