Research on the Innovation of UAV Products for Urban Traffic Accidents based on Interaction Design

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Abstract: To improve the efficiency of traffic accident handling and reduce the inconvenience and casualties caused by accidents. Analyze traffic accident handling methods and existing products, extract design goals, simulate user behavior and emotional changes, and innovate interaction models in traffic accident scenarios. The article uses traffic drones' product design as an example to show the product appearance and technical detail design. Obtaining a UAV that can efficiently handle traffic accidents This case can provide a reference for improving traffic accident handling efficiency and future related product innovation.

Keywords: Unmanned Aerial Vehicle Design; Traffic Accident Handling; Interaction Model; Modeling.

1. Introduction

In 2022, if the total number of vehicles is 261.5 million and the data released in the 2022 Bulletin: 1.80 deaths per 10,000 vehicles, then 2022 road traffic accidents in my country will cause a total of 14,527 deaths [1]. This data shows that traffic accidents have caused varying degrees of harm to society and individuals. Traffic accidents cannot be avoided entirely because the urban traffic system is a dynamic coupling system composed of four factors: drivers, vehicles, roads, and the environment. Controllable driving behavior is the process of manipulating the vehicle. Once the external stimulus combined with the car, road, and environment exceeds the driver’s psychological expectations, the driver will adopt inappropriate driving behavior and increase the driving risk [2]. The reasons are diverse: death or injury, motor vehicles without license plates, drivers drinking alcohol, parties unable to move vehicles alone, etc., will all lead to accidents. Therefore, standardizing the handling of traffic accidents and reducing the loss of accidents is an urgent problem to be solved.

2. Preliminary Research

2.1. My Country's Traffic Accident Handling Methods

Method 1: Handling by the parties concerned. The author conducted research and data analysis on 378 traffic accidents and divided them into two ways: phone processing and private. One of them is telephone alarm processing. When people encounter minor accidents, the parties usually use the telephone to call the police and communicate with the traffic police. The overall process is relatively smooth and needs to be dealt with according to the guidelines of the traffic police. Still, parties may experience more significant emotional or physical injuries in large-scale accidents. Can't narrate or call the police cause the traffic police to be challenging to understand the accident quickly and cause the situation to delay the treatment of the wounded, producing irreversible consequences. Another way to deal with it is private. This method is an improper behavior adopted by the parties to reduce insurance costs or evade relevant legal responsibilities. There is a high probability that the discussion will take too long, and verbal or physical conflicts will occur when the two parties are at a stalemate, blocking traffic roads and prompting secondary accidents. At the same time, even if it ends privately, the risk of disputes in the future will increase.

Method 2: On-site handling by the police, as shown in Figure 1. It can be seen from the picture that this was a simple rear-end collision accident between a motorcycle and a car, and no casualties were caused. The traffic police at the scene questioned and recorded the relevant personnel of the accident. The author observed the whole process. After the parties called the police, the police car 18 It took 23 minutes to arrive at the scene, and the communication and processing time between the two parties and the traffic police was 23 minutes, and it took 51 minutes from the time of calling the police to the completion of the accident handling. Such a processing method is legal and compliant, but the processing time and efficiency should be shorter. The accident occurred on a Saturday, and vehicles and pedestrians were not congested. Then, if this type of accident happened on a rush-hour road, it would cause severe road congestion. It is inappropriate to use the same processing method. Therefore, data analysis and on-site records show that our country's accident handling needs to be improved, and the handling method needs improvement.

3. Analysis of Existing Transportation Products

Most urban intersections have real-time road traffic equipment. After research, the product's shortcomings are summarized as follows: 1. Functional limitations. The product used at this stage is designed to monitor the traffic conditions of different road sections in the city. It can scan the real-time situation of each traffic road section. When encountering severe traffic jams, it can adjust the time of changing traffic lights through the system to make reasonable
diversion and adjustments. It is beneficial to slow down the occurrence of vehicle congestion and ensure smooth traffic, but this type of product has a single function. If an accident occurs, the biggest flaw is that the dispute cannot be discovered and resolved in real-time, and the video at that time needs to be retrieved to restore the situation. Many wires need to be fixed. If the equipment is installed on the crossbar, if the number is large, the number of installed wires will increase. The wires will be messy and disorderly, increasing the difficulty of disassembling and assembling the equipment. Even if the circuit cannot be repaired, the wiring of other equipment could be smoother. The shooting angle is not flexible. The equipment is often fixed in one place, and the mobile shooting angle is limited. Suppose an accident occurs in a dead corner of monitoring. In that case, it will not be able to record, which is not conducive to the follow-up image evidence collection of the accident. Working at heights. The equipment usually needs to work 24 hours a day, which is long and prone to problems. The height of the crossbars in the city is more than five meters above the ground. Maintenance personnel must use professional ladders to rise to a specific height. The road is closed to prevent subsequent vehicles from entering the maintenance area and causing casualties to maintenance personnel.

4. Innovative Design Thinking of UAVs

Achieving innovative design means changing the existing design ideas and designing products in new ways and concepts. Then, the design needs to make a rational analysis based on the different situations encountered in the actual scene and then on the user's goal. The design goals are extracted as follows: (1) Fast arrival. The shorter the time to effectively deal with the accident, the more casualties and economic losses can be reduced. Then, on the other hand, when the car goes to the police, it cannot arrive quickly when the traffic is jammed. Although the existing urban iron riders (police motorcycles) are not easily affected when congested, their speed is limited, and the above commonly used methods are challenging to meet the design goals. Therefore, the designer chose the form of a drone that is neither affected by the road nor faster than a car. (2) Smooth communication. There are many factors for accidents, and the existing telephone communication method sometimes cannot communicate quickly and effectively. People often adopt face-to-face communication, which is the most used and efficient method. The designer wants to use drone innovation to replace the traffic police imitating the face-to-face communication mode between people and using real-time imaging technology to help drones quickly receive feedback information, ensuring the timeliness and convenience of information and image transmission, and finally realizing Smooth communication goals. (3) Fast processing. The accident scene needs professionals' guidance to ensure the efficiency of handling. When the traffic is heavy, or the police force is insufficient, and the parties involved do not have their professionalism and execution ability, it is difficult for both parties to reach an agreement, which becomes an essential reason for the low efficiency of accident handling. UAVs can use remote control technology to realize that the traffic police are not present and can guide the parties to complete the accident handling, significantly improving work efficiency. Based on the above description, designers must determine clear design goals and prepare for UAV design.

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6. UAV Design Practice for Traffic Accidents

6.1. Behavior and Emotion Analysis

The analysis elements in the design process need to be extracted from the user's logical behavior experience, combined with the obstacles in the user's actual scene to analyze the user's pain point data in the background and derive the user scene interaction design basis [3]. Designers simulate the entire use process of drone products. It is divided into five stages: driving-driving-parking-handling accident-handling completed. The results show that users will have different behaviors at different locations. After induction, it will be shown at the behavioral level that accompanying behaviors are emotional changes, such as stable, surprised, angry, bored, restless, to happy. Through the above analysis, it is clearer to show the emotional changes of users in different behaviors, and on this basis, extract the most urgent problems that users need to solve and provide the best solutions around these problems. It needs sufficient data support, and after the scientific screening, it solves users' needs best. Based on this, it is essential to simulate user behavior and emotional process in the early stage of product design. This also provides a scientific basis for subsequent product design and avoids
6.2. Scenario Interaction Model Establishment

Human-computer interaction is a highly complex process. The content and form of interaction design need to match the psychological behavior of users. The simple operation of the product interface will generate more interaction levels and present a diversified development trend. The UAV in the article is designed with the interaction model in the traffic accident scenario. Among them, situational interaction mainly includes five essential elements: people, behavior, means, purpose (goal), and scene [4]. Because, in the process of interacting with the product, the user will guide the following operations according to the feedback of the product [5]. Therefore, the feedback element is added to the new interaction model, which can promote more interaction between the product and the user. Designers can discover new design points through user feedback and focus on solving the input in the design process. At the same time, the feedback content also provides solid scientific support for future product upgrades, avoiding the blindness of product design, as shown in Figure 2.

![Figure 2. UAV scene interaction mode](image)

6.3. UAV Product Design

6.3.1. Appearance Design

In real life, users often pay more attention to product appearance when choosing products, which is also why users prefer it. It needs to have a particular aesthetic and can express the designer’s design concept at the same time. In the field of UAV design, as the technology matures, it provides the audience with objects and starting points for use and evaluation activities. At the same time, product modeling is the result of design, and it is also a medium for designers to communicate and interact with audiences [6].

Shape, the barrel shape of the UAV is based on the design goals and structure. The traffic pole beside the road was selected as the landing point to ensure that the UAV could quickly reach the accident site. First, the data shows frequent accidents on the road, and the poles are closer to the accident site, which can reduce the arrival time; The pole is in the shape of a barrel, and the UAV is the same shape as a smaller size. The designer designed the UAV on the top of the improved column to make a concave shape, and wireless charging technology can realize the needs of staying and charging. Drainage holes are designed to ensure practicality so that the existing product design can be broken through without changing the appearance of the pole. The appearance of the UAV barrel requires a more compact internal structure. With the support of technology, the use of advanced intelligent chips and humanized system design at this stage ensures the matching of hardware and software, making it easier for the UAV to fly out and Work promptly.

Color, most transportation products are white, and this drone chooses black instead of the previous color. First, such a choice can be distinguished from similar products; secondly, in color psychology, black has meanings such as seriousness, defense, and authority, which aligns with the functional positioning of traffic drones, so black is chosen as the primary color. The local color is red, a commonly used color in the product, and the color visual effect is outstanding. The designer designed the LED light strip on the drone to be a red aperture when it works, which plays the role of guidance and warning. The propeller is also printed with red horizontal stripes, with a reminder function when turning. The coated camera head is a hemispherical transparent color, which guarantees the infrared night vision function and can suppress intense light and adapt to outdoor work; the selection of appearance color is always based on the needs of product functions.

Material, most outdoor products no longer use traditional steel as the shell because there are more restrictions on shape, high cost, and heavyweight. These are the inherent characteristics of materials that limit the diversified development of products. Considering comprehensively, the UAV uses the new ASA material that can resist ultraviolet rays. It has the mechanical properties that engineering plastics should have such as high strength, high impact resistance, and thermal stability. It can also be exposed to conventional outdoor environments for a long time and recycled. And reuse, the material is lightweight and meets the requirements for UAV design. Therefore, the designer finally chose this material for the shell.

6.3.2. Technology Application

(1) Real-time image transmission

The critical point of UAV's efficient handling of accidents is to achieve barrier-free communication. Communication is the core of transportation product design, and drones for interactive innovation require corresponding technical support. For example, the video call function in the mobile APP WeChat can realize real-time communication of voice and image between the two parties. Given this, drones can use video call technology to learn real-time image transmission, and the execution text output in the execution system enters the speech synthesis system to output synthesized voice and feeds back to the user through the speaker [7], realizing remote guidance and barrier-free traffic police through drones’ purpose of communication. The whole process is that after the drone receives the alarm, it flies out from the column closest to the accident site. After arriving at the accident site, there is no need for personnel to describe it. Incident handling is complete. In a severe accident, when the scene is chaotic and multiple rescues are required, you can immediately understand the situation on the stage and contact the emergency center or fire department in time to carry out rescue work. Real-time image transmission technology breaks through the inflexibility of existing traffic products and speeds up the efficiency of handling accidents.

(2) Wireless charging

Existing traffic products are usually fixed on the roadside pillars. According to the previous analysis, it is found that there are many areas for improvement in the existing products. In the design of drones, using wired methods to complete work tasks is impossible. Based on this, the drone chooses wireless charging technology. This technical solution is suitable for charging after the fixed-point landing of the UAV, and the small magnetic field range also ensures that it is easier
to establish a strong coupling relationship between the coupling coils and it is easy to achieve high power density design. Electric field coupled UAV wireless charging system. It is also based on the principle of near-field coupling, so it is more suitable for short-distance charging after the UAV lands at a fixed point [8]. It belongs to a particular power supply method and does not require a power cord. It only relies on electromagnetic wave propagation to convert electromagnetic wave energy into electrical energy and finally realize wireless charging. Solve the problems of wire wiring, messy wires, power supply, etc. When a failure occurs, it subverts the traditional "return the whole machine to the factory for maintenance" mode and does not require on-site professional maintenance. It only needs to replace the drone's circuit board, which significantly improves system operation efficiency, saves maintenance time, and reduces system maintenance.

3) Intelligent positioning

The practical and precise positioning of UAVs is a technical difficulty. The system needs to ensure that UAVs arrive at the designated location accurately to complete the guidance work. The VINS Fusion VIO autonomous positioning system must be pre-installed, and the EGO-Planner open-source visual obstacle avoidance algorithm must be internally adapted. It is equipped with a single-axis gimbal + image return to always keep an eye on the target, which can quickly achieve fixed-point tracking of the target. It can remotely control the operation of the device at anytime, anywhere, and state [9]. When the equipment fails, it will automatically send a fault message, choose to fly out and arrive at the designated maintenance location automatically. The drone can be recovered remotely, which is convenient for the staff to overhaul, and the system can also be replaced directly, which is better than the traditional monitoring system.

This article takes the design of UAVs in traffic accidents as the primary research object, adhering to the design entry point to ensure people's safety and reduce accident losses. The author shows the accident UAV design, as shown in Figure 3. First, analyze the existing traffic accident handling methods and products to obtain product design goals. Through design thinking, simulate people's behavior and emotional changes when using drones, support the design, and establish interaction with traffic accidents as scenarios. Model, and finally discusses the appearance design and technology application in detail, and shows the final plan, which is believed to be a reference for creating my country's transportation drones.

![Figure 3. Working Effect Diagram of UAV Products](image)

**References**


[9] For UAV products, refer to the relevant technical parameters of the latest owl mini mini L products launched by AVIC Hengtuo and Weiss Power.