The Impact on Customer Satisfaction towards Robotic Service in Indian Muslim Restaurants

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ABSTRACT

This study investigates customer satisfaction with service robots in the restaurant industry, focusing on Penang, Malaysia. It begins by exploring the adoption of innovative robotic technologies in the food and beverage sector and traces their evolution over time. The research also examines the benefits and drawbacks of implementing service robots in modern restaurant environments. According to the Department of Statistics Malaysia, Penang had a population of 1.77 million in 2021. A minimum sample size of 385 respondents was determined using Raosft.com, which was selected for its accuracy in sample size estimation. A quantitative research approach was utilised, with data converted into numerical form for subsequent analysis. The study employed SPSS software due to its reliability, widespread use among researchers and institutions, and ability to provide accurate results through a user-friendly interface. The research aims to assess how service robots influence customer acceptance in the restaurant context. By analysing factors impacting customer satisfaction with these robotic services, the study seeks to provide insights into enhancing their adoption and usage. The findings highlight that understanding the elements that affect customer satisfaction is crucial for promoting the continued use of service robots. This understanding is vital for ensuring the sustained development and integration of robotic services within the food and beverage industry. Addressing the identified factors can ultimately contribute to the growth and acceptance of robotic technologies in restaurant settings, facilitating their role in the evolving food service landscape.

BACKGROUND OF THE STUDY

In the context of globalisation and widespread internet access, the rapid advancement of artificial intelligence (AI) has significantly impacted various sectors, including the food and

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beverage industry (Teneja et al., 2023). While service robots have been prevalent in Japan, they represent a novel phenomenon in Malaysia, where such technology increasingly attracts customer interest. Robots are utilised in the food and beverage industry and across manufacturing, industrial, and healthcare sectors (Khan et al., 2018; Tuomi et al., 2020). As Sarker et al. (2021) noted, these robots have substantial potential to enhance daily life, serving applications such as health monitoring and nutritional advising for individuals with physical limitations, including the elderly, those with infectious diseases like COVID-19, and people with disabilities. Modern robotics, information technology, and AI are increasingly applied in restaurants to improve service efficiency, cost-effectiveness, and customer satisfaction (Shah et al., 2023). In developed countries, robots have supplanted mainly human labour for specific tasks (Decker et al., 2017; Ye et al., 2023). However, their use is not universally accepted due to limitations such as the need for constant power, restricted programming capabilities, and high installation and operational costs (Newman, 2022).

Integrating food service robots in restaurants is a growing trend, including in India, where technology is being adopted to enhance efficiency and customer experience. However, in culturally specific settings like Indian Muslim restaurants, this shift presents challenges. These restaurants traditionally emphasise personalised service and cultural authenticity, which may be compromised by robotic service. In their study, Said and Al Hajri (2022) indicate that while 40% of customers are intrigued by food service robots, 60% are concerned about losing the personal touch central to their dining experience. This gap between customer expectations and the reality of robotic service can lead to decreased satisfaction, reduced customer loyalty, and potential damage to the restaurant's cultural identity and reputation. Addressing this issue through research is crucial, as it can provide insights for balancing technological innovation with preserving cultural and service quality, helping restaurant owners make informed decisions.

In Malaysia, particularly in Indian Muslim restaurants, commonly known as Mamak restaurants, robotic technology is becoming more prevalent. These establishments are popular among Malaysians, particularly the youth, who frequent them for socialising and entertainment (Ibrahim et al., 2017; Chinelato et al., 2023). The Malaysian Muslim Restaurant Owners Association (Presma) reports a significant labour shortage, estimated at 30,000 workers, which has prompted restaurant owners to explore robotic solutions to mitigate staffing issues (Ragananthani, 2022). Despite the high costs associated with service robots, they are considered a viable solution to labour shortages exacerbated by reliance on foreign workers (Aziz, 2022). The integration of robotics in the food and beverage sector is also driven by technological advancements and hygiene concerns heightened by the pandemic (Ragananthani, 2022). While they promise improved efficiency and customer experience, it is crucial to evaluate both immediate and long-term effects on service providers, customers, and the broader service ecosystem (Cambra-Fierro et al., 2021). Expectation-confirmation theory (ECT) is employed in this study to assess customer satisfaction by comparing pre-service expectations with post-service evaluations (Dabholkar et al., 2000; Habib & Attiq, 2020). This paper aims to investigate customer satisfaction with robotic services in restaurants, beginning with a review of innovative robotic applications in the food and beverage industry and the evolution of these technologies.

The specific objectives are:

i. To examine the effect of the relationship between expectations and satisfaction towards customers on robotic service in Indian Muslim restaurants.

ii. To evaluate the effect of the relationship between perceived performance and satisfaction towards customers on robotic service in Indian Muslim restaurants.

LITERATURE REVIEW

Customer Expectation and Expectation Confirmation Theory

Expectations are the anticipations regarding products, services, or experiences formed before actual consumption or use (Vichiengior et al., 2023). Typically, these expectations are shaped by a company's marketing communications and interactions with customers before a purchase. In the contemporary business landscape, expectations can also be influenced through advanced technologies such as smart devices and associated applications, which allow companies to gather detailed insights into customer preferences. Consequently, the increasing number of firms leveraging such technologies to understand customer expectations significantly impacts consumer perceptions (Bhattacherjee, 2001; Chinelato et al., 2023).

Expectation Confirmation Theory (ECT) is a framework in marketing that explores consumer satisfaction and dissatisfaction by evaluating the alignment between expected and actual performance (Juliana et al., 2021). The ECT model delineates consumer behaviour into three interconnected stages: the pre-purchase expectation stage, the disconfirmation/confirmation stage, and the response/feedback stage. Initially, consumers form expectations about a product or service. During the usage phase, they compare the anticipated performance with the actual performance to assess the degree of expectation confirmation. This comparison underpins the formation of satisfaction or dissatisfaction. The final stage involves consumer reactions, such as repeat purchases or complaints. The predictive validity of ECT has been validated across various research contexts (Juliana et. al., 2021).
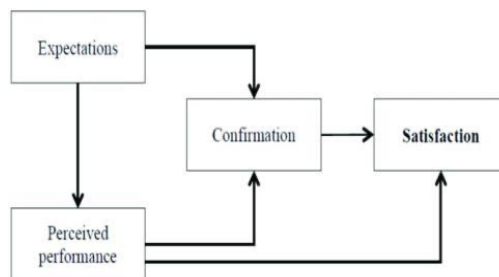

Figure 1. Expectation Confirmation Theory (Juliana et al., 2021)

The Perceived Performance of Service Robot

In Keller's (1993) multidimensional framework of "brand attitudes," which encompasses a consumer's overall evaluation of a brand and its influence on brand choice behaviour, perceived utility is a crucial component. Both relevant aspects shape brand attitudes—those necessary for fulfilling the product or service function—and irrelevant aspects, such as packaging or delivery quality, relate to the purchase or consumption experience. The perceived usefulness of a product is a significant attribute that continuously impacts consumer behaviour across various stages of IT product usage (Bhattacherjee, 2001; Chinelato et al., 2023; Rivaroli et al., 2022).

The "perceived service quality" construct extends this concept to include non-product-related attributes and is pertinent to both the post-consumption phase and ongoing usage patterns. This perspective aligns with the Expectation Confirmation Theory (ECT), which posits that perceived performance functions as a post-consumption indicator (Lee et al.,2014; Oliver,1999; Shieh et al.,2023). Woodruff et al. (1983) and Shieh et al. (2023) highlight brand attitudes and expectations as critical factors in perceived performance within marketing literature. ECT suggests that satisfaction or dissatisfaction is determined through a cognitive comparison between actual brand performance and performance standards based on prior experiences, with perceived brand

performance as a pre-consumption variable and performance norms as a post-consumption variable.

Recent analyses of the measurement and structural models have confirmed their validity and reliability, although six items, including perceived ease of use and perceived performance, were removed (Baharum & Jaafar, 2015; Chinelato et al., 2023). The remaining constructs aid in developing a user interface that is intuitive, user-friendly, and memorable. Despite excluding some items, the model provides valuable insights for enhancing interface usability. Lin et al. (2020) further indicate that service expectations influence satisfaction directly and indirectly through service confirmation, underscoring the pivotal role of service expectations in shaping subsequent satisfaction through multiple pathways.

Customer Satisfaction

In Expectation Confirmation Theory (ECT), customer satisfaction is determined by the degree to which actual experiences confirm initial expectations, with the level of expectation serving as the baseline for this confirmation (Atapattu et al., 2016; Niranga & Sedera, 2024). According to ECT, customers evaluate their perceived experiences, such as the firm's responsiveness, against their initial expectations to assess satisfaction (Bhattacherjee, 2001; Rivaroli et al., 2022; Chinelato et al., 2023). Lower initial expectations make achieving customer satisfaction easier for a firm than customers with higher expectations. Taneja et al. (2023) define satisfaction as the affective response following a purchase or based on cumulative brand experiences, thus incorporating "brand satisfaction" into the proposed model. Consistent with ECT, repurchase behaviour, often equated with brand loyalty in the context of continued brand purchases, is primarily driven by brand satisfaction. However, some studies suggest that brand loyalty encompasses additional dimensions, such as attitudinal loyalty (Chaudhuri & Holbrook, 2001; Habib & Attiq, 2020). Vichiengior et al. (2023) further note that brand satisfaction alone does not fully account for repurchase behaviour, mainly when consumers engage in brand extension purchases, where factors beyond satisfaction influence their decisions.

METHODOLOGY

The study aims to explore the relationship between customer expectations, experiences, and perceived performance of robot services in Indian Muslim restaurants in Penang, employing a quantitative approach. As Brewer (2003) outlined, followed by Creswell (2017), quantitative research facilitates examining variable relationships through numerical measurement and statistical analysis. The study uses a structured questionnaire developed with a 5-point Likert scale to gather customer expectations and experience data. A sample size of 385 respondents was determined using Raosoft.com, representing a reliable subset of Penang's population of 1.77 million in 2021 (Official Portal Department of Statistics Malaysia). Convenience sampling and voluntary sampling methods were employed to select participants who were easily accessible and willing to participate, complemented by snowball sampling to enhance sample reach through referrals (Mills, 2021; Sekaran & Bougie, 2016). The questionnaire was validated for reliability and relevance and distributed via an online survey platform to ensure data accuracy. Screening questions were used to confirm respondents' experience with robot services in Indian Muslim restaurants, ensuring the validity of the collected data, with the survey conducted over two to three months (El-Said & Al Hajri, 2022).

RESULTS AND FINDINGS

Sampling Description

Based on the questionnaire distributed, respondent demographics revealed that 59% were female and 41% were male, indicating a predominance of female consumers, which may influence customer expectations and satisfaction at Indian Muslim restaurants. The age distribution showed that 45% of respondents were between 23 and 27 years old, 31.7% were between 28 and 32 years old, and 12.1% were between 33 and 37 years old, with the remaining respondents aged 18 to 22, highlighting a dominant presence of young adults. Regarding education, 39.9% held a diploma, 37.3% had a bachelor's degree, and the rest had primary or secondary education. Educational background likely impacts opinions on food service robots. Occupationally, 39.9% of respondents were employed in the private sector, 32.6% in other fields, and 14% were self-employed, with the remaining in government positions, reflecting a majority from the private sector and young adult demographic. Notably, 94.4% of respondents had dined at service robot restaurants with varying frequencies, while the remaining had no such experience, suggesting that familiarity with robot services may significantly affect customer satisfaction.

Reliability and Validity Test Results

To evaluate the reliability of service robot performance measurement at Indian Muslim restaurants, the study employed Cronbach's alpha coefficient. This statistical method assesses the internal consistency of survey items related to service robot performance, ensuring that the items are interrelated and consistently reflect the same underlying concept. In this study, a high Cronbach's alpha score signifies that the items reliably measure service robot performance. The study achieved a Cronbach's alpha of 0.989, well above the 0.8 threshold commonly regarded as excellent (Mills, 2021; Sekaran, 2016). This result indicates a solid internal consistency among the items, affirming that the measurement scale used in this study is highly reliable for assessing service robots in Indian Muslim restaurants.

Table 1. Cronbach's Alpha Coefficient Results

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.989	.989	21

Mean and Standard Deviation

The descriptive analysis of customer satisfaction with food service robots at Indian Muslim restaurants reveals varying levels of approval across different dimensions. The highest mean score, 3.47 (SD = 0.999), was recorded for the statement regarding the robot's ability to provide the latest information, indicating moderate satisfaction. Following this, the perceived appropriateness of using service robots garnered a mean score of 3.44 (SD = 1.011), and satisfaction with the robot's service received a mean score of 3.43 (SD = 0.994). Other aspects, such as the robot's effectiveness in satisfying customer needs and overall customer happiness with the service, scored slightly lower, with mean scores of 3.40 (SD = 1.019) and 3.38 (SD = 1.036), respectively. Regarding perceived performance, the robot's interface ease of navigation led to a mean score of 3.50 (SD = 1.020), indicating a user-friendly design. This was followed by the perceived reasonableness and consistency of the service (mean scores of 3.47 and 3.46,

SDs of 0.999 and 1.024, respectively). The organisation and readability of the robot's interface were also positively rated, with mean scores of 3.45 (SD = 1.009 and 0.995).

Concerning customer expectations, the highest mean score of 3.52 (SD = 1.054) reflects positive feedback and alignment with customer expectations. The ease of interaction and effectiveness of the robot's operation received mean scores of 3.50 (SD = 1.037) and 3.49 (SDs = 1.039 and 1.012), respectively. Service quality and overall experience scored a mean of 3.48, with standard deviations of 1.034 and 1.032. The robot's fit with customer expectations and perceived value were rated at mean scores of 3.47 (SD = 1.018) and 3.46 (SD = 1.045), respectively. The lowest score was for the stability of service robot quality, which was 3.44 (SD = 1.060), indicating variability in perceived reliability.

Correlation Analysis

Correlation coefficients assess the degree of association between two variables, with Pearson's correlation coefficient being the most employed. Also known as Pearson's R, this coefficient measures the strength and direction of the linear relationship between variables (Mills, 2021; Sekaran, 2016). It quantifies how closely one variable's values predict another's values.

Table 2. Correlation Analysis of Customer Expectations and Customer Satisfaction

Customer s Expectation	Pearson Correlation	1	.739[**]
	Sig. (2-tailed)		.000
	N	429	429
Customer s Satisfaction	Pearson Correlation	.739[**]	1
	Sig. (2-tailed)	.000	
	N	429	429

[**]. Correlation is significant at the 0.01 level (2-tailed).

The Pearson correlation analysis reveals a strong positive linear relationship between customer expectation and satisfaction, with a correlation coefficient of r = 0.739 and a significance level of p < 0.005. This indicates that customer expectations regarding service robots significantly influence customer satisfaction, encompassing aspects such as the accuracy of information, service quality, the user interface, and the perceived value for the price paid.

Table 3. Correlation Analysis of Perceived Performance and Customer Satisfaction

Perceived Performance	Pearson Correlation	1	.724[**]
	Sig. (2-tailed)		.000
	N	429	429
Customer Satisfaction	Pearson Correlation	.724[**]	1
	Sig. (2-tailed)	.000	
	N	429	429

[**]. Correlation is significant at the 0.01 level (2-tailed)

The Pearson correlation analysis reveals a strong positive linear relationship between perceived performance and customer satisfaction, as evidenced by a correlation coefficient of r=0.724 and a significance level of p < 0.005. This coefficient indicates a substantial positive association, meaning that higher perceived performance of the robot service is closely linked with greater customer satisfaction. The significant p-value confirms that this correlation is statistically robust and not due to random chance. The data suggests that improvements in the perceived performance of the robot service are likely to enhance customer satisfaction, highlighting the importance of effective service delivery in achieving higher levels of customer contentment.

Multiple Regression

This study seeks to calculate the R-squared value and evaluate the relative influence of independent variables on the dependent variable, following the approach outlined by Newman (2022). The focus is on understanding how customer expectations and perceived performance impact customer satisfaction, which is the dependent variable. The results of the multiple regression analysis are presented in Table 4. The R-squared value of 0.612 indicates that 61.2% of the variance in customer satisfaction can be attributed to the independent variables—perceived performance and customer expectations. This finding implies that these factors represent a significant portion of the variability in customer satisfaction. Additionally, the ANOVA results verify a statistically significant model interaction, with a significance level of 0.000 ($p < 0.05$).

The coefficient analysis reveals a significant relationship between customer satisfaction and both independent variables, with p-values less than 0.05 ($p = 0.000$). Furthermore, the beta coefficients for the variables are positive, with perceived performance having a beta value of $\beta=0.387$ and customer expectations $\beta=0.450$, indicating that increases in these independent variables are associated with higher levels of customer satisfaction.

Table 4. Regression Analysis Results

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.782[a]	.612	.610	.647

a. Predictors: (Constant), Customer Expectation, Perceive Performance

b. Dependent Variable: Customer Satisfaction

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	280.541	2	140.271	335.498	.000[b]
	Residual	177.691	425	.418		
	Total	458.232	427			

a. Dependent Variable: Customer Satisfaction

b. Predictors: (Constant), Customer Expectation, Perceive Performance

RESULTS DISCUSSION

This research investigates the demographic of customers who have patronised Indian Muslim restaurants where service robots are provided. Using convenience sampling, the researcher evaluated the sample size of 385 respondents based on the Raosoft.com formula. However, 429 complete responses were successfully obtained. The case study revealed that about 59 per cent of the respondents were women, while 41 per cent were men. The peak respondents (45%) were within the age bracket of 23-27, the sticker level was a diploma (39.9%), and the respondents mainly worked in the private sector (39.9%). This implies that young adults seem more favourable towards using restaurants that involve newer technology, such as service robots, among others. Reliability analysis using Hair et al. (2019) and their approach found that

all the constructs achieved the composite reliability value of 0.7 at the minimum, with the overall measure being 0.989, implying high inter and intra-consistency and reliability of the measurement items and convergence of the constructs. This does not compromise the convergent validity of the constructs and concurs with the previous research about expected confirmation theory (Liao et al., 2009; Lin et al., 2020; Juliana et al., 2021; El-Said & Al Hajri, 2022). Bivariate correlation results suggest that customer expectations, perceived performance and customer satisfaction are positively correlated. Specifically, the correlation between customer expectations and satisfaction was highest at 0.739, while the correlation between perceived performance and satisfaction was 0.724. These results affirm that customer expectations and perceived performance significantly influence customer satisfaction.

This study explores the impact of experience on customers' intention to revisit robot service restaurants. It proposes an extended Expectation Confirmation Theory (ECT) model by integrating three key variables, expectation, perceived performance, and satisfaction, alongside traditional technology acceptance constructs. The investigation reveals significant insights into factors influencing customer behaviour in restaurant service robots. Firstly, the study confirms the positive influence of customer expectations on using food service robots. This finding aligns with prior ECT research by Atapattu et al. (2016) and Niranga and Sedera (2024), which reported a β coefficient of 0.437 and 0.554 for customer expectations in their studies. The current study's higher β value of 0.739 ($p < 0.005$) reflects a robust relationship, possibly due to a larger sample size of 385 respondents and the broader inclusion criteria. The substantial R-value underscores that the service robot's interface content and usability meet customer expectations. Secondly, the research corroborates that perceived performance, a critical antecedent in ECT, significantly impacts customer satisfaction. This result is consistent with Baharum and Jaafar's (2015) and Ramakrishnan et al. (2024) findings, which reported a correlation of $r = 0.62$ and $r = 0.69$ in their studies. The current study, with $r = 0.724$ ($p < 0.005$), reinforces that perceived performance is pivotal in determining customer satisfaction and acceptance of robot service restaurants. El-Said and Al Hajri (2022) highlight that user-friendliness and perceived usefulness are crucial in reducing the perceived complexity and liability associated with service robots.

The analysis further demonstrates that perceived performance, encompassing the attractiveness of the robot interface, the perceived value of the service, and the interface's organisation, significantly enhances customer satisfaction, with a strong correlation of $r = 0.680$. This supports the findings of El-Said and Aziz (2021), indicating that the effectiveness of service robots in meeting customer expectations is a significant determinant of public acceptance. Finally, El-Said and Al Hajri (2022) established that novelty seeking significantly moderates the relationship between experience novelty and satisfaction (R^2-change = 0.0315, F = 18.37, $p < 0.001$). This suggests that the perceived performance of robot services at Indian Muslim restaurants notably influences customer satisfaction, validating the moderating role of novelty seeking in this context. The results of this study substantiate the achievement of its objectives. The findings provide robust evidence supporting the proposed hypotheses and demonstrate the effective integration of expectation, perceived performance, and satisfaction within the extended Expectation Confirmation Theory (ECT) model.

CONCLUSIONS AND RECOMMENDATIONS

This study investigated customers' satisfaction at Indian Muslim restaurants, expectations, and perceived robot service performance. The supporting analysis indicates that confounding variables affected satisfaction levels, although both are dominant factors. Nevertheless, the study had limitations, especially looking at the sample size of 429 respondents; this limits the study to a particular portion of the customer population, making it hard to generalise the results. Moreover, the scope was restricted to customer expectations and perceived performance without

considering other factors such as local information, ratings, emotional involvement and features essential to consumer behaviour. A more extensive assortment should be pulled in for the following purposes to develop the degree of comprehension regarding the above issues. In any case, it would be appropriate to emphasise that further research must be conducted within the framework of other ECT and enterprise managerial practice areas. Understanding organisational agility from a customer's perspective can also be improved by conducting studies on other components of ECT, such as supply chain management activities and operational efficiency.

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CONFLICT OF INTEREST STATEMENT

The authors agree that this research was conducted without any self-benefits or commercial or financial conflicts and declare the absence of conflicting interests with the funders.

AUTHOR'S CONTRIBUTIONS

Mohd Zool Fadli Ibrahim: Responsible for conceptualising the research design, formulating research questions, and overseeing the overall research methodology. Contributed significantly to data analysis and interpretation.

Nur Wafiqah Mohd Amran and Joesri Mohamad Saber: Conducted literature review, developed the research framework, designed the survey instruments, and collected data. They also assisted in drafting and revising the research findings.

Khairil Anuar Bahari and Noorsa Riza Johari: Led the development of the theoretical framework, provided expertise in statistical methods, and assisted in interpreting the results. They also contributed to writing the methodology and results sections, thus playing a pivotal role in reviewing and editing the manuscript for clarity and coherence.

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