Intention to Adopt Online Food Delivery Using Augmented Reality Mobile Apps: A Perspective of SOR Framework

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Abstract— **Globally, the COVID-19 pandemic has affected all sectors, including the food and beverage industry. The pandemic has changed customers' behavior from dine-in services to online food ordering systems. Technology advancements make ordering food easier with Online Food Delivery (OFD) service. However, before buying food online, consumers require a physical assessment to decide to buy the food or beverage. Augmented Reality (AR) is a popular technology to show 3D virtual elements. Meanwhile, the stimulus-organism-response (SOR) framework can be used to analyze consumers' behavior. More specifically, the SOR model has been used to evaluate the user's behavior intention to accept online shopping apps. However, in the OFD context, there is a lack of research investigating the customer's intention to use the AR app based on the SOR perspective. This study aims to assess the factors influencing consumers' intention to adopt augmented reality apps. 52 AR OFD app customers participate in this study. Partial Least Square-Structural Equation Modeling (PLS-SEM) and SMARTPLS 3 was used to analyze the research model. This study evaluated from measurement and structural model. The measurement model using factor loading, Composite Reliability (CR), Average Variance Extracted (AVE), and heterotrait-monotrait (HTMT) ratio. The structural model assessed the variance inflation factor (VIF), R2, path coefficient (β), f2, and p-value. The results showed the significance of food image on hedonic, utilitarianism, and perceived informativeness. Furthermore, hedonism was the only determinant that positively influenced the customers' intention to use the AR OFD apps.**

Keywords— **Augmented reality; e-commerce; mobile application; online food delivery; stimulus-organism-response.**

I. INTRODUCTION

Globally, the COVID-19 pandemic has affected the health sector and many other sectors, including the food and beverage industry. The pandemic has changed customers' behavior from dine-in services to online food ordering systems [1]. Some efforts have been made to control the virus's spread worldwide, especially in Indonesia. Many big to small restaurants have started to shift their business model to Online Food Delivery (OFD) [2]. Technology advancements make ordering food more accessible. OFD is a service for food ordering and online delivery [3]. Customers can choose and order from different variants of food and beverages with a single tap on their smartphone. OFD can be found mostly in urban cities in Indonesia, such as Jakarta, Bandung, Semarang, Yogyakarta, Surabaya, Malang, and Bali. The most popular OFD applications in Indonesia are Go Food, Grab Food, and Shopee Food. However, some restaurants use their OFD services application, such as McDonald, Pizza Hut, Domino Pizza, Hoka-Hoka Bento, and many more.

A previous study explained that many factors could affect OFD services, such as time, service, quality, price, food condition, variety of restaurant, menu, and delivery tracking [4]. Another previous study explained that visual and information design are essential aspects of food delivery [5]. Visually appealing and good information about food and beverage would influence customer purchase decisions [5]. Menus with good or attractive pictures in the application can appeal more and reduce search time [6]. So, the food or beverage with bad-quality pictures can affect customer purchase decisions. Previous research explained many obstacles in online food shopping. For example, before buying food online, customers require a physical assessment to decide to buy the food or beverage [7]. Currently, OFD service in Indonesia uses 2D pictures to visualize food and beverages in OFD services. So, customers cannot afford a physical assessment of their product.

Many companies use more 3D visuals than 2D visuals to help customers in decision-making [8]. Augmented Reality (AR) is the latest technology to show 3D virtual elements in the physical environment. AR helps many sectors to visualize 3D objects in real life. People can do real-time interactions with virtual objects. Many researchers and professionals recommend using AR to improve their marketing strategies and customer engagement [9]. It also helps online commerce to increase its sales [10]. Especially today, developer applications and smartphones in AR have significant growth. Customers can use just their smartphones for used AR. This technology also can use in the food industry. The previous study used AR to improve serving accuracy and consistency in food [11]. AR can help someone check the size of the food accurately. This technology can provide an interactive experience for the user to promote food [12]. Some mobile applications like Kabaq AR use an application to see food products. So, customers can visualize before buying food or beverages. On the other hand, AR can be an excellent tool to promote restaurants [13].

Many studies have adopted the stimulus-organism-response (SOR) model to analyze consumer behavior, technology, and psychology [8], [14]–[16]. More specifically, the SOR model has been used to evaluate the user's behavior and intention to accept online shopping apps in fashion shopping [17] and halal cosmetics [14]. However, in the OFD context, there is a lack of research investigating the customer's intention to use the AR app based on the SOR perspective. Therefore, this study assesses the factors influencing consumers' intention to adopt augmented reality apps.

II. MATERIALS AND METHOD

A. Online Food Delivery Service

Online Food Delivery (OFD) service is a platform for choosing and ordering food, payment, and monitoring our order from choosing to delivered. There are two categories of OFD service [4]—first, retailers such as McDonald's, Hoka-Hoka Bento, KFC, and Pizza Hut. Second, the category comprises multiple restaurants such as GoFood, GrabFood, Shopee Food, Klik-Eat, Raja Makan, etc. In Indonesia, OFD services proliferate. Go Food has become a market leader in OFD service, and Grab Food is in position number two as the top OFD service in Indonesia compared with others [18]. People are busier every day. They don't have time to prepare their meal or go out to buy a meal. Thus, these things make a demand on OFD service [19]. Moreover, the COVID-19 pandemic increases the demand for OFD services [1]. A study reported the total transaction of one OFD service in Indonesia, Go Food, have increased by 10 percent in April 2020 because people must dine at home [20]. This OFD service enables customers easier to buy food more through mobile apps or websites.

Nowadays, many restaurants have already used OFD services to deliver their food. As a consequence, customers have many app choices. Previous studies have investigated the factors affecting customers' intention to use OFD. Most customers were concerned about price, quality, and delivery [21]. Moreover, a study confirmed two factors affecting OFD service: direct and indirect [4]. Direct factors related to service quality, delivery time, delivery process, price, and food conditions. Indirect factors such as menu, number of restaurants, attitude delivery service, and delivery tracking process. Meanwhile, the design was also reported to become the essential factor affecting customers use OFD services, including visual design, information design, nautical design, and collaboration design [5]. Many authors argued that product image affects the customers' decision to buy an online product [4]–[6], [22], [23]. However, a limited study focuses on food visualization affecting customers using OFD services.

B. Augmented Reality in Food

Nowadays, the use of Augmented Reality (AR) is extensive. Customers use their smart device to visualize and assess products or services instantly to create an enjoyable experience [24]. AR is an advanced technology that provides many opportunities. The popularity of AR is swiftly becoming an established research domain. Starting from education research [25] up to marketing research [8], [26], [27]. But still, slightly some research about Augmented Reality in food and beverage. However, this technology has many opportunities in the food and beverage industries [28]. A prior study explored the usage of AR to enhance customers' experience [13]. The result showed AR can lead to positive post-consumption behaviors and is important in improving customers' overall food well-being [13]. Furthermore, AR can be improved serving accuracy and consistency to support serving food accuracy [11]. In addition, AR is very helpful in improving the visual of food.

Another study explained that AR could have functioned as a digital food menu. This application can help customers visualize any food item available on the menu and save time choosing food [29]. Customers will be easier to imagine the food by looking at a 3D model. Some people often have high expectations about the meal on the menu but get disappointed after the meal is ready. AR has become good technology to visualize the menu. The actual visualization of the meal can be very helpful for a user to choose their menu [30]. Additionally, mobile AR positively affects to user's decision-making process [8].

C. S-O-R (Stimulus, Organism, Response) Theory

The S-O-R framework is a Stimulus, Organism, and Response. This model examines the relationship between input as a stimulus, process as an organism, and output as a Response [31]. Based on the previous research, the S-O-R framework was used to predict user behaviors [8], [31]–[34]. For example, technology adoption, purchase intention, and word-of-mouth were included in SOR theories [35]. In addition, previous research examined that the S-O-R framework was also used to identify OFD service [36]. Chandra argued that stimulus in OFD services includes perceived ease of use, perceived usefulness, privacy, facilitating condition, and informativeness [36].

Stimulus is the S-O-R component as a factor that incites or amplifies action [35]. Stimuli can influence the internal consumer experience to do something [8]. A previous study explained stimuli such as sensory appeal, ecological warfare, natural content, nutritional content, price, product quality attributes, social and economic environments, authentic experience, and involvement [15]. In addition, much previous

research explained that product image could affect consumers to buy online products [4]–[6], [22], [37]. Therefore, this study proposes food image construct as stimuli.

The organism is the second S-O-R component, a mediator of stimulus and response [35]. This is the individual evaluation process as stimuli they got and reaction to technology use [8], [15]. In this component, the individual analyses the stimuli or input from internal and external the processed by affective and cognitive reactions. Affective reactions are emotional responses from user interaction with technology [8]. The hedonic attitude or enjoyment is used as an affective reaction. Cognitive reactions are intellectual responses from mental process feedback [8]. Utilitarianism attitude and informativeness are used as cognitive reactions. Previous research examined hedonic, utilitarianism, and informativeness as the factors that predict consumer behavior to use AR applications [8]. Therefore, these variables are included in the proposed theoretical model.

The response is the third component, the final output from input and individual evaluation process about the use of technology [35]. The response relates to consumer behavior to continue using the app. A previous study employed intention to use as a response variable [24]. Moreover, the intention to use correlates with consumer response behavior to reuse or reuse applications [38]. Thus, this research uses the intention to use the AR OFD app to represent a response.

D. Theoretical Model and Hypotheses Development

The development of the theoretical model refers to the existing literature on AR app adoption. The model consists of four determinants (food image, hedonic, utilitarianism, perceived informativeness) and one dependent (intention to use) variable, as presented in Fig. 1. The model used the SOR framework as a basic model.
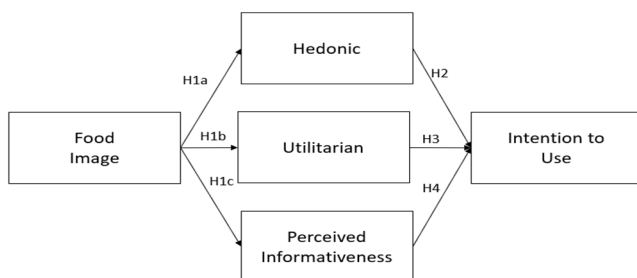

Fig. 1 The theoretical model

A menu with attractive pictures can appeal more and reduce the search time [6]. Furthermore, high-quality photos have higher enjoyment than low-quality ones [8]. The greater image quality can improve consumers' enjoyment of OFD app service. Moreover, consumers can gain more hedonic and utilitarianism with high-quality visuals [39]. The greater quality of the image affects utilitarianism and hedonism. A high-quality image can help consumers evaluate, browse, compare, and select products [39]. A menu with good-quality pictures reduces the search time for choosing the items to order [6]. It means more good quality pictures can give enough information to ensure consumers buy food or beverage. Especially using augmented reality as a food image can give more information than 2D image, such as portion size and ingredients [30]. So, food image in the OFD app

positively affects hedonism, utilitarianism, and perceived informativeness. Therefore, we hypothesize:
- H1a. Food Image in the OFD app positively affects hedonics.
- H1b. Food Image in the OFD app positively affects utilitarianism.
- H1c. Food Image in the OFD app positively affects perceived informativeness.

Hedonism is suited to the emotional and affective experience of fun or pleasure in using technology [40]. Hedonism is important in making a positive opinion of consumers [8]. The more consumers enjoy using this application, the more positive emotions they feel while using the OFD app. Hedonism needs emotional release and enjoyment to entertain consumers [8]. Creating pleasure in online shopping for consumers is important to make consumers have a positive mind to come back to using and shopping in the online store [41]. A previous study explained that hedonism positively affects intention toward using the applications. Therefore, we hypothesize H2: Hedonism positively affects the intention to use the AR OFD app.

Utilitarianism is the functional characterization of online experiences, such as app usability [14]. An overall functional benefits and sacrifices [42]. Perceived utilitarianism value relies on the accession of the benefits perceived by consumers [43]. Perceived utilitarianism has an important role in affective and cognitive states in the organism [8]. Consumers' utilitarian feelings can affect their positive feelings and desire to shop online [39]. Utilitarianism makes a feeling and evaluates the apps, which can affect the intention to use [44]. The good utilitarianism value positively affects consumers' intention to use OFD apps. Especially using augmented reality to visualize products can affect consumers' positive intention to use the app. Therefore, we hypothesize H3: Utilitarianism positively affects the intention to use the AR OFD app.

Information has an important role in consumer decision-making [8]. A prior study also explained good information could enhance consumers' decision-making [5]. Information experience from a user can affect positive feelings to purchase products [16]. Relevant information in online shopping can increase positive feelings like trust and enhance intention to use the product [5]. In this case, augmented reality has more information than 2D images. Augmented reality can give information such as portion size and ingredients [30]. The complete information given to consumers can affect positive intentions to consumers. Therefore, we hypothesize H4: Perceived informativeness positively affects the intention to use the AR OFD app.

E. Measurement

The authors developed a questionnaire from the variables used in this research. This research has five variables: food image, hedonism, utilitarianism, and intention to use OFD app. Each variable has three indicators to construct this questionnaire. Every indicator had a reference from previous research. All the statements have been modified to fit this research. The questionnaire scale item and reference are listed in Table I. The authors used a five-point Likert scale to assess the construct. The range used for this research is from 1 (strongly disagree) to 5 (strongly agree). In the first part of the

questionnaire, the participants must fill in demographic information such as gender, age, education, job, and validity in 3 months using OFD apps such as GoFood, GrabFood, Shopee Food, etc.

TABLE I
QUESTIONNAIRE SCALE ITEM

Variable	Scale Item	Reference
Food Image	Food image in apps is very attractive.	[6], [39]
	Food image in apps has good quality.	
	Food images in apps similar to the original product.	
Hedonism	Using the AR OFD app is fun.	[45]
	I am very happy using the AR OFD app feature.	
	Food images on the AR OFD app make me enjoy them.	
Utilitarianism	I found the AR OFD app to be very easy to use.	[45]
	The AR OFD app feature was intuitive to use.	
	It was easy to learn how to use the AR OFD app.	
Perceived Informativeness	The AR OFD app provides detailed information about the food.	[45]
	The AR OFD app provides complete information about the food.	
	The AR OFD app provides information that helps me in my decision.	
Intention to Use	I will use the AR OFD app.	[46]
	I will use the AR OFD app for purchase food next time.	
	I will try using the AR OFD app.	

F. Data Collection and Evaluation

Firstly, the author created the AR OFD Apps. Figure 2 shows a screenshot from the AR OFD applications. This app was developed using Unity 2018.4.32.f1 and Vuforia version 8.3.8. First, customers found the homepage. In the homepage, they could check the homepage banner with promo buy 1 get 1. After that, they could choose food or beverage. They could choose which food or beverage they want to buy. Customers can look at the 3D images of food or beverage, description, and order the food or beverage. There were 4 3D model for the food and 4 3D model for the beverage. The AR OFD apps use a marker system using an image target from food or beverage. This application was uploaded on Google Drive. Participants could download it on their android device and try the AR OFD apps. Finally, they can fill out an online questionnaire. The questionnaire had demographic questions such as gender, age, level of education, and jobs.

PLS-SEM was used to evaluate the research model. The evaluation process consisted of two steps. The first step was the measurement model, which evaluated the factor loading of each indicator and checked both validity and reliability using Composite Reliability (CR) and Average Variance Extracted (AVE). The heterotrait-monotrait (HTMT) ratio was used to evaluate the discriminant validity of the measurement model [47]. The second step was the structural model, which assessed the variance inflation factor (VIF), R^2, path coefficient (β), f^2, and p-value.
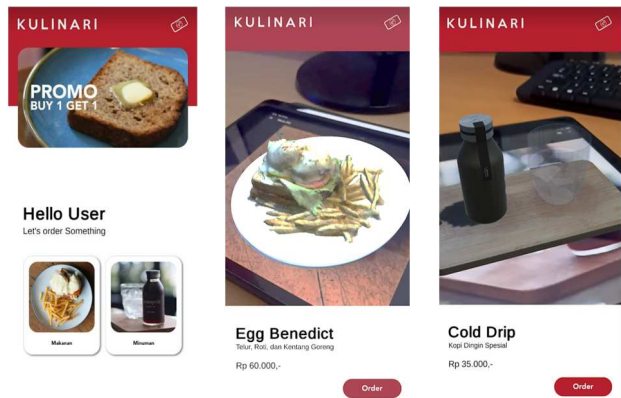

Fig. 2 AR OFD Apps

III. RESULTS AND DISCUSSIONS

The results of this research are explained in the form of a sample profile, measurement model, and structural model. The results are continued with a comprehensive discussion.

A. Sample Profile

Initially, the study obtained fifty-three participants. However, one of them was excluded because he did not use OFD apps in the last 3 months. Thus, the final sample size used in this study was fifty-two participants. The number of male and female respondents was 36 and 16, respectively. Participants were aged 18 to 39, and most participants were aged twenty. The number of participants having education level of senior high school, bachelor's degree, and master's degree are 30, 17, and 5, respectively. The characteristic of respondents' jobs varies, including students, private employees, public employees, businessmen, and others, with the majority being students. After seeing and trying the AR apps, the participants filled out the online questionnaire.

B. Measurement Model

Initially, in the measurement model, the factor loading score must be 0.708 or above, following the guideline from [47]. The results showed that all the factor loadings had been accepted with a score range of 0.759 to 0.952, as presented in Table II. The reliability of the variables was tested using Composite Reliability (CR), and the score for CR was expected to be equal to or above 0.80 [47]. Meanwhile, the Average Variance Extracted (AVE) was used to check the validity of each construct. The score for AVE should be equal to or above 0.60 [47].

TABLE II
QUESTIONNAIRE SCALE ITEM

Constructs	Loadings
Food Image	
IMG 1	0.869
IMG 2	0.757
IMG 3	0.832
Hedonism	
HED 1	0.800
HED 2	0.895
HED 3	0.782

Utilitarianism
UTI 1	0.827
UTI 2	0.932
UTI 3	0.791
Perceived Informativeness	
INF 1	0.869
INF 2	0.759
INF 3	0.794
Intention to Use	
ITU 1	0.952
ITU 2	0.869
ITU 3	0.791

The results confirm that all CR scores were higher than 0.8 for each variable, with the values ranging from 0.850 to 0.905. Meanwhile, all the AVE values had greater than 0.6 for each variable having values between 0.654 and 0.763. Therefore, all the variables were valid. The results of CR and AVE can be seen in Table III.

TABLE III
CR AND AVE RESULTS

Variable	CR	AVE
Food Image	0.860	0.673
Hedonism	0.866	0.684
Utilitarianism	0.888	0.726
Perceived Informativeness	0.850	0.654
Intention to Use	0.905	0.763

Most of the research used Cross-loadings and Fornell-Larcker to assess the discriminant validity. However, this testing was insufficient to show discriminant validity [8]. A prior study tested the discriminant validity using the heteroit-monotrait (HTMT) ratio of correlations [8]. Thus, this research used the HTMT ratio to ensure the discriminant validity of the data. The recommended value for HTMT ratio is less than 0.85 or 0.90 [47]. The results showed that all HTMT ratios were less than 0.85, which satisfied the discriminant validity. The results of the HTMT ratio are shown in Table IV.

TABLE IV
HTMT RATIO RESULTS

	HED	IMG	INF	ITU	UTI
HED	1				
IMG	0.656	1			
INF	0.535	0.699	1		
ITU	0.678	0.503	0.518	1	
UTI	0.584	0.452	0.755	0.504	1

C. Structural Model

This study tested the structural model using PLS-SEM. The application used to calculate PLS-SEM is Smart PLS 3. PLS-SEM was considered a very suitable statistical tool for relationship testing. This study used p-value thresholds for the hypothesis testing: $*p<0.05$, $**p<0.01$, $***p<0.000$. The results of hypotheses testing for AR that food image in the OFD app positively affects hedonism ($\beta = 0.532$, $p = <0.000$), utilitarianism ($\beta = 0.360$, $p = <0.000$), and perceived informativeness ($\beta = 0.553$, $p = <0.000$); H1a, H1b, H1c were supported. The relationship of hedonism positively affects intention to use AR OFD app ($\beta = 0.431$, $p = <0.000$); H2 was supported. Utilitarianism ($\beta = 0.121$, $p > 0.05$) and perceived informativeness ($\beta = 0.170$, $p > 0.05$) positively affect the

intention to use AR OFD app but are not significant. H3 and H4 were not supported. The results of the hypotheses are shown in Table V.

TABLE V
RESULTS OF HYPOTHESES TESTING

	Hypothesis	Path Coefficient	p-value	Support for Hypotheses
H1a	Food Image -> Hedonism	0.532 ***	0.000	Supported
H1b	Food Image -> Utilitarianism	0.360 ***	0.005	Supported
H1c	Food Image -> Perceived Informativeness	0.553 ***	0.000	Supported
H2	Hedonism -> Intention to Use AR OFD App	0.431 ***	0.000	Supported
H3	Utilitarianism -> Intention to Use AR OFD App	0.121	0.483	Not Supported
H4	Perceived Informativeness -> Intention to Use AR OFD App	0.170	0.261	Not Supported

Note: $* p < 0.05$; $** p < 0.01$; $*** p < 0.001$

Then, the study checked the model's predictive power by calculating R^2 from the endogenous construct. The expected value for R^2 was not above 0.90 [47]. The results showed that all values were between 0.112 and 0.319, indicating accepted as explanatory power. Results of the R2 value showed in Table VI.

TABLE VI
R^2 RESULTS

Variables	R2
Hedonism	0.269
Utilitarianism	0.112
Perceived Informativeness	0.292
Intention to Use	0.319
UTI	0.584

D. Discussion

AR has been used a lot in the online industry. This technology helps people to see an object with a 3D model. This research assesses the factors influencing consumers' intention to adopt augmented reality apps. Fig. 3 shows the results of the structural model. This research finds that when using AR OFD apps with 3D images, consumers have a positive influence and are significant to hedonism, utilitarianism, and perceived informativeness. 3D images from AR with high-quality images can gain more utilitarianism, hedonism, and perceived informativeness [46]. Consumers can enjoy AR images. With AR OFD apps, 3D food images make consumers feel useful and give more information.

The finding confirmed that hedonism was the only determinant that positively affected the intention to use the AR OFD app. Therefore, hedonism became an important variable in AR OFD apps. This is in line with previous research that hedonism has influenced the intention to use mobile apps [24], [42], [48]. The joy or pleasure took effect on consumers using AR OFD apps. Customers enjoyed and

were pleased with 3D images from AR. Customers can view a 3D image of the food or beverage they choose, and they feel more enjoyable seeing 3D images to choose which food or beverage they want to buy. This drives consumers to use and reuse AR OFD apps.
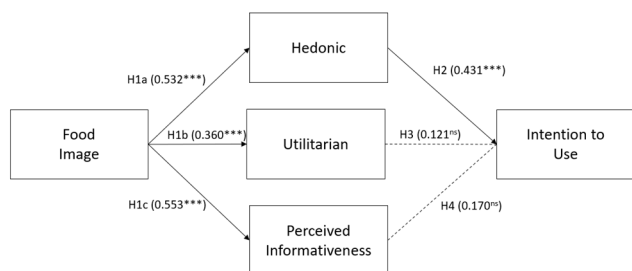

Fig. 3 Results of The Structural Model

This study failed to show the significance of both determinants, utilitarianism and perceived informativeness, on intention to use AR OFD apps ($p > 0.05$). The results were not in line with some prior research which confirmed that utilitarianism and hedonism were two influential variables that affect user perceptions and acceptance of online shopping [42]. The result implies that Indonesian consumers disregard the functionality and informativeness in developing their intention to use AR OFD apps.

IV. CONCLUSION

The study uses the SOR model to assess the factors influencing consumer behavior intention toward augmented reality app adoption. AR OFD apps with 3D images positively influence utilitarianism, hedonism, and perceived informativeness. Hedonism positively and significantly influences the intention to use AR OFD apps. Whereas utilitarianism and perceived informativeness did not significantly affect consumers' intention to use.

However, there are some limitations related to this study. First, the total population of this research was only 52 participants, and future research may add more participants from different cities to improve the validity. Second, this research was conducted in Indonesia, which cannot be generalized to other countries. Third, because the research model did not include moderating factors, future research can add some moderating factors such as gender, age, education, etc. Fourth, other different constructs may be added to the theoretical model to increase the explanatory power of the research.

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