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Aspect-based sentiment analysis on online customer reviews: a case study of technology-supported hotels

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Abstract

Purpose – The purpose of this study is to determine the satisfaction of the guests who stay at hotels offering technology-supported products and services related to the services and products they receive by using the opinion mining technique.

Design/methodology/approach – In this research, 12,396 customer reviews on booking.com related to ten hotels belonging to a hotel chain using technology-supported products were evaluated with aspect-based sentiment analysis techniques.

Findings – As a result of this study, it has been determined that using technology in hotel businesses creates a positive impression on customer satisfaction. It has been determined that the enrichment of standard hotel business products such as beds and room lighting with technology, in a way that will not be very costly, affects the guests. In addition, it is interesting that technological features such as robots and room service robots, which are called "High & Technology" in this study, are evaluated by customers in the service process.

Practical implications – The hotel managements have the opportunity to evaluate the services we offer by analyzing their online comments and to see their own image from the eyes of the guests. Hotel businesses must learn about customer expectations for technologies with high investment costs. This study, which analyzes online customer reviews, enables tourism businesses that offer technology-supported products and services and invest in technology in service delivery, to understand how customers evaluate the service.

Originality/value – In this study, customer reviews of a hotel group operating in many countries belonging to a hotel group that enriches its standard products with technology and provides service with the concept of a "smart hotel" were examined. This study contributes to the understanding of customers' experience of using technological products in hotel businesses. This study contributes to the literature on customers' satisfaction with technological hotel products and services and the decision of hotels to invest in technology.

Keywords Data mining, Text mining, Hotel technology, Aspect-based sentiment analysis, Customer reviews

Paper type Research paper

基于特定层面的在线客户评论情感分析：技术支持酒店的案例研究

摘要

研究目的 – 本研究通过使用意见挖掘技术旨在确定入住酒店的客人的满意度。这些客人接受酒店提供的产品相关的技术支持和服务。

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研究设计/方法/方法 – 在这项研究中, 使用基于特定方面的情感分析技术评估了 booking.com 上与属于连锁酒店的 10 家酒店相关的 12,396 条客户评论, 这些酒店均使用科技支持的产品。

研究发现 – 作为这项研究的结果, 已经确定在酒店业务中使用科技会对客户满意度产生积极的影响。已经确定, 标准酒店商务产品（例如床、房间照明等）的丰富科技以不会非常昂贵的方式影响客人。此外, 客户感兴趣的是在本研究的服务过程中包括机器人和技术特征, 例如客房服务机器人, 作为“高科技”层面。

研究实际意义 – 酒店管理层分析了客人的在线评论, 并有机会评估他们的服务并从客人的眼中看到自己的形象。酒店企业必须了解客户对高投资成本技术的期望。本研究分析了直接体验过的消费者的意见。因此, 研究结果将使决定投资服务技术的酒店企业受益。

研究原创性/价值 – 在这项研究中, 我们对一家在许多国家经营的酒店集团的客户评论进行了调查。该酒店属于一家酒店集团, 该集团以技术丰富其标准产品, 并以“智能酒店”的概念提供服务。该研究有助于了解客户在酒店业务中使用技术产品的体验。该研究扩展了客户对酒店科技产品和服务的满意度的文献, 以及对酒店投资技术的决策做出贡献。

关键词 关键词 数据挖掘, 文本挖掘, 酒店技术, 基于特定层面的情感分析
文章类型 研究型论文

Introduction

Technology, which plays an important role in people's daily lives in the 21st century, is an important tool in differentiating product and service providers in the tourism sector. The pioneers of the tourism industry frequently use technology to become an attractive destination/business for existing and potential consumers and to offer a unique experience to consumers with technological and new service delivery tools such as smart destinations, smart cities and smart hotels/restaurants (Yavuz *et al.*, 2018). Today, technology is not only effective in the development of product and service presentations of tourism enterprises but is also frequently used in sharing the experiences of consumers. Individuals may easily access information via the internet, thanks to the popularity of the internet and smartphones, and they may also transfer their experiences to others. Online reviewing is essential in tourism research (Hlee *et al.*, 2018; Gretzel *et al.*, 2010). The customers generally share their reviews, suggestions or opinions on websites after their stay at a hotel. Reviews through social media influence the preference of a certain location and provide the management to correct any failure and fulfill any deficiency. Customer reviews are a fundamental resource for evaluating the service quality and customer satisfaction of hotels and destinations (Camlica *et al.*, 2022; Zhang, 2018; Ye *et al.*, 2014; Horster and Gottschalk, 2012; Hu *et al.*, 2008; Mudambi and Schuff, 2010).

According to the literature, technology is applied at two levels in hotel businesses: in-room services and managerial and operational levels (Lee *et al.*, 2003). In-room technological services can be listed as follows; Wi-Fi, in-room entertainment services, smart assistant, smart lighting, smart and adjustable beds, climate control system and electronic lock and safe. Technology services at the managerial and operation level include other services offered to guests, starting with the reservation. The rapid development of technology has caused a change in customer expectations from hotel businesses (Kashyap, 2014). For this reason, hotel businesses aim to provide their consumers with a unique experience by offering their services with technology. Hotel consumers value hotels that offer up-to-date technology, and such technologies directly impact hotel guests' overall satisfaction, purchasing behavior and repurchase intentions (Chen, 2015). In addition, updating in-room technologies and keeping up with the latest trends are crucial to shaping and improving hotel image and perceived quality (Šeric *et al.*, 2016). Studies show that in-room technologies are the third most valuable amenities when guests rate a hotel, just behind bathroom facilities and bedding (Heo and Hyun, 2015). However, hotel businesses invest very high amounts for all this technological equipment, which creates costs for them.

Hotel businesses offer various automatic technologies in service delivery to meet consumers' technological needs and demands (Erdem *et al.*, 2019). However, to understand the expectations of the guests from the hotel technologies, it is necessary to determine the guest requirements correctly (Buhalis and Moldavska, 2021). The current research aims to analyze the customer reviews regarding the hotels that have recently increased in number and are offering technology-supported products and services and identify the determiners of customer satisfaction and dissatisfaction through opinion mining. At the same time, this research examines the comments of people staying in a hotel chain who want to increase guest satisfaction and therefore invest in technology for the room and reveals consumer expectations. Therefore, the results of the research give an idea to the sector representatives in their technology investment decisions for the services they offer to the consumers.

Literature review

Application of service technologies for the hospitality industry

The advances in artificial intelligence technologies with the rapid development in technology after the 2000s have increased technology use by hotel management. Consumer expectations, undoubtedly, have an impact on this. According to the research report "Current and future technology use in the hospitality industry" published by American Hotel and Lodging Association in 2008, information technologies have an important role in increasing customer satisfaction. Cobanoglu *et al.* (2011) have shown that technological possibilities can significantly affect a hotel guest's overall satisfaction.

Today, people are using technologies such as high-speed internet, digital entertainment devices and voice over in their daily lives (Bilgihan, 2009) and want to find the same at the hotels where they are staying for fun. Therefore, hotel management is adding more technological applications in their room designs and hotel concepts. Hotels use technological implementations such as customized welcome messages on in-room high-definition televisions, mobile applications to set in-room systems, high-speed Wi-Fi, interactive TV systems and video games to meet customer expectations (Bilgihan *et al.*, 2016). In industry-leading hotels like Starwood Hotel and Hilton Hotel, concierge robots that welcome guests, luggage carrier robots and room service robots are used (Crook, 2014; Trejos, 2014; Hilton Hotel, 2016). Hotel management use technology in room designs and service processes to differentiate from the competitors, minimize labor and labor costs, standardize the services offered, minimize service disruptions, increase productivity, offer different consumer experiences, improve customer satisfaction, etc. (Ivanov *et al.*, 2018; Ivanov *et al.*, 2017; Murphy *et al.*, 2017). Technologies used in hotel management contribute to improving service quality, and thus, it is observed that satisfaction from technological opportunities impacts overall customer satisfaction. It is indicated that hotel managers and customers agree that technology impacts customer satisfaction (Cobanoglu *et al.*, 1999, 2011).

According to the 2022 Hotelier Technology Sentiment Report, hotel customers' interest in in-room technology has increased during the pandemic, and more people are starting to adopt these technologies. According to this report, in-room technologies provide guests with convenience, comfort and personalization. Technology-assisted service delivery such as guests smart room controls, mobile check-in/out, etc. can increase guest satisfaction and operational efficiency. According to industry surveys, two-thirds of travelers said investment in hotel technology is critical to the guest experience (Intelity, 2017). For this reason, hotel businesses that want to satisfy their customers and ensure customer loyalty have invested more in in-room technology in recent years (Katlav, 2020). Hotels such as Hilton, Marriott and Yotel offer smart hotel concepts to their guests (Hotelier Technology Sentiment Report, 2022). There are studies on customer satisfaction with hotel technologies.

However, in this study, unlike other studies, the comments of people who directly experience these technologies and only stay in a chain hotel business, whose aim is to provide technology-oriented services, are analyzed by text mining.

Text mining in online customer reviews

Online customer reviews (OCR) are defined as the customer content published on the website, social media, online travel agencies, etc. of the business or a different party regarding the evaluation of a product or a service (Mudambi and Schuff, 2010). OCR allow a service/product to be evaluated in all aspects (price, quality, presentation, etc.) and provide information to potential consumers about the inspection after consumption. The hospitality industry should consider user-generated content and determine the ignored customer concerns, problems, satisfaction and dissatisfaction. Because of the service profit chain theory, customer consumption experience with a product directly determines customer satisfaction (Tseng *et al.*, 2021). Text analysis (content analysis) and text mining methods should be used to analyze OCR in tourism establishments (Li *et al.*, 2013).

It is a general method for hotel businesses to analyze and evaluate customer expectations after accommodation (Shen *et al.*, 2021). The feedback received from customers enables hotel managers to improve the features of the products and services they offer, increase the business value and support marketing activities (Kitsios *et al.*, 2021). However, the traditional evaluation method is time consuming and laborious, even for a small sample group. With the development of online booking platforms, hotels have reached a vast data source for customer evaluation, which can quickly examine these data with the text mining method (Shen *et al.*, 2021).

Evaluation of textual contents in OCR through scientific methods is possible by using text mining methods, a subdomain of data mining. Text mining is a process where the unstructured text data is edited and digitized and the qualified information therein is extracted. Text mining has a common field of study with data mining, web mining, statistics, natural language processing (NLP) and artificial intelligence disciplines to analyze the data consisting of natural language texts (Miner *et al.*, 2012). Text mining is a field of research aiming to find a solution to the problem of understanding the texts created using the spoken language by using text classification, text clustering, topic extraction, sentiment analysis or opinion mining methods (Li *et al.*, 2019).

In recent years, text mining analysis has begun to be used in the hotel industry to learn about customer expectations and evaluate customer satisfaction. Studies that analyze customer comments in hotel businesses with text mining and sentiment analysis have been found when the literature is examined (Shen *et al.*, 2021; Mylocopos and Dickinger, 2021; Yu and Xu, 2021; Chanwisitkul *et al.*, 2018; Berezina *et al.*, 2015). When all these studies are examined, it is seen that all of them have a large sample size, and businesses belonging to more than one hotel or hotel chain are analyzed by the text mining method. The different aspect of this study from the studies in the literature is to evaluate how consumers who stay in a chain hotel in many different countries of a hotel business that enriches its services with technology perceive this service and customer satisfaction.

Many hotel businesses benefit from technology. Businesses such as Marriott, Hilton and Yotel have included robots, which have recently attracted much attention to their business processes (www.yotel.com; Mathis, 2020). However, they make the essential services they offer different from technology. For example, the bed, the essential product for the hotel business, has become a "smart bed" by integrating it with Yotel technology. Check-in/out transactions, which is a service that today's consumers are used to, have become quickly done via smartphones. The face recognition system has replaced the door cards. Supporting

the products they offer with technology increases their investment costs or causes an additional cost to the enterprises. For this reason, determining the satisfaction of consumers with these products is very important in terms of investment decisions. Previous studies (Cobanoglu *et al.*, 2011; Bilgihan *et al.*, 2016) examine the effects of technological amenities on customer satisfaction. However, in these studies, data were obtained by the survey method on a smaller sample. This study analyzed the comments of consumers staying in all businesses of a chain hotel business in different countries. For this reason, it will contribute to the literature and give them an idea about the investments of hotel businesses in technology. The research question of this study is as follows:

RQ1. What is the satisfaction or dissatisfaction of consumers staying in hotel businesses that offer technology-supported products?

Text mining and sentimental analysis were used to answer this research question.

Sentiment analysis

Sentimental analysis/opinion mining is a text mining method closely related to the NLP discipline, with a broad research area. It aims to extract the emotional expressions in the texts. In addition, sentiment analysis is used in studies on mood, ideas and more complex emotions in texts (Seker, 2016). Sentiment analysis research, document level (Wilson *et al.*, 2005), sentence-level (Meena and Prabhakar, 2007) and aspect/feature-based level (Jo and Oh, 2011) are categorized as. At the document level, sentiment analysis is the analysis to determine the positive or negative polarity of the analyzed document. On the other hand, sentence-level sensitivity analyses aim to determine the positive or negative polarity of a sentence. Positive or negative polarity is expressed as a reflection of the positive or negative thoughts of the person who wrote the sentence or the document. Analyses at both levels do not fully reflect a person's feelings about what they like and dislike (Agarwal and Mittal, 2016). Aspect-based sentiment analysis identifies the entities and events of a view in a text and makes separate sentiment inferences for each. In aspect-based sentiment analysis, three different features are derived from the entities related to that text when text input is given. Aspect-based sentiment analysis performs the process of classifying an opinion as positive (positive), neutral (neutral) or negative (negative) (Mostafa, 2013). To illustrate the perspective-based sentiment analysis with an example, in the sentence "I liked the food very much although the service was very bad" in the customer reviews, an opinion was expressed about the entities of "service" and "food." In this sentence, which is subjected to aspect-based sentiment analysis, the assets (service and food) mentioned are defined first. In addition, a view or opinion is drawn about these assets, and a positive, negative or neutral value is defined for each asset (Saeidi *et al.*, 2016).

Aspect based sentiment analysis (ABSA) technique used in our model

The ABSA technique is roughly divided into machine learning and lexicon-based approaches (Jo and Oh, 2011). In the literature, ABSA was first applied to customer reviews for a digital camera by Hu and Liu (2004). In the model developed by Hu and Liu (feature-based opinion summarization), a dictionary-based approach was used to determine positive or negative opinions for the features related to the product. They benefited from the "WordNet" dictionary. The most crucial problem in dictionary-based sentiment extraction is the lack of domain-specific dictionaries in determining positive and negative aspects from customer comments. The sentiment dictionaries used in the literature (SentiWordNet, WordNet, etc.) are general. It has been verified to outperform general dictionaries. The

words or terms used in domain-specific dictionaries may not have the same meaning in two different topics and/or contexts (Bagherzadeh *et al.*, 2021). For example, a dictionary created in restaurants may give much worse results in the area of hotels than in the area of relatively similar books. Therefore, differences between fields are an important problem in emotion extraction (Ruder *et al.*, 2016).

In recent years, studies on analyzing tourist comments using the ABSA technique developed by Aylien have been increasing. Özen and İlhan (2020) analyzed customer reviews for restaurants on Tripadvisor, Ching and De Dios Bulos (2019) on Yelp, and Joseph and Varghese (2019) on Airbnb using the ABSA technique developed by Aylien. In these studies, customer comments were categorized as positive and negative aspects. These studies indicate that the ABSA technique is a suitable technique for analyzing customer comments. In our model, machine learning and NLP supported ABSA technique was used. This technique includes a pretrained algorithm (H-LSTM) for hotels using customer comments, especially machine learning (Aylien, 2016; Ruder *et al.*, 2016). In addition, as a result of ABSA, positive and negative words and terms related to the aspects of the products and services offered in the hotels are presented in order of importance in all comments.

Method

Sample and data collection

In this study, an international chain hotel business providing technology-supported products and services constitutes the research sample. The reasons for choosing this hotel chain in the research are as follows. First, it is one of the leading hotel chains that attach importance to technology-supported investments to facilitate customer experiences among global hotel brands (Davari *et al.*, 2022). This hotel chain became the first hotel chain in the industry to use artificial intelligence-supported technologies in its hotels in 2013 (Guo, 2021). This hotel chain uses cutting-edge technologies such as airline-style cabins, self-check-in kiosks, keyless entry, convertible double beds, adjustable ambient lighting and a unique robotic luggage concierge to enrich customer experiences in the hotel operations and rooms. Second, the hotel chain is the standard offering of products and services with the same technological features in all locations. This hotel chain differs from other hotel chains and hotels in these aspects. While positioning itself in the market, the hotel chain has identified customers using smart design and technology as the target audience. The hotel chain claims that it is a new generation that can use smart technologies while defining its customers. He defines this target customer group as the "YO" generation (www.yotel.com/en). For the reasons mentioned above, the research sample consists of ten hotels belonging to this hotel chain. Third, this hotel chain has hotels in major destinations around the world. For this reason, it reveals the perspectives of the consumer profile with quite different characteristics in terms of research data. This study consists of customers who have experienced accommodation in these chain hotels and shared this experience on booking.com.

At the data collection phase, the text content consisting of customer reviews about the hotels was collected automatically from the website "booking" using the web scraping technique for the dates between 11 November, 2019 and 21 November, 2019. Web scraping is a technique for automatically extracting information from various web documents. Based on the query, it retrieves the relevant contents, collects the data and converts it from an unstructured format to a structured representation (Saurkar *et al.*, 2018). The collected data set consists of 12,396 cases consisting of customer comments. The data set includes 15,077 paragraphs, 27,896 sentences and 301,220 words (Table 1).

Table 1.
Customer reviews of hotels

Hotel code	Hotel location	No. of review
YAIR_SG	Singapore Changi Airport	320
YAIR_AMS	Amsterdam Airport	674
YAIR_CDG	Paris Charles de Gaulle Airport	175
YAIR_GW	London Gatwick Airport	1,410
YAIR_LHR	London Heathrow Airport	605
YB	Boston	2,079
YE	Edinburgh	371
YN	New York Times Square	2,240
YS	San Francisco	130
YSING	Singapore Orchard Road	4,392
	Total	12,396

The customer comments data set of ten hotels presented in Table 1 was used in the model created in the Method section.

Customer review texts to be analyzed in the research were examined to check whether they include fake texts. The validity and reliability of the analysis depend on reviews made by real people who received the product or the service. Therefore, the data collection method of the booking.com website, which is subject matter to the research from its customers, was examined. According to this, booking.com invites the customers who make reservations through the website to fill in a customer satisfaction form by sending them an e-mail shortly after their stays. The customers are asked to type in their positive and negative ideas on this form. These reviews are analyzed and added as content to the review sections of the relevant hotels that are accessible by the visitors. Thus, only the reviews of those who make their reservations through booking.com and who stay in the establishment are published. The texts of the site reviews were, therefore, considered to be important in terms of reliability. Besides, the site's work system was determined to have the quality to improve reliability (Filieri, 2016).

Modeling and analysis

The data set obtained during the data collection phase was analyzed using RapidMiner software. The model used in the analysis consists of six steps. The model and implementation steps are presented in Figure 1.

Model application steps

Step 1: It refers to the data set obtained during the data collection phase in the created model.

Step 2: ABSA technique developed by the Aylien company was used.

Step 3: The ABSA result identifies words and terms related to aspects in each interpretation as positive and negative.

Step 4: The data set was preprocessed in accordance with the ABSA model.

Step 5: In this step, the words, terms and aspects obtained in steps 3 and 4 are combined. Each word and term is defined for the relevant aspect.

Step 6: The data set is evaluated in the crosstab. The crosstab displays the distribution of words and terms in the text set by matching them co-occurrence, using rows and columns (Péladeau, 2021). In our application, the distribution of words, terms, aspects and sentiments (positive and negative) in the text set according to their co-occurrence is revealed by using a crosstab. In addition, the connection level between the terms was explained by making a

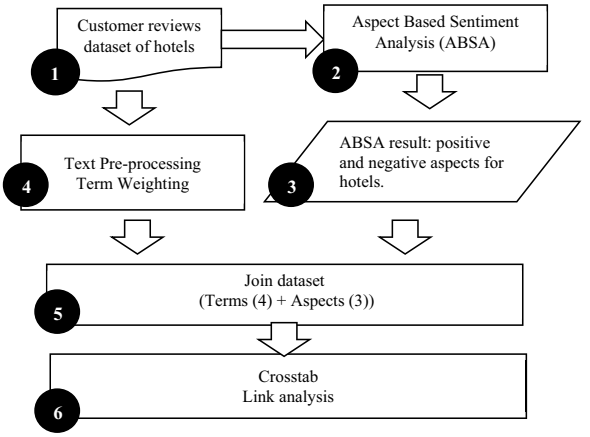

Figure 1.
Application model

connection analysis. In our research, the frequencies of positive and negative words were calculated for each term. Thus, the terms are visualized as negative and positive. In addition, the level of relationship between the terms was explained by making a connection analysis.

Findings

ABSA technique was applied to the data set of 12,396 cases related to hotels to reveal the positive and negative aspects/features. As a result of the ABSA technique, 12 aspects/features and terms explaining these aspects/features were determined hierarchically.

The 12 aspects/features obtained as a result of the analysis and the number of terms belonging to these aspects/features are presented in Table 2. This provides general information about the hotels. However, a more detailed framework can be drawn when examined on the basis of terms in the aspects/features and terms.

As a result of ABSA, the positive aspects were realized in the upper aspects of Location, Room Amenities, Cleanliness, Customer Support, Food/Drinks, Design, Staff, Facilities, Payment, View, High Tech and Value, respectively. Negative aspects occurred in Room Amenities, Customer Support, Cleanliness, Location, Facilities, Food/Drinks, Payment, Design, Staff, View, Value and High Tech, respectively. The positive and negative upper aspects that emerged as a result of the analysis are presented in Figure 2.

According to Figure 2, the location of the hotels was the aspects with the most positive comments by the customers. Although the aspect with the most negative comments is "Room Amenities," it is seen that the number of positive comments is higher. "Customer Support" and "Facilities" aspects, where negative and positive values are close to each other, are seen. Customers have given the least negative comments on the High Tech aspect. In order to provide more detailed information about the positive and negative aspects obtained as a result of the analysis, the positive and negative terms were examined in the cross table.

When we examine the High Technology aspect and terms that are the subject of our research, it is understood that some expressions with technology content used in hotels are not included. This is because customers use abbreviations and proper names when expressing technology-related terms in their comments. For example, for service robots used in hotels, customers wrote comments using special names such as YOSHI, YO, YOLANDA, YOBOTS, YOBOT, YO2D2 and R2D2. An example customer comment about this situation is "YO2D very friendly and teenagers loved the robot" (Case number, 73). In addition, special

Aspects	No. of positive terms	No. of negative terms
Location	10,971	2,915
Room Amenities	8,484	5,510
Cleanliness	5,329	3,328
Customer Support	4,849	4,233
Food/Drinks	3,246	1,766
Design	2,911	984
Staff	2,804	589
Facilities	2,133	2,185
Payment	994	1,248
View	538	326
High & Tech	520	82
Value	278	253
Total	43,057	23,419

Table 2.
Positive and negative aspects

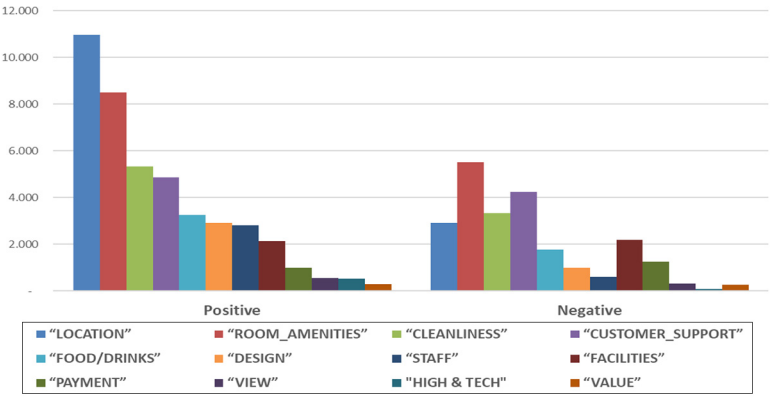

Figure 2.
Positive and negative aspects

names with technology content such as Bluetooth, Led, Mood Lighting and monsoon shower used in the rooms are either incompletely written or abbreviated in the comments.

Therefore, using the named entity extraction technique, terms with emphasizing technological features have been identified. Named entity extraction is the process of automatically determining custom entity names from unstructured text sets (Miner *et al.*, 2012, p. 921). The technology-containing expressions determined using the named entity extraction technique were added to the "High Tech" aspect by creating the "Robot" and "Other Tech" terms. The reason for creating two separate terms is to determine the point of view of customers on robots and other technologies used in hotels. In Table 3, the terms added to the "Robot" and "Other Tech" terms are presented.

Table 3.
Terms added to the "Robot" and "Other Tech"

Aspects	Terms	Words
High Tech	Robot	Yoshi, Yo, Yolanda, Yobots, Yobot, Yo2d2, R2d2, Robot
	Other Tech	AI, Bluetooth, High Tech, Led, Mood Lighting, Tech, USB, Wi-Fi

The terms obtained as a result of ABSA and the terms added to the High Technology aspects were combined and their weights in the data set were calculated. The term weighting refers to the process of calculating and assigning the weights of each word in the document according to the degree of importance (Jo, 2019, p. 25). Term frequency – inverse document frequency – TF*IDF technique was used to calculate term weights.

According to this approach, the weight of a term is directly proportional to the frequency of occurrence in the relevant document and inversely proportional to the frequency of occurrence in all documents (Jo, 2019, p. 26). Therefore, a term with a high TF*IDF value means that it has been included in a small number of documents. This strengthens the distinctive feature of the related term (Manning *et al.*, 2010, p. 109). With the TF*IDF technique applied to the data set, 25 terms with the highest TF*IDF value were determined. The aspects obtained as a result of the analysis and the terms related to these terms are presented in Table 4 by ranking according to TF* IDF values.

According to the aspects and terms listed according to TF*IDF values, it was seen that the aspects with technology were in the first two places. The data set formed as a result of the analysis was evaluated in the cross table in terms of positive and negativeness. While evaluating the crosstab, the rate of repetition of terms in 10,000 words in the entire document was taken into account. Thus, it is possible to evaluate the terms more precisely. The obtained results are presented in Table 5.

Positive and negative opinions for all terms obtained in Table 2 are presented graphically in Figure 3.

According to Figure 3, the aspect in which customers make the highest positive comments about hotels consists of comfortable beds. Positive comments about technology

Aspects	Terms	Frequency	No. of cases	(%) of cases	TF*IDF
High & Tech	Robot	593	465	3.75	845.5
High & Tech	Other Tech	438	397	3.20	654.6
Room Amenities	Comfortable Bed	612	3,250	26.22	355.8
Room Amenities	Rooms Are Small & Space	429	2,606	21.02	290.6
Customer Support	Front Desk	123	302	2.44	198.4
Payment	Free Coffee & Tea	147	1,011	8.16	160
View	Rooftop Bar	106	687	5.54	133.2
Staff	Helpful Staff & Friendly	165	2,174	17.54	124.7
Cleanliness	Clean And Modern & Tidy	317	5,934	47.87	101.4
Location	Shops And Restaurants & Bars	77	744	6.00	94.1
Food/Drinks	Hot Drinks & Drinks	55	1,228	9.91	55.2
Room Amenities	Mood Lighting & Monsoon Shower	29	180	1.45	53.3
Customer Support	Easy Check & in	102	4,032	32.53	49.8
Design	Modern Style & Futuristic	71	2,775	22.39	46.2
Location	Minutes' Walk & Minutes	38	756	6.10	46.2
Customer Support	Robot Towel Water & Deliver	37	1,122	9.05	38.6
Food/Drinks	Breakfast Buffet & Delicious	48	2,419	19.51	34.1
Value	Price & Reasonable	24	470	3.79	34.1
Facilities	Luggage Storage	21	448	3.61	30.3
Room Amenities	TV Channels	21	557	4.49	28.3
Facilities	Pool And Gym & Swimming	14	319	2.57	22.3
Room Amenities	Shower Head & Rain	19	1,001	8.08	20.8
Room Amenities	Room was Compact	19	1,041	8.40	20.4
Location	Places to Eat	10	420	3.39	14.7
Facilities	Glass Wall	17	2,076	16.75	13.2

Table 4.
Aspects and terms sorted by TF*IDF values

Aspects Terms	Rate per 10,000 term Positive	Negative
Comfortable Bed	39.04	0.75
Robot	33.91	4.82
Other_Tech	22.48	6.25
Clean and Modern & Tidy	20.01	0.61
Rooms Are Small & Space	2.67	15.89
Helpful Staff & Friendly	10.52	0.2
Easy Check & in	6.56	0.07
Free Coffee & Tea	6.17	3.53
Shops And Restaurants & Bars	4.68	0.34
Rooftop Bar	4.42	2.58
Modern Style & Futuristic	4.16	0.48
Front Desk	3.77	4.41
Breakfast Buffet & Delicious	2.47	0.68
Minutes' Walk & Minutes	2.4	0.07
Robot Towel Water & Deliver	1.95	0.48
Hot Drinks & Drinks	1.82	1.83
Mood Lighting & Monsoon Shower	1.62	0.27
Price & Reasonable	1.36	0.2
Room Was Compact	1.17	0.07
Tv Channels	1.04	0.34
Pool And Gym & Swimming	0.91	0
Luggage Storage	0.71	0.68
Shower Head & Rain	0.65	0.61
Places to Eat	0.52	0.14
Glass Wall	0.39	0.75

Table 5.
Rate per 10,000 term

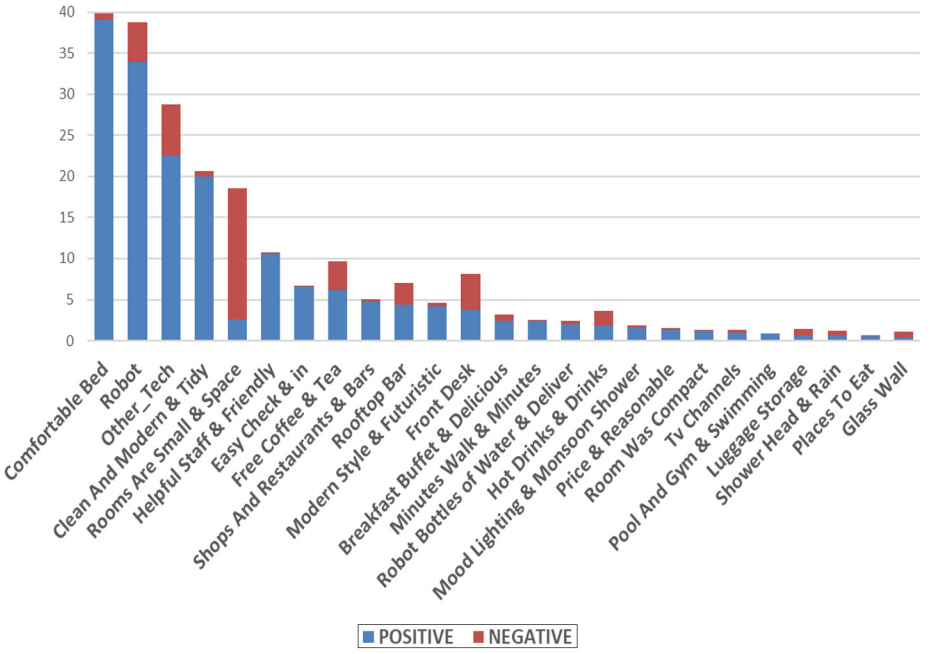

Figure 3.
Positive and negative terms

take place in the second and third places. The fourth place is about cleanliness and the modernity of the hotel. It is seen that the size that the customers evaluate negatively is related to the small area of the rooms.

A word cloud with a frequency of 100 and above was prepared to include the words in the list created according to the importance level as a result of the frequency analysis.

Link analysis in technology aspects

Link analysis provides a visual indication of the existence and strength of one or more links between two or more words and terms (Uğur and Akbiyik, 2020; Péladeau, 2021). To understand the details of the technology-related terms obtained in Table 4, a link analysis was applied between the terms and the related words. Thus, the technology aspects are better explained (Figure 4).

According to Figure 5, the technologies used in the hotels were evaluated by the customers in the "Modern Style & Futuristic" aspect. The room services (such as coffee and tea, towel, water) offered by the high-tech robots were positively evaluated by the customers. In addition, smart TV channels in terms of other technologies are seen as a positive feature for customers. Customers positively expressed the comfortable beds (adjustable), mood-adjustable lights and special shower heads in the rooms in terms of technology. Customers have positively evaluated the easy check-in processes they encounter at the entrance to the hotels and the elevator with special music in terms of technology.

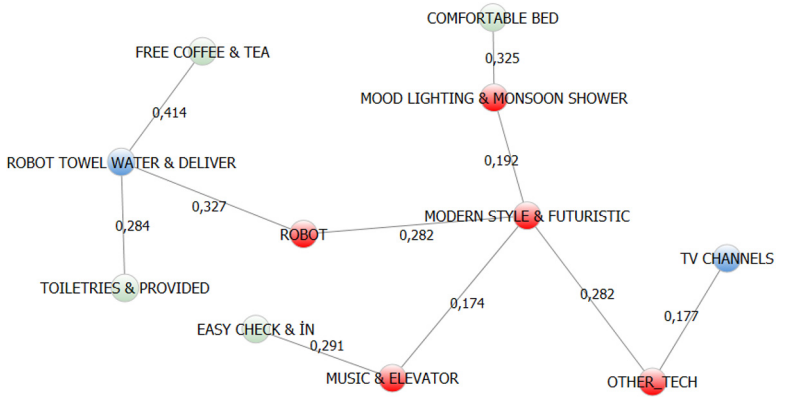

Figure 4.
Technology dimension link analysis

Figure 5.
Positive and negative word cloud

Conclusion and discussion

In this research, customer reviews of the hotel chain, which offers technology-supported products and services to its guests, were examined by using the ABSA technique developed for the hotel industry. As a result of the analysis, negative and positive aspects related to the hotels Location, Room Amenities, Cleanliness, Customer Support, Food/Drinks, Design, Staff, Facilities, Payment, View, High Tech and Value were determined. When these aspects are examined, the dimensions other than the "High Tech" dimension are similar to the results of the studies in which customer comments were analyzed before (Ma *et al.*, 2018; Brezina *et al.*, 2015; Kim *et al.*, 2016; Brochado *et al.*, 2016; Li *et al.*, 2013; Cobanoglu *et al.*, 2011; Choi and Chu, 2001). However, another point that distinguishes this study from other studies is the evaluation of technology as a separate dimension as a result of the analysis. Previously, Luo *et al.* (2021) analyzed the service features provided by service robots with sentiment analysis. According to the findings of this study, feelings about robotic services positively correlate with hotel service satisfaction, which plays an essential role in determining customers' overall satisfaction. The OCR analyzed in this study created a particular aspect, the "High & Tech" aspect. Customers evaluated service robots and technological services supported by artificial intelligence under the "High & Tech" aspect, which saw that this positively affected satisfaction.

According to the research findings, customers expressed high-tech robots and other technologies as modern and futuristic in a positive way. The use of robots in hotel room services is seen as the most important feature that is positively evaluated by the guests. On the other hand, guests saw the technologies used in the rooms (lamps that can be adjusted according to mood, adjustable headboards, smart TV channels, shower heads) as a positive feature. In addition, the guests evaluated the music-playing elevators used in the hotels and the technologies that provide easy check-in/out as a positive feature. Based on the findings, it can be said that although the costs of these products, which are enriched with technology, are not as high as the robots used in room service, they affect the customers. This hotel chain has used technology as an important difference against its competitors, while increasing customer satisfaction, thanks to the technologies it uses in its hotels. A study by Hospitality Technology found that 72% of guests are more likely to return to a facility when the technology they want is available. With the development of technology, long waiting times and slow responses are unacceptable to customers and can have a negative impact on hotel choices. For this reason, hotel businesses should follow the latest technology trends and tools and proactively integrate them into their business processes to ensure customer satisfaction (Montreil, 2021).

Theoretical implications

Sentiment analysis studies in the tourism sector generally determine the positive and negative aspects of the sentences by considering the sentences in the customer comments. In this study, unlike other studies, customer comments were examined on the basis of both sentences and relations between sentences by using pretrained machine learning technique. The positive and negative aspects of the products and services offered by the hotels are presented in detail for each product and service. In the study, unlike other studies field, the "High Tech" dimension used in hotel management was determined as a separate dimension. When the comments about the hotel are examined, it can be said that the guests who prefer and stay in the hotel also want to experience these features and find these features remarkable. Previous studies have emphasized that the use of technology in tourism increases customer experience (Luo *et al.*, 2021; Law *et al.*, 2014; Neuhofer *et al.*, 2014; Cobanoglu *et al.*, 2011; Buhalis and Law, 2008). The results of this study support the

literature. The main theoretical contribution of this study is to expand the scope of application of the Technology Acceptance Model theory to tourism research. When the results of this study are examined, it is possible to say that hotel customers like technology-supported products and services and that a standard hotel bed is more interesting when presented as a "smart bed" with technology.

Managerial implications

When evaluated from a managerial point of view, it is necessary to take into account the results of the study. Because hotel managers can see not only ratings but also customer feelings on online reservation platforms such as booking.com, feedback on customer experience will help businesses to correct their deficiencies and faults and to compensate for service errors. Evaluating customer reviews using ABSA can enable managers to understand customers' feelings toward hotels (Geetha *et al.*, 2017). This study is beneficial in terms of revealing the point of view of customers on a product and service that has been enhanced with technology.

However, the lack of feedback from customers to businesses can cause much more cost to businesses. For this reason, it is very valuable for hotel businesses to get feedback through text mining from guest comments on social media or platforms where products and services are evaluated after service. Crick and Spencer (2011) stated that guest comments should be considered important so that "the voice of the customer is not lost" and that the feedback received by constantly monitoring customer expectations should be included in the service process. According to Brezina *et al.* (2015), with the text mining approach, hotel managers will not only be able to see the feedback about a guest but also to see a bigger picture that will be created collectively by the feedback generated by all guests who have stayed at the hotel. Evaluation of OCR by text mining supports the results of studies by Brezina *et al.* (2015) and Crick and Spencer (2011). Hotel managers make use of customer comments and experiences when deciding to invest in technology in their service processes. According to the results of this study, it is seen how the services supported by technology are evaluated by the customers. Therefore, the results of the study are important for hotel managers and investors. Identifying the likes and dislikes of products and services supported by technology will affect future guest satisfaction, repeat visits and recommendation intentions.

Limitations and future studies

The limitations of this research are as follows: primarily, the data from the booking.com website was obtained from the guest reviews staying at hotels offering technological products and services between 11 November, 2019 and 21 November, 2019. Failure to generalize the research result constitutes another limitation. The other limitation is that the module used in the model and which runs aspect-based sentiment analysis could analyze only 1,000 lines. As there was a time limitation in this study, the time interval may be extended in future studies. For future studies, it is recommended to use a technology glossary at the hotels offering technological products and services to discover customer sentiments. In text mining, sentiment extraction is separated as field dependent and field independent. The field-dependent sentiment extraction enables receiving more comprehensible analysis results by generating a glossary regarding the field to be analyzed in advance. At the same time future studies can investigate with qualitative research methods that allow in-depth analysis using data collection methods such as cognitive mapping, interview, etc. to comprehensively understand customers' experiences with technology-enabled hotel service features.

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