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Mini Electric Vehicle Based on LMD Algorithm and Green Travel Concept

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Abstract: *With the progress of society, people's awareness of environmental protection is gradually increasing. The sustainable development of society is threatened by many problems, such as resource shortage, global warming and other issues, and miniature electric vehicles play an invaluable role in solving environmental pollution and traffic congestion. The design and development of electric vehicles is even more important. Combined with the social development trend and the concept of green travel, this paper takes the design of micro electric vehicles as the research object. Through market research, it analyzes users' needs for micro electric vehicles from three perspectives, such as styling style design, color design, and performance demand design, and determines the design plan. After designing the preliminary model of the electric vehicle, the satisfaction of 50 users in experiencing the mini electric vehicle was tested, and the results showed that the majority of users had a high degree of satisfaction and could be put into mass production. Later, the LMD algorithm is used to detect the damage degree of the miniature electric vehicle under the condition of door deformation. The experimental results prove that the miniature electric vehicle designed in this paper has good anti-collision performance.*

Keywords: *LMD Algorithm, Green Travel Concept, Micro Electric Vehicle, Anti-Collision Performance*

1. Introduction

The development of transportation has brought unprecedented changes to human society, and various negative effects have followed. Lack of energy, environmental pollution, and urban congestion, we urgently need a new way of travel. Micro electric vehicles are born with the development of urban society. They make urban travel more intelligent, environmentally friendly, energy-saving, convenient and efficient, thereby greatly improving the quality of people's urban life.

Many scholars at home and abroad have conducted in-depth research on the design of micro electric vehicles based on the LMD algorithm and the concept of green travel, and have achieved good research results. For example, in order to meet the diversified needs of current users, major miniature electric vehicle manufacturers have successively launched light, simple and environmentally friendly miniature models, and use large curved surfaces to shape the body. In addition to the overall shape of the curved surface, the waist Parts of the car pay great attention to the interspersed lines, which not only guarantees the overall shape, but also has a deep visual impact. It reflects the quality of the car from the details, which is in line with the luxury taste of contemporary consumers [1-2]. Based on the concept of green vehicle models, a scholar studies the relationship between people, vehicles and traffic, and applies the systematic way of thinking to propose a design scheme for miniature electric vehicles from two aspects of software and hardware, which greatly improves the driving efficiency and improves the current situation of traffic congestion [3]. Although the research on the design of micro electric vehicles based on the LMD algorithm and the concept of green travel is progressing well, it is still necessary to expand the scope of use of micro electric vehicles in cities and promote the concept of green travel to people.

This paper first introduces the principle of LMD algorithm, and proposes an algorithm model, then expounds the advantages and disadvantages of micro electric vehicles, and then locates the public's demand for micro electric vehicles through market research, then determines the design scheme, and then tests the micro electric vehicles after they are designed. The test results verify that the miniature electric vehicle designed in this paper can meet the user's requirements and ensure the user's driving safety.

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2. LMD Algorithm and Micro Electric Vehicle Design

2.1. LMD Algorithm

The full name of LMD algorithm is local mean decomposition algorithm. This method can decompose complex and unstable signals into the original signal by means of step-by-step decomposition, and the decomposed signal will be formed into a whole by the way of product and summation. The product function the sum can be represented by PF [4]. There are many similarities between LMD and HHT. The signal with various mixed disturbances is decomposed by the most primitive feature scale and performance of the signal itself. LMD has advantages in selecting endpoints and screening times, saving signal acquisition and analysis. At the same time, the most accurate power quality signal is extracted, and the influence on the signal itself is small in the process of extracting the signal, which makes the amplitude signal extracted by LMD has complete authenticity [5]. The LMD algorithm has been widely used in many fields in signal extraction, such as the extraction and analysis of brain waves, the location of mechanical vibration fault signals, the acquisition of accurate instantaneous frequency and the detection of power grid oscillation faults got good results [6].

The core problem of the LMD algorithm is to decompose the extracted signal into one or more groups of functional product components (PF) after multiple iterations, in which all amplitude information in the original function is recorded in the envelope function, and the pure FM signal is mainly Displays frequency-related data information. Piecing these scattered function information together can get the complete original function information [7].

$$y_s(i) = \frac{1}{2n+1}\left[y(i+n) + y(i+n-1)... + y(i-n)\right] \tag{1}$$

In the formula, $y_s(i)$ is the original order of the data, and 2n+1 is the sliding width.

$$h(t) = x(t) - m(t)$$

Where x(t) represents the original signal, m(t) represents the local mean function, and h(t) the new signal function.

2.2. The Concept of Green Travel

At present, there is no unified definition of the concept of green travel. From the content of the description, the concept of green travel can be reflected in the research on green transportation. From the perspective of the development process of green transportation concept research, green travel originates from the green transportation concept and is a new travel concept that emerged with the development of society. Therefore, combined with the meaning of green transportation, it is believed that green travel is a travel behavior that adapts to the development trend of urban living environment and uses green transportation such as walking, non-motor vehicles and public transportation as tools. Its core is to guide the formation of short-distance travel and slow A multi-modal transportation structure with coexistence of multi-modal transportation and complementary advantages in long-distance travel and public transportation as the main purpose is to maximize the good operation of the transportation system and save land resources [8-9]

2.3. Features of Micro Electric Vehicles

2.3.1. Advantages Of Mini Electric Vehicles

Small and flexible: Due to the small size of the miniature electric vehicle itself, the steering radius of the vehicle is also relatively small, it will be more flexible to drive, the operation will be more convenient, and it will be easier for the driver to complete various actions (such as reversing into the garage). At the same time, because the size and volume of the body are relatively small, and the space occupied by the vehicle is relatively small, it is helpful to alleviate the traffic congestion problem during the rush hour of urban commuting. At the same time, the area required for parking is smaller, so problems like parking difficulty can also be improved [10].

Miniaturization: Since the battery life of the vehicle is directly related to the weight of the vehicle, and the miniaturization can greatly reduce the weight of the vehicle, under the premise of limited battery capacity, the miniaturization can improve the battery life of the vehicle. Compared with

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traditional large and small vehicles, micro electric vehicles are more flexible and convenient to drive, so micro electric vehicles are more suitable for this congested environment [11]. At the same time, it can also achieve the purpose of energy saving and emission reduction, so the development prospects of micro electric vehicles are bright.

Economical and environmentally friendly: Micro electric vehicles are environmentally friendly vehicles, and their noise is much lower than that of traditional fuel vehicles, so they are favored by people. Moreover, the production cost, maintenance cost, and consumption cost of micro electric vehicles will be greatly reduced.

2.3.2. Disadvantages of Mini Electric Vehicles

Due to the limitation of the size of the miniature electric vehicle itself, it is not so free in terms of shape expression. Moreover, because of the small size of the miniature electric vehicle, it is not easy to give people a sense of stability visually. It always makes people feel that the car is easy to overturn, and the miniature electric vehicle does not give people a strong sense of speed. At the same time, due to the limitation of body size, the interior space of the car will also be affected accordingly, which is especially easy to make people feel depressed. Therefore, how to solve these problems from the design has become the focus of research on the design of miniature electric vehicles [12].

3. Market Research Positioning

The purpose of market research is to formulate a design plan through research and analysis of users' demand for styling, color, function and travel of mini electric vehicles.

3.1. User Needs Positioning

Micro electric vehicles need to meet the needs of different users, so this market research selected a total of 180 users of different age groups, and the number of users in each age group is relatively average. The research and analysis results show that most people experiment with micro electric vehicles to meet travel needs, such as commuting to and from get off work, shopping, entertainment, tourism, etc., so they need to meet basic short- and medium-distance travel needs.

3.2. Modeling Style Positioning

According to the analysis results of the target users' demand for the styling style of miniature electric vehicles in terms of styling, there are five styles of automobile styling styles, such as technological avant-garde, round and lovely, individual vitality, dynamic simplicity, and sports fashion. The choice of each style The number of people is 31, 16, 36, 42, and 55 respectively. Most people tend to be technological, fashionable, simple and sporty. Therefore, the car styling should be dynamic and simple in line with the concept of environmental protection. Fashion also needs to adapt to social development trends and show a sense of technology. At the same time, it also needs to reflect the sporty style of miniature electric vehicles.

3.3. Color Positioning

Color is an important way to express style. According to the user's psychological needs for miniature electric vehicles and the positioning of the styling style, the concept of environmental protection and the sense of technology should be highlighted in the color design. Since blue-gray is a color close to nature and is also a representative color for a sense of technology, blue-gray can be used in the color design of the vehicle, and a relatively pure white can be used with metallic gray to reflect the sense of technology.

3.4. Positioning of Functional Requirements

As shown in Figure 1, in terms of functional requirements for mini electric vehicles, the majority of users believe that intelligent interaction, safety and comfort, energy conservation and environmental protection are more important, accounting for 23.33%, 19.45%, and 20.56%, respectively. Therefore, it is necessary to combine intelligent technology to make the operation of the car more ergonomic and realize the sense of technology.

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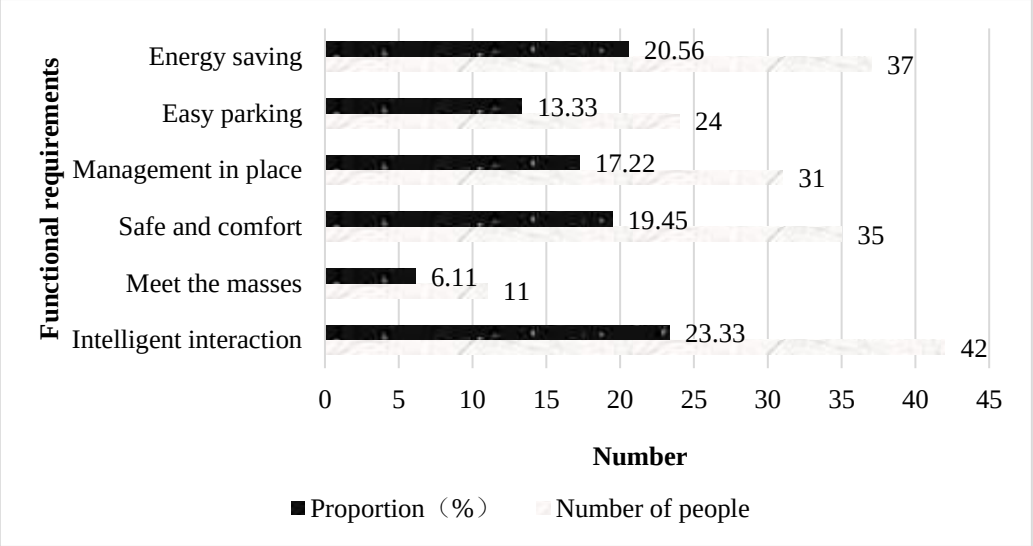

Figure 1: Functional requirements analysis

3.5. Determination of Design Scheme

According to the above research and positioning results, the design plan is determined. In order to meet the needs of most users for mini electric vehicles, mini electric vehicles too meet the basic implementation needs. In the design of shape and color, it can be biased towards a low-key and elegant style without losing dynamic vitality, and realize intelligent operation and convenient management, green travel and other functions.

4. Market Research Positioning

User Satisfaction Survey

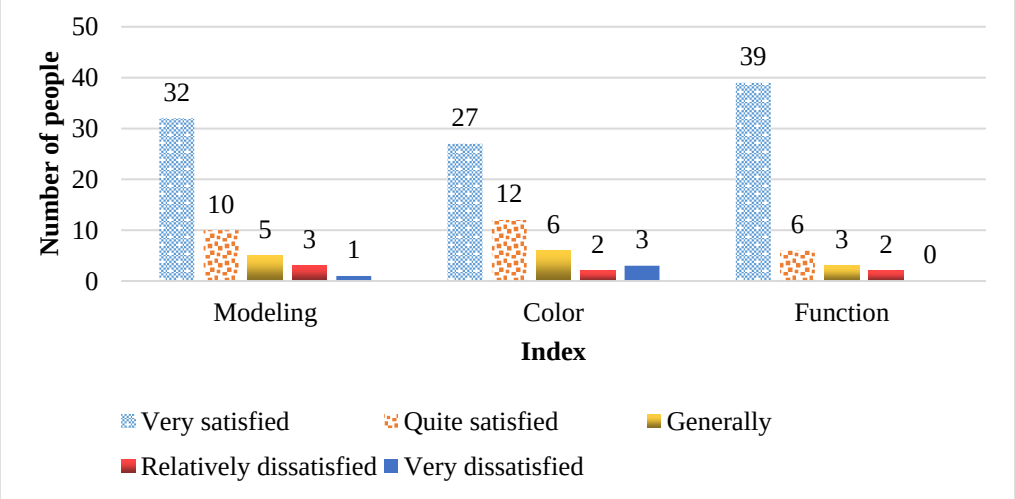

Figure 2: User satisfaction

According to the above-mentioned design scheme, the micro electric vehicle manufacturer builds a preliminary car model, and selects another 50 users to experience the mini electric vehicle travel. The 50 users were then surveyed on their satisfaction with the use of the car. If the user satisfaction is high, then it can be put into mass production. The satisfaction results are shown in Figure 2. In terms of styling, 42 users are satisfied, accounting for 84% of the total; in terms of color, 39 users are satisfied, accounting for 78% of the total; in terms of functions, 45 users are satisfied , accounting for 90% of the total population. User satisfaction with these three items is very high, indicating that the design scheme is approved, then the manufacturer can carry out mass production according to this scheme, so as to

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meet the needs of public users.

4.1. User Satisfaction Survey

Table 1: Collision detection results

	level of damage
5ms	0
10ms	2
15ms	3
20ms	4
25ms	5

After the miniature electric vehicle is designed, in order to ensure the safety of the driver and passengers, it is necessary to test the anti-collision index of the vehicle. The LMD algorithm can detect the degree of fault damage according to the vehicle fault signal. In this paper, taking the door collision test as an example, the LMD algorithm is used to detect the damage degree of the car after the door is knocked and deformed, and the damage degree is represented by a score value, and set 0-2 points to indicate slight damage, 3-5 points to light to moderate damage, 6-8 is divided into moderate to severe damage, and 9-10 is divided into severe damage. Through the data query, it is known that the door trim panel is generally in contact with the occupant's body before 25ms, so the test mainly focuses on the deformation within 25ms. The results are shown in Table 1. When the door is deformed for 5ms, 10ms, the damage degree of the miniature electric vehicle is slight damage. When the door is deformed for 15ms, 20ms, 25ms, the damage degree of the miniature electric vehicle is mild to moderate damage, and the maximum deformation amount that reaches the occupant's body contact is 25ms. The miniature electric vehicle also has mild to moderate damage. Therefore, the miniature electric vehicle designed in this paper has a high anti-collision ability and can ensure the safety of the members.

5. Conclusion

In this paper, after understanding the needs of users for the design of miniature electric vehicles, a miniature electric vehicle with energy saving, environmental protection, intelligent interaction and strong sense of technology is designed. In terms of color and function satisfaction, 84% of users are satisfied with its shape, 78% of users are satisfied with its color, and 90% of users are satisfied with its function, indicating that the mini electric vehicle is recognized by most users. The anti-collision experiment also shows that the miniature electric vehicle has excellent anti-collision performance. People use this car model not only to meet the social development needs of green environmental protection, but also to ensure the convenience of parking and driving safety.

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