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# Application Program Interface on Artificial Neural Network in QGIS using Python

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**ABSTRACT: This study presents an application program interface for artificial neural network in QGIS using python. The plugin has been created using the open-source software, QGIS which allows the user to digitize maps along with data attributes and a plugin can be installed from the QGIS official plugin repository to increase the functionality. The plugin can be used as a prediction tool for various GIS studies. This study is a combination of geoinformatics along with machine learning which helps in exploring various research applications. The artificial neural network is there volutionizing machine learning concept used for prediction using layers. As an experimental setup, we have conducted a survey to predict the Number of vehicles per house in a locality.**
**The advantages of this study are:**
**(i) it is quick and cost-effective compared to other traditional prediction methods (ii) predicts unavailable data and (iii) knowledge gained from this study can be used for pollution control.**

**Keywords:** API, artificial neural network, geoinformatics, machine learning, plugin, plugin repository, QGIS.

**Abbreviations:** ANN, Artificial neural network; QGIS Quantum geographical information systems; GIS, geographical information systems.

## I. INTRODUCTION

The artificial neural networks are computational models based on algorithms. It is mostly used for interpretation of regression analysis. Artificial Neural Networks (ANN) is one of the famous conjecture techniques used to discover an answer while other mathematical methods aren't applicable. This technique predicts the values by using hidden layers, as shown in Fig. 1. Ahmed *et al*., (2019) concluded that ANN gives error-free values [1]. ANN provides an easier method for estimating target variables than compared to manual based approach. Tang *et al*., (2006) stated that ANN was better than traditional methods [2]. Wagh *et al*., (2016) confirms that geoinformatics alongwith machine learning has been explored in various research applications [3]. Darwishe *et al*., (2017) represents that ANN model gave fast results using a less tedious method whose results are satisfactory [4].

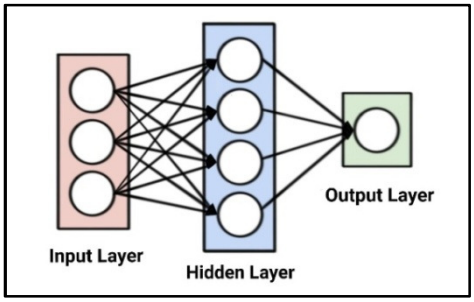


**Fig. 1.** The artificial neural network.

The tool application program interface is built with Qt creator and the plugin is installed in QGIS software. Becker *et al.,* (2016) also used PYQT and PYQGIS for plugin installation in QQIS software [5]. The plugin created here is the artificial neural network plugin which is used to predict values. The values here taken are independent and dependent values. The ANN plugin predicts the output values by using hidden layers which gives precise output values. Mair *et al*., (2000) referred that ANN methods have superior accuracy [6]. Badami depicts that the motor vehicle activity in India is contributing high levels of urban population along with socioeconomic, environmental, health and welfare impacts [7].

In a Metropolitan city like Hyderabad, Pollution plays a major role. On 23rd December 2019 Telangana today reported that the numbers of vehicles in Hyderabad have been doubled to approximately 50 lakhs from 25 lakhs in 2010. In 2011 Hyderabad had a population of 7.7 million which has grown to an estimated 8.7. Ghorani-Azam *et al.,* (2016) discussed the increase in air pollution due to vehicles cause cardiovascular, respiratory health problems, and skin irritations along with mental health issues [8]. This alarming rate of population growth leads to a concerning increase in vehicular pollution. The survey has been conducted for obtaining the predicted number of vehicles in comparison to number of people living in a house. The number of vehicles per house hold are independent values and the number of people in the house are dependent values.

## II. MATERIALS AND METHODS

### *A. Data and Study area*

The current study area- Shantinagar Colony is located in Hyderabad, Telangana, India as shown in Fig. 2. The study has been conducted for the residential buildings of the area. There are a total of 100 residential buildings

including individual houses and apartments. Individual flat in an apartment has been studied and the total combined information for the apartment has been presented in the features in each field. The vehicular data also has been collected by the authors as a part of the survey.

Fig. 2 shows the area of Shanti Nagar and its land division.


**Fig. 2.** Shanti Nagar Area.

*B. Pre-Processing*

The data presented has been processed and the unknown values or the missing values have been eliminated. After the removal of such entities, the data is scaled. Further the fit method is applied to the data. Buitinck *et al*., (2013) explained about fit method [9].

*C. Softwares used*

The plugin was created using the Plugin Builder plugin and Plugin Reloader plugin in QGIS installed from the repository. Plugin GUI application development has been done using QT Creator as shown in Fig. 3. Rischpater provided detailed information on QT creator [10]. The ANN model was created using the SciKit Learn package. Pedregosa *et al.,* (2011) specified Scikit learn and its uses in machine learning [11]. Matplotlib package has been used to generate plots of the model. Garcia indicated that Python is the most used programming language in machine learning [12], Python3 has been used to write the ANN program. Rossum & Drake described that python3 is easy to learn object-oriented programming language [13].

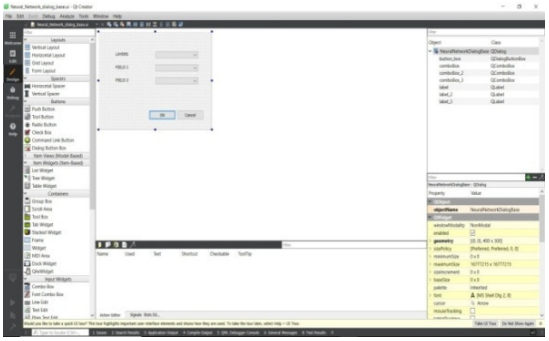

**Fig. 3.** QT Creator.

*D. Experimental Setup*

The ANN has three active layers, they are input layer, the hidden layer and the output layer. Nguyen *et al*., (2019) gives the related information about ANN model [14]. The data X goes through the hidden layers which is a layer between input and output layers, before giving prediction values.

The gathered information on vehicular data is taken from the survey of Shantinagar colony, Hyderabad, Telangana, India.

Here the x and y values for Artificial Neural Network (ANN) analysis are number of people per household and the number of vehicles per household respectively are presented in Tables 1 to 4.

**Table [1 to 4]: Survey on Vehicular Data**

**Table 1.**

| S.No. | X | y |
|---|---|---|
| 1. | 2 | 0 |
| 2. | 2 | 0 |
| 3. | 2 | 1 |
| 4. | 2 | 1 |
| 5. | 3 | 1 |
| 6. | 3 | 3 |
| 7. | 3 | 1 |
| 8. | 3 | 2 |
| 9. | 3 | 1 |
| 10. | 4 | 3 |
| 11. | 4 | 4 |
| 12. | 4 | 3 |
| 13. | 4 | 2 |
| 14. | 4 | 2 |
| 15. | 4 | 1 |
| 16. | 4 | 3 |
| 17. | 5 | 4 |
| 18. | 5 | 3 |
| 19. | 5 | 5 |
| 20. | 5 | 3 |
| 21. | 5 | 1 |
| 22. | 6 | 2 |
| 23. | 6 | 4 |
| 24. | 6 | 3 |
| 25. | 6 | 2 |

**Table 2.**

| S.No. | X | y |
|---|---|---|
| 26. | 7 | 3 |
| 27. | 7 | 2 |
| 28. | 8 | 5 |
| 29. | 8 | 3 |
| 30. | 8 | 4 |
| 31. | 8 | 6 |
| 32. | 8 | 2 |
| 33. | 8 | 3 |
| 34. | 8 | 2 |
| 35. | 8 | 3 |
| 36. | 8 | 5 |
| 37. | 8 | 5 |
| 38. | 9 | 5 |
| 39. | 9 | 3 |
| 40. | 9 | 4 |
| 41. | 9 | 4 |
| 42. | 9 | 4 |
| 43. | 10 | 5 |
| 44. | 10 | 4 |
| 45. | 11 | 6 |
| 46. | 11 | 5 |
| 47. | 21 | 11 |
| 48. | 24 | 13 |
| 49. | 27 | 18 |
| 50. | 28 | 11 |

**Table 3.**

| S.No. | X | y |
|---|---|---|
| 51. | 30 | 13 |
| 52. | 30 | 13 |
| 53. | 31 | 11 |
| 54. | 33 | 17 |
| 55. | 33 | 10 |
| 56. | 34 | 12 |
| 57. | 34 | 25 |
| 58. | 34 | 14 |
| 59. | 35 | 15 |
| 60. | 35 | 12 |
| 61. | 35 | 15 |
| 62. | 35 | 13 |
| 63. | 36 | 16 |
| 64. | 36 | 16 |
| 65. | 36 | 17 |
| 66. | 37 | 15 |
| 67. | 37 | 14 |
| 68. | 40 | 14 |
| 69. | 41 | 19 |
| 70. | 42 | 14 |
| 71. | 42 | 23 |
| 72. | 42 | 14 |
| 73. | 45 | 15 |
| 74. | 46 | 22 |
| 75. | 46 | 21 |

**Table 4.**

| S.No. | X | y |
|---|---|---|
| 76. | 47 | 17 |
| 77. | 47 | 21 |
| 78. | 49 | 18 |
| 79. | 49 | 18 |
| 80. | 49 | 23 |
| 81. | 49 | 26 |
| 82. | 49 | 22 |
| 83. | 50 | 20 |
| 84. | 51 | 19 |
| 85. | 51 | 22 |
| 86. | 52 | 27 |
| 87. | 52 | 27 |
| 88. | 53 | 22 |
| 89. | 53 | 12 |
| 90. | 53 | 24 |
| 91. | 53 | 20 |
| 92. | 53 | 18 |
| 93. | 54 | 21 |
| 94. | 54 | 20 |
| 95. | 55 | 22 |
| 96. | 69 | 24 |
| 97. | 70 | 26 |
| 98. | 70 | 29 |
| 99. | 71 | 31 |
| 100. | 73 | 27 |

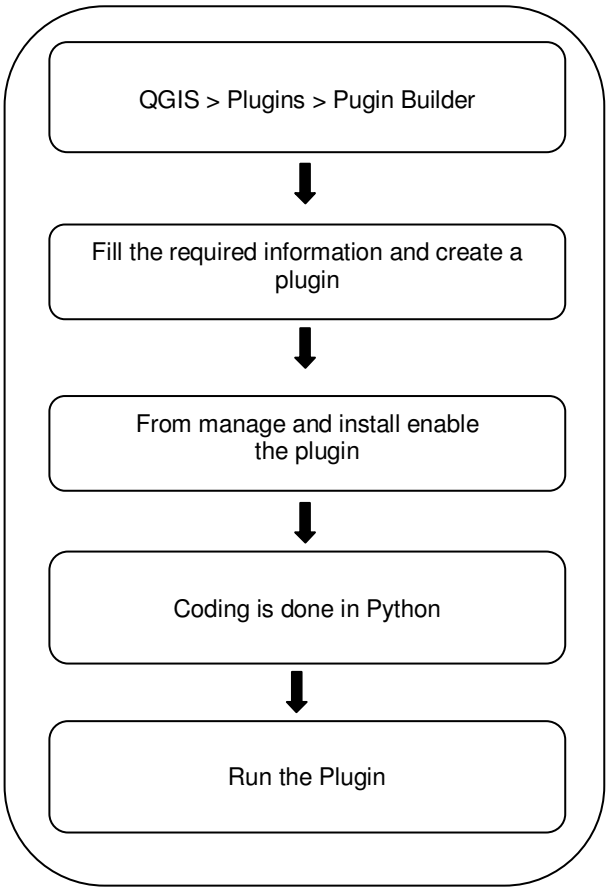


**Fig. 4.** Flow diagram for Artificial Neural Network analysis.

## III. RESULTS AND DISCUSSION

Once the plugin has been created, it has been implemented on the survey data.
After implementation, a dialogue box pops up with the necessary details. The required information has been selected, as shown in Fig. 5.

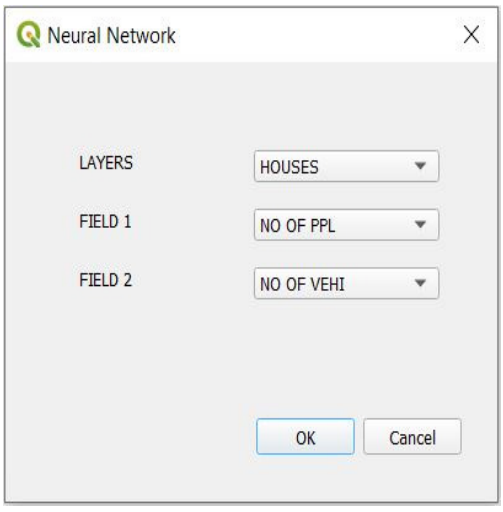


**Fig. 5.** Dialog box.

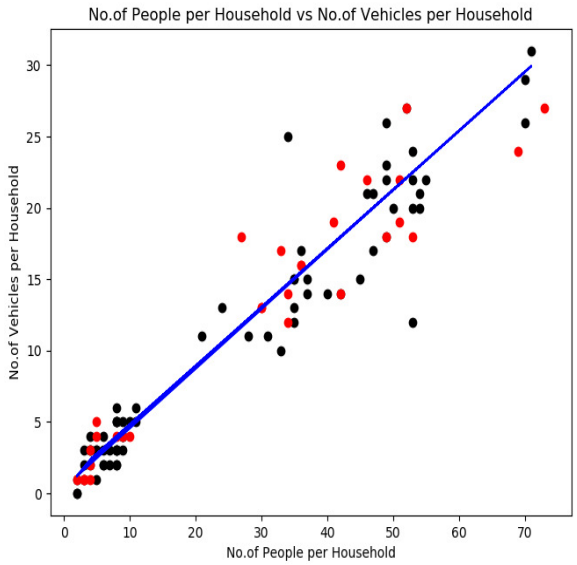


**Fig. 6.** Plotted image.

Fig. 6 shows the resulted plotting.
The blue line in the Fig. 6 shows the Artificial Neural Network Regression line.
The plotted image, as shown in Fig. 6 and the predicted values [Table 5 to 8] appear in a new layer simultaneously after the plugin has been run.

**Table 5: Resulted Predicted Values of Vehicular Data.**

| S.No. | X | y | Predicted Values |
|---|---|---|---|
| 1. | 2 | 0 | 1 |
| 2. | 2 | 0 | 1 |
| 3. | 2 | 1 | 1 |
| 4. | 2 | 1 | 1 |
| 5. | 3 | 1 | 2 |
| 6. | 3 | 3 | 2 |
| 7. | 3 | 1 | 2 |
| 8. | 3 | 2 | 2 |
| 9. | 3 | 1 | 2 |
| 10. | 4 | 3 | 2 |
| 11. | 4 | 4 | 2 |
| 12. | 4 | 3 | 2 |
| 13. | 4 | 2 | 2 |
| 14. | 4 | 2 | 2 |
| 15. | 4 | 1 | 2 |
| 16. | 4 | 3 | 2 |
| 17. | 5 | 4 | 3 |
| 18. | 5 | 3 | 3 |
| 19. | 5 | 5 | 3 |
| 20. | 5 | 3 | 3 |
| 21. | 5 | 1 | 3 |
| 22. | 6 | 2 | 3 |
| 23. | 6 | 4 | 3 |
| 24. | 6 | 3 | 3 |
| 25. | 6 | 2 | 3 |

**Table 6: Resulted Predicted Values of Vehicular Data.**

| S. No. | X | y | Predicted Values |
|---|---|---|---|
| 26. | 7 | 3 | 4 |
| 27. | 7 | 2 | 4 |
| 28. | 8 | 5 | 4 |
| 29. | 8 | 3 | 4 |
| 30. | 8 | 4 | 4 |
| 31. | 8 | 6 | 4 |
| 32. | 8 | 2 | 4 |
| 33. | 8 | 3 | 4 |
| 34. | 8 | 2 | 4 |
| 35. | 8 | 3 | 4 |
| 36. | 8 | 5 | 4 |
| 37. | 8 | 5 | 4 |
| 38. | 9 | 5 | 4 |
| 39. | 9 | 3 | 4 |
| 40. | 9 | 4 | 4 |
| 41. | 9 | 4 | 4 |
| 42. | 9 | 4 | 4 |
| 43. | 10 | 5 | 5 |
| 44. | 10 | 4 | 5 |
| 45. | 11 | 6 | 5 |
| 46. | 11 | 5 | 5 |
| 47. | 21 | 11 | 9 |
| 48. | 24 | 13 | 11 |
| 49. | 27 | 18 | 12 |
| 50. | 28 | 11 | 12 |

**Table 7: Resulted Predicted Values of Vehicular Data.**

| S.No. | X | y | Predicted Values |
|---|---|---|---|
| 51. | 30 | 13 | 13 |
| 52. | 30 | 13 | 13 |
| 53. | 31 | 11 | 13 |
| 54. | 33 | 17 | 14 |
| 55. | 33 | 10 | 14 |
| 56. | 34 | 12 | 15 |
| 57. | 34 | 25 | 15 |
| 58. | 34 | 14 | 15 |
| 59. | 35 | 15 | 15 |
| 60. | 35 | 12 | 15 |
| 61. | 35 | 15 | 15 |
| 62. | 35 | 13 | 15 |
| 63. | 36 | 16 | 15 |
| 64. | 36 | 16 | 15 |
| 65. | 36 | 17 | 15 |
| 66. | 37 | 15 | 16 |
| 67. | 37 | 14 | 16 |
| 68. | 40 | 14 | 17 |
| 69. | 41 | 19 | 18 |
| 70. | 42 | 14 | 18 |
| 71. | 42 | 23 | 18 |
| 72. | 42 | 14 | 18 |
| 73. | 45 | 15 | 19 |
| 74. | 46 | 22 | 20 |
| 75. | 46 | 21 | 20 |

**Table 8: Resulted Predicted Values of Vehicular Data.**

| S. No. | X | y | Predicted Values |
|---|---|---|---|
| 76. | 47 | 17 | 20 |
| 77. | 47 | 21 | 20 |
| 78. | 49 | 18 | 21 |
| 79. | 49 | 18 | 21 |
| 80. | 49 | 23 | 21 |
| 81. | 49 | 26 | 21 |
| 82. | 49 | 22 | 21 |
| 83. | 50 | 20 | 21 |
| 84. | 51 | 19 | 22 |
| 85. | 51 | 22 | 22 |
| 86. | 52 | 27 | 22 |
| 87. | 52 | 27 | 22 |
| 88. | 53 | 22 | 22 |
| 89. | 53 | 12 | 22 |
| 90. | 53 | 24 | 22 |
| 91. | 53 | 20 | 22 |
| 92. | 53 | 18 | 22 |
| 93. | 54 | 21 | 23 |
| 94. | 54 | 20 | 23 |
| 95. | 55 | 22 | 23 |
| 96. | 69 | 24 | 29 |
| 97. | 70 | 26 | 30 |
| 98. | 70 | 29 | 30 |
| 99. | 71 | 31 | 30 |
| 100. | 73 | 27 | 31 |

## IV. CONCLUSION

The authors have developed an ANN Plugin in QGIS software and shown its application by conducting a survey regarding the vehicular usage per house in Shatinagar colony. This plugin can be used to predict any other fields in a shape file as well. The user can connect their field data from an attribute column of a shape file to artificial neural network.

## V. FUTURE SCOPE

In future, the presented plugin can be used by GIS experts or users to connect this artificial neural network prediction model plugin to their own geographical information.


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**Conflict of Interest.** The authors don't have any conflicts of interest.


## REFERENCES


[1]. Ahmed, N., Diptu, N. A., Shadhin, M. S. K., Jaki, M. A. F., Hasan, M. F., Islam, M. N., & Rahman, R. M. (2019). Artificial Neural Network and Machine Learning Based Methods for Population Estimation of Rohingya Refugees: Comparing Data-Driven and Satellite Image-Driven Approaches. *Vietnam Journal of Computer Science*, *6*(4), 439–455.

[2]. Tang, Z., Leung, C. W., & Bagchi, K. (2006). Improving Population Estimation with Neural Network Models. *Advances in Neural Networks, Lecture Notes in Computer Science*, 1181–1186.

[3]. Wagh, V. M., Panaskar, D. B., Muley, A. A., Mukate, S. V., Lolage, Y. P., & Aamalawar, M. L. (2016). Prediction of groundwater suitability for irrigation using artificial neural network model: a case study of Nanded tehsil, Maharashtra, India. *Modeling Earth Systems and Environment*, *2*(4), 1–10.

[4]. Darwishe, H., El Khattabi, J., Chaaban, F., Louche, B., Masson, E., & Carlier, E. (2017). Prediction and control of nitrate concentrations in groundwater by implementing a model based on GIS and artificial neural networks (ANN). *Environmental Earth Sciences*, *76*(19), 649.

[5]. Becker, D., Willmes, C., Bareth, G., & Weniger, G. C. (2016). A Plugin to Interface Openmodeller from QGIS for SPECIES' Potential Distribution Modelling. *ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, *3*, 251-256.

[6]. Mair, C., Kadoda, G., Lefley, M., Phalp, K., Schofield, C., Shepperd, M., & Webster, S. (2000). An investigation of machine learning based prediction systems. *Journal of systems and software*, *53*(1), 23-29.

[7]. Badami, M. (2005). Transport and Urban Air Pollution in India. *Environmental Management*, *36*(2), 195-204.

[8]. Ghorani-Azam, A., Riahi-Zanjani, B., & Balali-Mood, M. (2016). Effects of air pollution on human health and practical measures for prevention in Iran. *Journal of research in medical sciences: the official journal of Isfahan University of Medical Sciences*, *21*, 1-12.

[9]. Buitinck, L., Louppe, G., Blondel, M., Pedregosa, F., Mueller, A., Grisel, O., ... & Layton, R. (2013). API design for machine learning software: experiences from the scikit-learn project. *arXiv preprint arXiv:1309.0238*.

[10]. Rischpater, R. (2013) Application Development with Qt Creator. *Packt Publishing Limited*.

[11]. Pedregosa, F., Varoquaux, G., Gramfort, A., Michel, V., Thirion, B., Grisel, O., & Vanderplas, J. (2011). Scikit-learn: Machine learning in Python. The *Journal of machine Learning research*, *12*, 2825-2830.

[12]. García, Á. L. (2019). DEEPaaS API: a Rest API for Machine Learning and Deep Learning models. *Journal of Open Source Software*, *4*(42), 1-2.

[13]. Rossum, G.V., & Drake, F.L. (2003). An Introduction to Python. *Network Theory Ltd*.

[14]. Nguyen, G., Dlugolinsky, S., Bobák, M., Tran, V., García, Á. L., Heredia, I., Hluchý, L. (2019). Machine Learning and Deep Learning frameworks and libraries for large-scale data mining: a survey. *Artificial Intelligence Review*, *52*(1), 77–124.



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