SERVICE LEVELS OF SIDEWALKS FOR PEDESTRIANS UNDER MIXED TRAFFIC ENVIRONMENT USING GENETIC PROGRAMMING CLUSTERING

M. Durga¹, Prof.(Dr) A. Shanmuganathan², Dr. Paritosh Srivastava³, Dr. Dwaitha Jagadish⁴

¹Civil Engineering Department, Noida international university, Greater Noida, India
²Vice-Principal, NIMS Institute of Engineering & Technology, NIMS University, Jaipur
³Associate Professor, HOD -Civil Engineering, Noida International University (NIU), Greater Noida
⁴Assistant Professor, FET, Jain University, Bengaluru, India
Email: ¹durgaraj.raj@gmail.com, ²basaironit@gmail.com, ³paritosh.srivastava@niu.edu.in, ⁴dwaitha.c@gmail.com

Abstract: PLOS or pedestrian level of services helps in measuring the performance of mixed traffic conditions in terms of traffic flow and sidewalk conditions. Through specific measures and conditions, a traffic management team can incorporate genetic programming clusters to develop data processing operations. This study highlighted the introduction with aims and objectives that can allow in identifying the goals. Literature review helped in analysing the importance of PLOS and genetic programming clustering. Moreover, methodology also defined adequate methods that are responsible for managing the reliability and validity criteria of data management processes. This study also highlighted experimental and thematic analysis through which specific requirements of controlling mixed traffic conditions with the help of PLOS can also be analysed properly.

Keywords: Sidewalks, Pedestrians, Traffic Environment, Programming, Clustering

I. Introduction

Rationale and background

Service levels of sidewalks help in identifying pedestrian operations in terms of traffic flow conditions and perception of road users. Through the usage of genetic programming clustering, traffic flow activities can assist in understanding road conditions in mixed traffic to maintain traffic management systems. It can assist road users to identify the congestion rate and maintain their transmission speed without any issues. However, sometimes, due to reliable and valid results, road users have failed to identify the traffic flow operations and decrease the transmission speed accordingly. It can directly affect the traffic management operations through which traffic management team members cannot operate their tasks effectively. For this reason, modification in traffic management processes using genetic programming clustering can help in avoiding these issues and develop traffic flow operations.

Aim

The aim of this study is to analyse the procedure of managing sidewalks in mixed traffic conditions with the help of genetic programming clustering to arrange traffic flow and speed.
Objectives

- To identify factors that are responsible for improving pedestrian flow in mixed traffic conditions.
- To address issues in handling traffic management systems while using genetic programming clustering.
- To recommend effective strategies to develop performance of traffic management systems in relation to traffic flow and speed.

Significance of the study

The significance of this study helps in analysing traffic flow operations through which traffic management team members can make their decisions in developing their mixed traffic conditions. Through the assistance of genetic programming clustering, pedestrian flow of sidewalk activities can be analysed that can allow traffic management teams to analyse traffic flow. Therefore, they can provide detailed information towards road users in reducing congestion rate and also develop the performance quality of traffic management systems. In this way, structure and quality in mixed traffic conditions can give a favourable impact on the sustainable environment within urban arterial areas in India.

II. Literature Review

Explaining the concept of pedestrian flow in traffic management system

Pedestrian flow plays a crucial role in distributing specific information regarding traffic flow and speed to manage traffic management systems. Through the assistance of a traffic management system, team members can identify service levels of sidewalks and they can make decisions to control mixed traffic conditions. As followed by Sahani et al. (2017), a dynamic traffic management system can give the opportunity in controlling pedestrian flow and also develop design aspects in terms of transportation projects. It can also decrease complexities in arranging traffic flow conditions that can allow in managing six LOS operations without any issues. Traffic management systems can also help in increasing density of mixed traffic and decline pedestrian speed.

Identifying the importance of genetic programming clustering

The significance of genetic programming clustering helps in arranging data mining and traffic pattern recognition processes. Through clustering, the distribution process can help in distributing all specific information in terms of traffic management and sidewalk activities. As influenced by Tang et al. (2017), it can help traffic management team members to identify the categories and make suitable decisions against these services to improve traffic flow and conditions. Through the assistance of genetic algorithms, partial algorithm issues in controlling data segments in the traffic management process can help in providing required steps for developing mixed traffic conditions by avoiding congestion and accident related issues.

Analysing issues in traffic management system

Lack of adequate information of traffic flows

Lack of adequate information on traffic flows can decrease the value and services of traffic management systems. This issue can decrease the position of mixed traffic conditions through...
which the traffic management team cannot provide adequate information towards road users. Therefore, they would not identify specific requirements to control pedestrian flow in this mixed traffic conditions.

**Difficult to understand genetic programming clustering**

Difficult to understand genetic programming clustering is one of the critical issues that can decrease the probability of managing data of traffic flow operations. It can violate the data collection process due to which the possibility of arranging information regarding mixed traffic conditions cannot be incorporated within the traffic management system (Sahani *et al.*, 2017). It can directly affect the condition of controlling traffic flow operations within this data segmentation.

**Lack of reliable resources**

Lack of reliable resources can violate the performance criteria of traffic management systems that can decrease the position of managing sequence in traffic flow operations. Sometimes, due to lack of time, traffic management team members have failed to maintain the balance in traffic flow and pedestrian flow operations properly. It can decrease reliability and validity factors within traffic management systems.

**Theoretical overview**

**Three phase traffic theory**

![Figure 1: Three phase traffic theory](source: As inspired by Zeng *et al.* 2019)

Three phase traffic theory helps in identifying the relationship between synchronised and free flow operations in traffic management systems. The traffic management team members can use this theoretical knowledge to incorporate genetic programming clustering to rearrange traffic flow in mixed traffic conditions. Therefore, road users can easily maintain transportation services using vehicles and side walking activities without facing any congestion or issues. As proposed by Zeng *et al.* (2019), it can allow users to make their individual decisions in avoiding congestion and accidents through which structured performance in traffic flow management can develop mixed traffic conditions.
Pedestrian simulation model

![Diagram of a pedestrian simulation model with levels of interaction and assembly, and sub-levels of microscopic, mesoscopic, and macroscopic views.](Figure 2: Pedestrian simulation model
(Source: As inspired by Feliciani et al., 2017)

Pedestrian simulation models help in identifying discrete and continuous values of traffic flow operations that can guide road users to analyse level of interaction and level of assembly activities. According to Feliciani et al. (2017), it can guide traffic management team members to use specific ideas to maintain a group of road users that can operate their tasks in a sequenced manner by avoiding complexities. This model can also give opportunities in arranging mixed traffic conditions by rearranging traffic management systems depending on specific requirements within mixed traffic conditions.

Strategies to overcome issues in traffic management system

**Training and development**
Training and development process helps in developing knowledge for service providers in traffic management systems. It can allow them to recognise the specification and handling methods of genetic programming clustering. As influenced by Kontogiannis and Malakis (2017), using this programming, traffic management team members can provide accurate details and develop knowledge for road users so that they can understand the conditions properly. It can allow in reducing complications and issues within traffic management processes that can avoid congestion in mixed traffic conditions.

**Implementing resource management plan**
Implementing a resource management plan can guide service providers to provide adequate resources and information to road users that they can identify traffic conditions properly. It can allow users to maintain the structured balance in mixed traffic operations and also avoid congestion issues. In this way, structured balance in mixed traffic operations can allow in creating a sustainable environment without any issues that can be beneficial for traffic management operations.

**Modifying traffic management system**
Modifying traffic management systems helps in generating a sequenced plan for executing all operational activities through which potentiality in data collection and data management can develop the process of mixed traffic conditions. According to Wang et al. (2018), introducing...
internet based technologies in traffic management systems can bring structured stability within data processing of traffic management operations that can give reliable results properly.

**Literature gap**

In this literature, genetic programming clustering related information cannot be incorporated successfully that can violate the process quality management in this research. More information about theoretical concepts is required to be incorporated to develop the information procedure of mixed traffic conditions.

### III. Methodology

#### Research philosophy

Research philosophy helps in managing nature, source and development of knowledge within a research by presenting practical information. Through research philosophy, profound information helps in developing quality and accuracy of valid data while performing data collection methods. Positivism philosophy has been selected to manage the structure of this research by presenting accurate information from reliable sources. As inspired by Dougherty *et al*. (2019), using this philosophy, validation process in pedestrian flow in mixed traffic conditions can allow in managing traffic management processes. It can generate a sequence of data collection processes through which performance criteria of genetic algorithms in terms of handling traffic flow can develop the situation of mixed traffic conditions without any issues.

#### Research approach

Research approach provides validation of proper assumptions through which data managerial activities can allow in developing quality of research. According to Harrison *et al*. (2017), using research approaches, contributions of emergence theories can give reliable information that can allow us to understand current situations without any issues. Deductive research approach helps in generalising traffic flow information that can allow traffic management teams to use that information to manage sidewalks and mixed traffic conditions. This approach can also give opportunities for traffic management teams to make suitable decisions in developing their existing performance criteria of mixed traffic situations.

#### Research design

Research design defines a sustainable way of executing data analytical techniques to develop the process of data collection activities. As proposed by Rahi (2017), specific research design helps in creating a general plan for research through which validation and reliability in data management processes can develop the process of managing all kinds of situations. In this way, quality and structure of research study can help in avoiding complications in research methods and strategies. Conclusive research design has been incorporated in this study to maintain the structured information of traffic flow operations and genetic programming clustering. It can guide traffic management team members to use their knowledge using this clustering and maintain data management processes without any issues.

#### Data collection method

Data collection method plays a crucial role in arranging data sequences and developing the current procedure of creating sequences of data management processes. Through data collection methods, specific information or data can help in managing validation and reliable criteria
without any issues. Mixed method has been used in this research study to incorporate specific data from external sources. Experimental data has helped in identifying traffic flow operations and also provide accurate information regarding speed and density of traffic flow. On the other hand, thematic analysis also provided adequate information regarding the perspectives of external authors without any issues.

**Search strategy**

Search strategy is one of the crucial aspects in data collection processes and this strategy can guide to incorporate specific information related research topics. It can develop the sequence of managing all kinds of aspects through which structured operations can allow decreasing complications in data quality and data validation. Through the usage of Boolean operators, specific information regarding traffic flow, pedestrian activities and genetic programming clustering can be incorporated within this study. It would assist in presenting the validation and reliability criteria through which improvement in data collection can be operated successfully without any issues. It can bring structured requirements within this study through which traffic management team members can analyse this information and perform accordingly.

**Ethical consideration**

Ethical consideration helps in managing respects and dignity of research participants by providing security. Data Protection Act 2018 (c.12) helps in securing data from unauthorised members to maintain the data validation. It can allow in managing proper sequences and also develop the criteria of managing priority of research participants. Confidentiality level in research study can also be maintained properly to develop the quality and effectiveness of research data. It can decrease complexities in disclosing data from external sources that can arrange reliability within research study without any challenges.

**IV. Data analysis**

**Data analytical technique**

Data analytical techniques help in identifying the procedure of data collection that can help users to identify the specific requirements and steps for understanding all the collected information. Through specific data analytical techniques, sequential steps and methods would help users to incorporate all kinds of information without any issues. Mixed data collection method has been used to identify traffic flow and pedestrian activities in controlling mixed traffic conditions. It can also develop knowledge criteria of understanding the importance of genetic programming clustering while performing data collection processes. In the words of Esser and Vliegenthart (2017), using experimental data collection methods, specific information regarding traffic flow and vehicles’ activities can allow in developing the quality of this research without any issues. Through the usage of thematic analysis, perspectives of different authors can help in analysing the conditions of mixed traffic and allow road users to make proper steps in avoiding complexities. It can bring stability and also enhance quality in research methods with the help of this data analytical technique.

**Primary data collection**

Primary data collection method is responsible for providing accurate data that can allow in developing the quality of data management process. Through the usage of experimental data,
reliable factors in traffic management processes can develop the sequence of controlling pedestrian activities within mixed traffic conditions without any issues.

**Experimental data collection**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Platoon size</th>
<th>TS</th>
<th>SS</th>
<th>CS</th>
<th>MS</th>
<th>AS</th>
<th>Fss</th>
<th>Fmr</th>
<th>Fnn</th>
<th>Fpdl</th>
<th>Fm3</th>
<th>Sρ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platoon</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>TS</td>
<td>0.010</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>SS</td>
<td>0.058</td>
<td>0.477</td>
<td>0.364</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CS</td>
<td>0.349</td>
<td>0.684</td>
<td>0.364</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>MS</td>
<td>0.121</td>
<td>0.365</td>
<td>-0.139</td>
<td>0.301</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>AS</td>
<td>-0.247</td>
<td>0.478</td>
<td>0.213</td>
<td>0.338</td>
<td>0.081</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Fss</td>
<td>-0.045</td>
<td>-0.765</td>
<td>-0.491</td>
<td>-0.766</td>
<td>-0.179</td>
<td>-0.750</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Fmr</td>
<td>0.073</td>
<td>0.801</td>
<td>0.442</td>
<td>0.754</td>
<td>0.301</td>
<td>0.727</td>
<td>-0.624</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Fnn</td>
<td>-0.220</td>
<td>0.780</td>
<td>0.664</td>
<td>0.583</td>
<td>0.131</td>
<td>0.584</td>
<td>-0.6811</td>
<td>0.799</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Fpdl</td>
<td>-0.044</td>
<td>0.756</td>
<td>0.594</td>
<td>0.706</td>
<td>0.140</td>
<td>0.730</td>
<td>-0.3898</td>
<td>0.839</td>
<td>0.880</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Fm3</td>
<td>-0.127</td>
<td>0.602</td>
<td>0.428</td>
<td>0.665</td>
<td>0.164</td>
<td>0.739</td>
<td>-0.866</td>
<td>0.771</td>
<td>0.795</td>
<td>0.902</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Sρ</td>
<td>0.110</td>
<td>0.827</td>
<td>0.459</td>
<td>0.748</td>
<td>0.123</td>
<td>0.696</td>
<td>-0.858</td>
<td>0.909</td>
<td>0.742</td>
<td>0.744</td>
<td>0.61</td>
<td>1</td>
</tr>
</tbody>
</table>

**Figure 3: Correlation matrix of Pedestrian level of Services**  
(Source: As inspired by Sahani et al., 2017)

From the correlation matrix of pedestrian level of services, it has been identified that most of the traffic flow is based on traffic congestion rate which is nearly 0.114. Through this information, the traffic management team is expected to make suitable decisions in avoiding this congestion rate and develop their traffic performance. 0.319 values helps in identifying the discrimination in traffic conditions that is required to be developed with the help of traffic management team members. It can also allow the creation of a sustainable environment in the traffic management system with the help of genetic algorithms in mixed traffic conditions.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficients</th>
<th>P-value</th>
<th>t Stat</th>
<th>test result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-5.19998</td>
<td>0.000</td>
<td>-9.73598</td>
<td>accepted</td>
</tr>
<tr>
<td>gender</td>
<td>0.019468</td>
<td>0.944</td>
<td>0.071162</td>
<td>-</td>
</tr>
<tr>
<td>age</td>
<td>-0.01171</td>
<td>0.901</td>
<td>-0.12532</td>
<td>-</td>
</tr>
<tr>
<td>Platoon</td>
<td>0.268991</td>
<td>0.020</td>
<td>2.415965</td>
<td>accepted</td>
</tr>
<tr>
<td>transit</td>
<td>0.058872</td>
<td>0.367</td>
<td>0.910155</td>
<td>-</td>
</tr>
<tr>
<td>TS</td>
<td>0.139486</td>
<td>0.030</td>
<td>0.948862</td>
<td>accepted</td>
</tr>
<tr>
<td>SS</td>
<td>0.167186</td>
<td>0.010</td>
<td>1.645706</td>
<td>accepted</td>
</tr>
<tr>
<td>CS</td>
<td>0.507469</td>
<td>0.000</td>
<td>3.779813</td>
<td>accepted</td>
</tr>
<tr>
<td>MS</td>
<td>0.099101</td>
<td>0.040</td>
<td>0.79804</td>
<td>accepted</td>
</tr>
<tr>
<td>AS</td>
<td>0.495963</td>
<td>0.000</td>
<td>4.67073</td>
<td>accepted</td>
</tr>
</tbody>
</table>

**Figure 3: Statistical analysis of Pedestrian level of Services**  
(Source: As inspired by Sahani et al., 2017)

Statistical analysis of PLOS can help in identifying the specific requirements in controlling all operational movements through which traffic flow and congestion rate can be identified adequately. 0.167 values and 0.268 values can help in analysing the traffic variables and other operations regarding the sequence of managing mixed traffic conditions. It can help in guiding traffic management team members to operate their tasks in decreasing these rates and develop performance capacity in mixed traffic conditions.

**Secondary data collection**

www.turkjphysiotherrehabil.org
Secondary data collection method helps in gathering information from external sources to maintain the structure in research topics with respect to goals. In this study, thematic analysis has been used to identify perspectives of different authors in terms of this research. It can allow for comparison of traffic flow and pedestrian activities within traffic management processes. It can develop the process of creating a sequence for managing all kinds of operations without any issues.

Thematic analysis

Theme 1: Pedestrian Traffic monitoring and management process in mixed traffic conditions

Pedestrian traffic monitoring process helps in identifying traffic flow management that can guide the traffic management team to make proper steps in controlling all operations in mixed traffic conditions. According to Sutheerakul et al. (2017), unmanned aerial vehicles (UAV) play a crucial role in identifying traffic speed and density of traffic conditions through which specific measurements can be taken by the traffic management team. It can help this team to perform remote control operations in handling pedestrian management and monitoring processes. Therefore, the traffic management team can provide guidance towards road users to avoid congestion rate without any issues.

Theme 2: Operational analysis in mixed traffic condition with the help of multi genetic programming

Multi genetic programming helps in presenting reliable information regarding highway capacity manuals through which the traffic management team can make suitable decisions to control mixed traffic conditions. As followed by Jena et al. (2019), through this programming, traffic congestion rate can be analysed and that can help road users to avoid that condition and develop performance of their transportation services. It can also generate a sequence for managing infrastructural development in mixed traffic conditions without any issues.

Theme 3: Addressing issues in mixed traffic conditions in terms of autonomous vehicles

Autonomous vehicles help in presenting the transportation speed and density of heavy vehicles through which traffic management team members can make suitable choices to control all conditions without any issues. However, sometimes, due to some complications, traffic management team members have failed to arrange specific information regarding mixed traffic conditions. It can decrease the procedure of managing data processing and traffic flow operations within mixed traffic conditions. For this reason, traffic management team members can use DUI (Driving under Influence) policy to develop knowledge for road users without any issues.

V. Conclusion

From the above study, it has been concluded that traffic management team members play an effective role in managing mixed and congestion traffic conditions with the help of specific methods and processes. Through the usage of genetic programming, clustering and pedestrian models, this team can provide accurate information towards road users. Therefore, they can understand the mixed traffic conditions and perform their transportation operations accordingly. It can develop the procedure of creating a sequential platform through which this team can make suitable decisions in developing their traffic management operations without any issues. It can bring structured stability through which the possibility of managing mixed and congestion traffic conditions can allow in handling traffic flow and density level.
Recommendations
From the above study, it can be recommended that the traffic management team is expected to identify the situation of managing mixed traffic conditions and incorporate specific policy and rules to maintain the balance in density and speed of traffic. Moreover, introducing DUI and UAV can help in developing mixed traffic conditions that can help road users to get specific information about mixed traffic conditions. Modification in the traffic management system can help in analysing all specific information related to mixed or congestion traffic conditions. It can develop the process of creating a sequence for achieving all goals and requirements in mixed traffic situations.

Linking with objectives
Objective 1 has been met in the literature review section by understanding all specific information regarding pedestrian flow and mixed traffic conditions in terms of traffic management system. Objective 2 has been met in the data analysis section by analysing specific issues regarding controlling mixed traffic conditions with the help of traffic management systems. Objective 3 has been met in the literature review section by presenting specific strategies to develop traffic management systems or processes.

Future scope
Development in theoretical overview can help in developing quality within this research in the future. Introducing more issues and practical information regarding mixed traffic conditions can also develop the data analytical operations within this study as well.

References


