

Research on Trends of Design of Electric Vehicles

Ruidi Jiang

College of art and information engineering of Dalian Polytechnic University, Dalian, China

1542338926@qq.com

Abstract. With energy shortages, advances in technology and the urgent need for environmental protection, electric vehicles are developing rapidly and have a tendency to replace petrol vehicles in the future. The appearance design of electric vehicles is the main direction of future vehicle styling design. Therefore, it is of great importance to study the design of electric vehicles.

Keywords: Electric vehicles, traditional cars, styling differences, design trends.

1. Analysis of styling changes in conventional cars

In the last 100 years or so. While traditional car styling has changed considerably from the earliest horse-drawn carriage type bodies, the development of electric cars has been developed on the basis of traditional cars. Therefore, before examining the styling trends of electric cars, it is necessary to analyse how the design of traditional cars has changed from their inception to the present day.

In the early days of the automobile, the aesthetic style of the time influenced the complex and graceful curves of the body. With industrial production, the boxy car replaced the carriage type body design and the concept of functional design was introduced. After the end of World War II, the American people in the post-war affluent society pursued extravagance and exaggeration, and the wide, exaggeratedly shaped boat-shaped cars were loved by the American people at the time; at the same time, Europe began to explore small, practical cars, such as the Mini Cooper, in the post-war economic recession; later, influenced by the hard-edge art, people liked the hard shape, and cars pursued a straight, hard shape language, and the car became flat. The car body became flat. Towards the end of the 20th century, attempts were made to blend flat styling features with rounded and full curves. It was not until the 1990s that Ford introduced its sharp, sporty small cars, which had a big impact at the time. Now, each brand has its own unique family identity. The entire styling development of the traditional car is illustrated in Figure 1.

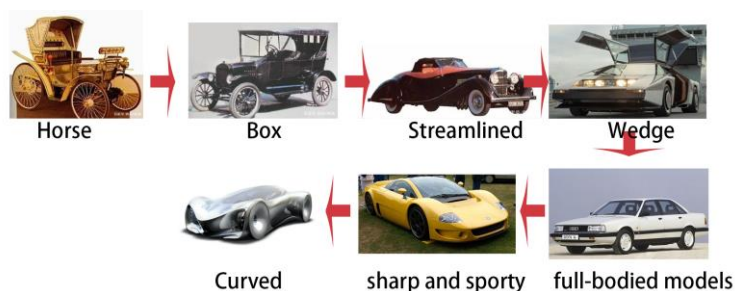


Figure 1. The styling development process of the traditional car

A review of the changes in traditional car styling shows that changes in car styling have been influenced by a number of factors and are the result of a combination of technology and society.

2. Differences in design between new energy vehicles and conventional vehicles

In recent years, there has been a clear difference in appearance between new energy technology vehicles and traditional petrol cars. Compared to the design of conventional cars, new energy technology vehicles are more technological and futuristic. [1] Unlike traditional diesel and petrol cars, conventional engines as well as mechanical drive trains are simplified or even disappear in the design of electric vehicles, and the interior space of the vehicle is effectively enlarged, as in the case of the

new Mercedes-Benz electric concept sports car released. As new energy technologies continue to advance, the design style of electric vehicles will become even more distinctive in the future.

3. Analysis of electric vehicle styling trends

The current focus of electric vehicle styling is on proportional stance, the treatment of feature lines and surfaces, and detailing. In the future, the design of electric vehicle styling could also start with these styling elements.

3.1. Overall proportions

Compared to conventional cars, the wheelbase of an electric car is a larger proportion of the overall body length and the front and rear overhangs are significantly shorter. Take the Tesla Model Y for example and compare it to the Mercedes-Benz GLC in the same class. As shown in Figure 2, the two models are almost equal in length, and it is clear that the rear overhang of the Tesla Model Y is shorter than the rear overhang of the Mercedes-Benz GLC and the front overhang is almost equal, so the wheelbase is longer. Due to the unique arrangement of the batteries in the electric car, a longer wheelbase can be more effective in increasing the range of the car; from a design point of view, the electric car has a cleaner design language with larger tyre sizes, while balancing the visual proportions between tyre size and wheelbase.



Figure 2. Tesla Model Y (top) vs Mercedes-Benz GLC (bottom) wheelbase comparison

In order to reduce the visual impact of the electric front end, the bottom of the A-pillar is brought forward and its angle of inclination is increased as a feature of the electric vehicle. The tilt angle of the front windscreen is closer to the tilt angle of the front end, which visually gives a smoother contour line continuity and effectively reduces the wind resistance coefficient. [2] In a break with the traditional layout and design of cars, the thinking behind the design of cars has changed from "embedding the passenger compartment in the shell" to "adding an exterior and four wheels to the passenger compartment". This thinking has led to a number of electric concept cars that show designers exploring the characteristics of innovative models for electric vehicles.

3.2. Feature lines and surfaces

The surfaces of electric vehicles are cleaner, simpler and have significantly fewer feature lines, and in the 21st century the surface treatment of conventional vehicles has become increasingly complex. In contrast, the body of an electric car is mostly curved with a larger radius of curvature, and the feature lines are mainly created by the intersection of two surfaces. [3] This design trend is influenced by minimalism and is more technological, while also reducing the coefficient of air resistance. The VW ID Concept (left) and the Altas CrossSports Concept (right), a concept car released by the same brand in recent years, are shown in Figure 3. The ID Concept's body surfaces are less varied, consisting mainly of large surfaces with almost no feature lines; compared to the cross-sectional lines of the Altas CrossSports Concept, the ID Concept's cross-sectional lines are even

less varied, even without side features. Another noticeable change in the surface of the EV body is the shift in emphasis from the variation in the surface itself to the shaping of the 'structure' of the surface. As shown in Figure 4, the Mercedes-Benz body has no dramatic surface changes and few redundant feature lines, and the design language of the body is shaped by the folding and bending of nearly single surfaces.

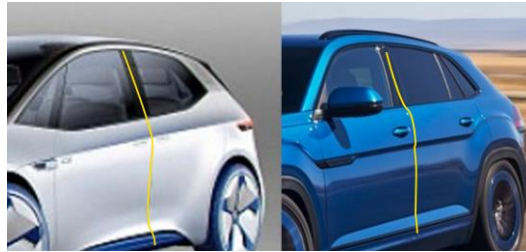


Figure 3. Comparison of car surface treatments



Figure 4. Trends in surface treatment for electric vehicles

3.3. Detailing

From a detailing point of view, the design of electric cars is mainly in the grille, rims and lights. The grille has always been an important part of the front face of a car because of its ability to carry the brand's DNA and to dissipate heat from the engine, but electric cars no longer need a grille. It has therefore been an important issue to create a front face that is suitable for an electric car without a grille. Three different solutions have been used: (1) retaining the original area of the grille and making only the parts inside the grille closed, as it shown in Figure 5A; (2) retaining the shape of the grille by replacing it with a material or by outlining it with a light strip, as it shown in Figure 5B. (3) The design of the front of the car completely abandons the shape of the grille, as it shown in Figure 5C.

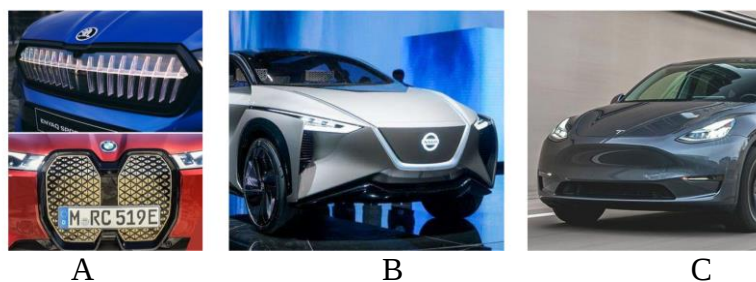


Figure 5. Design of the grille of a car

There is also a tendency for the rim design of electric vehicles to "replace complex curves with flat curves and geometric styling elements" (Figure 6). At the same time, the rims of electric vehicles are covering a larger area, even with fully enclosed rims. The smaller cavities in the rims give a visual suggestion of low wind resistance.



Figure 6. Wheel design for electric vehicles

In terms of light design, electric cars have a simpler design, preferring to use light strips and a change to more flat, geometric elements within the lights. [4] More recently, backlit textures (where the lights are hidden in the paint when dark and only become visible when bright) have been seen on many concept cars, as shown in Figure 7. Another important design trend in electric vehicle detailing is the use of parametric design, which is a regular array of elements. This array arrangement allows for a more futuristic and technologically advanced visual appearance of the electric vehicle e.g. the headlights of the Audi Acion.



Figure 7. Light design for electric vehicles

4. Result

In terms of overall proportions, the electric car has a longer wheelbase, shorter front and rear overhangs, larger wheel diameters and a greater dip in the A and C pillars. In terms of styling, the electric car has a cleaner look, with significantly less variation in character lines and curves. In terms of detailing, more and more electric vehicles are exploring parametric design and breaking away from the original light and grille design, giving brands the opportunity to explore a wider range of frontal forms.

5. Conclusion

By comprehensively analysing the styling differences between new energy vehicles and traditional cars and studying the characteristics of current pure electric concept car styling, the changes and development trends of future pure electric car styling can be effectively grasped. The styling of pure electric vehicles cannot rely entirely on the existing styling styles of traditional cars, nor can they be blindly innovated. The design of electric vehicles requires companies to make planned changes in combination with their own brand characteristics and the aesthetic changes and acceptability of consumers. Only by designing a design language that is unique to electric vehicles and understanding their development trends can we help the electric vehicle industry have a better future.

References

- [1] Hong Xiao. New Energy Vehicle Appearance Design Innovation Research [J]. Internal Combustion Engines and Automobiles, 2021, (2021) 12-0150-02.
- [2] LI Yanlong, ZHU Hui, YANG Zhigang. Electric Car Design Based on Low Drag [J]. Journal of Tongji University (Natural Science), 2017, 45(9): 1366-1371. (in Chinese).
- [3] Wang Bo, Geng Shuochen. Research on the development trend of electric vehicle exterior design [J]. 2019.
- [4] DENG Jian-guo, YU Jin, HAO Ge-hong. Analysis in One of New LED Headlights Design [J]. Light Industry Science and Technology, 2013(7): 88.