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Research Article

Automated Train using Genetic Algorithm for Railway Scheduling with GPS

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Abstract

This work has proposed to develop and implement a model of an efficient unmanned Metro Train using train scheduling software with automated control system. Model developed for Metro Train with sensors, wireless communication, control system and GPS to control train remotely or by itself and prevents trains from disaster. All information are available in database, so it's easy to schedule a train for any journey. All process will be done automatically, so administrator would not worry about scheduling and allocating track for particular session. Through the exchange of information between train and computer server control unit, the train schedule software produces more reliable and precise core train control data, trains starts moving or stop according to generated data instructions and scheduled time. Because of this continuous communication train's movement on track can seen on server's monitor screen on some stations. This generated data instructions will stored in train control system as in cache, this cache can be used as a backup if computer server get down or communication fails. If two trains come on same track or two trains become in front of each other then train will be automatically stop, this activity can be seen on computer's screen.

Keywords: *Unmanned Metro Train, sensors, control system, GPS*

1. Introduction

In recent Years, metro system trains have been rapidly developed due to their high speed and safety in public transportation system. Many large cities have to depend on metro system to alleviate the pressure of public transportation. The efficiency of metro systems depends on maximum utilization of track, scheduling available advanced control technique, such as the Automated Control to unmanned train (i.e. without driver), it is one of the key techniques to achieve highly secure and accurate performance.

A model of an efficient unmanned Metro Train using train schedule software and self-controller system and GPS. Model developed for Metro Train with sensors, control system, wireless communication system and GPS, prevent trains from disaster. Through the exchange of information between train and computer server control unit, the train schedule software produces more reliable and precise core train control data like start time, destination, shortest route or available track route. Train will start moving according to the schedule. Train speed will be decided automatically according to the track status and position. All movement on track can be visible on the monitor screen. If two trains are come on same track then both train will stop automatically. Even trains can be controlled remotely by server program if any need.

The work in this paper is motivated by achieving human simulated intelligent control of the train control system, which pretends that train Start/Stop control is an experienced by control system who can adjust the braking rate just a few times to make a train stop accurately. To accomplish this goal, we use the precise location data provided by locating devices, i.e., GPS receivers because it can offer continuous location data, which are installed in the trains. By using this system, we can find the location of trains & position can be seen on servers screen i.e. simulation. When a train passes a location, it transfers the stored precise location data to the computer server instantly. We can use this location data or information for Train Automatic Start/Stop Control on stations when it arrive, to achieve fewer adjustments of the braking rate, fewer stopping errors, and better robustness to various disturbances.

2. Related Work

Dewang Chen is motivated by achieving human simulated intelligent control of the train stop system, which pretends that TASC is an experienced driver who can adjust the braking rate just a few times to make a train stop accurately. To accomplish this goal, we use the precise location data provided by locating devices, which are installed in the middle of a rail track and are widely used in the European Train Control System and the Chinese Train Control System. When a train passes a balise, it transfers the stored precise location data to the train instantly. The main idea of our approach is to develop on line learning methods driven by the precise location data for TASC to achieve fewer adjustments of the braking

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Table 1*:* Real ADIF for trains

Problems	Infrastructure Description					Trains in Circulation		New Trains	
	KM	1-way	2-way	Loc	Stat	Trains	T-ts	Trains	T-ts
1	96	16	0	13	13	47	1397	16	180
2	129	21	0	22	15	27	302	30	296
3	256	38	0	39	28	81	1169	16	159
4	401	37	1	39	24	0	0	35	499

rate, fewer stopping errors, and better robustness to various disturbances. It is worth pointing out that, to control the cost, there are only a small number of balises installed in front of the stations in urban metro systems. Therefore, many sophisticated algorithms are not suitable for online learning as they require a large amount of data to identify parameters.

Braking system time delay and time constant (BST). Similar to many control systems, there exist time delay and time constant in a train braking system. This part is very important as train have to stop on station. Obviously, the stopping precision is affected by the response time of a train braking system, which can vary with time and different trains.

Genetic Algorithms (GAs) have been successfully applied to combinatorial problems and are able to handle huge search spaces as those arising in real life scheduling problems. Genetic Algorithms perform a multidirectional stochastic search on the complete search space that is intensive in the most promising areas. The Train Timetabling Problem (TTP) is a difficult and time-consuming task in the case of real networks. The huge search space to explore when solving real-world instances of TTP makes GAs a suitable approach to efficiently solve it. A feasible train timetable should specify for each train the departure and arrival times to each dependency of the network in such a way that the line capacity and other operational constraints are taken into account. Traditionally, plans were generated manually and adjusted so as all constraints are met. However, the new framework of strong competition, privatization and deregulation jointly with the increasing of computer speeds are reasons that justify the need of automatic tools able to efficiently generate feasible and optimized time tables.

Following algorithm shows the general scheme of a generic genetic algorithm. First, the initial population (P), whose size is POP SIZE, is generated and evaluated following a scheduling scheme and subsection Initial Population. The following steps are repeated until the terminating condition end condition (execution time, number of feasible solutions or number of generations), is reached. Some individuals that compose the population P, are modified by applying the procedures Selection(), Crossover(), and Mutation(). Thus, a new population P is obtained in each generation. Each iteration corresponds to a new generation of individuals.

```
Function Genetic_Algorithm(POP_SIZE, end_cond) As
Timetabling
begin
    P =Generate_Initial_Population(POP_SIZE)
    while NOT (end_cond) do
    begin
        P =Selection(P )
        P =Crossover(P )
        P =Mutation(P )
        BEST_L =Evaluate_Population(P )
    end
    return BEST_L
end
```

Railway Infrastructure(ADIF). The description of the instances is given in Table 2.1 (columns 2 to 10) by means of: length of the railway line, number of single/double track sections, number of locations and stations, number of trains and track sections (T-ts) corresponding to all these trains, considering trains in circulation and new trains, respectively.

3. Sections

A model of an efficient unmanned Metro Train using train Time-Table schedule software and self controller. This model provides an unmanned metro train which will automatically controlled by its controlling system and computer server program. Model developed for Metro Train with sensors, wireless communication, control system and GPS and Anti Collision System prevents train from disaster. There are several sections that are as follows:

3.1 Scheduling Software using Genetic Algorithm

This module based on Genetic Algorithm, which schedule the time table for trains. This module is responsible for scheduling the trains according to track availability. It set departure and arrival time for each trains in stations. It sense train's position, and display the position of trains o server screens. Trains movement can be schedule automatically by software or can be set manually by administrator.

3.2 Controlling Interface with wireless communication between Train & Server

This module related with interface like how a server software can interact with hardware(train). This part of project makes communication between software and embedded system. This module takes data/instruction from server and sends the data/instruction to hardware (train). It will operate hardware as per software's generated instructions. Hardware (Train) continuously send the data to the server i.e. GPS longitude and latitude, by these information admin can see the position on the server screen.

All the data transformation between train and server through wireless network. A wireless system, called distributed wireless communication system (DWCS), is proposed. Logically, it is divided into four layers. They are distributed antennas, a distributed fiber-optic transmission network, distributed processing network and a distributed core network. To support different radio access standards, the distributed processing network is realized with a software radio technique. It is foreseen that the DWCS has three phases of development and how it conforms to the Internet is considered.

3.3 Automated Train Module

This module develop a automated unmanned train which will able to receive signals from server and start running or stop according to received signals. OR it can save the scheduled data into its control system. It have its own Anti-Collision System to prevent trains from disaster. It will base on distance feedback given by a laser Time Of Flight (TOF) sensor. Train module contain laser trans-receiver which automatically sense to the another train and movement will stop automatically; this activity can be seen on server screen.

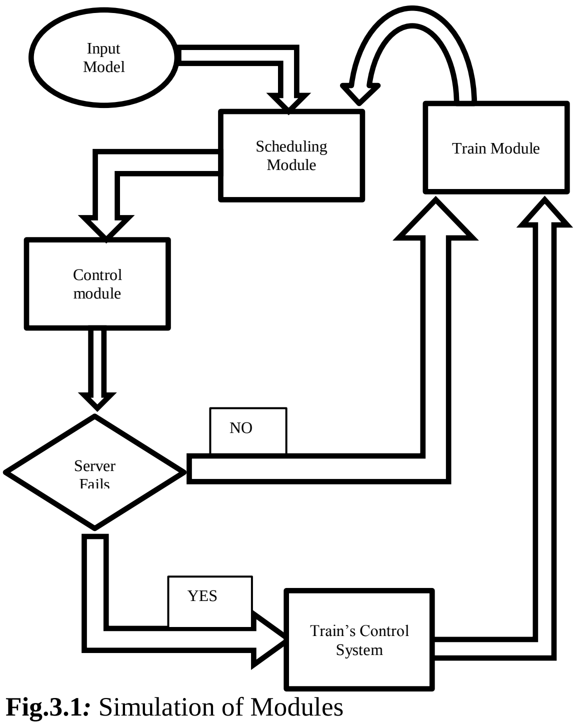

Fig.3.1*:* Simulation of Modules

3.4 Train Control System

If server fails, in this case this module will take charge of failures. This module has ability to save the data from server. It will have backup of server scheduled information. It always activate inside train, if communication stop with serevr then it will take it charge of train and start execution. Distributed wireless communication system (DWCS), is proposed to communicate it from server, for tower to tower communication or station to station communication.

Conclusion

All the train operations are fully automated. Failure can be handled by using Terminal's Tower and even train collision can be avoided by using Anti Collision System. It have Anti-Collision System to prevent trains from disaster. It will based on distance feedback given by a laser Time Of Flight (TOF) sensor.

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