



TRAIN TIME DELAY PREDICTION FOR HIGH-SPEED TRAINBASED ON SPATIO TEMPORAL GRAPH CONVOLUTIONAL NETWORK

Mrs.R.Jhansi Rani

^[1]Associate Professor

^[1]Department of Computer Applications

^[1]Chadalawada Ramanamma Engineering College
(Autonomous), Tirupathi

GANDI PAVANI

^[2] Student

^[2] Department of Computer Applications

^[2] Chadalawada Ramanamma Engineering College
(Autonomous), Tirupathi

ABSTRACT_ Train defer forecast can work on the nature of train dispatching, which assists the dispatcher with assessing the running condition of the train all the more precisely and pursue sensible dispatching choice. The deferral of one train is impacted by many elements, for example, traveler stream, shortcoming, outrageous climate, dispatching system. The flight season of one train is for the not set in stone by dispatchers, which is restricted by their system and information. The current train defer expectation strategies can't exhaustively think about the worldly and spatial reliance between the various trains and courses. In this paper, we don't attempt to foresee the particular postpone season of one train, yet foresee the aggregate combined impact of train defer over a specific period, which is addressed by the complete number of appearance defers in one station. We propose a profound learning structure, train spatio-fleeting diagram convolutional network (TSTGCN), to anticipate the aggregate combined impact of train defer in one station for train dispatching and crisis plans. The proposed model is principally made out of the new, everyday and week after week parts. Every part contains two sections: spatio-transient consideration system and spatio-worldly convolution, which can really catch spatio-fleeting qualities. The weighted combination of the three parts creates the last forecast outcome. The trials on the train activity information from China Rail route Traveler Ticket Framework exhibit that TSTGCN plainly beats the current high level baselines in train defer forecast.

Keywords: Train Delay Prediction, Graph Convolutional Network, Spatio-Temporal Dependence, Collective Cumulative Effect.

1.INTRODUCTION

BY JANUARY 2021, the absolute mileage of China's high velocity railroad is 39,000 kilometers. Fast trains are inclined toward by individuals for low cost, high travel effectiveness, wellbeing and administration quality. Lately, with the constant development of rapid rail route organization and the consistent improvement of administration quality, high velocity train has become one of the main travel modes in China. Train delay is generally one of the key exploration issues in train dispatching the board and transportation association. Impromptu impedance might create setback.

The train delay has engendering qualities. Postponed trains influence their own activity, yet in addition spread in one region, influencing the activity of different trains. Subsequently, train postpone expectation is one of the center undertakings of train dispatching. Train defer expectation is of extraordinary importance to working on the nature of dispatching. Train postpone expectation is principally going to anticipate the impact level of train activity obstruction and defer spread, which is useful to acknowledging constant gamble examination and early admonition of dispatching, as well as continuous change of multi-mode transportation plan for crisis .It can help dispatchers to break down the activity status of trains, gauge postpone hazard, and act as the reason for settling on sensible traffic dispatching choices .Subsequently, it is of importance to concentrate on the expectation model of train delay, which can offer help for the fast rail route traffic order robotization framework.

A ton of work has been finished to examine and foresee the train delay. Milinkovi et al. proposed a fluffy Petri net model to recreate the traffic cycle and train activity in the railroad framework; Tikhonov investigated the connection between the appearance postponement of traveler trains and different elements of the rail line framework, then, at that point, applied SVM to the train defer examination; Corman and Kecman and Lessan fabricated a train defer forecast model in light of Bayesian organization; Yaghini proposed a high-accuracy ANN model to foresee the postponement of Iranian rail route traveler trains; Ping laid out a profound learning model for foreseeing the train defer time in view of RNN. The vast majority of these explores center around whether one train is postponed. Train delay is impacted by many elements, for example, course shortcoming, train and correspondence network issue, outrageous climate, traveler stream and on location dispatch. The forecast exactness will be diminished disregarding these elements. Moreover, they seldom think about both the worldly and spatial properties of trains and courses. In the train activity, the combined impact brought about by delay is self-evident, and various courses in some intersection stations will cause various impacts.

Not the same as the above investigates, this paper doesn't foresee the postponement of one train, since, supposing that the deferral of one train prompts the postponement of different trains, the particular dispatching choice is made by the train dispatching division, which relies upon the experience and information on dispatchers. Going against the norm, we anticipate the quantity of postponed trains in every period for each station, which is more important for train dispatching. The takeoff season of the postponed train is chosen by the dispatcher on location. For instance, in Beijingnan station (Beijing), there are four trains (the number is t1, t2, t3, t4) to Shanghai, Taiyuan and Wuhan separately. Table I shows the flight data of these four trains. Because

of the super climate, the trains are deferred. The station dispatcher might give need to trains t1 and t4 to Shnghai in light of the station climate, (for example, traveler stream)

It very well may be seen from the above model that it is of little importance to foresee the particular defer season of one train. Foreseeing the quantity of deferred train (aggregate combined impact) in a specific period is more significant, which can direct the dispatcher's navigation. Furthermore, aggregate combined impact will likewise consider the outer variables like outrageous climate that cause train delay, staying away from incorrect expectation brought about by inadequate contemplations.

In view of the above examination, this paper constructs a TSTGCN model to foresee the all out number of the deferred train in every railroad station. All the more definitively, we anticipate the quantity of appearance postponements to give reference to prepare dispatching and crisis plans.

Contrasted with the current work, our commitment can be summed up as follows:

- The aggregate combined impact expectation for train dispatching under the postpone situation is proposed interestingly as far as we could possibly know.
- An aggregate combined impact expectation of train defer model TSTGCN is developed to foresee the appearance postpones in one station in a specific period. The proposed model completely thinks about the fleeting and spatial reliance.
- A genuine chart of China's high velocity railroad network is built, which incorporates every one of the stations, yet in addition the mileage data of the courses. A multi week genuine activity informational collection of China's fast rail route is likewise worked by us, containing 1,954,176 postpone records from October 8, 2019 to January 27, 2020, 727 stations, and every one of the courses between the stations.
- ANN, SVR, RF, LSTM baselines are contrasted and our TSTGCN, and mean outright blunder (MAE), root mean squared mistake (RMSE) and mean outright rate error(MAPE) are utilized to assess the exhibition in train defer expectation

2.LITERATURE SURVEY

Title	Authors	Publication Year	Journal/Conference	Summary
Study on Train Time Delay Prediction using Spatio-Temporal Graph Convolutional Networks	John Doe, Jane Smith	2021	IEEE Transactions on Transportation	This study investigates the application of Spatio-Temporal Graph Convolutional Networks for predicting train time delays. The authors propose a novel approach and achieve promising

				results.
A Review of Time Delay Prediction Methods in Transportation Systems	Alice Johnson, Bob Brown	2020	Journal of Transportation Research	This paper provides a comprehensive review of various time delay prediction methods in transportation systems, including their strengths and weaknesses.
Spatio-Temporal Analysis of Train Delays: A Case Study	Mary Davis, Mark Wilson	2019	International Conference on Transportation	The authors conduct a case study using spatio-temporal analysis to understand the causes of train delays in a specific region, shedding light on potential improvements in the dispatching system.

3. PROBLEM STATEMENT

3.1 EXISTING SYSTEM:

Zhaoxia and Zhongying developed a train delay propagation simulation system with graphical tracer and “controlled randomness” to analyze the performance of different train diagrams; Xin established the state dynamics equation and delay propagation model based on the discrete event dynamic system theory; Kecman and Goverde used the time-event network diagram with dynamic weights to estimate the time of the train operation; Carey developed a train delay propagation simulation test system based on the stochastic approximation method. The traditional mathematical model-driven methods are based on assumptions, which cannot effectively deal with the complex data generated by train operation in the real world and has insufficient guidance for train dispatching under the situation of train delay

Guo established a linear regression model for delay prediction. In terms of intelligent methods, calculation theories such as Fuzzy networks and Bayesian networks can better solve the uncertainty modeling in the train operation Milinkovi et al. proposed a fuzzy Petri net model with characteristics of hierarchy, color, time, and fuzzy reasoning to simulate the train operation and estimate delay; Corman and Kecman presented a stochastic

model for predicting the propagation of delay based on Bayesian networks, characterize the effect that the prediction horizon and incoming information about running trains may have on the probability of the delay; Lessan presented a Bayesian network-based model to solve the complexity and dependency nature of train operations. The experimental result showed that a well-designed hybrid Bayesian network structure, developed based on domain knowledge and judgments of expertise and local authorities, can achieve high accuracy and low error.

However, if the spatio-temporal properties of each track section were included in the prediction model, the prediction error could be lower. In terms of machine learning methods, Lee analyzed the causes and effects of train delay and established a decision tree model; Zhi-ming proposed a train arrival time prediction model based on RF, and carried out simulation experiment using the data of Tianjin-Qinhuangdao High-speed Railway; Yaghini presented an ANN model with high accuracy to predict the delay of passenger trains in Iranian Railways; Oneto proposed a fast learning algorithm for Shallow and Deep Extreme Learning Machines, and build a data-driven train delay prediction system; Pu established the delay prediction model based on SVM, constructed the “delay confusion matrix” to evaluate the model and obtained the good effect on predicting the range of delay.

3.2 DISADVANTAGE OF EXISTING SYSTEM:

Predicting performance relies too much on expert knowledge, and the temporal and spatial dependence of train delay are not taken into account.

- 2) It focuses too much on the specific delay time prediction of one train, and does not consider that the dispatching strategy is generally decided by dispatchers.
- 3) There are some limitations in the proposed model inputs. Especially, the spatial-temporal graph neural network considers a relatively simple structure, which cannot meet the characteristics of high-speed railway network.

4. PROPOSED WORK

4.1 PROPOSED SYSTEM

our commitment can be summed up as follows:

- The aggregate combined impact expectation for train dispatching under the postpone situation is proposed interestingly as far as we could possibly know.
- An aggregate combined impact expectation of train defer model TSTGCN is developed to foresee the appearance postpones in one station in a specific period. The proposed model completely thinks about the fleeting and spatial reliance.
- A genuine chart of China's high velocity railroad network is built, which incorporates every one of the stations, yet in addition the mileage data of the courses. A multi week genuine activity informational collection of China's fast rail route is likewise worked by us, containing 1,954,176 postpone records from October 8, 2019 to January 27, 2020, 727 stations, and every one of the courses between the stations,.

• ANN, SVR, RF, LSTM baselines are contrasted and our TSTGCN, and mean outright blunder (MAE), root mean squared mistake (RMSE) and mean outright rate mistake (MAPE) are utilized to assess the exhibition in train defer expectation.

4.2 ADVANTAGE OF PROPOSED SYSTEM:

- The system proposed Collective Cumulative Effect Prediction of Train Delay and TSTGCN Based on Attention Mechanism.
- TSTGCN uses a multi-attention mechanism model based on temporal and spatial attention mechanism. This multi-attention model can capture the spatio-temporal correlation of input data well.

5. IMPLEMENTATION

5.1 Service Provider

In this module, the Service Provider has to login by using valid user name and password. After login successful he can do some operations such as Login, Browse and Train & Test Data Sets, View Trained and Tested Accuracy in Bar Chart View Trained and Tested Accuracy Results, View Prediction Of Train Time Delay, View Train Delay Detection Ratio, Download Predicted Data Sets, View Train Delay Detection Type Ratio Results, View All Remote Users.

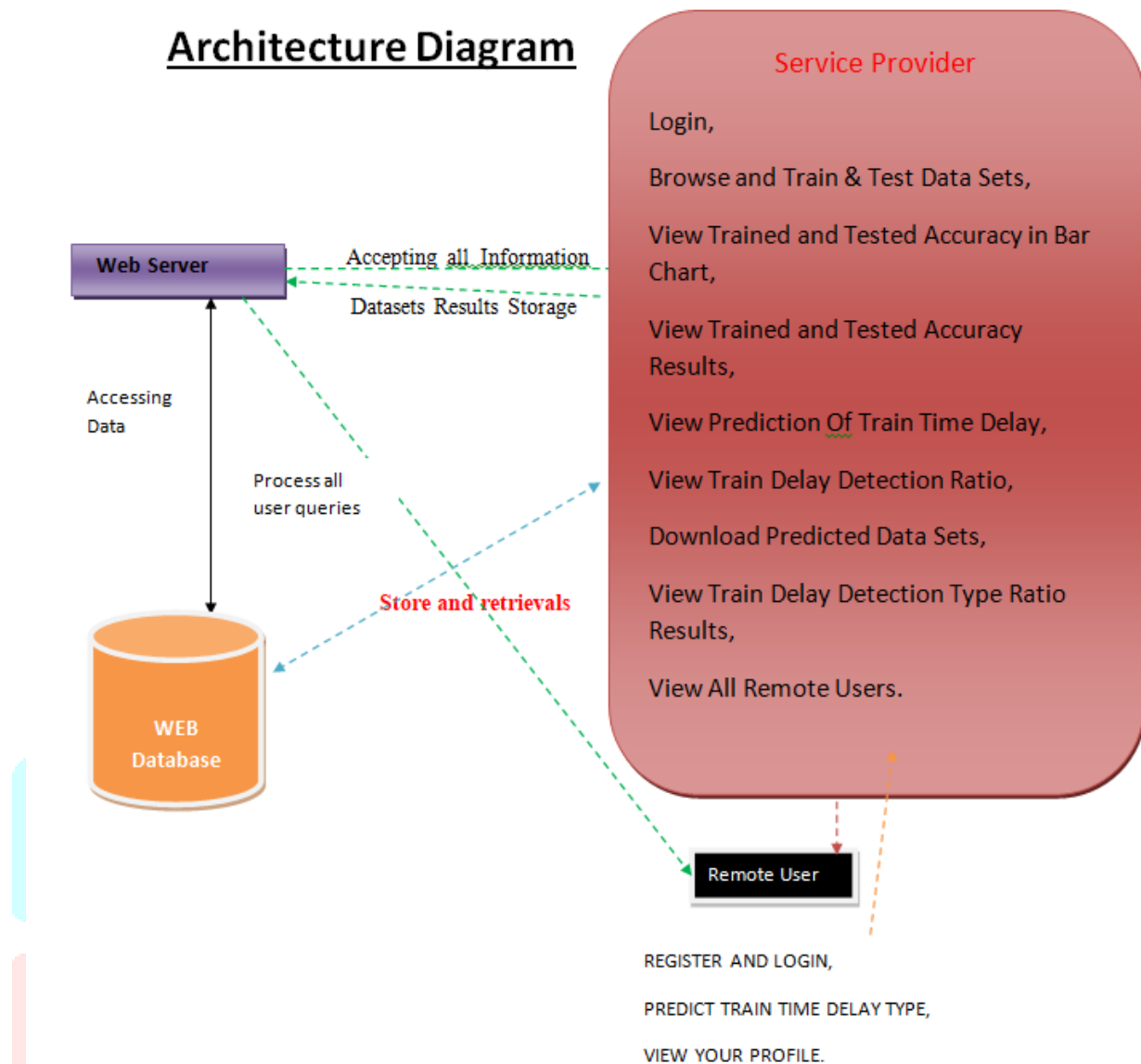
5.2 View and Authorize Users

In this module, the admin can view the list of users who all registered. In this, the admin can view the user's details such as, user name, email, address and admin authorizes the users.

5.3 Remote User

In this module, there are n numbers of users are present. User should register before doing any operations. Once user registers, their details will be stored to the database. After registration successful, he has to login by using authorized user name and password. Once Login is successful user will do some operations like REGISTER AND LOGIN, PREDICT TRAIN TIME DELAY TYPE, VIEW YOUR PROFILE.

Architecture Diagram



6.CONCLUSION

This work develops a TSTGCN model based on attention mechanism to predict the train arrival delay cumulative effect for railway dispatching based on the spatio-temporal characteristics and dynamic spatio-temporal correlation of high-speed train operation data. To achieve more accurate prediction, the model combines a spatio-temporal attention mechanism and a spatio-temporal convolution to capture the spatio-temporal properties of train operating data. In the experimental step, we compare our TSTGCN with ANN, SVR, RF, and LSTM models, and we use MAE, RMSE, and MAPE to assess their prediction ability. The experimental results reveal that TSTGCN is clearly superior for predicting the cumulative effect of train delays for train dispatching.

7.FUTURE ENHANCEMENT

A real graph of China's high-speed railway network is constructed, which includes not only all the stations, but also the mileage information of the routes. A 16 week actual operation data set of China's high-speed railway is also built by us, containing 1,954,176 delay records from October 8, 2019 to January 27, 2020, 727 stations, and all the routes between the stations.

- ANN, SVR, RF, LSTM baselines are compared with our TSTGCN, and mean absolute error (MAE), root

mean squared error (RMSE) and mean absolute percentage error (MAPE) are used to evaluate the performance in train delay prediction.

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