

Research on the Design of Intelligent Helmets for Deliverymen Based on User Experience

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Abstract:

Improve the user experience of delivery drivers during delivery, enhance the safety, efficiency, and logistics quality of delivery drivers. Based on methods such as questionnaire surveys and user interviews, establish user-centered design principles, build user personas and user journey maps, analyze the user characteristics of delivery drivers and the demand and pain points of using helmet products. Combining ergonomics and user experience, innovate the design of the delivery driver's helmet and design a new intelligent helmet product. Through the user experience design process, enhance the driving safety attributes of delivery drivers and provide a reference for the design of intelligent helmet products.

Keywords:

User Experience, Delivery, Intelligent Helmet, Product Design

1. Introduction

With the continuous development of the e-commerce industry and the increasing popularity of delivery services such as express delivery and food delivery, the latest statistics show that in 2021, the business volume of domestic express delivery service enterprises reached 108.3 billion parcels, an increase of 24.9 billion parcels compared to 2020, a year-on-year increase of 29.92%. [1] The logistics and distribution industry has become one of the fastest-growing fields at present. At the core of the logistics industry are delivery drivers, who play an important role in the entire delivery process. The daily back-and-forth travel of delivery drivers, the long hours of high-intensity work environment, and the complex traffic environment pose many difficulties and risks for them. Therefore, developing an intelligent helmet that is suitable for delivery drivers to improve their work efficiency and safety, and to ensure their personal and property safety and economic benefits, is imperative.

2. Overview of Product Status

Helmets, as a safety gear to protect the head, have been widely used in transportation scenarios such as motorcycles, electric bicycles, as well as in industrial and military fields. In recent years, smart helmets have gradually come into people's sights and have become one of the development trends of the future helmet market. Smart helmets mainly target young people who frequently travel and workers who need to perform high-intensity operations in the workplace. In addition, with the continuous expansion of the functions and application scenarios of smart helmets, the user base of smart helmets will also continue to expand, including users of all age groups who have demands for safety, convenience, and fashion.

Table 1. Helmet Type Comparison Analysis.

Type	Style	Materials	Advantages	Disadvantages
Open-face helmet		ABS plastic or fiberglass	Good ventilation, visibility, and easy to use	Offers a smaller protection area
Full-face helmet		Carbon fiber and fiberglass	Provides comprehensive protection for the head and neck	It is heavy and has poor ventilation
The 3/4 helmet		ABS plastic or fiberglass	Provides a larger protection area and better head and neck protection	The protection ability is relatively weak and heavier
Half helmet		ABS plastic or polycarbonate	Lightweight and good breathability	Provides the smallest protection

3. Theory of user experience design

3.1. Overview of User Experience

The concept of user experience was originally proposed by Donald Norman, which involves deeply understanding the users' needs, behaviors, and feelings, and designing products and services that meet their expectations, are easy to operate, and aesthetically pleasing and comfortable, in order to enhance user satisfaction and loyalty and achieve business objectives. The core of user experience design is centered around the user, emphasizing the three levels of human cognition and emotion: instinct, behavior, and reflection. Instinct level focuses on designing for people's intuition and emotional response, emphasizing intuition and emotionality, and triggering emotional resonance in users through considering design elements such as shape, color, texture, etc. Behavior level design mainly focuses on people's behavioral habits and operating methods, and based on people's behavior patterns and usage habits, designers need to understand users' usage scenarios and needs and provide convenient and easy-to-operate designs for users. Reflection level design focuses on users' rational thinking and decision-making process, that is, the evaluation and reflection of the product during the usage, in order to provide users with a meaningful and satisfying usage experience. [2]

3.2. The Process of User Experience Design

In 2005, the UK Design Council proposed the Double Diamond model, which divides the design process into four stages: Discover, Define, Develop, and Deliver. [3] User experience design involves multiple aspects, including user research, human-computer interaction, usability testing, information architecture, visual design, interaction design, and more. Among them, user research is the foundation of user experience design, including user characteristic analysis, survey research, field interviews, user profile construction, user journey mapping, and other steps. The goal is to gain a deep understanding of users' needs and behaviors, providing critical guidance and support for designing products and services. [4] Human-computer interaction and usability testing are key to ensuring product usability and user experience. Information architecture, visual design, and interaction design are essential to ensuring the visualization and operability of products and services.

4. Analysis of Delivery Driver Users

4.1. User Survey

This study employed a combination of survey and user interview methods, with a total of 160 questionnaires distributed and 154 valid questionnaires collected. The survey sample was diverse in terms of age, with 49% aged 18-25, 35% aged 26-35, and 16% aged 35 and above. The majority of delivery riders (87%) expressed satisfaction with their delivery service. Most respondents (46.7%) worked from 10:30am to 9:00pm, with 31% of respondents averaging 21-30 food delivery orders per day and a minority exceeding 31 orders per day. In order to deliver orders on time, 72% of respondents admitted to breaking traffic rules during their delivery, with 28% frequently doing so. Through in-depth interviews with 12 selected users, their specific usage situations and feedback were collected. It was found that users had high concerns about the ease of use, functionality, and comfort of wearing the helmet. Valuable conclusions and suggestions were drawn from both the survey and user interviews, which will be helpful for improving the user experience and satisfaction with the product.

4.2. The Service Process of a Deliveryman

The smooth operation of the delivery service requires mutual cooperation among the platform, merchants, delivery personnel, and users. [5] Users place orders through the platform's mobile application, and the platform receives the information and sends the order to the designated merchant. After the merchant confirms the order, the platform assigns it to the delivery personnel who then proceed to the merchant to pick up the order and finally deliver it to the user. Once the user receives the purchased goods, the order is completed, and the delivery personnel receive their commission. The user achieves their goal by receiving the product, while the merchant benefits from commercial gains. The platform earns a certain percentage of commission, achieving its own commercial benefits, and together they form a closed business loop, as shown in Figure 1.

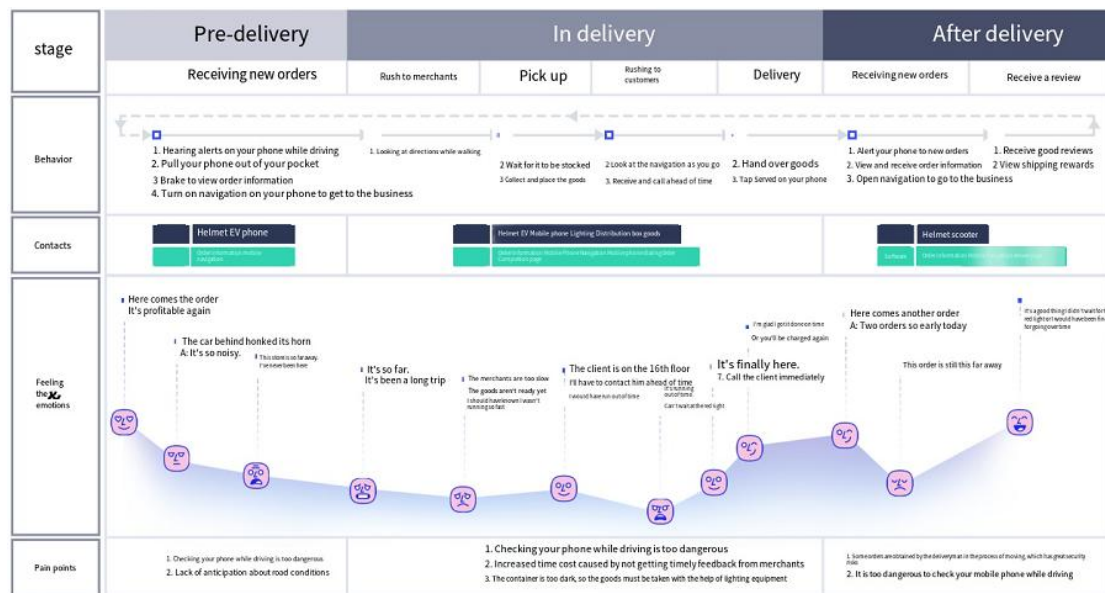


Figure 1. User Experience Journey Map.

4.3. Behavioral Characteristics of Dispatchers

On a daily basis, delivery personnel cover a distance of approximately 150 kilometers on their bicycles and need to recharge their electric bicycles at designated points along the way. It is very common for delivery personnel to use their mobile phones while on the road, whether to check navigation information or to take a break on the side of the road. These actions not only increase the risk of road safety hazards but also pose significant challenges to their familiarity with the area's roads and buildings, route planning, time management, and ability to adapt to unexpected situations.

4.4. Psychological Characteristics of Dispatchers

The occupation of delivery personnel mainly consists of migrant workers from third- and fourth-tier cities, who generally have lower levels of education and come from average economic and family backgrounds. [6] Due to the lack of career planning and reflection, they are easily influenced by the opinions of those around them and the social discourse, leading to a lack of sense of belonging to their profession. In addition, delivery personnel often face unfair treatment and discrimination in their daily work, such as being denied access to elevators or residential areas, which greatly increases their psychological burden. Due to these factors, there is a high turnover rate in this profession, with many workers choosing to leave after only a year and seek other job opportunities.

4.5. Characteristics of The Distribution Environment

In the urban delivery industry, delivery drivers are required to navigate through a complex and constantly changing road traffic environment, which includes a high volume of traffic lights, intersections, forks, and pedestrian-filled sidewalks. Additionally, the address information provided by customers when placing orders may not be detailed enough, or navigation systems may not accurately guide drivers to their destinations, often leading drivers to seek more detailed information from pedestrians or clients. Moreover, when delivering to older residential areas or office buildings, delivery drivers often struggle to accurately identify building numbers. In

extreme weather conditions such as heavy rain, delivery drivers are unable to use umbrellas and have to rely on raincoats, which can cause discomfort by making their clothes wet. Rainfall in southern regions of China is often sudden and unpredictable, and in rainy conditions, delivery drivers may find it challenging to operate their smartphones. As a result, they often purchase waterproof bags to protect their phones, adding to their already heavy workload.

4.6. Components Affecting Distribution Efficiency

Subjective factors include: dispersed locations, difficult optimization of delivery routes, delivery personnel's unfamiliarity with delivery routes and place names, requiring the use of real-time navigation tools for navigation; time constraints on food delivery increase the psychological pressure on delivery personnel when time is running short, leading to anxiety, which in turn prompts riders to engage in violations of traffic rules and poor driving behavior in order to complete orders on time.

Objective factors include: extreme weather conditions which can affect the driving experience of delivery personnel and ultimately threaten their life safety; the efficiency of the restaurant can affect the safety of the delivery rider, especially during peak delivery times, where there is a higher risk of traffic violations such as running red lights, which threatens personal safety; traffic conditions are difficult to predict, especially in situations with high pedestrian and vehicle traffic, where delivery personnel are more likely to make erratic driving maneuvers and cause traffic accidents; and customer pressure to receive their order quickly can lead to delivery personnel speeding and engaging in reckless driving behavior, which in turn can lead to traffic accidents.

5. Design Practice

5.1. Product Functional Design

Based on research results and user analysis, a functional design idea is presented in Figure 2.



Figure 2. Demand target transformation.

The core concept of the product's functional design is to improve the safety, efficiency, and comfort of delivery personnel, consisting of five main functions: route navigation, information processing, real-time communication, intelligent order processing, and safe driving assistance. The purpose of these five functions is for delivery personnel to wear the smart helmet and connect with their phones to avoid device interference, enhance safety awareness, and reduce the risk of road accidents.

It can also improve the efficiency and quality of logistics delivery by optimizing routes through real-time positioning and order monitoring technologies, ultimately reducing delivery time.

5.2. Product Size Design

The design of the helmet size needs to follow relevant standards in safety, comfort, and ergonomics. The helmet must meet safety performance standards, with a head circumference size between 52-62cm and a weight between 1.1-1.6kg, to protect the head from impact and vibration. [7] At the same time, it should be stably fixed on the head without affecting head rotation and vision. The wind resistance coefficient should be below 0.5, maintaining wind noise within a reasonable comfort zone during driving. As shown in Figure 3, a represents that the distance between the goggles and the eyeballs should be no less than 40mm, and the central plane of the helmet's field of view should be greater than 105 degrees. b represents that the brim is best positioned above the brow bone. c represents that the gap between the head and the helmet should be 25.5mm, with 5.5mm being the thickness of the helmet.

Additionally, the internal liner is the part of the helmet that directly contacts the head. Its design should comply with the principles of ergonomics, providing improved comfort and protection. [8] The thickness of the internal liner should be determined according to the size of the helmet and the user's head circumference to ensure a proper fit and stability. The material should be soft, breathable, and sweat-absorbent to maintain a dry and comfortable elasticity on the head. The surface should have some elasticity and shock-absorbing ability to adapt to users with different head circumferences, providing a stable fit and absorbing vibrations and impact forces during motion. The size should be closely integrated with other parts of the helmet to ensure the overall stability of the helmet and prevent the liner from moving or detaching inside. Additionally, it should be easy to remove and clean to maintain the helmet's hygiene and comfort.

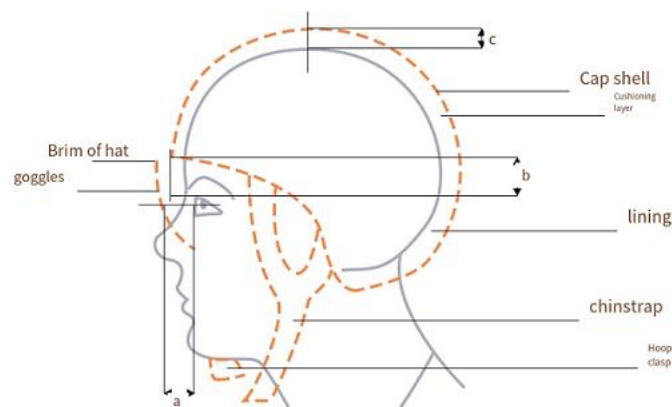


Figure 3. Components of the helmet.

5.3. Product CMF Design

Color: The color of the delivery rider's helmet should be selected with high visibility in mind, such as bright white or blue, in order to make the rider more noticeable on the road and increase the probability of being noticed by other vehicles, thereby reducing potential traffic accident risks. In addition, the delivery company's logo or name can be printed on the helmet to increase brand exposure, improve delivery efficiency and image.

Materials: The material of the helmet should have good impact resistance and comfort. [9] Generally, the outer shell of the helmet should be made of high-strength polycarbonate or ABS material, and the inner lining should be made of comfortable and breathable materials, such as foam polyurethane.

Surface treatment: The surface treatment of the helmet should have good durability and aesthetics. Generally, the surface treatment of the helmet can be carried out through methods such as spray painting or film application to improve the appearance quality of the product.

5.4. Design Solutions

This product is a system concept that includes a mobile app, helmet software program, and hardware helmet product, as shown in Figure 4. The product is designed to provide delivery drivers with a safer and more efficient delivery environment. It can be categorized into four main functions: road navigation, safe driving, emergency alerts, and quick communication. Users can connect the mobile app to the built-in system of the helmet before departure and perform basic command operations through voice control, avoiding the distraction of visually checking the phone screen during driving, reducing the occurrence of accidents, and ensuring the safety of the driver. The front top of the helmet is equipped with a sensing camera, imaging camera, and LED light source. The sensing camera can upload the surrounding environment in real time, the imaging camera acts as a driving recorder, and the LED light source can function as an auxiliary function in dark conditions. The back of the helmet has an

LED light hole, and the light will turn on when the gravity sensor detects a sudden drop in speed, serving as a warning to vehicles and pedestrians behind. The waist of the helmet has a hollow design to enhance internal air circulation and alleviate the common problem of stuffiness. The top of the helmet is equipped with a filter mesh, which can prevent rainwater intrusion on rainy days while maintaining internal air circulation.



Figure 4. Renderings.

The helmet display employs a grid system, as shown in Figure 5. The layout of information is integrated at the top 1/4 of the helmet's visual range to reduce visual interference and maintain driving focus, avoiding the impact of information changes on driving. Navigation information is primarily displayed in the central area of the overall information, simplified to the most critical information, with voice reminders and control as the main method. Order information and status are located on the left, and element attributes are presented in a translucent manner, reducing the user's reading cost. The pages of the mobile app adopt a deep visual visualization, as shown in Figure 6. The graphical presentation of page content is more intuitively concrete, reducing the user's reading time cost. The page content is streamlined, with commonly

used operations located on the first-level pages, simplifying the user's operating process and making it easy to use. At the same time, personalized setting options are provided to further improve the user's reading and operating efficiency and meet their special needs.



Figure 5. Display effects.

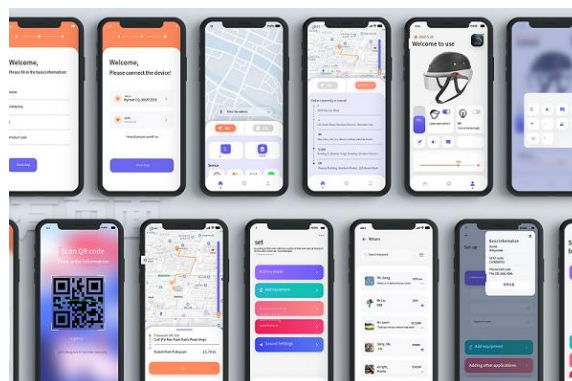


Figure 6. APP interface.

6. Conclusions

Currently, there are relatively few accessories available for delivery personnel, especially when it comes to wearable products that can enhance their comfort and safety, such as helmets. Most helmets on the market are designed for basic protection and lack intelligent features. Delivery personnel often face safety issues while on the job, and helmets are an essential piece of equipment for them. Moreover, the market for such products is huge, and the associated costs are usually covered by the company rather than the delivery personnel themselves. As the competition among delivery companies intensifies and revenue and profitability stabilize, many rely on their bottom-line delivery staff to support their operations. Therefore, it is urgent to improve the delivery efficiency. The smart helmet product, while maintaining or even improving delivery efficiency, can also serve as a safety warning. With technological advancements and improved user experience, the company's reputation will improve, attracting more talent and creating positive effects on the company's performance.

Therefore, the application of smart helmet products can reduce the occurrence of accidents among delivery personnel to some extent, and improve delivery efficiency. Additionally, the government can effectively regulate and strengthen the sense of belonging and professional identity of delivery personnel within their respective companies.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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