TRAVEL TIME PREDICTION OF PUBLIC TRANSPORT IN A SELECTED ROUTE USING ARTIFICIAL NEURAL NETWORKS

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Abstract

People, living in cities like Bengaluru have to plan their daily travel schedule against the congested traffic. Studies report that the travel time in Bengaluru increases by 6% for every quarter of the year. Travel time prediction enhances the passengers to plan their daily routine. Several tools such as machine learning, ARIMA model, MARE, MAPPE, cluster algorithms, ANN are used by the researchers for the travel time prediction. In this work, the authors propose Artificial Neural Algorithm for the travel time prediction, which exhibits a very high accuracy in the results. The real time data of Metropolitan Transport Service has been collected for a route from Kempegowda Bus Station to Kempegowda International Airport in Bengaluru. The length of this route is 34.5km. The method which the authors propose for the travel time prediction will be more accurate as more data sets appear in the algorithm. Passengers can easily plan their schedule according to the predicted travel time and also transportation authorities can plan their operations and schedules for providing better service.

Keywords: Travel time prediction, Artificial Neural Network, Bengaluru Metropolitan Transport Corporation, Public transport

I. INTRODUCTION

India‟s transport network is one of the most extensive in the world. The road transportation contributes around 6.5 percent of GDP, according to a World Bank report. In Indian cities like Delhi, Mumbai, Bangalore, Chennai, traffic congestion will be the major problem which decreases in accessibility and reliability. These problems are due to increase in private and intermediate transport service. Therefore, it is necessary to improve the quality of bus transit system. Intelligent transport systems (ITS) are transportation service and technologies arrived at enhancing the efficiency, safety, reliability and eco-sustenance of transportation systems. An important aspect of ITS are to advance public transportation to make it more attractive than private transport. The prediction of travel time is one of the main aspect in Intelligent Transportation System.

The travel time prediction is basically on the vehicle speed and flow of traffic. The real-time database collected from the BMTC. Proposed algorithm is done for the route Kempegowda bus station to Kempegowda International Airport. Proposed ANN uses these databases and calculated predicted the statistical approach is made to generate random numbers for the shared data. According the result, ANN method is the best method in terms of predicted accuracy. The accurate travel time prediction helps in route planning, time scheduling and trip planning. The dwell time and waiting time of the bus can eliminate by the forecast of time of the travel.

II. LITERATURE REVIEW

Now a days, prediction of travel time has become one of the research areas. There is a number of researches which deals with travel time prediction on road networks. Travel time prediction methods classified into two major parts, one as path estimation and other as link estimation. The research is carried more on path estimation as that is time between two places in a road.

The predicted time is done by algorithm using the historical data and the location of the start and end point of travel. The data is collected on the analysis of links of the location. This uses GPS to collect the real time data. The prediction accuracy of links is about 95% [1]. ANN method is used for the road segment to calculate the travel time. It is very difficult to predict travel time in uncertain situation. The experiment conducted and they collected real data. Data contains start time and end time of vehicle in particular road segment. This is done for the constant time per day. The data is then used in the algorithm and prediction of travel time is calculated. The comparison of proposed algorithm with the other methods and error also calculated. In this analysis, the proposed method has accurate performance while from other algorithms [2].

Kwon et al used linear regression method. Their approach is to forecast the travel time on flow and data from loop and also from the historical information [3]. The proposed algorithm is comparison of both historical data and real time data. Zhang et al proposed a smoothing average method for the prediction of the departure time. Rice et al used linear predictor method that combines or uses both historical data and current time details to predict the travel time.

III. DATA COLLECTION

The real-time data is collected from the BMTC. We selected the one of the long routes i.e. from Kempegowda Bus Station to Kempegowda International Airport. The bus route number is KIAS-9. The total distance that the bus travels is 34.5 km. the scheduled time from the BMTC to reach the destination is 1 hour. This route has 18 substations as shown in figure 1.

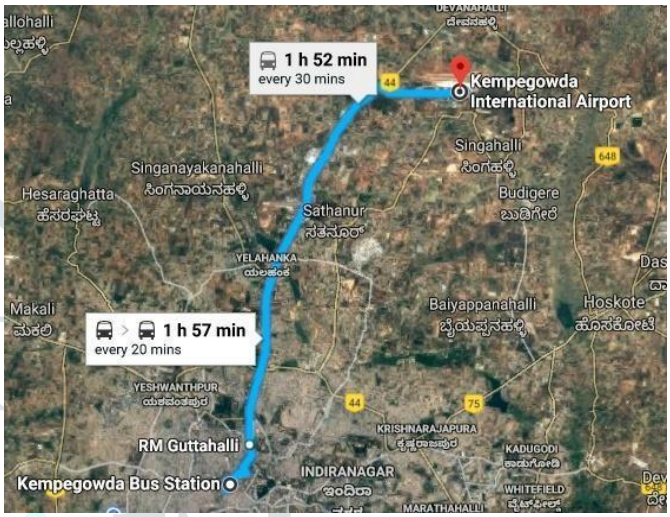

Figure 1:- The route from Kempegowda bus stop to Kempegowda International Airport

The database shared gives the information of the bus arrival at one station and departure from that bus station. The data provided is only of 6days (fro 25/12/2017 to 01/01/2018) and for 8 trips per day as shown in the table no 1. To get accurate output, we used statistical approach. The stat fit is done for the given data using the pro model software. The given data is fitted for the weibull distribution. By using the weibull parameters i.e. minimum value is 37, α shape parameter is 1.3540 and β scale parameter is 19.4015, generated 1200 random numbers. These random numbers are used as input in proposed algorithm.

Route No.	Bus stop name	Entry Time	Exit time
KIAS-9	Kempegowda bus stand	01:17:02	00:00:00
KIAS-9	Kempegowda bus stand	01:15:26	01:50:36
KIAS-9	Shivananda store	02:14:34	02:14:43
KIAS-9	RM Guttahalli	02:16:43	02:16:53
KIAS-9	Mekhri circle	02:19:43	02:19:52
KIAS-9	Hebbala(Towards Yelahanka)	02:22:41	02:22:51
KIAS-9	Military Dairy Farm	02:24:41	02:24:51
KIAS-9	Navayuga Devanahalli Toll Plaza	02:24:41	02:24:51
KIAS-9	Byatarayanapura	02:27:21	02:27:32
KIAS-9	Allalasandra Gate	02:29:20	00:00:00
KIAS-9	Kogilu Cross	02:32:10	02:32:20
KIAS-9	Venkatala	02:33:29	02:33:39
KIAS-9	Indian Air Force	02:36:18	02:36:28
KIAS-9	Hunasamaranahalli	02:38:17	02:38:27
KIAS-9	Bettahalasuru Cross	02:40:57	02:41:07
KIAS-9	Chikkajala	02:42:57	00:00:00
KIAS-9	Sadahalli gate	02:44:56	00:00:00
KIAS-9	Trumpet	02:45:36	02:45:46
KIAS-9	Kempegowda International Airport	02:54:26	00:00:00

IV. PROPOSED ALGORITHM FOR TRAVEL TIME PREDICTION

A new method for predicting travel time of bus from historical data is proposed using Artificial Neural Network (ANN). By analyzing the data, calculate the time taken to reach the destination for every trip and every day. Then by using distance calculate the velocity. These values are tabulated in table no.2. Calculate the expected time with respect to velocity and as well as frequency. The logistic sigmoid function 'e' is used as activation function to calculate predicted time. The edge weight is 1 (constant), this is multiplied with travel time. The edge weight is used for the large database in prediction travel time. The value will be in binary 0 or 1, where 0 is represents no buses are

arrived and 1 represents buses will arrive. As the buses will arrive confirm, the edge weight is taken as 1. Then find the average time. Finally approximate predicted travel time will be obtained.

A. PROCEDURE OF ALGORITHM

Step 1:- Convert the travel time from seconds to minutes and velocity from m/sec to m/min.

Step 2:- The frequency of each travel time is noted down by counting the repetition of that

Travel time in different record.

Step 3:- The two edge values are used, one"s edge value is velocity and other frequency.

Let,

The velocity edge value be represented by 'I'.

The frequency edge value be represented by 'J'.

Step 4:- Find the value of I and J by multiplying with actual travel time.

I = weight * travel time

I = velocity * travel time

I = vt……Eq 1

J = weight * travel time

J = frequency * travel time

J = ft……....Eq 2

Step 5:- Now calculate the approximate travel time for I and J.

T_1 = vt/ total velocity……..Eq 3

T_2 = ft/ total frequency…….Eq 4

Step 6:- The logistic sigmoid function is used as activation function. By applying logistic Sigmoid function the travel time is calculated.

P (I) = 1/1+e^-T_1.....Eq 5

P (J) = 1/1+e^-T_2.....Eq 6

Step 7:- Multiplying the travel time (T_1) and (T_2) with edge weight, where edge weight is 1 (constant).

O = (1 * T_1) + (1 * T_2)…….Eq 7

Step 8:- Apply logistic sigmoid function, we get the desire travel time.

P (O) = 1/1+e^-O.……....Eq 8

Step 9:- Find the average predicted time by taking difference between the I^{th} and J^{th} travel time which is calculated from equation 1 and 2. And also find difference betweenthe desired travel time.

P (m) = [{P (O) – P (I)} + {P (O)– P (J)}]/2..Eq 9

P (n) = P (I) – P (J)……Eq 10

Step 10:- Accurate predicted travel time is calculated.

P (T) = [P (m) – P (n)] /2…..Eq 11

The final output is the predicted travel time for the route KIAS – 9.

B. CALCULATION

Travel time (min)	Velocity (m/min)
56.813	607.2554
38.7077	891.2955
53.5861	643.8237
44.4876	775.497
56.6334	609.1812
40.3953	854.0598
47.7565	722.4147
55.3111	623.7446
38.2338	902.343
54.5361	632.6085

The sample calculation of 10 numbers are shown in table no.2, the actual random numbers are 1000 in numbers.

Table no.2:- Sample calculation of Velocity in m/min.

The values for the proposed algorithm are tabulated below

- I = 41400000 m
- J = 65737.43 m
- T1=52.09731 mins
- T2=54.78119 mins
- P(I)=0.9779 secs
- P(J) = 0.5613 secs
- O=1.5392 mins
- P (O) = 0.823348 secs
- P (m) = 0.7876 secs
- P (n) = 0.8459 secs

V. RESULT

The actual travel time from the available data is 55 minutes and 18 seconds. The proposed algorithm reduces the travel time. The predicted travel time from the algorithm by ANN method is 49 mins : 05 secs. Here, around 5 mins travel time is reduced. This helps passengers to plan their travel and BMTC can reschedule their route timings and can increase the number of trips per day. This provides better service for end users.

VI. CONCLUSION

A new ANN method proves that, it is accurate and speed to predict the travel time. Further, the analysis of the proposed algorithm can compare with the other algorithms such as Naïve Bayesians (NBC) method, Successive moving average (SMA), linear regression method. This comparison can say which algorithm is better. The reliability is the responsible factor for the success or failure of the public transport service. An improvement in service efficiency and reduction of waiting time attracts passengers towards public transport system. Without changing any infrastructure, implementation of Intelligent Transport System (ITS) will solve such problems.

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