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Accident Avoidance and Minimal Delay Time Efficient Automated Railway System

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***Abstract*-In this paper an attempt is made to solve systematically some problems on railway transportation such as minimising time delay , abating accidents along with constant monitoring of train over a period of time and AI techniques to improve the efficiency in route planning and execution of the same with safety .**
For this purpose optimisation of problems ,microprocessor for communication with the respective station, approximation and probability concepts are used to measure and minimise the time delay and movement plan over a period of time, expected time to reach destination is calculated. Routing algorithm with modification is used for plan generation and optimising the routes of the trains.

I. INTRODUCTION:

The railway transport is one of the most important mode of transportation. Millions of passenger travel in it everyday and consequently there comes heavy loads of work and problems. Here , some of the problems are considered and tried to solve using routing algorithms, AI techniques like min-max ,finding optimal route and to prevent accident.
Input will be the time schedule, route and acknowledgment of rate of success over the intermediary levels. The trains will have camera fitted in front of it and a specific range of distance along its path is divided into 3 different States NORMAL,NEARBY ,DANGEROUS. Using these parameter considering the speed of the vehicle other side by the rate of change in magnification of image captured, these parameters will change. In this C++ programming is used to evaluate possibility of changing the track if necessary to which track and its consequences. The situation will be automatically updated to other trains as using slightly modified Link state routing algorithm ,for this too to optimise we first identify the affected trains in those tracks and then will update only for those trains. The trains will be provided with the routes by the optimal route generator which takes the schedule ,time estimate and other details of train and generate a route plan based on which the trains will have their most possible optimal route.

II. SCHEDULING THE TRAINS:

The trains are scheduled initially by the inputs which has to be given before by the authority, according to which the route scheduler will assign values to the trains on the basis of priority and will find best suited path for the trains considering all the conditions including the priority ,season and weather forecasting. The scheduler will schedule based on previous routes and using any optimal algorithm which will find a number of optimal paths ,from which we will eliminate based on the priority and other factors like whether the route it chose would delay many or indirectly delay other train which has more priority than it also it must ensure safe distance of trains.
The scheduler then passes to the optimiser which will check whether there is any problems like that of weather or unavailability of proper track which are occasional or from previous experience (initially won't have any experience) from which it learns using any self-learning algorithm.The optimiser must reduce the impact of change in schedule if some dynamic problem occurs in between route ,so as to ensure that it won't affect all other trains much. It will consider the weather input and the season of the region which the train has to pass through and gives scores for that which will provide an effective change in the plan. Then the optimiser sends the schedule to generator which will generate in the required format.

III. MAINTAINANCE OF SAFE DISTANCE :

It is very essential to maintain safe distances in trains as it is very important factor in occurrence of accidents in trains. According to the relative speed of train ,the distance vector variable will adjust itself to the safe distance .Initially by default it will be given a value. Then it will be adjusted by the factor of of rate of enlargement of the image from the camera ,from this the sensors will automatically prompt if the train breaches the safe limit it will change from the NORMAL state and will go to the state mentioned above and the which makes it to signal to the receiving station ,which through close monitoring and the positions of the nearby trains from the log frequently updated by LINK STATE routing algorithm will calculate and assigns a position for the train responsible.In this the receiving station has to calculate the present position from the position given in the log by assuming certain factors.

- It assumes the speed given to be uniform and calculates the present position with respect to that.
- It checks acceleration or deceleration and assumes it to continue in that manner as sudden change of acceleration or deceleration is not possible for the trains.
- It will convey the problem of intended position to the trains which are going to be affected.
- If delay of some train is inevitable it must choose the lowest possible delay along with the priority of the train.
- The new trains which will be originating from the stations to come must be considered and planned accordingly such that the delay is minimum.

By considering these factors the system will precisely calculate the new position and changes the track of the train accordingly. This will get updated along with its speed in the log. This will first just consider the neighbouring tracks and then it considers their neighbours for track change of the train to prevent accident automatically and without much delay in reaching the destination.

As link state algorithm proceeds it will intimate to other stations about the update. This also will give an estimate of reaching time and delay of the train also the other trains originating from stations that comes on the way must be adjusted to the disturbances based on priority,this estimate would help the new trains or the trains arriving to adjust.

The minimum disturbance is very much needed for optimal solution, so the deviation from the normal is calculated and is tried to minimise to ensure a less delay and satisfactory plying of train, as some trains are non-stop trains hence it is very essential to make them not to deviate from the original plan much as it would cause great loss like , hygiene of toilet and availability of water which are essential to keep the credentials of those trains.

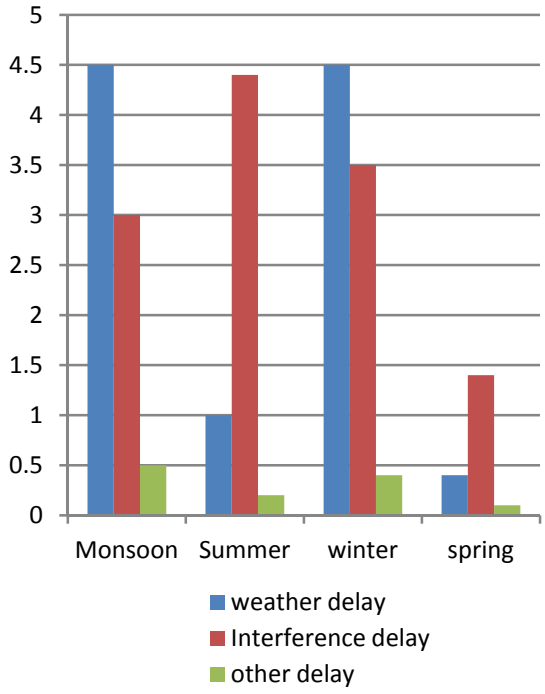

Figure 1.1: Reasons for Delay in different seasons in India considered broadly out of 5 for each delay.

The above figure is a rough estimate out of 5 over a year for delays in Indian railways .In monsoon the delay due to weather is very high succeeded by delay due to interference of trains, most interference delays are due to the result of weather. Similarly in winter delay due to weather peaks but also the delay due to interference is more than that of monsoon. But in summer and spring interference delay is highest. In summer it is due to the special trains in vacation period. The figure shows the different reasons of delay in different seasons, also it is true for different regions but here overall delay is only considered. In winters it is mainly due to fogs the delay occurs in Northern half part of the country.

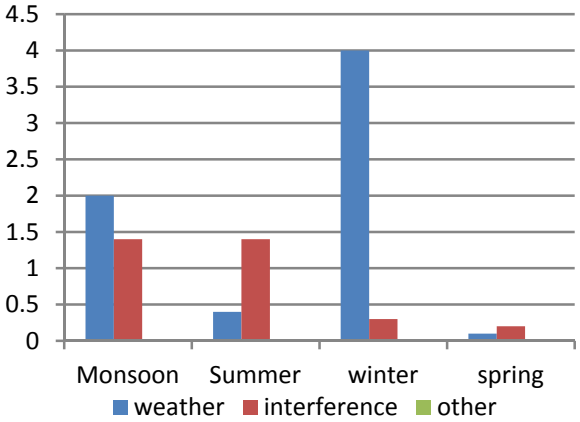

Figure 1.2: Estimate of the result out of 5 after applying the system at the same scenario assuming certain parameters

The estimates above are just considered based on above data and the result of the plan is taken into account. In this others is not considered as it cannot be predicted. Here we can see that winter has relatively low interference problem but almost same weather delay because of low visibility, but in monsoon there is a significant decrease in both. By gradual learning the system may abate the problems in winter by prediction and shall be more effective.

IV. SOFTWARE DEVELOPMENT DETAILS:

In the railway system we will be considering as mentioned above those assumptions when an event of safe distance breach occurs. The prompting train from the array of trains with corresponding tracks is considered and details of that is taken along with its neighbourhood .

Using those details present distance and position is calculated from

D=D+(speed)*time;speed=speed+acceleration*time ,where D is distance, acceleration if required immediately is to be calculated from the rate of change of the image size(R).

To decide minimum distance ,R*(X),where X is distance factor for which is experimentally taken with respect to the camera image.

The starting and ending stations are considered and D is based on that, for position it will be fixed and is mapped along with by the calculated D for a train ie D+starting position.

Using minimum disturbance principle learning algorithm is used for optimisation of routes using previously learned experience.

The safe distance mentioned before will also be calculated based on learning by using the rate of change in image size and relative speed of train. By default it will be given a value. Then the present state is determined based on the safe distance measured .If the train is beyond safe distance then the state is set as NORMAL,

If the train is within safe distance but is greater than half of the safe distance then state changes to NEARBY. It will start giving signals to the nearby station .

If the train is within the half of safe distance the state changes to DANGER then it will prompt for immediate change of track and stops down immediately as it will switch on the break.

Following possibilities are considered:

1. The trains delayed due to environmental factors: The trains ,after intimation to the nearby station will provide with new optimised routes also for the trains nearing there .
2. A train nears other train in the same track and moving in same direction : In this if the lagging train comes within the safe distance the neighbouring tracks are checked if the neighbouring tracks are/will be occupied ie speed of trains in neighbouring track>speed of present train and are near enough(some distance >>safe distance) to make a change ,to calculate whether they are near enough we consider the positions as mentioned earlier . The preceding train is slower than the considered one. In this case we will either reduce the speed of the selected train and change the track after crossing if the preceding train is of lower priority or increase the speed of the preceding train.
3. Preceding train stops but the selected train has no stoppage and trains of neighbouring tracks are not near enough but have more priority: If it is not similar to above mentioned case then from the log the optimiser will try to find an optimised route from that point of time,ie it will change the track of the selected train in such a way that it will not delay the other trains at the same time it has to adjust the log of the train affected and the selected train.For example the train will go to either of the neighbouring track whichever is suitable and then will be relocated to the same track after passing the preceding train.
4. Trains coming in opposite direction and conditions as in case 2. There will be two trains selected in this case so the train which is relatively free of neighbouring track will consider the other tracks to move if possible then it will move to the second or other neighbour and will come back after the trains passes, this is to reduce the delay.

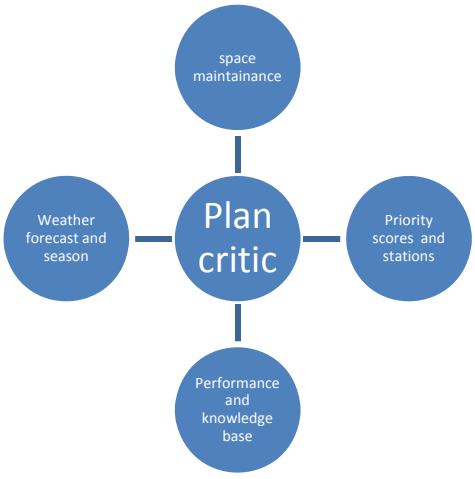

Fig: Model of the plan critic

V. PROBLEMS TO BE CONSIDERED:

1) Head light for a train is very much important as in night the camera may not capture the image properly.
2) Maintainance of the system must be ensured constantly as any error in any part may cause disastrous effect, it could be solved by having a mechanism for error detection in the system and deactivate them and use the original way for the time concerned.
3) Connection between different devices and the platform of the program must be compatible so as to have smoother processing and working of the system.

VI. CONCLUSION:

The system shall provide an insight and efficient approach in resolving train delay and accident problems ,also it ensures a well-designed most efficient route for the passengers convenience as well as for the railway employees. As it needs monitoring ,it may be a difficulty for the management but it ensures the safety , less labour as well as prevention of many disadvantages like manual track changing and it will try to make railway a better mode of transportation.

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