Undergraduate Research Opportunities Programme

University of Reading

Exploring the impact of service robots as frontline employees within the hospitality industry

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Introduction

The extent to which the use of artificial intelligence service robots has influenced customer evaluation of hotel services via online reviews was explored for the following reasons:

- Service robot implementation within the hospitality industry has seen a sharp increase of **125%** from 2022 to 2023 (International Federation of Robotics, 2023).
- Post pandemic research into service robot use is limited and long-term use has not been fully investigated (Borghi and Mariani, 2021) .

As such, the need for a post-pandemic exploration into the impact of service robots is required to fully evaluate the effectiveness of long-term service robot use within the industry.

International Federation of Robotics (2023). World Robotics 2023 – Service Robot report, *International Federation of Robotics Press Room*, available at: https://ifr.org/ifr-press-releases/news/staff-shortage-boosts-service-robots-sales-up-48

What is an Artificial Intelligence Service Robot?

For this research, it was important to define what constitutes as an artificial intelligence service robot. Therefore, we have established several criteria to categorize and define service robots (Wirtz et. al., 2018). Service robots must:

- Be a physical entity and not just a piece of software accessible via a computer or similar interface.
- Have a level of autonomy to them and cannot be pre-programmed to complete tasks.
- Have a role in servicing customers directly and not just a tool that employees can use to improve their workflow internally.

Dawes, J. (2023) *New Hotel Tech: Room Service Robots and Holograms*. Available at: https://skift.com/2023/06/29/new-hotel-tech-room-service-robots-and-holograms/

Wirtz, J., Patterson, P.G., Kunz, W.H., Gruber, T., Lu, V.N., Paluch, S. and Martins, A. (2018), "Brave new world: Service robots in the frontline", Journal of Service Management, Vol.29 No.5, pp.907-931

Developing a Conceptual Framework

In terms of our methodology, we first established a conceptual framework to identify and categorize different types of hotel using established hospitality analytics benchmarking firm STR (Smith Travel Research, 2023).

Once the parameters used to categorize hotels were established, we then used the following methodology to find and categorize hotels with service robots (robot hotels):

1. TripAdvisor's search function using the query-string "robot" to search for all hotels with the word "robot" mentioned within its reviews.
2. Check if number of robot mentions are more than ten.
3. Manual verification of whether these hotels had mechanical artificial intelligence robots using the definition above.
4. Research into hotel parameters defined by conceptual framework (Fig. 1).

Using this information, we were then able to search for the most similar hotel that did not incorporate a service robot (non-robot hotels). The order in which parameters were prioritized are shown in the figure below:

Smith Travel Research (2023) *Data-driven solutions empowering the hospitality industry, STR*. Available at: https://str.com/data-insights/resources/glossary (Accessed: 25 October 2023).

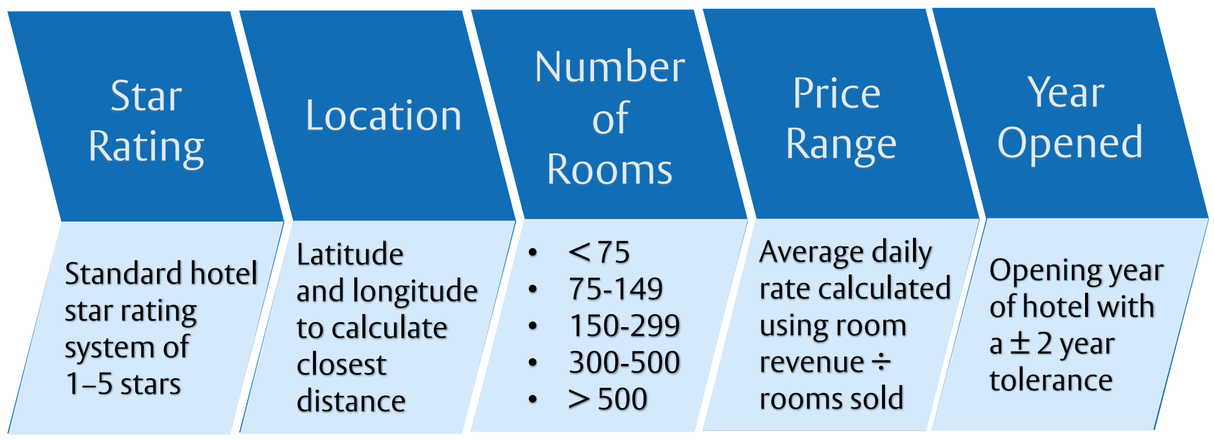


Figure 1: Conceptual framework of hotel parameters in order of priority

Use of Online Reviews as Basis of Research

With the advent of Web 2.0, electronic word-of-mouth and similar user-generated content has become a much more popular tool for consumers to make decisions on their purchases. The hospitality industry is no exception to this with the rise of platforms such as TripAdvisor, Booking.com, and Trip.com being widely used by consumers to evaluate hotels based on electronic word of mouth (Borghi and Mariani, 2021) .

However, there is an inherent danger in basing decisions on online reviews due to the lack of verifiability of reviewers.

As such, we have identified Booking.com as the most reliable option since the platform:

- Requires reviewers to have booked through their website before they are permitted to write a review. This ensures that reviews cannot be artificially inflated via robots and review farms.
- Only stores review data for three years allowing the most relevant post-pandemic reviews to be shown thus improving the reliability of our dataset.

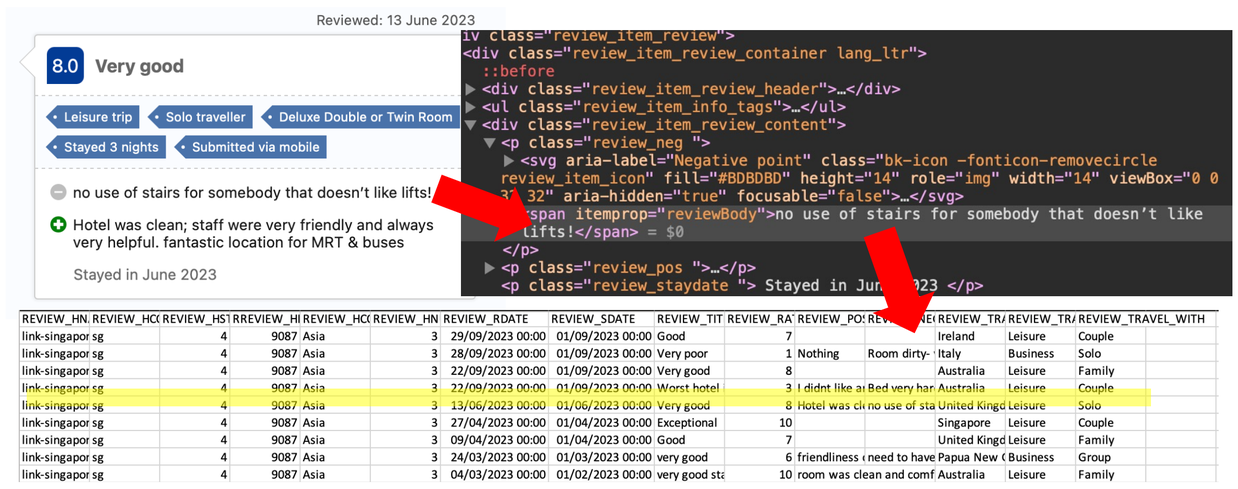
Matteo Borghi, Marcello M. Mariani, (2021), "Service robots in online reviews: Online robotic discourse", Annals of Tourism Research, Vol. 87

Collecting and Cleaning Online Review Data

For the collection of online review data, we used the following methodology:

- Compile list of Booking.com review pages to extract reviews of robot hotels and their most similar non-robot counterpart.
- Download the review webpage content using Python webscraping tool Requests.
- Extracting review webpage elements using Python parsing tool BeautifulSoup4.
- Compile extracted elements into dataset for analysis.
- Filter hotels with outlier review scores outside **15th** and **85th** percentiles (Tableau, 2023).

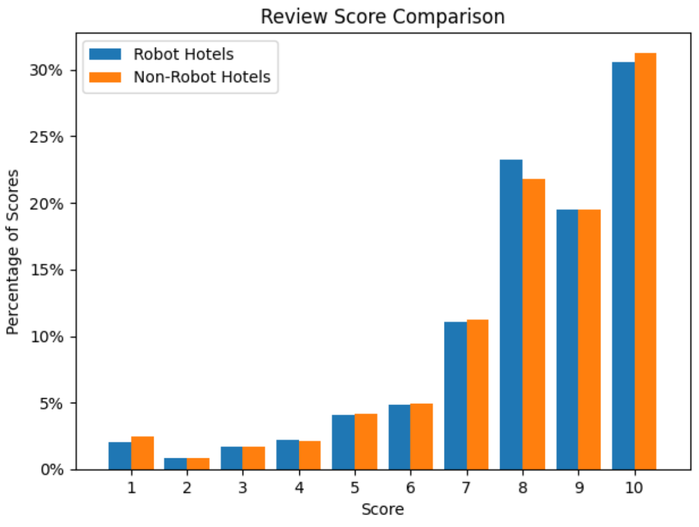
Tableau (2023) *How explain data works, Tableau*. Available at: https://help.tableau.com/current/pro/desktop/en-gb/explain_data_explained.htm?source=productlink



REVIEW_HN	REVIEW_HC	REVIEW_HS	REVIEW_HI	REVIEW_HC	REVIEW_HN	REVIEW_RDATE	REVIEW_SDATE	REVIEW_TIT	REVIEW_RA	REVIEW_PO	REV		REVIEW_TR	REVIEW_TR	REVIEW_TRAVEL_WITH
link-singapor	sg	4	9087	Asia	3	29/09/2023 00:00	01/09/2023 00:00	Good	7			Ireland	Leisure	Couple	
link-singapor	sg	4	9087	Asia	3	28/09/2023 00:00	01/09/2023 00:00	Very poor	1	Nothing	Room dirty-	Italy	Business	Solo	
link-singapor	sg	4	9087	Asia	3	22/09/2023 00:00	01/09/2023 00:00	Very good	8			Australia	Leisure	Family	
link-singapor	sg	4	9087	Asia	3	22/09/2023 00:00	01/09/2023 00:00	Worst hotel	3	I didnt like a	Bed very har	Australia	Leisure	Couple	
link-singapor	sg	4	9087	Asia	3	13/06/2023 00:00	01/06/2023 00:00	Very good	8	Hotel was cl	no use of sta	United Kingd	Leisure	Solo	
link-singapor	sg	4	9087	Asia	3	27/04/2023 00:00	01/04/2023 00:00	Exceptional	10			Singapore	Leisure	Couple	
link-singapor	sg	4	9087	Asia	3	09/04/2023 00:00	01/04/2023 00:00	Good	7			United Kingd	Leisure	Family	
link-singapor	sg	4	9087	Asia	3	24/03/2023 00:00	01/03/2023 00:00	very good	6	friendliness	need to have	Papua New (	Business	Group	
link-singapor	sg	4	9087	Asia	3	04/03/2023 00:00	01/02/2023 00:00	very good sta	10	room was clean and comf		Australia	Leisure	Family	

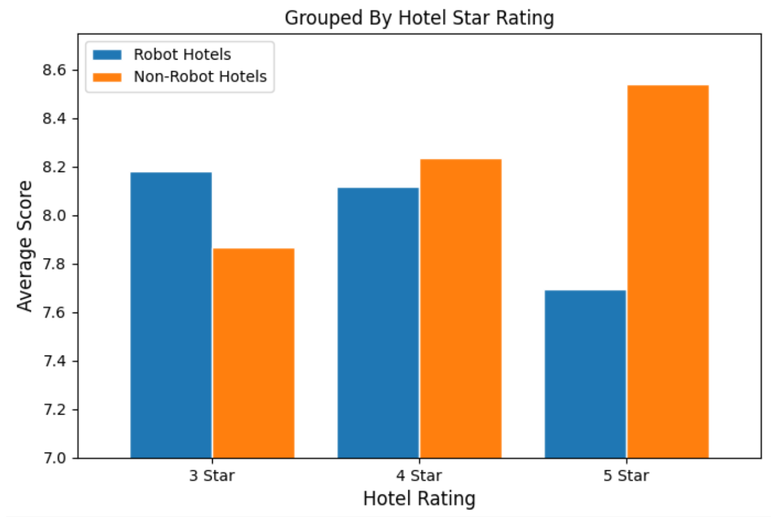
Preliminary Results, Analysis and Findings

After the data collection stage, we collected **59,631** reviews from robot hotels and **37,590** reviews from non-robot hotels from the past three years from September 2023. One notable finding was that while robot hotels were scored higher on average compared to their non-robot counterparts, the statistical significance of the difference is quite small for this size of dataset **($p > 0.1$).** This means that both datasets are statistically similar to one another, suggesting that service robots are successfully emulating service employee interaction. One reason for this could be that the novelty of service robots in hotels has worn off and people are now perceiving it as more commonplace within hotels, like how widespread adoption of technologies such as the ATM has normalized them in everyday life.



Measure	Robot	Non-Robot
Total Reviews	59,631	37,590
Mean Score	8.112	8.090
Median Score	9	9
Modal Score	10	10
Std. Dev.	2.038	2.099

Statistical test	p- value
Welch's t-test	0.110
Mann-Whitney U/ Kruskal-Wallis H	0.663
Wilcoxon Rank Sum	0.671



The lower the star rating of the hotel, the better service robots are perceived.

This could stem from the fact that customers of high star rating hotels value human to human interaction more than lower star rating customers who may value aspects such as speed and convenience.

Limitations and Future Research

Overall, while this research is designed to be practical in nature, it is primarily an explorative piece into this field of study and techniques used. Some further areas of study include:

- Using natural language processing to extract meaningful insights about the use of service robots within reviews via the language used in the review.
- Conducting multiple linear regression analysis to identify and assign weightings to the factors that affect whether robots are viewed positively or negatively.

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