International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 11 Issue: 9s
DOI: https://doi.org/10.17762/ijritcc.v11i9s.7421
***Article Received**: 10 May 2023 **Revised:** 30 June 2023 **Accepted:** 26 July 2023*

Modelling Accessibility based on Urbanization using Artificial Neural Networks (ANN)

T.Pavan Kumar[1], Dr.K.M.Lakshmana Rao[2]
Research Scholar in JNTU Hyderabad,
Assistant Professor in TKR Engineering College
Medbowli, Meerpet (V), Balapur(M), Hyderabad-500097
Email Id: pavanphdtelluri@gmail.com
[2]Professor
Department of CIVIL Engineering
JNTU Hyderabad, Telangana
Email Id: kmlrao@jntuh.ac.in

Abstract—The present study involves modelling the accessibility index with respect to the traffic volume, Right of Way width and Population density. It also involves the collection of number of different types of opportunities like schools, hospitals, ATMs, bus-stops and parks to determine the accessibility index. Two different methods are used in the study such as Multiple Linear Regression (MLR) and Artificial Neural Networks (ANN) to develop models in order to predict the accessibility index. Based on the R^2 value obtained in the models, it is observed that ANN has better prediction capability than MLR model. The study acts as a guide to the urban transportation planners to understand the change in accessibility index when there is a change in urbanization variables.

I. INTRODUCTION

The process of restricting and governing transport options to promote the efficient operation of the country's life in politics, society, and the economy at a minimal social cost is known as planning for urbanization. When it comes to traffic, mobility, and right of way, urbanization is the main issue. Urbanization models include changes in land use, the prevalence of automobile ownership, socioeconomic conditions, average incomes, retail activity, and industrial activity.Vianna et al. (2017) examined the likelihood of building a combined parking structure using telemetry resources and also covered the development a conceptual framework for handling and transmitting data and information. The methodologies of integrated transportation planning established for the Puget Sound Regional Council were reviewed by Reinke and Malarkey (2017). They also covered how integrated transportation planning will fit into the process of strategic planning.The 3,140 counties in the United States were examined by Cradock et al. (2018) in terms of region, population density and development, social and economic characteristics, and indicators of walking and bicycle for transportation. They also evaluated investments made to comply with national transport regulations related to cycling and walkers. This study's findings led to three important policy suggestions for enhancing public health outcomes. Velarde (2019) provided a demonstration of a mathematical framework to enhance sustainable in the management of transportation expenses in a system of distribution. In this paper, the vehicle routing problem is applied mathematically using mixed-integer linear programming. To lower the transportation costs involved with these routes, the model establishes the distribution routes from a distribution centre to each consumer. Theorems from network theory can be used to effectively choose sites for each bicycle station to be placed across the city, according to a mathematical model established by Kim (2020) for the installation of public transit systems.DynaMIT is a real-time system that generates passenger guidance, according to Ben-Avika et al. (2019). DynaMIT's guiding principle is that information should be trustworthy and easy to utilise.Cho and Hwanc (2020) created a flow evolution model for a vehicular network using expected journey data using the dynamical system approach. On a daily basis, the peak-hour average was used to measure the relevant system variables, path flow, and estimated minimal trip time of an origin-destination pair.Mishra and Das (2016) investigated a three-dimensional transportation problem with a similarly structured objective function—namely, the sum of a linear and linear fractional function—and created a simplex type technique for solution in addition to computational testing for local minimum. In a study of a paradox in linear fractional transportation problems with mixed constraints, Gupta et al. (2013) discovered a necessary condition for a paradox's existence. A counterintuitive spectrum of flow was also generated for any flow wherein the appropriate goal function value was smaller than the value of the initial Sequential Fraction Transport Problems with Mixed Constraints.

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 11 Issue: 9s
DOI: https://doi.org/10.17762/ijritcc.v11i9s.7421
***Article Received**: 10 May 2023 **Revised:** 30 June 2023 **Accepted:** 26 July 2023*

II. MATERIALS AND METHODS

The study is carried out in five phases. The first phase involves defining the objectives and identification of study area. The second phase of the study deals with the collection of field data such as traffic volume, speed data, road geometrics data etc. It also involves the collection of number of different types of opportunities like schools, hospitals, ATMs, bus-stops and parks to determine the accessibility index. In the third phase of the study, the collected field data is analyzed to develop models. The last phase of the study involves modelling the accessibility index with respect to the traffic volume, Right of Way width and Population density.

III. STUDY AREA

Hyderabad city, capital of Telangana state is chosen as the study area. The city of Hyderabad also serves as the central hub of transport and logistics within the state. Five mid-block sections and five signalized intersections were chosen to perform analysis. The mid-block sections and signalized intersections chosen for the analysis are given in Table 1.

TABLE I. MID-BLOCK SECTIONS AND SIGNALIZED INTERSECTIONS CHOSEN FOR THE STUDY

Mid-block Section S.No	Name of the Mid-block sections	Signalized intersection S.No	Name of the Signalized intersections
I	Shilparamam to Madhapur	I	Shilparamam
II	Moosapet to Miyapur	II	JNTU
III	Panjagutta to Lakdikapool	III	Khairthabad
IV	Paradise to Secundrabad railway Station	IV	Secundrabad railway station
V	Chikkadapalli to Musheerabad	V	RTC Cross Roads

IV. FIELD DATA COLLECTION

Different type of field data is collected for mid-block sections and signalized intersections chosen for the study. The type of data collected from the field are traffic volume using video-graphic method. The population data of the required locations was taken from the Statistics department of Telangana state. Five different opportunities like schools, hospitals, ATMs, bus-stops and parks chosen for the study. The number of each different type of opportunity is computed using Google Earth software in the selected locations of mid-blocks and signalized intersections. Then a weighted accessibility index is computed for each location.

V. MODELLING THE ACCESSIBILITY

The analysis of the data includes computation of accessibility index with respect to different types of opportunities. The weighted accessibility index obtained by giving weightages to different opportunities. The accessibility index is considered as the dependent variable in the models developed. The traffic volume (V), Right of Way width (W) and population density (PD) as independent variables. Multiple Linear Regression (MLR) and Artificial Neural Networks (ANN) methods have been used to develop the model in the present study.

VI. RESULTS AND DISCUSSIONS

6. 6.1 Multiple Linear regression (MLR) model

Multiple Linear Regression (MLR) model is developed to predict accessibility index with respect to the independent variables such as traffic volume (V), Right of Way width (W) and population density (PD). The results of the MLR model are shown in Table 2.

TABLE II. REGRESSION STATISTICS OF THE MLR MODEL

Dependent variable :accessibility index			
Independent variable	Coefficient	p-value	t-stat value
Intercept	25.43	0.00	3.01
V	0.001	0.00	3.75
W	-0.613	0.00	5.84
PD	0.36	0.00	4.25
R^2 value: 0.81			

The MLR developed in the study is used to predict accessibility index with respect to the independent variables such as traffic volume (V), Right of Way width (W) and population density (PD). The regression statistics such as p-value and t-stat value indicates that all the independent variables have significant impact on accessibility index. The change in each of these variables will reflect a considerable change in the accessibility index values.

6.2 Artificial Neural Network (ANN) model

The input layer, the hidden layer for determining input weights, and the output layer make up an ANN. Network training, choosing the best network topology, and testing are the three stages of ANN development. 70% of the data is used by ANN for training, 15% is used for testing, and 15% is used for validation. Based on the trial and procedure iterations, the number of hidden layers and neurons is determined. The ideal network topology is one that has a smaller error between measured values and values predicted by an ANN.

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 11 Issue: 9s
DOI: https://doi.org/10.17762/ijritcc.v11i9s.7421
***Article Received**: 10 May 2023 **Revised:** 30 June 2023 **Accepted:** 26 July 2023*

The ANN technique was also employed in this study to forecast accessibility index depending on the geometry of the road network. In this work, accessibility index is employed as the output layer and V, W, and PD are used as the input layers in a multi-layered feed-forward ANN. To find the ideal network layout, many iterations were done while varying the number of hidden layers and neurons. The ideal network topology is one that has a smaller error between measured values and values predicted by an ANN. Ten neurons were used in a network topology with two layers—one hidden and one output—and two hidden layers for predicting the accessibility index. The output of the ANN model is presented in Figure 1.

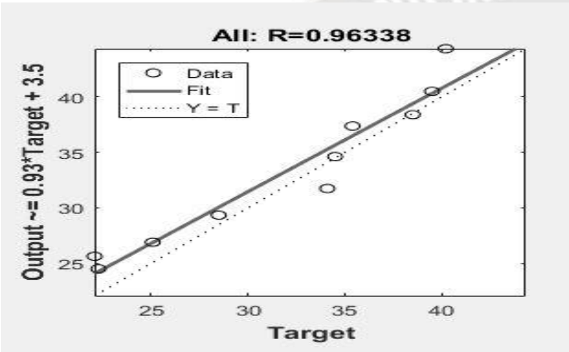

Figure 1 Output of ANN model

CONCLUSIONS

The study attempted to analyze the variation of accessibility index with respect to the urbanization parameters such as traffic volume, Right of Way width and population density. Two different methods are used in the study such as Multiple Linear Regression (MLR) and Artificial Neural Networks (ANN) to develop models in order to predict the accessibility index. Based on the R^2 value obtained in the models, it is observed that ANN has better prediction capability than MLR model. The analysis of variation of accessibility index with respect to urbanization parameters is a novel approach. The study acts as a guide to the urban transportation planners to understand the change in accessibility index when there is a change in urbanization varaibles.

REFERENCES

[1] Hauer, E., Kononov, J., Allery, B. and Griffith, M (2002). Screening the Road Network for Cites with Promise. Transportation Research Record, (1401): 17–25.

[2] Lohse, D. (1997). Grundlagen der Straßenverkehrstechnik und der Verkehrsplanung, Band 2: Verkehrsplanung, 2. Aufgabe, Berlin, izdatelstvo. BauwesenGMbH: 326 p.

[3] Lukanin, V.N., Buslaev, A.P., Trofimenko, Yu.W., Yashina M.V. (1998). Modeling and Optimal Control of Transport Flows in Megapolis. International Journal of Vehicle design, (3).

[4] Maslov, A. (1970). Motivation and Personality. Rev. ed. Harper and Row, New York. Ortuzar, J.D., Willumsen, L.G. (2001). Modeling Transport. John Wiley & Sons Ltd, 594 p.

[5] Kumar Pandey, A. . ., Arivazhagan , D. ., Rane , S. ., M. Yadav , S. ., Nabilal , K. V. ., & Oberoi , A. . (2023). A Novel Digital Mark CP-ABE Access Control Scheme for Public Secure Efficient Cloud Storage Technique. International Journal of Intelligent Systems and Applications in Engineering, 11(3s), 100–103. Retrieved from https://ijisae.org/index.php/IJISAE/article/view/2536

[6] Taha H.A., (1997). Operations Research: an Introduction. Prentice Hall International.

[7] Trofimenko, Yu.V., Yakimov, M.R. (2013). Transport Planning: Moulding of Efficient Transport Systems in Large Cities. Moscow: Logos, 464 p.

[8] Yakimov M.R. (2013). Transport Planning: Development of City Transport Model. Moscow: Logos.

[9] Jackson, J.H; ‗Migration and Urbanization in Ruhr Valley, 1821-1914', Humanities Press, New Jersey, 1997

[10] Pandey, Pradyumna: Impact of Industrialization on Urban Growth: A Case Study of ChotaNagpur', Allahabad Central Book Depot, 1970. 48.

[11] Prasad, M: Social Aspects of the mining Towns of the Tribal Region', Part I, New Delhi, 1986.

[12] Prasad N.; Determination of Stage of Landscape Evolution Through Relief Measures, Facets of Geomorphology (Edited by A. Kumar), 1985.

[13] Raj, Hans; Fundamentals of Demography'; Surjeet Publications, Delhi, 1998. 51. Ram, L. N.; ‗A Systematic Geography of Bihar', Geographical Society, Patna, 1991.

[14] Ramachandran, R.; Urbanization and Urban Systems in India', Oxford University Press, India, 1989. 53. Reissman, L.; The Urban Process, New York, 1964.

[15] Sahu, Shukdeo; Evolution of Terrain for Agricultural Land-use in the Ajay Basin, Bihar, (A Study in Environmental Geomorphology), 1997.

[16] Mr. Bhushan Bandre, Ms. Rashmi Khalatkar. (2015). Impact of Data Mining Technique in Education Institutions. International Journal of New Practices in Management and Engineering, 4(02), 01 - 07. Retrieved from http://ijnpme.org/index.php/IJNPME/article/view/35

[17] Saxena, H.M.; Environmental Geography', Rawat Publications, 1991, New Delhi, pp.87-89.

[18] R. Manonmani, S. Prabaharan, M. Ramalingam (2018), "Application of GIS in urban utility mapping using image processing techniques", Geo-spatial Information Science, Volume 15, Issue 4

[19] Sarath K. Guttikunda& Ramani V. Kopakka (2014), "Source emissions and health impacts of urban air pollution in Hyderabad, India", Air Qual Atmos Health, 7:195–20

[20] Kurre Sai Sahitya, C. S. R. K. Prasad (2020), "Modelling structural interdependent parameters of an urban road network using GIS", Spatial Information Research, volume 28, pages: 327–334

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 11 Issue: 9s
DOI: https://doi.org/10.17762/ijritcc.v11i9s.7421
***Article Received**: 10 May 2023 **Revised:** 30 June 2023 **Accepted:** 26 July 2023*

[21] Mohammed Akhter Ali (2017), "Remote Sensing &Gis A Tool For Urban Studies- Amenity Patterns In Hyderabad (A.P, INDIA).", City Planning Review,202, 64–72

[22] Bhupendra Singh, Ankit Gupta (2015), "Recent trends in intelligent transportation systems: a review" Research Directory • J. Transp. Lit. 9 (2)

[23] Thakre, B., Thakre, R., Timande, S., & Sarangpure, V. (2021). An Efficient Data Mining Based Automated Learning Model to Predict Heart Diseases. Machine Learning Applications in Engineering Education and Management, 1(2), 27–33. Retrieved from http://yashikajournals.com/index.php/mlaeem/article/view/17

[24] Miller, J., Evans, A., Martinez, J., Perez, A., & Silva, D. Predictive Maintenance in Engineering Facilities: A Machine Learning Approach. Kuwait Journal of Machine Learning, 1(2). Retrieved from http://kuwaitjournals.com/index.php/kjml/article/view/113

[25] Peng, Z. R. (1997). A Methodology for Design of a Gis-Based Automatic Transit Traveler Information System. Comput., Environ. and Urban Systems, 21(5), 359-372.

[26] Kumar, P., Singh, V., & Reddy, D., (1999). Advanced Traveler Information System for Hyderabad City. IEEE Transactions on Intelligent Transportation Systems, 6(1), 26-37.

[27] Hasnat, M. A., Haque, M. M., & Khan M. (2006). GIS Based Real Time Traveler Information System: An Efficient Approach to Minimize Travel Time Using Available Media, available from www.bracu.ac.bd.

[28] Zhang, J., Liaoa, F., Arentzea, T., &Timmermansaa H. (2011). A Multimodal Transport Network Model for Advanced Traveler Information Systems. Procedia Computer Science, 5, 912-919.