Design Studies and Intelligence Engineering
L.C. Jain et al. (Eds.)

doi:10.3233/FAIA231484

Mobile Agricultural Products Vending Vehicle with Autonomous Navigation Selling on Town Roads

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Abatract. In the future, farmers may be able to enhance their agricultural sales by designing an efficient interaction space and sales model for mobile sales vehicles. The traditional mobile sales vehicle sales methodology is primarily based on offline spot sales. Offline fixed-point sales cannot guarantee consumer flow and variety quality, cannot be traced, and the price is rising due to logistics and operation costs. This article presents a mobile sales vehicle for farmers' direct sales operations that integrates agricultural products with live e-commerce for public sales and presentation. The combination of agricultural products presented in the mobile live program in the mobile sales vehicle, The utilization of a set flow path by an intelligent people flow system. The crowd flows heat map and the TD original display system are utilized for this purpose. User feedback is used to validate quantitative data. The results show that a mobile sales vehicle combined with live e-commerce is critical for farmers experiencing little or no sales growth.

Keywords. mobile sales vehicle, interactive place, live e-commerce broadcast, brand

1. Introduction

When compared to businesses, street vending vehicles, which evolved from tricycles carrying goods for sale, are more handy and versatile. Because of these qualities, street vending trucks are beginning to appear in neighborhoods such as pharmacy, book, and coffee businesses [1,2]. As science and technology advance, we must reevaluate our assumptions about the usefulness and aesthetics of mobile vending vehicles. Mobile vans, such as methadone vans, have proven to be effective in lowering HIV infection and transmission, as well as drug-related criminality. These medical vans provide for both safe drug administration and good publicity [3].

Mobile vending carts are an economical and handy way to sell products and are becoming increasingly popular among the general population. However, this sort of

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vehicle has numerous disadvantages, including driver tiredness, wind and rain, damaged and rotting items, and so on. Street vending carts now have refrigerators to keep food fresh and well-presented.

Live e-commerce has grown in popularity in recent years, and with the emergence of the pandemic in recent years, sales of agricultural products have become increasingly depressed, prompting us to examine the present new mode of selling agricultural products. Agricultural products are also shifting from offline to online sales in this context, and the implementation of a collaborative multi-channel development approach for online and offline agricultural products can better help farmers expand sales channels, improve sales efficiency, and expand marketing reach.

The article explores user needs, creates a new sales scene, creates a new consumption scene of buying and selling, and provides users with a marketing and sales vehicle that combines online and offline sales by studying the opportunities and challenges facing traditional produce carts in today's e-commerce environment and applying marketing theory to analyze the problems of the sales model and consumer experience of traditional produce carts. Ceres is used to launch a transparent, full-color holographic display system[4], which allows for improved live streaming and interaction. Self-orientation and route planning in pre-planned locations are made possible by autonomous navigation.

In China, for example, Baidu Maps can detect population heat maps in real time and combine them with a mobile application for mobile sales.

2. Related work

Table 1 contains data regarding the products discussed in this article. It analyzes the sensors/features utilized by the for-sale autonomous vehicles, as well as measuring distances, etc. Sensors utilized in autonomous cars include millimeter wave sensors, laser sensors, ultrasonic radar, and image sensors, as illustrated in Table 1. Millimeter-wave radar sensors are quite expensive, have long sensing distances, and can operate in a wider range of situations, whereas image sensors are relatively inexpensive, rely on 3D information, provide visual effects [5], and are easier to install in self-driving vehicles.

Table 1. Information on unmanned dispensing vehicles.

Type	Sensors	Features	Test methods	Detection distance	Advantages
Unmanned dispensing vehicles	Unmanned dispensing vehicles	Electric waves	Measurement of distance, relative speed and direction as a function of the difference between the transmitting and receiving frequencies.	Long	Good reflectivity on metallic surfaces Can be used at night, against the light, in fog and in the rain
	Laser sensors (LiDAR) Waves of light		Distance measurement by time difference between emission and reflection of light	Medium	Good reflectivity on non-metallic surfaces Can be used at
			3DLiDAR direction and shape detection	Long	night, in fog and in the rain
	Ultrasonic	Sound	Distance measurement	Short	Glass and water

radar	waves	by time difference between the transmitted wave and the return wave		surfaces also reflect
Display sensors	Camera	Image capture and target object identification	Long(stereo scopic camera) Medium(single-lens camera)	Identification of target objects, colours

Because there has been little research on mobile vending vehicles mixed with live streaming for sales, typical examples of vending vehicles paired with live streaming for analysis were not found. As a result, we examined the product's attributes independently. Recognizing the significance of self-driving cars on city streets, Jorge Enrique Caicedo Martinez et al.developed AutoNavi3AT, a software application that estimates and tracks self-driving automobiles on urban travel roadways using vanishing points from panoramic photos [5]. Lulu Tai, on the other hand, earned the Rising Star Anchor award in the 2021 Lazada Southeast Asia Cross Border live talent contest, which brings users closer together through the joy and variety of live-streaming with a vibrant image that can generate sales [6].

In this work, we demonstrate an interactive self-driving automobile called "Mobile Premium" that uses autonomous navigation and real-time live-streaming to attract followers during their leisure time. The "Mobile Premium" reduces costs by utilizing ultrasonic radar and laser sensors to enable autonomous driving and obstacle avoidance. We discovered that Ceres could assist us in broadcasting live offline by introducing a full-color holographic projection technology and building a small interactive interface for customers to buy and participate online.

3. Formal research

The lack of sales of agricultural products cultivated by farmers, the rise of China's grassroots economy, and the present wave of live goods transmission owing to the epidemic affecting the world economy all motivated the creation of this work. We investigated and researched sales carts, users, consumers, and live banding to find the true wants and pain areas of users. We grasp the farm produce vending consuming environment, the capabilities of live streaming short movies with items, the future development trend of vending carts, user research and particular analysis of vending carts, and so on. To pave the path for our design solution, we examine and summarize the pain and itch spots below.

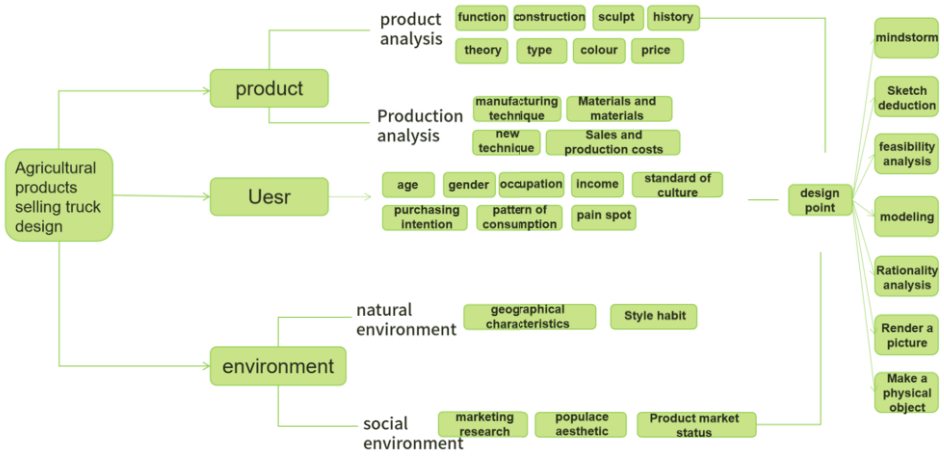

Fig. 1. Creating the vending cart research content.

3.1. Design survey

Produce vending vehicles must take into account the size of the vehicle and the user, leaving plenty of space for the user and consumer experience. The national standard GB T 13547-92 "Human dimensions of the working space" is employed as a data reference, taking into consideration the height and limb length of the 30-50-year-old business crowd I've positioned. The approximate height of the live cart space can be established by combining the condition of the scene in which both the user and the consumer are located, as indicated in the diagram below.

Fig. 2. The user's spatial position in the vending cart space is depicted on a map.

We combined theories of systematic design, digital design, interaction design, and brand design to design the spatial area of the vehicle in a unique way, investigating and analyzing the shape, color, structure, and materials of the mobile vending vehicle.

3.2. Design objectives

To address the issue of consumers' difficulty distinguishing between high quality and high price, we created a logo design for the branding of a mobile sales cart that would aid in the improvement of agricultural product brand image.

Fig. 3. Ideas for vending vehicle branding.

We name it "Mobile Premium" because it combines live broadcasting with the distribution of excellent agricultural products and the provision of health and peace of mind, with the letter "U" representing for quality products and also as a design language for the entire vehicle. The brand image of the vehicle and the agricultural products it markets aims to increase consumer recognition and visibility of quality agricultural products so that they can be distinguished from other agricultural products on the market, as well as to promote agricultural product consumption and development by creating and transferring brand value.

To provide consumers with a good shopping experience, it is necessary to divide the sales area into several parts: driving area, display area, interaction area, and service area, which have different responsibilities in different areas and combine to form a complete shopping process that fits consumers' shopping habits. The shop's display section should be where customers spend the most time; this area should provide them adequate time to try out the products. The interactive area is used to draw traffic to the area; it is developed in tandem with the design of the live area, with the front of the live interactive area behind the section for the purchase of interactive design, to draw the consumer's attention in the shop to buy. The interaction and service areas are akin to what we term functional areas, and I have subdivided this. The seating in the driving area is designed to swivel 360° to allow for a swift transition between driving and selling; in some regions, due to the small size of the shop, it is divided into fewer zones, or the zones are connected in series to plan the consumer's movement.

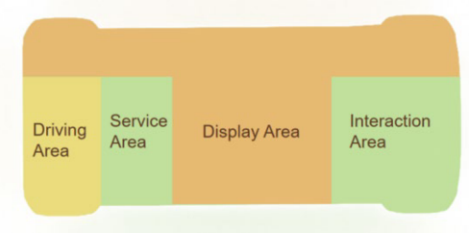

Fig. 4. Area planning for agricultural produce-selling vehicles.

3.3. Question Mining

During our problem-solving session, we videotaped and studied the scenario with the produce truck. The main issue was the need for a more intuitive live vending model for mobile vending than the typical produce truck, as well as autopilot vending, which

would ultimately alleviate most of the trouble, and a consumer-oriented foot traffic heat map.

Based on our findings and conversations, we have developed the following ten design requirements for our mobile vending vehicle:

- It's incredibly inconvenient not knowing where the traffic is.
- There was a large crowd gathered near the carts, and there was no order.
- The carts' appearance is not appealing enough, and many of them are over-decorated and do not seem nice.
- Vegetables and fruits, for example, are easily spoiled.
- The products offered by vending carts are all wholesale from many locations; it may be better to have a single brand, as in shops.
- The service provided to product customers has to be enhanced.
- When there are many people, one person can be quite busy...
- I'm hoping for genuine user input.
- Customers can place orders.
- My product is excellent; how can I communicate this to customers?

4. Design methods

This section discusses the "Mobile Premium" design and implementation, including functional and non-functional requirements, interface design, conceptual design, renderings, schematic testing, and test reports for the mobile vending trolley.

4.1. Design and implementation of the first mobile application

We explain the preliminary design and execution of the mobile application "Mobile Premium," which will be used for the laboratory simulator investigation. The following features are included in the original version of the application:

- The home page enables product purchases and information display. The customer can purchase the products they want using the search button on the home page, or they can select the things they want using the flowing tag recommendations and popular set recommendations. We may see the qualities of a certain product and a traceable photo of the pick-up location submitted by the farmer by clicking on a tag. This is really unusual.
- On the second screen, we can view the heat map distribution of the flow as well as the location of the mobile carts in real-time.
- The third page is a place for our users to provide comments and communicate about their purchases. Each user can take a picture of their purchase and share their status as an ins, allowing others to learn more about them.

- The final page is ours, where we can check information on our orders, logistics, preferred products, after-sales returns, and much more.

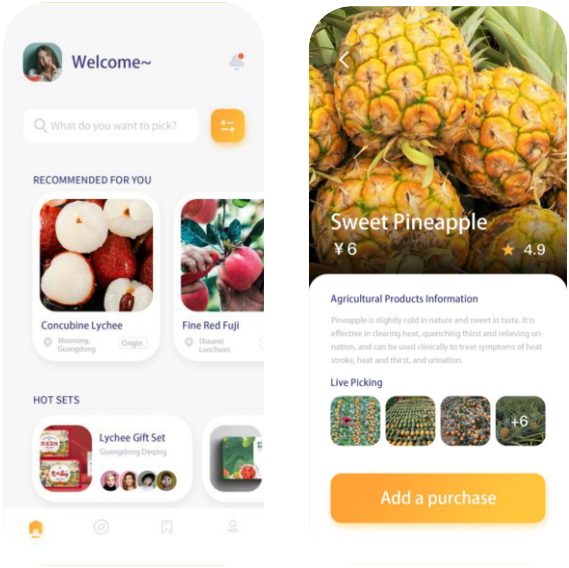

Fig. 5. Design of an interaction interface for sales vehicles.

Fig. 5 The interface design of the "Mobile Premium" is shown, and the application's implementation is backed by the UniAPP.

4.2. Hardware design

The following are the functional and non-functional needs of Mobile Premium, as well as the aforementioned working analysis:

- Configuration of ultrasonic and laser radar sensors and operation of the mobile dispenser vehicle; acquisition of images and corresponding panoramic images; road route planning; obstacle avoidance on the road by ultrasonic radar; live transmission on a continuous display; and servo control of the mobile dispenser vehicle for navigation.

- Non-functional requirements: The testing platform for the mobile delivery vehicle is a C51 development board; vision sensors include image sensors.

First, we used Rhino software to model and create the vending cart based on its functional needs, merging the general modeling structure with the U-shape and unifying the elements of the product modeling language. The effect was then rendered using Keyshot, which includes front, side, and top views, as well as a depiction of the vending cart scene.

Fig. 6. Diagram of the mobile product vending trolley.

Following that, we ran some important tests with the schematic machine, which can be seen in figure 7. We tested about 50 experiments, with the main ones being wireless control, ultrasonic obstacle avoidance, infrared tracking, ultrasonic tracking experiments, danger warning, ultrasonic distance measuring, and so on.

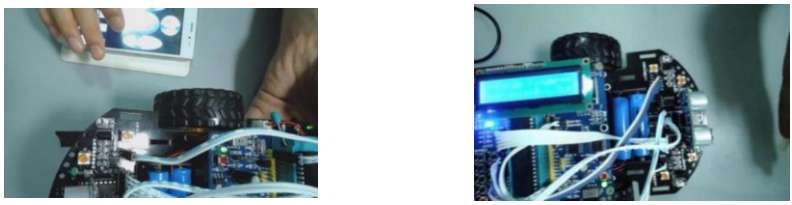

Fig. 7. Three different perspectives on the agriculture sales trolley.

4.3. Function and principle

The "Mobile Premium" is implemented in two parts: the first is the APP application on the Android device, and the second is the prototype's configuration, journey time, and route planning. The user can change the settings of the mobile vehicle, such as its speed, the fixed staging position, the control of the vehicle lights, the acquisition of image timings, and so on.

5. Initial user research

We did preliminary user research to establish that users could access the mobile cart movement and purchase things using the application. We put out an online appeal for experienced users, and we received many applications from people we dubbed K1, K2, K3, and K4 (with an average age of 31.6 years). All participants tested the application for three days in different settings, and the entire process was filmed with their permission. Table 1 shows the level of pleasure expressed by consumers after using the app.

Table 2. User survey results.

Questions	K1	K2	K3	K4	Media
1. Would you buy products over the air? (1: Yes - 6: No)	5.8	6	6	5.8	5.9

2. Do you find it easy to use the "Mobile Premium" application (1: easy - 6: not easy)?	5.3	5.5	6	5.4	5.55
3. Would you be willing to buy such products after experiencing the "Mobile Premium" application (1: Yes - 6: No)?	6	5.4	5.8	5.7	5.7

Due to the outbreak, we had a video conference with the experimenters after three days. First, we asked the users what they expected from a mobile vending cart, and the four experimenters watched the film with anticipation, since they were quite interested. "I used to buy fruit from the stalls because it was cheap," K1 answered when I asked him the question. It would be tempting for me to have software that could track the location of the vending carts at all times."K4 went on to say: "I would love to go to this mobile cart and experience it" . Both K2 and K3 are excited to see and experience it in person in the future, with K3 noting, "So I can buy gift boxes for people who are in a hurry and get them on the road" and K4 saying, "This mobile shop could win my heart more than a high-end branded shop."

5.1. Interview process

We basically questioned folks in the shape of friends during the interviews. Following that, we interviewed IT specialists to help us with our investigation. According to the experts, our concept was good, but it might not be perfect in terms of technical elements, and the needs of the users needed to be examined further. We are also encouraged by the experts' opinions because they will help us develop our mobile car.

5.2. Results and discussion

As seen in the table above, all members who participated in the experience showed a strong desire to try out this new mobile vending cart. In the future, the mobile live vending vehicle may offer various advantages:

- It It solves both the problem of not being able to leave the house, or rather leaving the house during an epidemic.
- It is more secure for the consumer to acquire.
- Protect the environment while conserving energy.

Experimenting with a prototype was used to validate the functionality of the Mobile Premium. Our goal was to check all of the mobile shopping cart's functioning needs and improve it if any issues were discovered. Once these issues have been resolved, it will be feasible to test the functionality of the Mobile Premium in real-world situations.

6. Limitations and future work

The mobile shopping trolley is popular among consumers due to its low cost and versatility. It does, however, have limitations: product quality is not assured; it tends to

break down over time; it is readily destroyed during transportation; and it has a limited distribution range. We focus on overcoming these restrictions and reimagining the classic mobile vending vehicle as a revolutionary self-directed, live-streaming mobile vending model in this work.

The study's disadvantage is that it was not experimentally tested in equal quantities, therefore our user data may be biased. We hope that it will be available on our city streets and on our mobile phones in the future. Meanwhile, we will focus on incorporating equiproportional physical testing into our future work so that we can better illustrate if it can solve the problems we are discussing.

7. Conclusions

This article explains the Mobile Premium application's interface design, functional design, appearance design, and user research. The software interface is the application that is utilized to give a shopping experience to the consumer. The program is supplemented with an applet to control the mobile shopping cart, which can be easily and swiftly controlled from the WeChat applet platform with a tiny memory. To obtain the greatest potential sales results, the applet instructs the mobile cart to go along a predetermined route and asks changes to the route plan based on a heat map of the crowd movement. The "Mobile Premium" live streaming function is based on a full-color holographic display device that is transparent [4]. We also plan the mobile car's purchase movements. For testing of the "Mobile Premium," we used a C51 microcontroller development board. Data processing for road obstacle avoidance, wireless networking, and user data collecting were the primary functional needs. Finally, the autopilot technology and live streaming format have increased the mobile vending vehicle's service channels, but there is still a lot of territory to cover for our technical services. This live mobile vending truck will surely increase agricultural product sales swiftly while also transporting regional farming culture to all parts of the world and making it a household name.

8. Acknowledgements

In addition, this study was supported by the 2021 Guangdong Provincial Quality Engineering Modern Industrial College Project "Eco-design Industrial College", the Guangdong First-class Professional Construction Point: Product Design, the 2021 Guangdong Provincial Department of Science and Technology/Guangdong Provincial Bureau of Rural Revitalization "Guangdong Provincial Rural Science and Technology Specialists in Towns and Villages," stationed in Jiangdong Town, Chaoan District, Chaozhou City, Project No.: KTP20210374, 2021 Zhongkai College of Agricultural Engineering Quality Engineering Special Talent Cultivation Program Construction Project, "Excellence in Rural Revitalization Talent Design and Innovation Class" support.

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