Web Page Design of Automobile Energy Saving and Emission Reduction System Based on Neural Network

ZU Lin-mei¹, Quan Kai-li¹, QI Guang-lei¹∗, HOU Xiao-gang²

(1 Century College, Beijing University of Posts and Telecommunications, Beijing 102101; 2 Research Institute of Network Technology, Beijing University of Posts and Telecommunications, Beijing 100876)

* Correspondent author, E-mail: qgl@email.bjut.edu.cn

Abstract: With the continuous development of economy and society, the demand and use of automobiles are increasing all over the world. China's automobile industry has gradually grown into one of the important industries. Automobile exhaust has become one of the main sources of air pollutants in many cities, and automobile exhaust in some cities has a great impact on many air pollution indicators. If we can provide a more energy-saving route for the driver before the driver leaves, combining with the traffic situation forecast, we can better realize the energy-saving and emission-reduction of automobile travel. This paper mainly introduces the web page design of an automobile energy saving and emission reduction system based on neural network, which is implemented by Python, Html, JavaScript, CSS, Java and other programming languages, and meets the basic needs of users.

1. Introduction

With the continuous development of the times, the automobile industry has gradually grown into one of the pillar industries of China's economy, and it is more obvious to pull the whole economy of China. Up to 2015, China's automobile sales have exceeded 24.5 million vehicles, setting a new high in the world, ranking first in the world for ten consecutive years, and at the same time, this figure is still increasing.

With the development of the automobile industry, related applications are constantly appearing. At the same time, the continuous construction of urban roads leads to diversified choices of travel routes, so navigation application has become one of the daily applications of people. Nowadays, the production of navigation systems all over the world is more focused on providing users with the shortest path. It is impossible to provide users with more choices of travel routes only by judging the travel time.

The Web page design of this automobile energy saving and emission reduction system based on neural network hopes to solve this problem better. With the continuous development of artificial intelligence technology and the emergence of neural network, we can write better programs to predict and estimate traffic, and provide the most suitable path for each user according to the results. After meeting the user's use requirements, it can not only save fuel costs for users, but also achieve the purpose of energy saving and emission reduction. With the increasing demand for car travel and the increasing emphasis on environmental protection, the utilization rate of this system will also increase, which will provide users with better and more suitable personalized travel planning for environmental protection, and also help the world's environmental protection.
2. Design of Function Module Based on Neural Network

2.1. Detailed design of time estimation function module based on neural network

In the functions of transportation travel system, the function of travel time estimation is very common, because more accurate time estimation can provide users with more efficient and accurate travel route planning. In the past, there were two ways to estimate travel time. One way was to calculate the individual time of each part of the whole route, and then sum the results of each part. However, in this calculation method, the transit time of each connection point will be ignored, and there will probably be traffic lights at the connection points, which will have a great impact on the results. However, in the method of multi-link summation, error accumulation will lead to greater error. Another calculation method is the complete time estimation of the whole line, but the length of the path data is different. With the increase of the length of the path, there will be fewer and fewer similar track lines. The reduction of reference data makes this calculation method cause the error to increase when the path grows. Therefore, the end-to-end time estimation method is used in this system, in which these two methods are integrated to reduce errors and finally achieve more accurate travel path time estimation.

The time estimation module based on neural network mainly includes two parts: one is data module and the other is program module. The neural network model is trained and tested by using the processed data set, so as to obtain the neural network model with better effect. The data module is mainly for processing data content and providing corresponding data sets for training and testing of models.

The program module is mainly composed of three functional modules, namely, external attribute component module, spatio-temporal learning component module and multi-task learning component module. The external attribute component module is used to deal with external factors (including week, weather, driver information, date) and basic information of the designated route (GPS and time, etc.). The data information in the external attribute component is sorted and transformed and then input to other components for use. At the same time, the spatio-temporal learning component module performs time estimation, which is also the most important algorithm component, and learns the time dependence and spatial correlation from the original positioning sequence to complete the estimation. The two parts are processed together. Finally, the time given in the first two components is used in the module of multi-task learning component, and the weight method is used to balance the independent path time estimation and the multi-link summation method estimation, so as to get a better travel time estimation.

![Traffic Forecast Flowchart Based on Neural Network](image)

Fig.1 Traffic Forecast Flowchart Based on Neural Network
2.2. Detailed design of traffic prediction function module based on neural network
Traffic forecast is essential in the planning stage before the car goes out. Because of the particularity and regularity of traffic flow, it is not easy to predict traffic flow, and there are a lot of research results in the field of transportation for many years.

For traffic flow prediction, this system uses neural network algorithm and constructs a graph convolution neural network with gating mechanism to complete the traffic flow prediction function based on neural network, in which the model based on spatio-temporal convolution network is used to process the graph data in traffic network. Many methods are used to record and simulate the spatial dependence and temporal correlation of traffic flow series. In the spatio-temporal convolution network, multiple spatio-temporal convolution blocks are used to simulate the dependence of time and space, so as to complete the traffic flow prediction.

This module is also divided into two parts: data module and program module. Among them, the data module will complete the processing and conversion of traffic flow data, and then apply to the training model and test model. In the program module, the model consists of a spatio-temporal convolution block and an output layer. Each spatio-temporal convolution block contains a time-gated convolution layer and a spatial map convolution layer. After the data is processed by the spatio-temporal convolution block, the features are integrated from the output layer to finally complete the traffic flow prediction. The specific operation flow chart is shown in Figure 1.

2.3. Detailed design of front end of automobile energy saving and emission reduction system
The front end of the whole automobile energy saving and emission reduction system is realized based on Java Web, and relatively complete system functions are designed and implemented to facilitate users to understand and use the system.

2.3.1. Design of front-end login and registration module
For the data security of the whole system, all users need to log in before they can use all the functions in the system. After the user completes the account registration when logging in for the first time, he can log in to the system with his own account password every time. The design timing diagram of the front-end login module is shown in Figure 2.

When users use system functions, they need to use their own accounts to log in to the system. The front-end system provides users with a registration interface, which can provide users with account registration services for the first time. During the registration process, users can create their own accounts corresponding to the information, and provide users with an information verification interface to help them better check and record their own account information, so as to complete the account registration function.
2.3.2. Design of front-end navigation function module corresponding to time estimation algorithm based on neural network

The front-end navigation function module corresponding to the time estimation algorithm based on neural network is designed to provide users with navigation service of automobile travel routes. In the module, we are determined to use the attribute information as in the time estimation algorithm based on neural network: collect the travel time, weather, week and driver's account number at that time, and the user can input the names of departure place and destination, and choose the calculation strategy (including the most energy saving and emission reduction, etc.). Click query route to generate planned route. Auxiliary functions are provided in the navigation function: calculation of travel time, calculation of straight-line distance, single journey record, summary map of all trips, statistics of fuel consumption and earth satellite map. To provide users with integrated and perfect travel navigation services. The design flow of the navigation function module of the front-end system is shown in Figure 3.

2.3.3. The traffic prediction algorithm based on neural network corresponds to the front-end traffic prediction function module design and introduces the front-end design of the module

The front-end traffic prediction function module corresponding to the traffic prediction algorithm based on neural network provides users with real-time traffic situation prediction display of automobile travel, and provides users with real-time traffic prediction and traffic situation prediction at specified time or week in the module. Users can check according to their own use needs, and complete the route planning with reference to the traffic conditions at that time in advance, so as to choose more energy-saving and emission-reducing travel results. This function module also shows users the effect after the completion of the traffic prediction function module based on neural network. At the same time, in order to make users have better and more beautiful use, this page also provides users with customized background and style of traffic prediction page.

In the introduction module based on neural network algorithm, it mainly shows the creativity and compilation of these two neural network algorithms for users, and provides the reappearance and explanation of ideas for interested users. The flow chart of the algorithm introduction module is shown in Figure 4.
2.3.4. Front-end design of automobile energy saving and emission reduction auxiliary module and design of personal information management module

Two neural network-based algorithms are used to complete the design of automobile energy saving and emission reduction system. In the front-end design of automobile energy saving and emission reduction auxiliary module, the main purpose is to let users know how to realize energy saving and emission reduction of automobile travel by using these two neural network algorithms and related functions. In this way, it shows the users that if the system realizes energy saving and emission reduction through the completion of neural network algorithm. The design flow of auxiliary module for automobile energy saving and emission reduction is shown in Figure 5.

The front-end system provides two permissions to use the personal information management function. One is administrator's authority, which can operate all user databases, including new user module and information update module. Administrators can manually add new users and modify user information under administrator's authority. The other is the right of ordinary users, which includes a module for modifying passwords and a module for editing personal information. Users can modify their own account information or modify passwords.

3. Web page design of automobile energy saving and emission reduction system

3.1. Front-end login and registration functions

The front end of the automobile energy saving and emission reduction system is realized through Java Web, and the database is connected to provide users with login function. If users use this system for the first time, they can use the registration function to register their personal accounts. After registration, log in, and the system will check with the information in the database, and then log in to the system successfully if the input is correct. The login system provides the function of judging whether it is administrator login. You can choose whether you have logged in as an administrator. If you choose, you will verify whether you have administrator authority in the database. If you have authority, you will enter the system as an administrator. If you don't, you will be prompted with insufficient authority. When users use the system for the first time, they can use the front-end registration function to create their own users to use the system. The first is the user input information interface, where users enter their own user information to create their unique accounts. Check whether the information input by the user meets the format requirements in this interface, and prompt the user if it does not; If yes, it will jump to the information confirmation interface. After the user confirms the information, the user account is successfully created, and the data will be saved in the database, so that the user can log in to the system later and use the login function to complete the login operation and enter and use the whole system.

3.2. Front-end navigation function corresponding to time estimation algorithm based on neural network

The navigation function module in the system occupies a very important position in the whole system,
and it is the goal of this module to provide users with various types of route planning. In this module, the attribute component of the time estimation algorithm based on neural network is imitated, and the information of time, weather, week and driver at that time is displayed on the page, as shown in Figure 6.

![Fig. 6 Screenshot of Navigation Main Page](image)

After entering the user's departure place and destination, provide the accurate address information of the selection box, and click the query route to obtain the route planning information. The query result of the path planning module of the front-end navigation function is shown in Figure 7.

Secondly, other parts of the featured navigation function are displayed: providing users with calculated travel time, calculated straight-line distance, single trip record, summary map of all trips, fuel consumption statistics, and earth satellite map, which are shown as follows.

![Fig. 7 Navigation function path planning detailed planning screenshot](image)

Among them, the auxiliary function of calculating travel time estimation is to calculate the travel time estimation of the designated route for the user, so that the user can know and know the time estimation result more directly, and show the user and interested people how the algorithm is used in real situations, and its page is as shown in the figure.

![Fig. 8 Time estimation interface pop-up window](image)

Other auxiliary functions have the function of calculating geographical straight line distance between departure place and destination, which uses geographical route distance as data reference in calculation time estimation algorithm, and shows this process to users in real functional way. The auxiliary function also has the function of recording single trip, which provides trip recording function for users. After recording a single trip, multiple trip summary maps can be drawn through summary
and fuel consumption statistics can be completed. After trip data summary and fuel consumption data analysis, users can be provided with accurate way of saving energy and reducing emissions.

Fig. 9 Results pop-up window of linear distance calculation interface

3.3. Front-end traffic prediction function corresponding to traffic prediction algorithm based on neural network

The purpose of the traffic prediction function module displayed in the front-end system is to show users the prediction results based on neural network traffic prediction algorithm more intuitively. Provide users with more accurate traffic forecast, which is beneficial for users to get accurate and effective travel planning results. In this function module, the user will first see the city map located by the login address, click the road condition information button to display the current real-time road condition information, and drag and drop the mouse to display the required content. The current road condition prediction situation is displayed to the user through red display congestion, yellow display slowness and green display smoothness. After that, if the user needs to check the traffic situation at the specified time, he can click the View Traffic Forecast button and check the corresponding traffic flow forecast by selecting the week and time. Each function page of the front-end traffic prediction function is shown in the following figure.

Fig. 10 Screenshot of Traffic Forecast Function Page
3.4. Auxiliary function of automobile energy saving and emission reduction and personal information management module

The main idea of the auxiliary module of the automobile energy saving function emission reduction system is indexed by the front main interface, which provides users with the latest content push, automobile energy saving and emission reduction information, the necessity of energy saving and emission reduction, the introduction of energy saving and emission reduction in this system, and the introduction and index of modules such as automobile news and picture appreciation. As the main interface, it provides help for users to understand the system intuitively. The main interface of the front end is shown in Figure 12.

Driving assistant page is a summary page that provides users with various function indexes and some auxiliary tools, and provides users with a complete car travel experience. The interface of energy saving and emission reduction method is mainly to provide users with relevant knowledge of automobile energy saving, so as to assist this program to realize energy saving and emission reduction of automobile travel. Each automobile fuel consumption leaderboard is the data obtained by crawler, which is displayed after collection and page design. There are four big classification leaderboard pages with detailed leaderboard links. Each detail leaderboard provides the functions of storing data lists in multiple ways, sorting independently according to each header and querying keywords.

In the page, the data of average fuel consumption, comprehensive road fuel consumption, urban road fuel consumption, suburban road fuel consumption and expressway fuel consumption calculated by users of various models are provided. The automobile news interface is composed of navigation and news, and the automobile brand introduction page is composed of the main interface and the introduction interfaces of ten famous brands at home and abroad. The realization of these two interfaces meets the browsing needs of users to provide daily automobile related information. The
realization of these pages together constitute the auxiliary function module of automobile energy saving and emission reduction system, and the details of each page are shown in the following figure.

![Fig.13 Some screenshots of each brand's automobile fuel consumption ranking page and screenshots of each ranking page list](image1.png)

![Fig.14 Screenshots of Fuel Consumption Rankings of Minicars](image2.png)

4. System test

In order to ensure the use quality and completion of the whole automobile energy saving and emission reduction system, system testing is a very necessary link. In the process of completing the testing, the possible loopholes and problems in the design and development process are found, so as to better complete the update and improvement of the program. Therefore, through a complete system test to verify whether the design of the whole system meets the corresponding requirements.

The tests of the automobile energy saving and emission reduction system, algorithm and front-end part are independently completed in their respective operating environments. The Python development environment is used to verify and monitor the functions and performance tests of the two neural network algorithms. Use Java Web development environment to verify whether each function and page in the front-end system can be used normally, and test whether users and administrators can log in to the system successfully. Finally, the test results are summarized, and the loopholes and defects found in the whole system are updated and improved by analyzing the results.

4.1. Front-end page function test

Test purpose: Check whether each function in the whole automobile energy saving and emission reduction system can be used normally, and realize the corresponding requirements of each part under better performance.

When the user logs in to the system homepage, the login or registration option will be provided, and the functions in the system can be used only after the login operation is completed. When users enter the system for the first time or need an account, they need to register.

The user fills in the information in the registration interface, and the system will prompt if there is any error in the filling process. The interface for filling in the registration information is shown in Figure 15.

![Fig.15 Query Results of User Table Data before User Registration](image3.png)
After the user completes the information entry and clicks Register, jump to the registration verification page to verify the information, as shown in Figure 17.

The query result of the user table after the user completes registration is shown in Figure 18.

Users can log in with their own username and password, and provide administrator login options as shown in Figure 19.

After the user logs in successfully, the page jumps to the main interface in the system, and displays the user login information in the navigation bar, as shown in Figure 20.

In the user center, there are two functions: updating personal information and updating password. The modify user information function page will display the current user information as shown in Figure 21, and the corresponding database query results are as above. After the user makes changes, the database query results are shown in Figure 4-8.
Update password function interface as shown in Figure 23, which requires the user to enter the correct password to complete the user password update, if the input password is wrong, prompt, if the password change is completed, the database query will be changed as shown in Figure 24.

When the user finishes using the system, he can use the safe exit function to safely exit the system and return to the login interface. When you can log in again later, now test the administrator login operation, as shown in Figure 25.

The difference between the administrator's usable function authority and ordinary users lies in the information management part. The user function can be added manually under the administrator's authority, as shown in Figure 26. After adding, the database query user table results are shown in Figure 27. Information management under all user rights can also be carried out as shown in Figure 28.
Fig. 26 The administrator manually adds user functions

Fig. 27 Update Results of User Table Query after Manually Adding Users

Fig. 28 User Information Modification Function under Administrator Permission

Fig. 29 Navigation function input information page
In the traffic prediction function, the user clicks the road condition information to query the real-time prediction result, which is shown in Figure 31.

To sum up, in the front page of the automobile energy saving and emission reduction system, all the functions described above are realized, which meets the expected results, and can provide users with help in automobile energy saving and emission reduction.

5. Conclusion
The data module of time estimation and traffic prediction based on neural network: processed and improved the driving data sets of different vehicle types and collected the fuel consumption information of different vehicle types, and completed data analysis, data cleaning and feature engineering on the data to ensure that the data sets can be used normally by the neural network model during training and testing.

The front-end design and development of automobile energy saving and emission reduction system includes user registration module, login module, characteristic navigation module, real-time traffic prediction module, automobile fuel consumption information module, auxiliary function module, algorithm introduction module and user information management module. The front-end function development of these modules has been completed, providing users with more intuitive experience, understanding the background algorithm and the way of saving energy and reducing emissions.

All the design requirements and functions have been realized normally, but there is more room for improvement in the whole system. For example, the real implementation of the background algorithm can be connected with the map in real time, because the open source environment provided by map development and use companies like Baidu and Gaode is limited, and now only part of the map can be developed and drawn, and many of the permissions and environments are still inaccessible. Therefore, the real-time application of front-end and back-end algorithms is still in the development stage. The designed front-end route navigation system still refers to the route planning provided by the existing
map manufacturers, but also provides an algorithm introduction page in the front-end interface, which provides a more direct display for users to understand the algorithm through manually drawn map lines. These are all difficult problems that can be studied and improved in the future. The design and development of this automobile energy saving and emission reduction system is not over yet, and it is constantly being improved and updated. I hope this system can be really applied in the future and contribute to the traffic and environment.

References:
[1] Zheng Zhang. Digital Image Processing and Machine Vision [M]. Beijing: People’s Posts and Telecommunications Press, 2014.
[2] Zhou Zhihua. Machine Learning [M]. Beijing: Tsinghua University Publishing House, 2016.
[3] Ian Goodfellow. Deep Learning [M]. Zhao Shenjian, Trans. Beijing: People's Posts and Telecommunications Press, 2017.
[4] Tariq Rashid. Python Neural Network Programming [M]. Lin Ci, trans. Beijing: People's Posts and Telecommunications Press, 2018.
[5] Dai Kui. Neural Network Design [M]. Beijing: Mechanical Industry Press, 2007.
[6] Francois Xiaolai. Python Deep Learning [M]. Sean, Trans. Beijing: People's Posts and Telecommunications Press, 2018.
[7] LeCun Y, Bengio Y, Hinton G. Deep learning[J]. Nature, 2015, 521(7553): 436-444.
[8] Li Qiuping et al. Analysis of the status quo of energy conservation and emission reduction [J]. Northern Environment, 2013,12: 149-151.
[9] Wang Yun. Research on Vehicle Navigation Path Planning Algorithm [J]. Practical Vehicle Technology, 2017, 21: 202-204.
[10] Wang Yisong, Wang Zhijie. Research on optimal path planning algorithm based on real-time traffic information [J]. Computer and Modernization, 2013,2 (210): 52-55.
[11] Ge Yan, Wang Jian. Research progress on dynamic path planning for vehicle navigation [J]. Highway Traffic Science and Technology, 2010, 11: 113-117.
[12] Teng Wen. Research on Optimal Path Search Algorithm for Vehicle Navigation System [J]. Automation and Instrumentation, 2016, 12 (206): 179-180.