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How Can Hospitality Industry Improve Customer Satisfaction by Determining the Relevant Degree of Robot Staff Implementation?

Shuang Zuo[1]

[1] Emlyon Business School, Lyon, France
Correspondence: Shuang Zuo, Emlyon Business School, Lyon, France.

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Abstract

This study tackled the issues with service robots in hospitality industry and how to leverage robotic technology effectively. The implementation of robots in the hospitality industry was pushed to the boundary; however, customer satisfaction did not improve much as people still complain about the lengthy check-in process, the confusing communication, and other common complaints; there are more associated issues, such as underwhelming welcome, robots do not understand a specific accent, robots run out of battery, robots struggle to understand guests' requests. Another issue was that some guests were uncomfortable with being served by service robots. The study aimed to determine the relevant degree of robotic staff implementation in the hospitality industry to improve customer satisfaction. For the empirical analysis, the data are coming from the given-out survey, including people who work at the hotel and people who do not work at the hotel, to gather comprehensive opinions from people with diversified occupancy. The study conducted a multiple-choice survey and a short answer question to leave them blank for people who want to express their feelings for service robots.

Keywords: robot staff, hospitality industry, labour shortage

1. Service Robots in Hospitality Industry

1.1 The Need for Service Robots in Hospitality Industry

The need for service robots in the hospitality industry is not only because of the trend and innovation in automation technology. Factors that decisively impact bringing service robots into the property can be divided into two perspectives: macro-environment influences and micro-environment influences. The macro-environment factors are turnover rate and seasonality. High turnover rate leads to labour shortage issue, and strong seasonality pattern results in massive layoff and recruitment depending on the volume of the guests. A high turnover rate would bring a negative impact on hotel operations and performance. The micro-environment drivers are retention rate, hidden rules in the hospitality industry and service enhancement. In the latest Job Openings and Labor Turnover (2021) report released by the Bureau of Labor Statistics, in the US, the total separation in the leisure and hospitality

industry reached 1,223,000 employees versus 836,000 in the retail industry, the hospitality industry is facing way serious problem. The level of recruitment for hospitality industry is a reflection of the reality of the preference for labour on the open market and the attractiveness of the industry. In the hospitality industry, the bond between quality service and the labour force is tightly connected; the more luxurious the hotel is, the more staff requires. According to Lopez-Andreu, Papadopolous & Jamalian (2019), in the hospitality industry, there are hidden rules in writing the employment contract which is unnoticeable violations that potentially posts the threat for the whole industry in losing its attractiveness to job seekers.

1.2 Service Robot's Advancement, Limitation and Implementation

According to a recent report published by International Federation for Robotics, 12% of the robots moved its the workplace due to the change in their serving purpose from manufacture to service automation, as "artificial intelligence, service automation, and robots are entering travel, tourism, and hospitality [industries]" (Gladstone, 2016; Ritzer, 2015). In 2016, Wynn hotel made its first move by bringing Alexa into the guestrooms. (Hotel Management.net, 2016)

A study forecasted that from 2020 to 2024, the market size for service robots in the hospitality industry and the healthcare sector is projected to grow by 942 million USD. (Technavio, 2020) Service robots are characterised by convenience, efficiency, equality, and productivity. Service robots do not have overwork or the bad mood issues. However, there is a downside to implement service robots, as some guests expect to be treated differently in a hierarchical way. VIP guests may not be able to receive the unique service to enjoy the privileges while being served by service robots. Personalisation is a secret key to delighting guests, but this approach requires a lot of customer interaction and communication. To improve the overall experience, it is not uncommon for hotels to use service robots to replace human staff at the front desk. Front desk is an exceptional place because it represents the hotel's class and standard. Ariel Yang demonstrated that guests prefer to be served as they expect communication and interactions when they check-in. In the article, *The Rise of Service Robots in the Hospitality Industry: Some Actionable Insights*, the authors identified that consumers found that service robots lack interpersonal skills, which is one of the key drivers to increasing service encounter satisfaction in the hospitality industry. Replacing the front desk with service robots is overwhelming for a large portion of guests.

Hilton Worldwide Group invested in a service robot powered by AI that performs Concierge's tasks; (Statt, 2016). Therefore, Connie, the concierge robot, made its first presence on Hilton's property. (Barry & Pele, 2018) Other hotel groups, like Marriott, also adopt concierge robots. (Escobar, 2017)

Beijing Yunji Technology Co. is specialized in accumulation in indoor intelligent robot positioning and navigation. In late 2019, the company introduced a delivery robot called Run which changed the rule of the game for all players in the hospitality industry; Run was designed to replace bellman as it delivers goods to guestrooms. By the end of 2019, Run was firstly brought into the property by Huazhu Hotel Group. After the Run implemented, the general manager from Mercure Hotel in Chengdu mentioned that during off-peak hours, especially midnight, delivery robots are a tremendous saving in replacing labour force; the manager from Shanghai Mercure Hotel said that delivery robots helped to increase the hotel's revenue as well as it helps to rise up the OTA ratings. For guests, especially children, who are curious about service robots running around in the hotel, service robots help create an unforgettable experience for guests. Some researchers have found that the correlations between service robots' features and guests' overall evaluation of their experience are positive, which means the service robot is crucial to enhancing an overall guest experience. (Park et al., 2021) Run has been implemented in more than 1,000 hotels across countries in Asia, Europe, and America continents, serving over 1.5 million persons-time which totaled up to 150,000 kilometers accumulatively. Patrick Moorhead, an analyst with Moor Insights and Strategy, once said that "If consumers warm up to it, it could keep them coming back." (Gaudin, 2015)

In 2016, Henn na hotel introduced the first robot-dominated hotel in Japan. There are no human workers in the hotel as service robots have taken over the work. From the front desk to room service, every single department in the

hotel uses only service robots. The service robot used in this hotel is human-like robots which are robots with added human-like features, such as the face, voice, and movement. (Choi & Wan, 2021).

1.3 Service Robots' Ability to Fully Replace Human Labour

Doctor Suzanne Godfrey once said luxury is about emotional connections; it is vital to deliver the feelings through a verbal context which is something robots cannot be programmed to perform the engagement. The general manager who works at A.T House, a local luxury hotel in Shanghai, emphasized that even though there is a self-check-in kiosk placed right beside the front desk, guests would still go to the front desk for services and a small chat.

In the hospitality industry, the possibility of service robots completely replacing human labour is not consumption, it's reality. The Henn na Hotel, which opened in 2015 with robotic staff, is known as a strange hotel. It is the world's first hotel with non-human labour, designed to solve the problem of high labour costs and overwork. From front of house to back of house, all the staff at the Henn na Hotel are robot staff. In the google reviews for one of the Henn na Hotel located in Nagasaki, half of the reviewers were not finding the service favorable. One of the reviews mentioned that the robotics hosts are multilingual, but they do have a preference of speaking in Japanese, and English speakers do need use a translator. Some guests mentioned that "checking in with the dinosaurs robotic host was interesting, but difficult," and it seems like the functions of reception robots are very much limited to check-in only. Few guests described the experience and selling point as a novelty. The reviews prove the point Choi et al. (2020) made on consumers find human-like service robots lack of interpersonal skills when comparing with receiving service from human staffs.

Choi et al. (2020) stated that human staffs are good at dealing with emotions, and service robots are good at mechanical and analytical work. As aforesaid, the core value of the hospitality industry is to deliver an experience, and the conflict is what a service robot really can deliver and consumers' expectations. (Ho, Tojob & Tsareko, 2020) It shows that consumers expect service robots to perform similar tasks, which increases their expectation that service robots will engage in service recovery efforts just as a human agent would.

In an article published in the *International Journal of Hospitality Management*, Lu, Cai & Gursoy (2019) did research on finding consumers' willingness to integrate artificial intelligence and service robots in different business sectors: airlines, hotels, restaurants, and retail stores. The research concluded that due to "psychological complexity and hidden dimensions," consumers' willingness to integrate with artificial intelligence and service robots in hospitality services is lower than in the other three industries. Moreover, Shin & Jeong (2020) emphasized that the human-like appearances of service robots could cause discomfort; added on to that, Yu (2020) highlighted that the feelings of discomfort could make consumers feel reluctant to have interactions with service robots. The hospitality industry emphasizes the enticing and interactions more than other service industries, and hence, when dealing with emotion and interpersonal tasks, humanoid robots should be supervised by human staff to reduce consumer anxiety effectively. (Lu, Cai & Gursoy, 2019)

Results of Cross Validations.

Sample split		Model	$x^2_{(df)}$	$x^2(df)$	RMSEA	CFI	TLI	SRMR
Industry	Airlines (N = 111)	CFA Model	$786.75_{(444)}$	1.77	0.08	0.91	0.90	0.06
		Nomological Validity Model	$1009.01_{(568)}$	1.78	0.08	0.90	0.88	0.06
	Hotels (N = 116)	CFA Model	$702.18_{(444)}$	1.58	0.07	0.93	0.93	0.06
		Nomological Validity Model	$878.03_{(568)}$	1.55	0.07	0.92	0.91	0.07
	Restaurants (N = 107)	CFA Model	$704.88_{(444)}$	1.59	0.07	0.92	0.91	0.06
		Nomological Validity Model	$807.41_{(568)}$	1.55	0.06	0.92	0.91	0.06
	Retail stores (N = 106)	CFA Model	$689.79_{(444)}$	1.55	0.07	0.92	0.91	0.07
		Nomological Validity Model	$910.95_{(568)}$	1.60	0.07	0.90	0.89	0.07
Gender	Male (N = 185)	CFA Model	$637.63_{(444)}$	1.44	0.05	0.96	0.95	0.05
		Nomological Validity Model	$819.18_{(568)}$	1.44	0.05	0.95	0.94	0.06
	Female (N = 251)	CFA Model	$675.10_{(444)}$	1.52	0.05	0.96	0.96	0.05
		Nomological Validity Model	$857.71_{(568)}$	1.51	0.04	0.96	0.95	0.05
Technology competence	High (N = 212)	CFA Model	$679.68_{(444)}$	1.53	0.05	0.95	0.95	0.05
		Nomological Validity Model	$867.02_{(568)}$	1.53	0.05	0.95	0.94	0.05
	Low (N = 228)	CFA Model	$683.00_{(444)}$	1.54	0.05	0.95	0.95	0.05
		Nomological Validity Model	$859.55_{(568)}$	1.51	0.05	0.95	0.94	0.05

Figure 1.

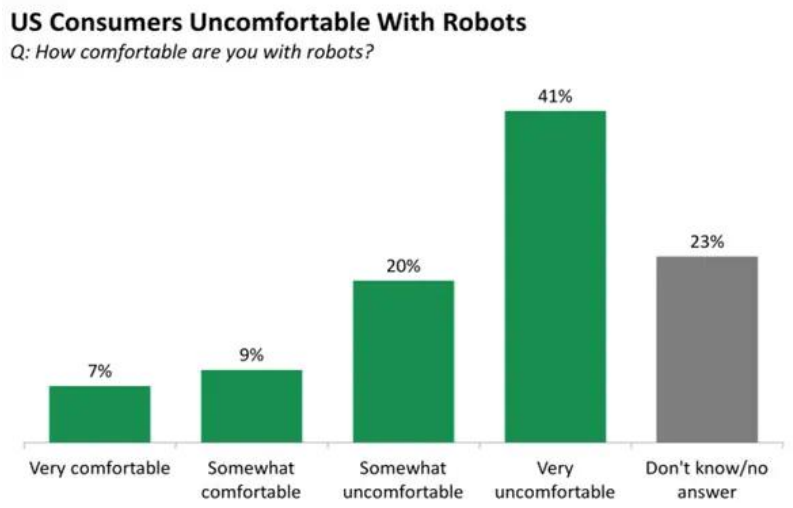

Figure 2.

In the hospitality industry, service robots still lack proficiency in serving. Because service robots are able to perform simple tasks such as checking in, delivering goods and giving directions, they are not able to perform emotional tasks such as building relationships. Having a service robot in a property to provide service is ultimately the opposite of the three words that describe the existence of the hospitality industry: welcoming, comfortable and professional. Some Marriott Hotels, like Aloft, Hotel EMC2, and Residence Inn, upgraded their service robot by featuring entertaining components, like humorous tone and dialogues. When the goods are delivered to the door by service robots, they would say, "I am just chilling; please remove your items," instead of being emotionless in asking guests to pick up the items. Kasperkevic (2017) stated that consumers would be more pleased with service robots' appearance and its features. Comfortable is a perceived feeling by familiarizing with the environment and receiving appropriate dialogue and actions. Service robots, specifically humanoid robotic staff do not increase the positive feeling since human priming causes a higher level of rejection. (Goudey & Bonnin, 2016) In *Developing and validating a service robot integration willingness scale*, Lu, Cai & Gursoy (2019) suggested that when hospitality introduces and involves service robots in business transactions in property, the exact human appearance should be steered clear in the designing stage to mitigate guests' discomfort level.

Compared to the frequency of human mistakes, guests expect fewer failures from service robots. (Lu, Cai & Gursoy, 2019) The goal of Henn na Hotel was to make it "the most efficient hotel in the world," said Hideo Sawada, the Hotel's owner, by reducing human resources and having as many robotic staffs as possible. Monisha Rajesh shared his experience on the Guardian; the check-in time is fixed, which means no robotic staff will take expectations since the system has set their "working time", the in-room assistant, Chu-ri-Chan, cannot tell the difference between snoring and giving commands, and would repeatedly wake him up at night. Rajesh drew the conclusion that in the hospitality industry, service robots cannot beat the human touch. (Rajesh, 2015) Hertzfeld (2019) mentioned that mentioned that robotic staff in Henn na Hotel annoys the guests, including front desk "staff" and in-room assistants who cannot answer basic questions, and the "bellmen" cannot handle luggage carrying and "staff" constant break downs. With all the complaints, Henn na Hotel, which is located in Nagasaki, announced that it would reduce its 243 robotic staff by more than half and return to traditional human staff mode. (Hertzfeld, 2019)

It is clear to conclude that service robots cannot fully replace human labour, at least not at this stage.

2. Determination of Relevant Degree of Robotic Implementation

2.1 Attractiveness of Service Robots in Property

There are three major groups of stakeholders in

the hospitality industry: guests, staff, and hotel owners.

Kuo, Chen & Tseng (2017) stated that service robots bring fun and enjoyment to guests to enhance safety, guest satisfaction, and overall experience.

Service robots offer guests unique first impressions and entertainments that unlock a brand-new experience. Hotel Jen Orchard Gateway, a hotel located in Singapore, "employed" two robotic staff to cater the simple requests, like delivering goods. (Kim, 2017) Yotel and Ji hotel also implemented service robots in properties to deliver goods. Hockman (2018) found that service robots are appointed to perform harder but repetitive tasks in some hotels, like storing and carrying luggage. By testifying to the attractiveness of such service robots, OTA reviews are highly referential and reliable in reflecting guests' feelings towards the robot staff. When broken down by types of travellers. Families would usually give a higher rating, because they found it "interesting", "fun place to bring the kids", "excellent experience for the kids everything uses robots".

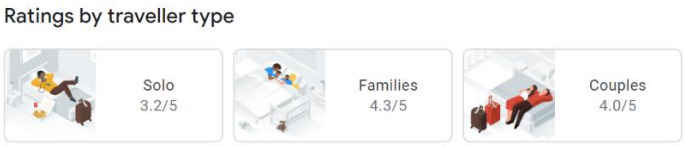

Figure 3.

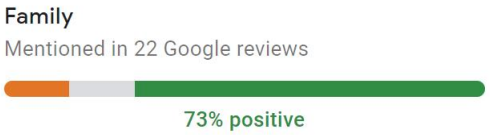

Figure 4.

Van Doorn et al. (2017) studies discussed guests' experiences with service robots; guests gave positive responses on interacting and receiving services from robot staff as the journey was new and memorable. Gronroos and Ravald (2011) summarized as guests can create value through interacting with service robots out of a mood of enjoyment, fun, and curiosity.

By implementing service robots, hotel guests can enjoy a higher level of personalized services (Pinillos et al., 2016); for example, Connie in Hilton hotels and Chun-ri-Chan in Henn na hotel serve as concierge and in-room personal assistants. The convenience of using a service robot is identical; for example, delivery robots enhance and efficient the process of service delivery (Pinillos et al., 2016), standardize the SOP, and keep heterogeneity in control (Belias, 2020; Lu et al., 2019; Shimmura et al., 2020), most importantly, the process goes smoother without upselling. (Bitner,2001; Curran et al., 2003)

Due to the unexpected global pandemic, COVID 19 raises a significant threat to the hospitality industry. Some studies show that because the nature of COVID 19 poses uncertainty which heightens the fear of infections, under this salience of pandemic, guests prefer a safety option to receive service in hotels. (Xie & Wang, 2003; Slovic et al., 1980; Lerner & Keltner, 2000) Consumers show their strong preference for the robot-staffed hotel over human-staffed hotels to reduce the chances of inflections. Recent studies show that the pandemic salience affects guests' attitudes and opinions toward robot-staffed hotels. (Galoni et al., 2020) The demand for service robots for implementation in hotel properties has been forecasted to be growing. (Jiang & Wen,2019; Zeng et al.,2020; Seyitoglu & Ivanov, 2020) Bartneck (2009) and Kim (2021) identified safety as one of the critical attributes of robotic staff, which has fewer risks of carrying the virus.

For hotel employees, having robot colleagues can be good and bad. Service robots can handle repetitive work such as delivering goods and carrying and storing luggage. In results, human staff can spare time to perform emotional tasks,

like providing the guest with a warm welcome at the reception. (Kim, 2021) In operations, robot-staffs may experience technological failure, which needs human staff to perform service robots' jobs and fix the break down problems. After over 130 robot staff being laid off at Henn na hotel, one of the human employees mentioned that now it is a relief as there is a no more sudden breakdown of service robots, and there will be no frequent calls on helping with the troubleshooting service robots. (Retrieved from https://www.hotelmanagement.net/tech/japan-s-henn-na-hotel-fires-half-its-robot-workforce)

For hotel owners, effectiveness and efficiency were the ultimate goals of implementing service robots on the property. (Hertfeld, 2019) Implementing a service robot responds to the change of direction by redefining the way of offering service in the hospitality industry. The consequence of the rapid adoption of service robots as to appear trendy and innovative is the mismatch between old and new values, especially service expectations. (Tuomi, Tussyadiah & Stienmentz, 2020) This leads to wasting money on both implementing robots and rehiring human employees back on the property.

Some researchers have proven that the use of service robots provides a new configuration of guest interactions and overall service experience for the hospitality industry, which is able to improve guest satisfaction levels and operations efficiency. (Kuo, Chen & Tseng, 2016; Melian-Gonzalez & Bulchand-Gidumal, 2016; Kim et al., 2012) Taken together with the concerns described above, we have concluded that although the development of service robots is not yet able to fully complement human service, service robots in the property have the ability to attract both existing and potential guests. (Zanchettin et al., 2013; Barrett et al., 2015; Johnson et al., 2008) Success in deploying robot staff is determined by matching the service provided to the skills required and the level of service to be provided.

2.2 Matching Technology with Hotel Scales

Hotel brands can be categorized by scales. American Automobile Association (AAA) clarified the hotel classification criteria, using the different levels of guest service provided and hotel amenities to rank the hotel level and categorize the similar kind into one segment. (Minazzi, 2010) Some research has found and proven that service is one of the critical influences on consumes preference on the hotel selection. (Pan et al., 2013) In the article published in the *Journal of Vacation Marketing*, pointed out that in order to formulate hotel positioning strategies and develop future product implementation, understanding the reasoning behind customer preference in hotel selection is a prospective source.

In acknowledging that the level of services tends to become higher when the hotel chain scale approaches to 1, towards luxury, it is crucial to understand the trade-off between perceived service quality and pricing. Finding the breakeven point where the majority of the guests would accept robot staffs to provide services by paying the reasonable price to stay.

Wong and Chi-Yung (2002) researched hotel selection attribute criteria identification by interviewing 300 Hong Kong hotel consumers face-to-face; price was identified as the decisive component, followed by hotel star rating. In accordance with the point made, "less-frequent upscale hotel customers consider price to be an important attribute." (Kim et al., 2018). Service quality was mentioned throughout the 300 face-to-face interviews (Wong & Chi-Yung, 2002), which is also an essential criterion to determine consumer preference on the hotel selection. (Kim et al., 2018) Since the hotel class reflects the relevancy of criteria that creates the level of consumer expectations, studies found that consumers have a high level of expectations of service when they stay at upscale hotels. (Knutson et al., 1993; Knutson, 1988; Griffin et al., 1997)

Cetin and Walls (2016) emphasized that a guest's experience occurs from interacting with hotel employees. Guests expects to receive a better service when staying at a high scale hotel. Luxury hotel tends to offer meticulous service that would go beyond guest's expectations, including offering personalized service. (Shin & Jeong, 2020) Due to the lack interpersonal skills and emotional sensing, delivering personalized service by service robots is challenging.

Through the research done by Zhang, Ye & Law (2011), it is identified that "the level of service is one of the most critical determinants of the room rate". The average daily rate (ADR) boosts as the level of service improves. (Shin & Jeong, 2020) Combining the findings with the criterion for

hotel selection drawn from 300 Hong Kong consumer interviews, ADR and service quality has taken a large part of the decision-making process. Guests invest more time in the purchase decision process for a stay at a high-end hotel, it is likely that the expectation and excitement of anticipating experiential aspects is higher due to the price. (Abukhalifeh & Som, 2015; Zaichkowsky, 1986; Cai et al., 2004) In the context of the hospitality industry, when guests choose to stay at a high-level service hotel, they seek to receive more personalized and quality guaranteed service rather than "standardized and/or technology-mediated services." (Cetin & Walls, 2016; Abukhalifeh & Som, 2015; Shin & Jeong, 2020) Robot staffs should not be implemented in this sector due to the lack of interpersonal, emotional and proficiency in serving.

The characteristic of an economy hotel is cheap and minimum service provided, such as Super 8, Ibis budget, and 7 days Inn. Considering the size of the economy hotel and consumer expectations on receiving service from staff, implementing service robots in property is extra and overbudget as fewer staff are needed. Guests who choose to stay at an economy hotel, known as a budget hotel, spend less time and effort on purchase decision-making, which might lead to less interest in service robots that they would encounter on the property. (Cetin & Walls, 2016)

Midscale and upper-midscale hotels are the most ideal chain sizes for implementing service robots to improve efficiency and increase customer satisfaction. Midscale and upper-midscale hotels have balanced the two most important criteria: service and price. Consumers' expectation of service in midscale and upper-midscale hotels is not as high as in upscale hotels, which require human staff to provide quality service. It is not too low, as guests do not expect service from economy hotels. By checking the robotic-staffed hotel scales, it is further confirmed that the target market and consumers are midscale and upper-midscale guests; Henn na hotel is rated upper-midscale, Aloft hotel is rated upper-midscale.

Service robots are an innovative implementation that can be the source of a hotel's strategy for sustainable competitive advantage. (Kuo, Chen & Tseng, 2016) It is believed that a new service concept can contribute to hotel positioning in order to compete by leveraging service robots and strategized promotions. (Kim, 2016; Bilgihan et al., 2011) The importance of the introduction of service robots in the hospitality industry is undoubted and unquestionable; the positive influence of service robots will be widely spread to more consumers and it has the potential to be one of the key attributes to enhance guest experience and meet guest expectations.

From a practical point of view, for hotels considering the use of service robots, it is very much a question of their brand image and positioning. Midscale to upper-midscale hotels can be further categorized by its brand image and types. There are two major categories: lifestyle brands and non-lifestyle brands. Lifestyle is defined as individuals living in a way where style, attitudes, and possessions are expressed. Lifestyle hotel brands like Moxy by Marriott, Mama Shelter by Accor, Canopy by Hilton, Even by IHG, and Joie de Vivre (JdV) by Hyatt, etc., have broaden the hotel management group's brand horizon. Lifestyle hotels are designed to be stylish and bold. It represents the attitudes as it accepts and adapts to the elements that are not commonly used in classic hotel brands like Ritz-Carlton, Hilton, Pullman, etc. Guests who prefer to stay at lifestyle hotels are usually recognized as early adopters and young consumers; it is assumed that they would feel comfortable with services providing by robots. The implementation of service robots in lifestyle hotels would, beyond any doubt that have enough attractiveness for its targeted customer segmentations, since it can enhance a fun, innovative, exciting, and enjoyable experience. (Kuo, Chen & Tseng, 2016)

2.3 Guest's Phycological Issues with Service Robot

Guest is one of the identified critical stakeholders in the hospitality industry. From aforesaid, every offered service included in the hotel is being considered as value-adding to enhance an experience. From a guest's perspective, every detail in a hotel should be like a piece of a puzzle that would eventually be built up together seen as completion. Due to the rapid growth of AI and its advancement, more and more non-human service robots are brought into the property as a means of interacting with guests in service activities as well as enhancing guest experience. (Baird, 2018) Implementing service robots in the hospitality industry should become a piece of the puzzle; however, many researchers questioned guests' perceptions of

service robots and their willingness to adopt them. (Shin & Jeong, 2020) Perceptions and willingness are linked to the guests' mental acceptance, whether guests have the intention to receive service provided by robot staff. It is crucial to testify if guests have any phycological issues related to being served by robots.

Many scholars highlighted that the importance of a service robot's first impression and attraction is correlated to service satisfaction. (Park et al., 2021) The first impression and attraction come from the outside, on how it looks, which makes the design of the service robot vital. In the article *Exploring the Attractiveness of Service Robots in the Hospitality Industry: Analysis of Online Reviews*, through data analysis, the finding is that the appearance of service robots is one of the reasons that influence guests' selection of the hotel. Robot designers and service managers focus on how to elevate the look. Through findings, it is better to add humanness elements through appearance and actions to positively influence guests' attitudes towards and increase guests' intention to interact. (Tinwell et al., 2011; Choi &Wan, 2021; Breazeal, 2003)

The variation of service robots can be divided into two types by appearance: anthropomorphic and non-anthropomorphic.

Anthropomorphic can be defined as a human body like robots, and it is designed to resemble humans, which could be mapped to the field of "uncanny valley". (Walters et al., 2008; Park et al., 2021; Mori, MacDorman & Kageki, 2012) Some scholars have already identified guests' reactions towards the two different appearance types of service robots. Scholars recorded both the feelings of discomfort and excitement when guests encounter and interact with them. (Choi & Wan, 2021; Park et al., 2021; Yu,2020) In an article published in MIS Quarterly, Scherer et al. (2015) highlighted that the customization of service robots with a humanness interface design is significant in appealing to a particular market of new consumer segmentation. Consumers accept and trust humanized service robots, as they feel secure and comfortable with its appearance, social actions, and emotional displays. (Breazeal, 2003; Tinwell et al., 2011; Wirtz et al., 2018). Epley, Waytz & Cacioppo (2017) examined consumers' perception of humanoid robots and found that the level of perception is based on the extent to which guests would treat service robots as human beings. In addition, Asian countries to be specific prefer service robots with a human-like appearance and an expressive faces. (Lee & Sabanovic, 2014) However, when humanoid robots are similar to human beings in both appearance and actions, consumers would not consider it as fun anymore; it is the feeling of creepy. Mori (1970) emphasized that the critical point of the theory of uncanny valley is that humans feel uncomfortable and eerie when robots' similarity level to humans gets to a certain point. The uncanny valley theory states that as the degree of affinity and acceptability of guests to service robots increases, the degree of the service robots' realism increases up to a certain point where the sense of affinity decreases sharply; the dramatic decline in affinity happens when the service robot approaches to a nearly human-like and humanness state. (Mori, 1970; Murphy et al., 2019) The theory is a guideline and warning to hoteliers when implementing robotic staff on the property, considering the guests' acceptability and affinity to humanoid technology. (Scarano, 2019; Tung & Au, 2018) When implementing humanoid robots in property, the position is highly crucial as the hotel consumers value the first impressions and services received. The consciousness of whether the humanoid robot's realism and similarity to humans may have approached a group of guests' acceptance limit, which might create an unpleased and dissatisfying experience for the guest. (Shin & Jeong, 2020) Many studies testified to the uncanny valley theory in terms of understanding the guests' perception of humanoid robots in conjunction with their appearance. (Tung & Law, 2017; Strait et al., 2017; Murphy et al., 2017) The interactivity level is the key criterion that affects guests' perception of the service robot and their phycological willingness to be served, which particularly an anthropomorphic robot complied with the high level of interactivity would be leaning to the uncanny valley curve where it sharply declines. (Heerink et al., 2010) Some studies suggested that in order to avoid the uncanny valley point, anthropomorphic robots can be designed with non-verbal cues, which could affect perceived interpersonal warmth that could potentially lead to higher guest satisfaction. (Yu & Ngan, 2019) Taken away from Shin and Jeong (2020)'s research, among three types of service robots: anthropomorphic, zoomorphic, and caricatured,

caricatured was the most acceptable service robot that appeals to hotel consumers, followed by zoomorphic.

Numerous hotels in Taiwan have been developing the use of service robots which are towards a practical and sustainable realization. (Zalama et al., 2014) It is crucial to determine the importance of the degree of service robot implementation in the hospitality industry.

3. Research Method, Results and Analysis

3.1 Methodology

The study aimed to determine the relevant degree of robotic staff implementation in the hospitality industry to improve customer satisfaction. For the empirical analysis, the data are coming from the given-out survey, including people who work at the hotel and people who do not work at the hotel, to gather comprehensive opinions from people with diversified occupancy. The study conducted a multiple-choice survey and a short answer question to leave them blank for people who want to express their feelings for service robots.

This study conducted a survey with two former hotel employees to ensure the survey questions' wording accuracy and content validity. The survey questions are modified and revised to fit the scope of the study. Before the survey was spread out to test the hypotheses, the survey questions went for a second check to ensure that the questions were listed clearly and that multiple-choice options were as understandable as intended.

3.2 Measurements and Questions Linkage

The manipulation of the outcome was done by providing participants with pictures of different types of service robots. The pictures show the appearance of the service robot, where participants can decide whether they would feel comfortable being served by one type. For participants who choose anthropomorphic robots, the question is linked to perceptions based on the degree of interactivity to test the uncanny valley point theory. The hotel chain scale is based on STR Global (2019); the options include the level of hotel service, which was manipulated by identifying the different levels of star rating, and the different levels of hotel service. (Five-Star hotel indicates the scale of upscale to luxury; Four-Star hotel indicates the scale of midscale to upper-midscale; three stars and below stands for economy and budget hotels)

All the questions were designed to tackle the aforesaid questions from previous studies and modified to aim at the context of the study to ensure reliability, understandability, and validity. The manipulation items were strategized to fit the nature of this study.

The morphology was measured with one modified item from Shin & Jeong (2020) and Nowak & Rauh (2008). The level of interactivity was measured with two modified items from Huang et al. (2017) and Heerink et al. (2010). The best fit positions for service robots were measured by providing modified six items from Shin and Jeong (2020). The best-fit hotel scale for service robots was measured with a categorized and summarized hotel chain scale from STR Global (2019). The Survey was concluded with an open question where participants could express their personal thoughts on their perception of being served by service robots in hostels with no manipulated restrictions.

3.3 Selection of Samples

A total of 68 complete and validated responses were received and further analyzed. The table 1 shows the results of the described analysis of the demographic profile of the participants. Gender was not taken into consideration due to the protection of gender equality and awareness of discrimination. More than half (63.24%) of the participants are aged between 19 and 28 years, followed by the age group between 29 and 38 years (29.41%). Only 1 participant is under the age of 18 (1.47%), and 4 participants are over 38 (5.88%). The survey was nearly evenly distributed, in terms of participants' occupancy. As previously mentioned, to testify the hypothesis throughout a comprehensive analysis, the survey was given to both people who work in the hospitality industry and those who work outside the hospitality industry. 35 participants (51.47%) who submitted the valid survey have occupied in hotel related positions, such as hotel staffs, staffs from hotel management group (Marriott, IHG, Hilton etc.); the rest of 33 participants (48.53%) are occupied in an industry apart from hospitality.

3.4 Manipulation Check and Analysis of Data

The minimum sample size required is 50 submitted complete and valid responses. Furthermore, after participants choose the types of service robot, the followed-up question is designed based on the specific choices made to

go deep down to testify participants' perception on that chosen type of robot by pushing the uncanny valley point to the boundary. Each option provided is closely related to the question where it can be further analysed for the study. As the two identified groups of participants have different knowledge backgrounds on hospitality industry, the questions are designed to be easily understood and board enough for "outsiders" to feel relatable and imaginable.

An inductive analysis strategy has been taken into consideration as it is the most appropriate method for the nature of the study due to correlations between occupancy and responses. The emerged data should be analyzed through categorization based on the occupancy differences. (Quinn Patton, 2002) Understanding and leveraging the two key stakeholders' perception of service robot in hospitality industry will contribute to the finalized conclusion. The analyzation of data is performed based on Krippendorff's (1980) theory for qualitative analysis procedures. The processed data that successfully identified all the relevant categories can be taken further in the process for interpretation. (Ezzy, 2002)

3.5 Results and Discussion

By analysing the data collected before the introduction by occupancy, it is clear that the majority of participants are between 19 and 28 years old, followed by 29 to 38 years old, which makes the survey highly attractive to Generation Z, and the results carried out reflect Generation Z's perception on service robot. Run (58.82%), the service robot designed for business use, was the most accepted type of service robot in the hospitality industry, regardless of the respondent's occupation. Then Connie by Hilton (26.47%) was the second most acceptive various of service robots which fall under the category of the caricatured agent. Only 10 participants (14.71%) considered receiving service from an anthropomorphic robot. Calculating the mean, we see that the anthropomorphic robot is -10.67 away from the mean, which can be interpreted as half of the guests finding it difficult to accept the service. For caricatured agents, 3 out of 22 guests would have a hard time accept services provided by the caricatured agent. For participants who chose anthropomorphic robot, a followed-up question on the appearance and actions of a service robot is approaching to human is given to test out the Mori's uncanny valley theory; more than half of the participants (60%) think the appearance and movements influence their perception of service robot.

Table 3. Through inductive analysis, participants tend to sense and perceive the same service robot type regardless of the occupancy. The majority of respondents chose Run, the service robot designed for use in a business context; 65.71% of respondents working in the hospitality sector and 51.52% of respondents working in other sectors consider that, of the three options provided, they prefer Run to the other two, followed by the cartoon agent, chosen by 20% and 33.33% of two groups of respondents respectively. It is also proven by Shin and Jeong (2020) that participants have unfavorable attitudes toward anthropomorphic robots, which could be related to the human likeness that provokes discomfort. The results suggested that participants would feel uncomfortable being served by an entity that is close enough to living creatures, especially with human details. Assuming that both the caricature agent and the anthropomorphic robot have the same level of interactivity, the proposed guests' perceptual ranking would be that the caricature agent comes before the anthropomorphic robot, since when the human-like creature has reached a certain level of interactivity, it causes uncanny feelings that directly affect guests' acceptance towards it. However, due to the usefulness of service robots, guests would still prefer service robots with high levels of interactivity. It is suggested that in order to avoid the uncanny valley point, which has the potential to cause dissatisfaction and discomfort, hotels should consider the balance between morphology and level of interactivity.

Table 5. This study reported that participants wanted service robots to work in the front of the house. It is interesting to note that two groups of respondents have different opinions on this issue. Among the participants who do not work in the hospitality industry, more than half of the participants (51.52%) think that service robots should work in the back of house, which includes jobs like housekeeping, laundry, kitchen staff, etc.; on the contrary, the majority of the participants (54.29%) who work in the hospitality industry think that service robots should be implemented in the front of house. I suspect that the level of knowledge of the industry is the key factor in the difference between the results of the two groups; the

outsiders think that they are paid to be served by a human, not a robot, and because the technology is not yet stabilised, they assume that service robots can help in the back of house. But the fact is that service robots belong in the front of house. The ability of service robots to perform tasks such as tidying rooms, making beds, doing laundry or even chopping vegetables is questionable; in terms of efficiency and effectiveness, using service robots in the back of house could be a waste. Many scholars have pointed out that service robots lack interpersonal skills and emotions. However, they tend to forget that the service robot's ability is still far from that of a trained human employee; it is reasonable and explainable that the service robot is used in the front of house, mainly for promotional purposes and to assist a little in the actual operations. Connie, as a robot concierge, has the sole task of answering guests' questions, and run, as a bellman, only delivers items; the current restrictions and limitations of service robots cannot meet the needs and perform the majority of tasks in the hospitality industry. If technology is advanced enough to compute service robots perform as a human staff in the future, would it be a step closer to the uncanny valley point? Would it affect guests' acceptance and affinity? Performing tasks like making the bed and helping in the back kitchen require hands or arms; when it comes to service robot design, considering the actual performance, would service robots be designed leaning towards a human? How would it influence human colleagues' perception of it? There are numerous questions related to the future type and functions of service robot implementation in the hospitality industry.

Table 6 develops the questions about the appropriate location for the service robot. The manipulation is designed to provide more front-of-house positions to test participants' perceptions of service robots working on the property. The options are carefully evaluated and selected for this study to determine guest acceptance of the service robot depending on the level of interactivity. Reception, concierge and bellman are Front of House (FOH) positions but have different levels of interactivity with guests; housekeeping and other areas are referred to as Back of House (BOH) positions, and no area is acceptable for participants who have already reached their uncanny valley point and don't want to be served by robots. Analysing the data collected, the top three options for participants who do not work in the hospitality industry are bellman (42.42%), front desk (39.3%) and housekeeping (36.36%). Two of the top three options are positions with low interactivity: bellman and housekeeping; bellman's work is very limited to carrying luggage and delivering items to guest rooms, the chance to have a conversation with guests is rare; for housekeeping, the work is usually done while guests are away. It is surprising to see that the front desk was ranked second, considering that the majority of participants are based in China, and the suspicion is that the results could be linked to a social norm in hotels in China that misleads a particular group of participants; an identity verification machine is used to scan facial and government ID, which is a crucial step for guests to check in, in this state, participants who do not know much about the hospitality industry may think that if now the work of the front desk is human to operate machines, then why can't robot operate itself. For participants employed in the hospitality industry, the top three choices are other areas (40%), front desk (37.14%), and concierge/housekeeping (34.29%). One of the assumptions for this group of participants choosing other areas is that service robots cannot perform the full job description for a position; for example, a bellman, a service robot like Run can deliver items, but its ability is minimal when guests ask questions about hotel facilities or restaurant opening hours, Run cannot answer as it is not "smart" enough to answer the simple question. As for the participants who chose the front desk, I happened to interview a few participants who made this choice because the front desk service robot can give direct answers without hesitation, and the process is smoother with upselling. "Service robots will follow commands unconditionally, without explanation or hesitation," said one of the participants. Usually, human staff working at the front desk tend to focus on how to please guests, while following the hotel's policies and SOPs. However, it is not a perfect balance and there is a trade-off. For example, if guests are about to celebrate their anniversary in the hotel and ask for a room upgrade, if the next level rooms (standard to deluxe) are sold out, the staff will have to give an explanation for not upgrading the room, if the guest is super suspicious, then it may cause a misunderstanding and denial of reality;

however, if the same situation happened to robot staff, because robots are emotionless, they would only follow the rules and make no exceptions, problem solved. Although the lack of emotions can be a disadvantage for guests, it can be an advantage for hotel staff; this study focused on how to improve guest satisfaction by using robotic staff; it is claimed that service robots serving at the front desk cannot please guests due to the stubbornness and emotionless characteristics.

Table 7. The primary aim of this study is to determine whether the hospitality industry should implement service robots; this is the landmark of the research question. The analysis of the collected data explains how participants from two different groups feel about the usefulness of service robots in the property. Among the participants who work in the hospitality industry, more than half of the participants (54.29%) vote occasionally, which means that they think that service robots are useful during operations. However, the frequency of usefulness is low. 28.57% of the respondents think that service robots often help in operations. Summing up the percentages for both options, nearly 85% of the participants who are employed in the industry assume that service robot is helpful; this response is relatively accurate enough to reflect how hotel employees perceive service robot as their colleagues and approve of its workability and performance through a high percentage on the agreement of service robot's usefulness during operations. For non-hotel participants, it is interesting to observe that the percentage of service robot that often helps is almost 11 percent higher, and the percentage for occasionally helps is 11.87 percent lower. From the guest's point of view, I assume that perhaps some of the services provided by the employees are useless, not useless in the service itself, but meaningless to the guests; since the service provided does not improve satisfaction, it does not lead to disappointment. As the service robot's capabilities are limited to basic and repetitive tasks, the service provided may be good from the guest's point of view, e.g., carrying luggage, delivering items, etc. Adding the two percentage points, 81.81% of the respondents think that service robots can help guests with the actual service. The "rarely" and "not at all" options are also worth looking at, as participants who do not work in the hospitality industry (18.18%) voted higher than the other participants (17.15%). My explanation for this is that everyone is an individual as their ease of acceptance and perception of technology cannot be the same; as previously stated, hospitality is all about experience and increasing guest satisfaction through interactions; I understand that for guests who perceive hospitality as a pure service industry, they believe human to human interaction and communication is irreplaceable, leading to ignorance of the performance of service robots. Service robots, which are now in the majority of properties, stay in the position where they can function well, they are placed there for a reason and part of that is their ability to save the workload of human staff. My other explanation is that when guests try to get an answer or a service outside the scope of the programme, it leads to a failure where guests wouldn't be happy with the situation. Guest behaviour influences the use of service robots by hotel staff, and it is clear from the data analysed in Table 6 that the percentages for each option are relatively similar for both groups of respondents.

Table 8 having established the suitability of a service robot for the hospitality industry, the next step is to get feedback on the research question of whether a service robot can improve guest satisfaction. However, guest satisfaction is difficult for hotel staff to observe, so the question is framed differently for different groups of participants; for participants who work in the hospitality industry, the question is how often guests mention service robots in their reviews on OTAs, and for the other group of participants, the question is whether a service robot can have a positive impact on their satisfaction. Based on the data collected from participants who do not work in the hospitality industry, 9 out of 33 participants (27.27%) chose a service robot that can always influence and improve their satisfaction, and 51.52% of participants voted for the frequency of sometimes. Almost 79% of the participants believe that service robots can influence guest satisfaction. Analysing the data collected from the other group of participants, 20% voted for often and 57.14% voted for sometimes. Taking into account that the questions are formulated slightly differently for two groups of participants, it can be concluded that 79% of the participants think that service robots have an impact on the improvement of guest satisfaction,

and over 77% of the guests who interacted with service robots during their stay would mention their experience with service robots in the reviews they post on OTAs, such as Bookings, Agoda, Ctrip, etc.

Table 9. In order to test the previously made hypothesis that service robots are most suitable for four-star hotels, which, according to STR Global (2019), range from upper-midscale to midscale, the survey includes a question about the suitability of service robots in hotel chains. Approximately 42.42% of the participants who fall under the group of non-hotel occupancy believe that service robots should be implemented in five-star hotels, such as Four Seasons Hotel, Ritz-Carlton, Fairmont, InterContinental, etc. The percentage for four-star and three-star and below is the same (27.27%). This particular group of respondents believe that service robots should exist in mid-market to luxury hotels because they believe that the latest technological advancement should match the luxury of hotels with higher service quality. I interviewed one of the participants to further understand the reasoning behind the choices; Siyu replied that technology should be implemented according to the scale hierarchy, "service robot should make its existence in a place where it costs a fortune", Siyu emphasised; this perfectly explains why the majority of participants believe that service robot is suitable for five-star hotels instead of four- or three-star hotels.

On the contrary, the group of respondents working in the hospitality industry thought that service robots would be best suited to four-star hotels (42.86%), followed by three-star hotels and below (37.14%). As the results in Table 8 were calculated, service robots can influence guest satisfaction through interactions, so it makes sense that all participants chose a particular hotel chain scale instead of choosing the last option: not applicable in hotels. It is interesting to interpret the results in combination with the comments from the open question, where participants were asked to express their opinion on service robots in the hospitality industry. One of the comments from a participant who has worked in the hospitality industry for over ten years, moving from one luxury hotel to another, questioned the ability of service robots to have a warm interaction with guests; he mentioned that in luxury hotels it is crucial to enhance the guest experience through communication and interaction; however, the service robot is not yet ready to face guests. Another participant mentioned that the human touch is a critical element of luxury hotels and the environment that luxury hotels create. "Interactions with guests, for example, improve guest relations, need to build a trust through a human's true heart, that is how important human staff is to the hospitality industry to provide soft service," said one of the participants who works in the hospitality industry. Some participants also rationally expressed that at the top and luxury level, human to human interaction is irreplaceable; if it is, then it is a motel or an inn. The previous hypothesis was tested and proved that a four-star hotel (upper mid class to mid class) is the best place to use service robots in the property to provide service. This explains why nearly 43% of respondents who work in the hospitality industry prefer to use service robots in four-star hotels, followed by three-star hotels and below (37.14%). This situation is further explained by Charles He, Partner of Alliance Hospitality, who believes that those respondents who do not work in the industry and who choose to implement service robots in five-star hotels have never been to a five-star hotel, so they have never experienced the service provided in the luxury tier of hotels. "For guests who spend more than one thousand yuan per night to stay in a luxury hotel, they would expect to receive high-quality service; human staff is also a key attribute in determining the scale of the hotel chain; you would never get the service perceived at Fairmont when you check in to a budget hotel like Ibis and Holiday Inn Express.

By grouping and analysing the comments received from the open question, the participants who wanted to implement a service robot in the hospitality industry were because of the efficiency of doing repetitive work (answered by the majority of the participants who work in the hospitality industry). It arouses the curiosity of the guest and it is interesting for the guest to see it and want to interact with it (written by participants from the other group).

Table 1.

Demographic Information (N=68)	N
Age	
18 years old and under	1
19 – 28 years old	43
29 – 38 years old	20
39 years old and up	4
Occupancy	
Hotel related Occupancy	35
Non-hotel related Occupancy	33

Table 2.

Manipulation	n	Distance from Mean
Service Robot Type		
Caricatured Agent	10	-10.67
Business-used Robot	18	-2.67
	40	13.33
Application Area		
Front of House	35	1
Back of House	33	-1
Helpfulness in Operations		
Often	23	0.33
Occasionally	33	10.33
Rare or Not at All	12	-10.67
Best-Fit Hotel Scale		
Five Star (Upscale to Luxury)	21	4
Four Star (Midscale to Upper Midscale)	24	7
Three Star and Below (Economy / Budget)	22	5
Not Applicable in Hospitality Industry	1	-16

Table 3.

Inductive Analysis (Service Robot Type)			
	Anthropomorphic Robot	Caricatured Agent	Business-used Robot
Hotel-related Occupancy	5(14.29%)	7(20%)	23(65.71%)
Non-Hotel related Occupancy	5(15.15%)	11(33.33%)	17(51.52%)

Table 4.

Inductive Analysis (Uncanny Valley Theory Test)		
Hotel-related Occupancy	3(60.00%)	2(40.00%)
Non-Hotel related Occupancy	3(60.00%)	2(40.00%)

Table 5.

Inductive Analysis (Applicable Area)		
	Front of House (FOH)	Back of House (BOH)
Hotel-related Occupancy	19(54.29%)	16(45.71%)
Non-Hotel related Occupancy	16(48.48%)	17(51.52%)

Table 6.

Inductive Analysis (Applicable Position)		
	Hotel-related Occupancy	Non-Hotel related Occupancy
Front desk	13(37.10%)	13(39.39%)
Concierge	12(34.29%)	8(24.24%)
Housekeeping	12(34.30%)	12(36.36%)
Bellman	11(31.34%)	14(42.42%)
Other Areas	14(40.00%)	6(18.18%)
No Area is Acceptable	3(8.57%)	1(3.03%)

Table 7.

Inductive Analysis (Usefulness During Operations)		
	Hotel-related Occupancy	Non-Hotel related Occupancy
Often	10(28.57%)	13(39.39%)
Occasionally	19(54.29%)	14(42.42%)
Rare or Not at All	6(17.15%)	6(18.18%)

Table 8.

Inductive Analysis (Improvement on Guest Satisfaction / Reviews on OTA)		
	Hotel-related Occupancy	Non-Hotel related Occupancy
Often	7(20.00%)	9(27.27%)
Occasionally	20(57.14%)	17(51.52%)
Rare or Not at All	8(22.86%)	7(21.21%)

Table 9.

Inductive Analysis (Improvement on Guest Satisfaction / Reviews on OTA)		
	Hotel-related Occupancy	Non-Hotel related Occupancy
Five Star (Upscale to Luxury)	7(20.00%)	14(42.42%)
Four Star (Midscale to Upper Midscale)	15(42.86%)	9(27.27%)
Three Star and Below (Economy / Budget)	13(37.14%)	9(27.27%)
Not Applicable in Hospitality Industry	-	1(3.03%)

3.6 Conclusion

The results of this study provide a theoretical contribution to the analysis of service robots in the hospitality industry. The research question investigated fills the gap in the current literature by elaborating the results to prove the hypothesis. The study examines the correlation between service robots in properties and guest satisfaction; from guest acceptance of service robots to the suitability of service robots in different hotel chain scales; the result is carried out with a comprehensive analysis of guest perception of service robots, including appearance, level of interactivity, preferred location, preferred perceived service type and contribution to a satisfactory level.

This study reported that guests' perception of service robots depends on their appearance/type. The study examined guests' acceptance intentions using the Uncanny Valley Theory (Mori, 1970). Participants preferred Run, the commercial robot, to other types of morphologies. The study also reported that there was a significant difference in perception (percentage) between guests' attitudes towards anthropomorphic robots and caricatured agents.

The study includes a follow-up question to investigate anthropomorphic robot pickers' attitudes towards robots when both the level of interactivity and the robot's appearance approach humans, known as the uncanny valley point. It is reported that the uncanny valley point negatively affects the affinity and acceptance of the service robot by the majority of participants. The study investigated the final workstation and preferred workstation position of service robots, which may influence guests' perceived willingness to increase guest satisfaction. The results indicated that service robots should be implemented in the front of house, performing tasks that are in the job description of front desk staff or bellmen. The study contributes to hospitality research by demonstrating the work that could potentially be replaced by service robots in the hotel environment. It is based on the hotel principle of enhancing guest experience and satisfaction through human-to-human interaction and communication. Remember that service robots lack emotion and interpersonal skills due to the limitations of technological advancement. The results reported that jobs such as front desk and sales should continue to be performed by human staff, and jobs that are repetitive and do not require guest interaction, such as bellman and housekeeping, should be performed by service robots. In addition, the study found that guests in four-star (upper midscale to midscale) hotels prefer to be served by robots than in five-star (upscale to luxury) hotels because of the importance of the human touch. For example, respondents repeatedly emphasised the quality of service and the human touch as an essential key for five-star hotels to remain in the luxury tier, as this is what guests checking into this level of hotel would expect to be served by humans, not robots. In this way, the analysis of the reasons for this study offers a deeper understanding of guest satisfaction and the academic field of technology adoption.

3.7 Limitations and Suggestions on Future Studies

The study had some limitations. Due to the participants' exposure to service robots in the hospitality industry, it is difficult to imagine being served by them. Further research is strongly recommended to include a test drive for participants unfamiliar with service robots in this sector. Although the study included two groups of participants to avoid bias in the results, it is highly recommended that future

researchers make the participant pool more diverse and extensive. Further research should include a more in-depth analysis of hotel brands and categories, e.g., leisure hotels, business hotels, lifestyle hotels, etc. It would also be interesting to examine guests from different countries, as different regions would lead to different results in terms of technology adoption and the uncanny valley point. Finally, it would be useful to investigate whether gender may be a factor influencing guests' perception of service robots.

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