The Innovative Path of AI Technology Empowering Marketing Strategy in Unmanned Supermarkets

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Abstract

This research , whose research objects are users' experiences, is a quantitative research t through methods such as literature method, questionnaire survey, and data analysis. The results show that the impact of unmanned supermarket technology on shopping experience, the evaluation of unmanned supermarket service and safety, and the correlation between technical difficulties and shopping frequency are the most important factors affecting user experience. Among them, the diversity of checkout technology and service response speed contribute the most. These analysis results provide important theoretical support and reference for unmanned supermarkets to optimize user experience in the future. At the same time, they are of great significance for optimizing the operation mode of new retail and meeting users' diverse consumption needs. Furthermore, they offer practical insights for enhancing the integration of AI technology to improve service efficiency, operational processes, and customer satisfaction, further supporting the sustainable growth and competitiveness of unmanned supermarkets in the evolving retail landscape.

1. Introduction

Nowadays， in the context of rapidly advancing production efficiency, consumer demand for higher living standards has significantly increased, particularly in the areas of convenience, variety, and intelligence in shopping experiences. At the same time, unmanned supermarkets, a new and innovative retail model, have emerged,attracting more consumers with their extended operating hours, diverse product offerings, and convenient payment systems. However, fierce competition from various retail models, unmanned supermarkets face the challenge of combining with consumer needs, addressing existing shortcomings, and innovating their service technologies. This study bases on market survey data to analyze the current gaps, market conditions, and development trends of unmanned supermarkets. By examining consumer behavior and competitor models, and utilizing current AI technologies, the study proposes targeted marketing strategies aimed at optimizing user experience and providing both theoretical and practical guidance for the future development of AI-powered unmanned supermarkets.

The rise of unmanned supermarkets, from rapid initial growth to their current struggles, highlights the ongoing challenges faced by this retail model. Thus, this study will focus on user experience, exploring the operational issues faced by unmanned supermarkets, and offer AI-based solutions for optimization.

This study uses quantitative research methods, collecting real data from consumer attitudes toward unmanned supermarkets through surveys. Its significance lies in solving the pain points of unmanned supermarket marketing, identifying where AI technology can be applied, and improving the most of user's experience. The study will also enhance the competitiveness of unmanned supermarkets within the "new retail + AI technology" model, fostering a more diverse retail landscape. Furthermore, a better user experience can stimulate consumer behavior and contribute to the broader economic cycle.

The research aims to identify the key factors influencing user experience in unmanned supermarkets by analyzing existing literature, conducting quantitative research, and collecting data through surveys. Based on the analysis, the study will propose specific marketing strategies to optimize user experience. The primary research question is: What are the factors affecting consumer experience in unmanned supermarkets, and how can these be optimized through AI-driven strategies? The research objectives include: exploring the key factors impacting user experience in unmanned supermarkets, understanding consumer perceptions of these factors, and proposing strategies to enhance user experience through AI technology.

1.1 Literature Review

Unmanned supermarkets, which emerged under the influence of "Internet +", have become another choice to meet the diverse needs of current consumers.With the development of big data technology and the needs to avoid people having indirect contact during the COVID-19, unmanned supermarkets have experienced rapid growth. But now, lots of unmanned supermarkets have closed down. This shows from the side that the competitiveness of unmanned supermarkets in the original model isn't obvious anymore. What's more, some factors can even affect the customers' experience and make the business really bad.Based on this, Wang and Tian (2023) once said that the decline in the competitiveness of unmanned supermarkets is caused by various factors. During the initial development stage of unmanned supermarkets, there were still shortcomings in areas such as technology, goods storage, and product category limitations. At the same time, unlike these direct factors, Chen (2020) also said that the competition from the old retail models that already exist and the support from government policies and money are also some indirect factors that affect unmanned supermarkets' growth. In a nutshell, the phenomenon, which unmanned supermarkets are slowly going down, isn't something happens by chance. It shows that when there are more bad points than good ones, consumers' needs can't be satisfied. So, this research aims to conduct an in-depth exploration of the phenomena mentioned in the previous literature to identify feasible solutions.

For this purpose, some papers were found that studied these factors in more detail. In summary, it can be obtained: For example, from Wang (2018), it was found that how convenient it is to get in and out of unmanned supermarkets can affect how satisfied customers are. Another scholar Zhang （2018） and the newspaper Chengdu Business Daily（2017） also found that how goods are arranged, how fast they are restocked, and how neat the shelves are can also affect the user experience.At the same time, Li , Yu and Zhang (2018) think that how unmanned supermarkets manage users' data can also greatly affect the users' experience. Users are really sensitive about their own information security. Furthermore, Du and Jiang (2017) pointed out that some service support technologies, quality and how fast they handle things in unmanned supermarkets also affect customers' experience a lot.So, according to what was mentioned in the research papers and newspapers above, this research has conclusioned nine variables in different factors to study the problems in detail

2. Research Methods

This study adopts a quantitative research approach, using a questionnaire to collect participants' personal information and user experience data. Based on 15 questions that influence user experience in the operation of unmanned supermarkets, the study measures users' perceptions of unmanned supermarkets. Targeting users who have previously shopped in unmanned supermarkets, an online questionnaire was distributed, resulting in 123 valid responses. In the data analysis phase, SPSS software will be used to statistically analyze the collected data to draw relevant conclusions. The questionnaire design for the variables is shown in the Table 1.

Table 1. Questionnaire

	Variable	Definition of operationalization	Measurement problems	Literature	Serial number
Independent variable	Consumption Frequency	Understanding the Basic Information of Users Who Have Used Unmanned Supermarkets	In the past six months, how often have you shopped at offline supermarkets? (1-10)	Wang（2018）	X1
	Convenience of Shopping Experience		Did you find shopping at the unmanned supermarket convenient and efficient? (1-10)	Yang（2019）	X2
	Access Control Method	Perception of Consumers on the Convenience of Access Control Methods in Unmanned Supermarkets.	Do you find the access control methods in unmanned supermarkets inconvenient? (1-10)	Wang（2018）	X3
			How does a more flexible access control method affect your shopping experience? (1-10)	Wang（2018）	X4
	Product Variety Selection	Consumer Attitudes Toward the Variety of Products in Unmanned Supermarkets	Do you think the product variety in unmanned supermarkets is sufficient? (1-10)	Chengdu Business Daily（2017.12.16）	X5
			Would adding more product categories make you more likely to shop at an unmanned supermarket? (1-10)	Chengdu Business Daily（2017.12.16）	X6
	Product Placement and Restocking Method	Exploring the Impact of Product Placement and Restocking Methods on Consumers	Does faster restocking improve your shopping experience? (1-10)	Zhang（2018）	X7
			Does placing popular products near the entrance improve your shopping convenience and experience? (1-10)	Zhang（2018）	X8

	Convenience and Process Efficiency	Impact of Payment Method Convenience and Process Efficiency on the Consumer Shopping Experience	How efficient do you find the checkout process in unmanned supermarkets? (1-10)	Chengdu Business Daily （2017.12.16）	X9
			Would faster and more diverse checkout technologies enhance your shopping experience? (1-10)	Zhang,Yao（2018）	X10
			Have you encountered technical issues during your shopping experience at an unmanned supermarket? (1-10)	Zhang,Yao（2018）	X11
	Technical Reliability	Exploring the Impact of Technical Issues on the Consumer Experience in Unmanned Supermarkets	Have you encountered any technical problems during your operation in the unmanned supermarket?（1-10）	Xu （2019）	X12
	User Factors and Data Security	Consumer Awareness of Data Security in Unmanned Supermarkets	Do you believe unmanned supermarkets can protect your personal data security? (1-10)	Li, Yu, Zhang （2018）	X13
	Support Service Quality	Exploring Consumer Experience of Service Quality in Unmanned Supermarkets Under Unmanned Management	When encountering an issue in an unmanned supermarket, are you able to get help quickly? (1-10)	Du, Jiang（2017）	X14
			Are you satisfied with the online or remote customer service of unmanned supermarkets? (1-10)	Du, Jiang（2017）	X15
Dependent variables	Consumer Intent and Attitude	Exploring the Degree of Consumer Inclination to Choose Unmanned Supermarkets	How inclined are you to choose unmanned supermarkets for your shopping? (1-10)		F

3. Result and Discussion

3.1 Reliability and validity test

This article first evaluated the overall reliability and validity of the questionnaire. The data obtained (as shown in Table 2) was analyzed through dimensionality reduction, and the KMO value was 0.849. This shows that the partial correlations among the data variables are strong, which strongly supports the use of exploratory factor analysis to examine the reliability and validity. It is also suitable for further factor analysis.

Table 2. KMO and Bartlett's test

KMO Sampling Adequacy Measure	0.849	
Bartlett's Test of Sphericity	Approximate Chi-square	836.601
	Degree of freedom	105
	significance	0.000

3.2 Correlation Analysis

We set the value less than 0.05 as significant correlation. The results of the correlation analysis (shown in Table 3) indicate that the vast majority of independent variables have significant correlations with the dependent variable (user experience). This shows that the independent variables (X2, X3, X4, X5, X6, X7, X8, X10, X11, X12, X13, X14, X15) can effectively predict the value of the dependent variable to some extent. However, many independent variables also have significant correlations among themselves. There is still a relatively high correlation among the independent variables in this study. Therefore, it is necessary to further use the principal component analysis method to reduce the dimension of the independent variables for the subsequent regression analysis.

Table 3. Correlation Analysis

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15
X1	--														
X2	0.111	--													
X3	0.079	0.617**	--												
X4	0.136	0.386**	0.351**	--											
X5	-0.059	0.294**	0.370**	0.340**	--										

X6	-0.065	0.381**	0.328**	0.333**	0.277**	--									
X7	-0.037	0.357**	0.251**	0.493**	0.353**	0.638**	--								
X8	-0.019	0.423**	0.341**	0.481**	0.487**	0.581**	0.701**	--							
X9	0.187*	-0.185*	-0.206*	-0.059	-0.165	-0.137	-0.132	-0.151	--						
X10	-0.016	0.534*	0.555**	0.291**	0.296**	0.324**	0.401**	0.442**	-0.212*	--					
X11	0.050	0.353**	0.366**	0.476**	0.305**	0.588**	0.555**	0.626**	-0.103	0.485**	--				
X12	-0.031	0.402**	0.320**	0.449**	0.322**	0.398**	0.506**	0.512**	-0.063	0.397**	0.654**	--			
X13	-0.080	0.338**	0.359**	0.261**	0.541**	0.340**	0.374**	0.450**	-0.066	0.442**	0.264**	0.381**	--		
X14	-0.039	0.272**	0.320**	0.192*	0.522**	0.134	0.282**	0.376**	-0.067	0.445*	0.232**	0.382**	0.652**	--	
X15	-0.109	0.341**	0.389**	0.186*	0.552**	0.178	0.260**	0.437**	0.021	0.429*	0.249**	0.424**	0.676**	0.697**	--

*Significant correlation at the 0.05 level (two-tailed).

**Significant correlation at the 0.01 level (two-tailed).

3.3 Principal Component Analysis

In the principal component analysis, we adopted the principal component analysis method to extract independent variables, and the rotation method was the Kaiser normalization varimax method. In the rotated component matrix, three principal components were obtained. The extracted keywords of these issues were classified into three categories respectively: the impact of unmanned supermarket technology on shopping experience (G1), the evaluation of unmanned supermarket services and security (G2), and the association between technical problems and shopping frequency (G3). We will use regression analysis for the three proposed principal components.

Table 4. Rotated component matrix

	original			**rescaling**		
	component			**component**		
	1	2	3	1	2	3
X11	1.537			0.812		
X7	1.502			0.768		
X6	1.437			0.753		
X8	1.333			0.731		
X4	1.249			0.668		
X12	1.160			0.631		
X2	1.054			0.578		
X10	0.862			0.501		
X3						
X15		1.550			0.875	
X14		1.713			0.867	
X13		1.595			0.810	
X5		1.110			0.637	
X1			2.100			0.895
X9			1.214			0.562

3.4 Principal Component Regression Analysis

Set the obtained values of the three principal components as independent variables, and then set the customer experience degree as the dependent variable (F) (see Table 5). The D-W value obtained after the regression analysis is 1.825, which is close to 2 and can ensure the independence of filling out the questionnaire to some extent.

The obtained R^2 is 0.553, indicating that the three principal components obtained in this study influence the customer experience by 55.3%. It also verifies that it is necessary to modify and optimize the marketing strategies in these three major operation modes: the impact of unmanned supermarket technology on shopping experience, the evaluation of unmanned supermarket services and security, and the association between technical problems and shopping frequency.

Table 5. Regression Analysis Model Summary

model	**R**	**R-squared**	**Adjusted R-squared**	**Standard Estimation Error**	**Durbin-Watson**
1	0.743	0.553	0.541	1.21551	1.825
a=G1、G2、G3（ijndependent variable）					
b=F（dependent variable）					

After regression analysis, in the coefficient a table, the significance value we got is less than 0.05 (see Table 6). This makes sure that when we control other independent variables in the model, the three principal components all have a significant impact on customers' experience. Especially, the t-value of the second principal component (the evaluation of unmanned supermarket services and security) is 10.471 ($p < 0.01$), which means it has a very significant impact.

Also, the B-values of the three principal components are all greater than 0. That is to say, the impact of unmanned supermarket technology on shopping experience, the evaluation of unmanned supermarket services and security, and the association between technical problems and shopping frequency all have a significant positive influence on customers' experience.

Table 6. Regression analysis results (Dependent variable: consumer experience)

model		**Unstandardized Coefficients**		**Standardized Coefficient**	**t**	**significance**	**significance**	
		B	standard error	Beta			tolerance	VIF
1	constant	6.417	0.111		57.829	0.000		
	G1	0.589	0.111	0.328	5.290	0.000	1.000	1.000
	G2	1.167	0.111	0.650	10.471	0.000	1.000	1.000
	G3	0.266	0.111	0.148	2.389	0.000	1.000	1.000

3.5 Problems and Measures

According to the data representation of the linear regression model, TR（Technical Reliability）, UF&D（User Factors and Data Security）, and SSQ（Support Service Quality）are several important factors that affect the user experience. And since the coefficient of each factors is greater than 0, it shows that all three factors have a

positive impact on the user experience of unmanned supermarkets, which correspond to the purpose of this research to improve the user experience of unmanned supermarkets.The coefficients for UF&DS are the highest, reaching 1.167. This means that when shopping in unmanned supermarkets, customers care most about their potential data security. Therefore, as managers, they must make sure users' data isn't leaked or misused. In this way, we can get users' trust and improve their shopping experience.The coefficient for TR is 0.589. This shows that when running a unmanned supermarkets, managers need to think about different groups of consumers and set up the technical operations in a reasonable way.The SSQ has a coefficient of 0.266. This tells us that in marketing, whether you can offer customers various, high-quality and timely services is also a really important factor that affects their shopping experience.

3.6 Problems

From the research in this paper, these problems are found:

① How easy or hard it is to set up the technology and operate the equipment in unmanned supermarkets can affect the shopping experience.

② Customers really care about how safe their data is in unmanned supermarkets.(They worry if their data will be leaked or misused)

③ The frequency of people go shopping in unmanned supermarkets is affected by the kinds of services like technical services and after-sales services.

3.7 Measures

Based on the problems summarized in this article, the following suggestions are put forward to optimize the user experience of consumers in unmanned supermarkets:

① Technical Reliability: Use AI technology to analyze user feedback and check whether the equipment in unmanned supermarkets needs to be upgraded or repaired. Link the 5G technology with the checkout system to optimize the speed of fee deduction. Use monitored images and AI to identify the goods purchased by customers, so as to realize a checkout-free system and improve the shopping convenience for customers.

② User Factors and Data Security: Use AI technology to protect data intelligently, ensuring that only authorized personnel can access customers' sensitive data and that the data won't be leaked or misused. Use AI to monitor unmanned supermarkets in real time for any abnormal activities, strengthen the security of unmanned supermarkets, and reduce the occurrence of potential theft and robbery incidents.

③ Support Service Quality: Strengthen the reserve of remote human customer service and AI customer service in unmanned supermarkets to ensure that customers can get help and services in a timely manner. Reduce the occurrence of incidents where technical problems trouble customers. Set up more channels for after-sales and pre-sales services (such as building a mini-program channel, setting up a customer service hotline, etc.).

Besides the three factors extracted by principal component analysis, this paper will also give some practical suggestions for the remaining four independent variable factors (Access Control Method, Product Variety Selection, Product Placement and Restocking Method, Convenience and Process Efficiency):

①Access Control Methods: Use AI identity recognition technology combined with facial recognition, iris recognition or fingerprint recognition technology to provide customers with a convenient way to enter and exit, improving the convenience of entry and exit while ensuring safety.

②Product Variety Selection: Based on big data, use AI technology to analyze consumers' shopping habits and preferences, regularly adjust the types of commodities sold in the supermarket, and focus on introducing popular or high-demand commodities at present. Meanwhile, use AI algorithms and machine learning

algorithms to predict future hot-selling commodities and dynamically adjust the types of commodities according to seasonal demands and surrounding market trends.

③Product Placement and Restocking Method: Use AI algorithms to predict hot-selling commodities and customer behaviors, optimize the layout of the shelves to ensure that frequently purchased commodities are placed in conspicuous or easily accessible positions. Combine AI with Internet of Things technology to realize an intelligent restocking system, monitor the inventory of commodities in real time, and improve the restocking efficiency through unmanned delivery or automated restocking technology.

④Convenience and Process Efficiency: Simplify the shopping process, use AI-recognized smart shopping carts and provide a seamless AI payment system to reduce queuing and checkout times and improve the overall smoothness and user experience.

4. Conclusions

This study is based on the existing operational model of unmanned supermarkets and uses quantitative analysis to examine the factors that affect user experience during their operation. A questionnaire was designed, and user perceptions were analyzed using SPSS software. The study concludes that unmanned supermarkets can improve user experience by optimizing service quality, technical support, and user information security. Finally, feasible recommendations are provided, based on the AI technologies currently available. However, the data obtained from the study may not be fully applicable to every unmanned supermarket's specific situation, and each case should be analyzed individually.

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