



Improve customer shopping experience in brick-and-mortar supermarket using AR glasses

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Abstract : In recent years, partly due to the impact of the Covid-19 infection, people's consumption activities have continued to shift from brick-and-mortar supermarket and convenience store to online shopping. In this study, in order to encourage customers to visit brick-and-mortar supermarkets, we overlap the virtual atmosphere in brick-and-mortar supermarkets using AR technology based on Mehrabian and Russel's environmental psychological model. We analyzed the relationship between the presented atmosphere and customers' satisfaction level and purchase intention through experiments with subjects, and proposed and evaluated AR-based brick-and-mortar supermarkets from a marketing perspective.

Keyword : :virtual atmosphere, brick-and-mortar, Augmented Reality, Purchase intention

1. Introduction

Brick-and-mortar supermarkets have long-lasting servicing for customers. Online shopping is catching up and overtaking traditional methods of purchasing because of the quick growth of Internet services. According to estimates from the Japanese National Supermarket Association, sales income for online supermarkets will increase from 6.7 trillion yen in 2014 to 12.2 trillion yen in 2020. However, the sales revenue of traditional supermarkets has barely increased. The number of average weekday consumers per day has dropped from 2004.5 in 2014 to 1835.2 in 2020. Furthermore, the outbreak of COVID-19 had made things worse. It is evident that online shopping poses serious threats to traditional supermarket and convenience store. To improve brick-and-mortar supermarket competitiveness in this circumstance, increasing revenues and bringing back more customers is an upcoming must.

We initially attempt to comprehend the process underlying consumer behavior in order to improve revenues. Kotler noticed the influence of ambient conditions on impulsive buying. According to Kotler P., atmosphere refers to the endeavor to construct shopping settings to elicit particular emotional impacts from the consumer that increase his likelihood of making a purchase. A model to describe the effects of atmospheric cues on purchase intention was further developed by Mehrabian and

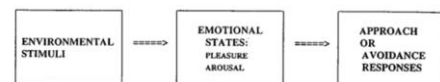


Fig. 1 Mehrabian-Russell Model

Russell. Consumers are influenced by atmospheric incentives, which cause two different emotional states—pleasure and arousal—and prompt an approach or avoidance reaction.

In recent years, the usage of Augmented Reality (AR) in retail establishments improved the customer experience and attracted the attention of various marketing researchers. More research has been done on augmented reality in areas including marketing, advertising, e-commerce, and shopping centers. In the physical supermarket and convenience setting, augmented reality is typically employed for product information displays and navigation. Despite the fact that studies on virtual stimuli based on augmented reality were undertaken, most augmented reality devices were smartphones or displays. It was discovered that few researchers were adopting smartphones as research device, head-mount displays were limited to be used due to deployment difficulty.

2. Research Purpose and Solution

Brick-and-mortar supermarket and convenience provides daily products for customers. We assume that if supermarket and

convenience can provide an unforgettable shopping atmosphere with AR technologies, customers would be more willing to visit, therefore increasing their purchase intention.

Investigation had highlighted customers' expectation on AR application in retail sceneries, but virtual atmosphere via AR is yet to be done. Therefore, it is possible to provide a virtual atmosphere. To confirm virtual atmospheric impact on purchase intention, we conducted experiment into two steps: 1)VR solution Design: conducted an experiment about the virtual atmosphere's impact on customers' purchase intention using VR, and confirmed virtual atmosphere's effectiveness. 2) AR solution Design: Based on the result of VR scenes, we further apply virtual atmospheric impact in brick-and-mortar supermarket and convenience store using AR HMD. And investigate how AR atmosphere impacts purchase intention.

2.1 VR Solution Design

In the first step, virtual supermarket design is basically trying to combine supermarket and aquarium together, and arouse customers' amazing experience in aquarium. We used blue lighting as the main color. Abyssal fishes, corals, bubbles and seaweed were added as decoration. Also, a song named Ocean Breath was also added in the VR supermarket. For comparison, we also developed a conventional supermarket. The VR software was developed in Unity and run on PC, Oculus Quest 2 was used as VR devices, providing head motion recognition and button input.

Subjects are required to first experience shopping both in a conventional supermarket and an aquarium theme supermarket, scenes were as fig.2 and fig.3. Then fill in a form for assessing pleasure level and purchase intention.



Fig. 2 Conventional supermarket



Fig. 3 Aquarium-style supermarket

Table. 1 Average level between two supermarkets

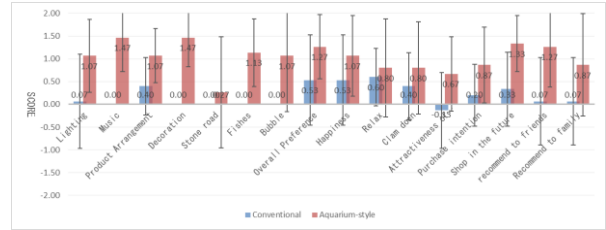


Table. 2 Correlation between elements and pleasure level

| | Happiness | Overall Preference | Relax |
|---------------------|-----------|--------------------|--------|
| Lightning | | .856** | |
| Music | | .701** | |
| Product Arrangement | .536* | | .578* |
| Interior | | .656** | |
| Stone Road | .709** | | .853** |
| Fishes | .529* | .610* | |
| Bubble | .789** | | .766** |

Indicators includes virtual atmosphere elements(lightning, music, product arrangement, stone road, fishes, bubble), pleasure level(happiness, overall preference, relax), purchase intention(Recommend to friend, recommend to family, purchase intention, shop in the future). Table 1 show average preference level between conventional supermarket and aquarium-style supermarket, which shows significant difference.

Due to individual difference, instead of T-test, ANOVA test

Table. 3 Correlation between pleasure level and purchase intention was

| | Recommend to friends | Shop in the future |
|--------------------|----------------------|--------------------|
| Overall Preference | .567* | .603* |
| Happiness | .799** | .873** |
| Relax | | .748** |

conducted, 5 indicators (happiness, overall preference, relax, recommend to friends, shop in the future) shows significant difference. Next, correlation analysis was conducted, results in Table 2 and Table 3 showed that the virtual atmosphere highly influenced customers' pleasure level. Pleasure level also influenced purchase intention. However, subjects were not able to touch the products, which became a limitation.

2.2 AR Solution Design

2.2.1 Virtual design

The atmosphere design in AR is similar to the VR solution design, we design a virtual candy park in a brick-and-mortar supermarket, and run on HoloLens 2 (AR glasses). We would like to also design aquarium theme AR scenes, but physical differences between VR devices and AR devices exist. For example, VR devices can display sunlight undersea clearly by applying light effects, but AR glasses cannot display clearly due to limited



Fig. 4 Candy Park theme in supermarket

brightness and light interference from the surrounding environment. Due to the limitation, we cannot apply an aquarium theme scene in AR. Instead, we designed a candy park theme atmosphere. Like fig.4, the candy park scene consisted of 4 parts: virtual atmospheric elements (VAE), music, interactable, particle system. Virtual objects include candys, candy knights, huge cakes and candy castles. A candy theme music was chosen as background music. Interactable functions like grabbing and moving were added for users to play. Particle system can simulate candy rain in the whole scene.

2.3 System Design

The AR system was developed in Unity, applying Vuforia SDK for spatial modeling and recognition, MRTK SDK by Microsoft for HoloLens 2 configuration and gesture recognition. Then the AR system was built on HoloLens 2, and run on HoloLens 2 independently. For spatial modeling, Vuforia Area Target Creator application on iPhone 13 pro max (Lidar sensor is a must) was used for modeling the whole brick-and-mortar supermarket as area target.

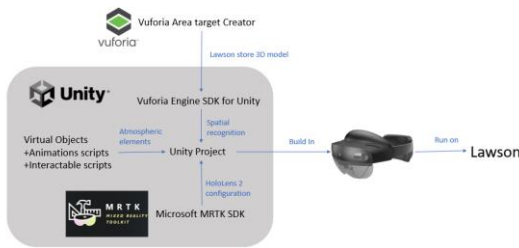


Fig. 5 System Structure

The model can be imported to Unity, and virtual objects can be set to the corresponding place. Next, HoloLens 2 official SDK MRTK was also needed for configuration, which include initiation, spatial mesh visualization, audio recognition and so on. Then export the projects as a HoloLens application and install it in HoloLens 2.

2.3.1 Experiment Design

Lawson is known as a convenience shop in Japan, but also operates supermarket named Lawson store 100. In this experiment, a Lawson store was set as experiment space. Like fig.6 subjects were required to 1) walk around in Lawson as usual, and fill up the questionnaire. 2) walk around in the Lawson with the virtual candy park theme using HoloLens 2, and fill up the

questionnaire.



Fig. 6 shopping with and without AR glasses

2.3.2 Questionnaire Indicator

In this experiment, indicators mainly assess pleasure level and purchase intention. Indicators are shown in the following Table.4. All questions were designed in Likert 5 scale.

Table. 4 Indicators

| |
|---|
| Pleasure |
| Do you like this supermarket? Do you feel happy? Do you feel excited? Do you feel relaxed? Do you feel calming down? Do you feel optimistic? Do you feel fulfilled? |
| Virtual atmospheric elements (VAE) satisfaction |
| Do you think the VAE are attractive? Do you think animations of VAE are attractive? Do you think the interactions of virtual VAE are attractive? Do you think the music is attractive? |
| Purchase intention |
| Do you think products are attractive? Are you willing to recommend it to your friends/partner? Are you willing to recommend it to your family members? Do you want to buy products? Will you shop here in the future? |

3. Result Analysis

3.1 Descriptive analysis

10 subjects attended the experiment, 4 subjects are male, and 6 subjects are female. All of them are in their 20s.

3.2 comparative analysis

All the indicators' average value and standard deviation are shown in the following fig.7, average value differs from two experiments.

Overall speaking, the majority of those indicators show a difference between two experiments. Due to individual difference, we conducted ANOVA instead of T-test. As is shown in ANOVA result, calming down, relax, and purchase intention didn't have variance between two experiments.

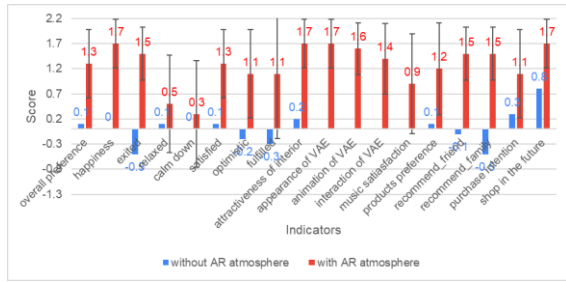


Fig. 7 Descriptive indicators

3.3 correlation analysis

To figure out the detail relation among virtual atmospheric elements(VAE), pleasure level and purchase intention, we conducted a correlation analysis. Results in chart 2 show that overall VAE, animation of VAE, interaction of VAE contribute to preference, happiness, excitement. overall of VAE, animation of VAE contributes to satisfaction, optimism and fulfillment. On the other hand, music shows no correlation with pleasure level.

Chart. 5 Correlation between virtual atmospheric elements (VAE) and pleasure level

| | preference | happy | excited | satisfy | optimistic | fulfilled |
|--------------------|------------|---------|---------|---------|------------|-----------|
| overall of VAE | 0.617** | 0.771** | 0.799** | 0.53** | 0.61** | .481** |
| animation of VAE | 0.625** | 0.745** | 0.762** | 0.491* | 0.549* | |
| interaction of VAE | 0.467* | 0.541* | 0.582** | | | |

Next, correlation between pleasure level and purchase intention was conducted. Results in the chart 5 showed that all factors had high correlation with product attractiveness, recommendation level(both friend/partner and family members). Preference, happiness, satisfaction, optimism shows high correlation with purchase intention. Only happiness and satisfaction show correlation with repurchase intention.

Chart. 6 Correlation between pleasure level and purchase intention

| | product attractiveness | recommend_friend | recommend_family | purchase_intention | repurchase-intention |
|------------|------------------------|------------------|------------------|--------------------|----------------------|
| preference | .666** | .544* | .672** | .667** | |
| happy | .543* | .674* | 0.699** | .702** | .531* |
| excited | .479* | .653** | .691** | | |
| satisfy | .658** | .695** | .760** | .643** | .448* |
| optimistic | .706** | .713** | .646** | .608** | |

3.4 Overall analysis

This experiment showed that the virtual environment in augmented reality may influence consumers' experiences by raising their degree of pleasure, and that degree of pleasure can influence customers' purchase intentions in brick-and-mortar supermarkets.

4. Discussion

4.1 Overall Discussion

This article demonstrates that applying virtual atmosphere in a brick-and-mortar supermarket can raise the consumer's degree of pleasure, and thus influence the customer's purchase intention. For supermarkets, AR applications can be more discovered in the

future to improve customers' experience, and result in higher revenue.

4.2 Limitation of the research

There are mainly 3 limitations in this research: 1)all subjects are in their 20s, so a limited range of age was confirmed. 2) HoloLens, as an AR glasses, provides a narrow field of view and a limited brightness degree, which limits the atmospheric effects. 3)feedback from subjects showed that although the AR atmosphere was interesting and new to them, AR sometimes attracts one attention from products to virtual object.

4.3 further research plan

Future research should provide more customized choices for different customers. Also, different age subjects should be tested in the future research.

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