

# Internet of Things (IoT) in smart tourism: a literature review

Internet of  
Things

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## Abstract

**Purpose** – Although there has been a significant amount of research on Smart Tourism, the articles have not yet been combined into a thorough literature review that can examine research streams and the scope of future research. The purpose of this study is to examine the literature on the impact of deploying the Internet of Things (IoT) in tourism sector development to attract more visitors using a text mining technique and citation based bibliometric analysis for the first time.

**Design/methodology/approach** – This study uses R programming to do a full-text analysis of 36 publications on IoT in tourism and visualization of similarities viewer software to conduct a bibliometric citation analysis of 469 papers from the Scopus database. Aside from that, the documents were subjected to a longitudinal study using Excel and word frequency using a trending topic using the R-tool.

**Findings** – Results from the bibliometric study revealed the networks that exist in the literature of Tourism Management. With the use of log-likelihood, the findings from text mining identified nine theme models on the basis of relevancy, which is presented alongside an overview of the existing papers and a list of the primary authors with posterior probability using latent Dirichlet allocation.

**Originality/value** – This study examines tourism literature in which IoT plays a significant role. To the best of the authors' knowledge, this study is the first to combine text mining with a bibliometric review. It significantly analyzes and discusses the impact of technology in the tourism sector development on attracting

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tourists while presenting the most important and frequently discussed topics and research in these writings. These findings provide researchers, tourism managers and technology professionals with a complete understanding of e-tourism and to provide smart devices to attract tourists.

**Keywords** Tourism, Text mining, Bibliometric, Internet of Things (IoT), Smart

**Paper type** Literature review

## Internet de las cosas (IoT) en el turismo inteligente: Una revisión de la literatura

### Resumen

**Propósito** – Aunque ha habido un número importante de estudios sobre el turismo inteligente, todavía no se dispone de una revisión bibliográfica exhaustiva que permita examinar las corrientes de investigación y las sugerencias de investigación futuras. Este estudio examina la literatura sobre el impacto del Internet de las cosas en el desarrollo del sector turístico para atraer más visitantes utilizando una técnica de minería de textos y un análisis bibliométrico basado en citas.

**Metodología** – Este estudio utiliza la programación R para hacer un análisis de texto completo de 36 publicaciones sobre IoT en el turismo y el software de visualización de similitudes (VOS) para realizar un análisis bibliométrico de citas de 469 documentos de la base de datos Scopus. Además, los documentos fueron sometidos a un estudio longitudinal mediante Excel y a la frecuencia de palabras mediante un tema de tendencia utilizando la herramienta R.

**Resultados** – Los resultados del estudio bibliométrico revelaron las redes existentes en la literatura de la Gestión Turística. Con el uso de la log-verosimilitud, los resultados de la minería de textos identificaron nueve modelos temáticos sobre la base de la relevancia, que se presentan junto con una visión general de los documentos existentes y una lista de los autores principales con probabilidad posterior utilizando la asignación latente de dirichlets.

**Originalidad** – Este estudio examina la literatura sobre turismo en la que la IoT desempeña un papel importante. Este estudio es el primero que combina la minería de textos con una revisión bibliométrica. Analiza y discute de forma significativa el impacto de la tecnología en el desarrollo del sector turístico para atraer a los turistas, a la vez que presenta los temas e investigaciones más importantes y más frecuentemente discutidos en estos escritos. Estos resultados proporcionan a los investigadores, gestores turísticos y profesionales de la tecnología una comprensión integral del turismo electrónico y los dispositivos inteligentes para atraer a los turistas.

**Palabras clave** Turismo, Inteligente, Internet de las cosas (IoT), Bibliometría, Minería de textos

**Tipo de artículo** Revisión de literatura

智慧旅游中的物联网 (IoT): 文献综述

### 摘要

**目的** – 虽然已经有大量关于智慧旅游的研究, 但这些文章尚未整合成一个全面的文献综述, 可以检阅目前的研究流和未来研究的范畴。本研究首次使用文本挖掘技术和基于引文的文献计量分析, 来研究有关在旅游业发展中部署物联网对吸引更多游客的影响的文献。

**方法** – 本研究使用R编程对36篇关于旅游业物联网的文章进行全文分析, 并使用相似性可视化 (VOS) 查看器软件对Scopus数据库中的469篇论文进行文献计量引文分析。除此之外, 还利用Excel对这些文献进行了纵向研究, 并使用R工具对趋势主题进行了词频分析。

**结果** – 文献计量研究的结果揭示了旅游管理文献中现有的网络。通过使用对数似然, 文本挖掘的结果根据相关性确定了9个主题模型。这些模型与现有论文的概述和主要作者名单在使用潜在狄里奇分配 (LDA) 的后验概率一起呈现。

**原创性** – 本研究对旅游物联网相关文献进行了分析研究, 它首次将文本挖掘与文献计量学审查相结合。这项研究着重分析和讨论了技术在旅游行业发展中对吸引游客的影响, 同时介绍了这些文章中最重要和经常讨论的主题和研究。这些发现为研究人员、旅游管理者和技术专家提供了对科技与旅游的全面了解, 并提供关于智能设备来吸引游客的建议。

**关键词** 旅游, 智慧, 物联网, 文献计量, 文本挖掘

**文章类型** 文献综述

## 1. Introduction

The Internet of Things (IoT) is a revolutionary technology that is progressively gaining traction in today's wireless telecommunications environment. The IoT concept's key strength is the significant impact it will have on various elements of everyday life and on potential user behavior (Atzori *et al.*, 2010). IoT is rapidly playing an essential role in services, where it is undoubtedly essential for the tourism industry, and one of the biggest drivers of internet use in the economy has been tourism (Hjalager, 2002). The tourist industry is made up of several stakeholders and has an influence on a country's overall gross domestic product (GDP); thus, expanding the tourism industry will slowly increase its GDP. As a result, the use of IoT in the tourism business is an important topic to consider. Innovation is still in its early stages of development and has seen both positive and negative effects, as well as various challenges (Verma and Shukla, 2019). Especially in hotels, transportation and attractions, the tourist industry is trying to keep up with the pace to be effectively linked with its guests all of the time.

IoT has evolved into a useful and practical tool for promoting evidence-based practice in tourism management. The way IoT has shown its uses in other sectors has also shown its magic in the tourism sector, such as smart applications, smart services and smart management. But this blessing can also turn into a curse if smart applications, data security or the data infrastructure are not used properly or are not user-friendly. All these positive and negative uses create conflicts about using IoT in tourism management, so the focus of this study is to analyze the previous papers and find out which use is more in practice.

In this paper, the lack of a comprehensive literature review on IoT in tourism is fulfilled through the bibliometric and text mining review methods. While technology continues to advance, the tourist sector has developed to become one of the most important sectors globally in this modern period. These facts have transformed the notion of "Smart Tourism", which is a step forward from heritage tourism. As a consequence of this smart tourism, a variety of review papers have been published. To the best of our knowledge, there is a substantial quantity of study on the topic of Smart Tourism, but the papers have not yet been compiled into a comprehensive literature review (Kontogianni and Alepis, 2020). As a result, a literature evaluation encompassing the majority of the documents published, including the application of IoT in the tourism business, are required.

Since there are no literature reviews on IoT in tourism, whether using the bibliometric or text mining approach, we decided to use both these methods to do the review. The complete list of documents related to the IoT-based tourism literature is studied in the first phase of the study using a citation mapping approach known as bibliometric analysis. The findings of this bibliometric study containing the co-occurrence network and bibliometric coupling demonstrate the importance of this research regarding deciding on an IoT application to enhance the tourist business. But for covering the maximum documents on IoT in tourism and having an effective analysis with a detailed review, the text mining technique is also used on a selection of 36 papers. So, in this paper, the text mining approach is a need side by side bibliometric analysis for uncovering the overall opinion of the authors about the use of IoT in tourism. Although both approaches are done using software, the visualization of similarities (VOS)-viewer software for the bibliometric approach has the limitation of not supporting other databases other than Scopus and the R software, whereas the text mining approach has the limitation of not taking many papers due to the time consumed.

The main aim of the paper is to examine the literature on the impact of deploying the IoT in the tourism sector to attract more visitors by using a text mining technique and citation-based bibliometric analysis. So, the people who will be benefitted from the paper are the tourists and people researching or involved with tourism and IoT. The demand for IoT is

increasing day by day, bringing special advantages to our daily life. Using IoT has impressed and impacted people greatly, and that is why tourism management through IoT is a topic worth reading as people will get to know new insights and directions. Since the tourism sector plays a great role in a nation's income, this motivates analyzing how IoT is used in tourism management. This study evaluated 469 papers through bibliometric analysis and 36 papers through text mining analysis. Both these methods have been the recent center of attraction (Ikra *et al.*, 2021; Jarin *et al.*, 2021; Loureiro *et al.*, 2020; Quatrini *et al.*, 2022), being used to analyze a huge number of articles, through which our knowledge will be enriched with new insights about tourism management through IoT.

The paper is divided into six sections. Section 1 provides an introduction, whereas the methodological elements and a brief overview of the procedures of text mining, bibliometric analysis and sentiment analysis used in this study are presented in Section 2. Section 3 explains the network analysis as well as a longitudinal review of the literature on using IoT in the tourism industry dubbed "smart tourism". Section 4 demonstrates the advanced review, including the text mining approach, results and discoveries, as well as the description. Section 5 discusses the limitations, research gap and future research objectives, followed by Section 6, conclusions.

## 2. Methodology

A literature review is a summary of previously published works on a particular subject. The bibliometric review system is used in this report as one of the numerous techniques of literature evaluation because of its ability to generate study items in a research subject based on citation mapping within newly published documents. According to past evaluations, a bibliometric approach is required for a more thorough and comprehensive literature review (Saul *et al.*, 2012), but like all other research methods, the bibliometric review has a few significant drawbacks where, according to Justicia De La Torre *et al.* (2018), text mining allows researchers to efficiently evaluate large amounts of data, revealing key connections between entities that could not have been discovered otherwise. As a result, the text mining approach is also used side by side along with bibliometric review to take this in-depth evaluation to the advanced level.

Text mining, also known as knowledge discovery, is a subprocess of data mining that is commonly used to uncover hidden patterns and important information in large amounts of unstructured textual data. This study covers text mining techniques using latent Dirichlet allocation (LDA) analysis for assessing articles because of these sophisticated characteristics.

The keyword "IoT" OR "Internet of Thing\*" was initially searched inside the title, abstract and keywords of articles in the Scopus database, resulting in a total of 121,845 papers being retrieved. The keyword "hospitality" OR "hotel" OR "tourist" was used to narrow down the number of paper which resulted in a total of 475 most relevant papers to the study. Finally, only articles published in English were chosen for the longitudinal research, resulting in a total of 469 papers. Among these documents, there are 142 articles, 232 conference papers, 22 book chapters, 65 conference reviews, five reviews, two editorial notes and one retracted article. Only 236 papers were discovered as advancing documents inside the topic limit after the authors manually observed them. The writers then manually selected 128 documents from those 236 based on their relevance to the issue. Only 36 papers were picked manually for text mining based on a five-year journal impact factor larger than 1.36. Figure 1 depicts the selection procedure of the articles.

Why 36 publications were picked for the study is addressed below. We began by searching for articles related to the issue using key terms, and we discovered 475 papers,

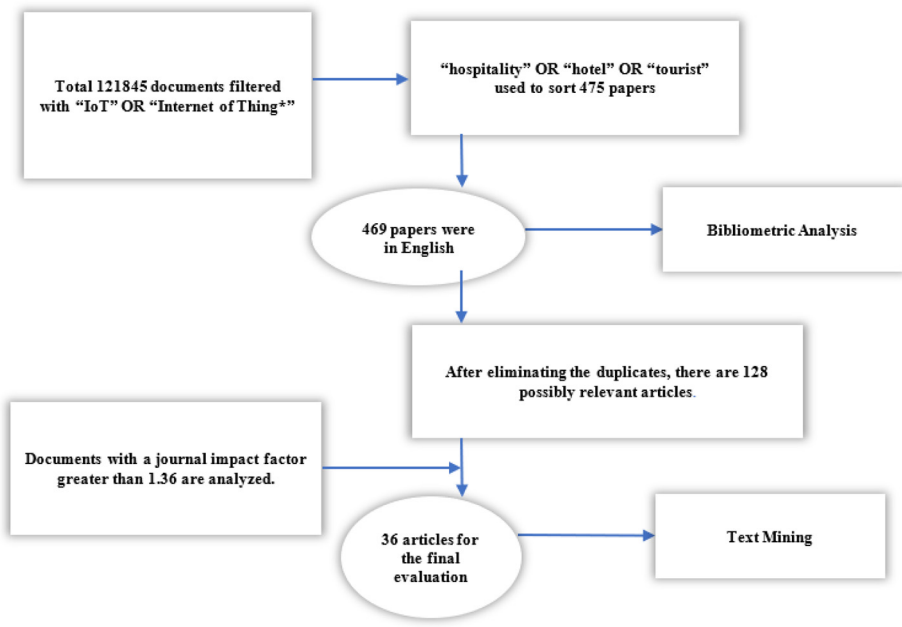


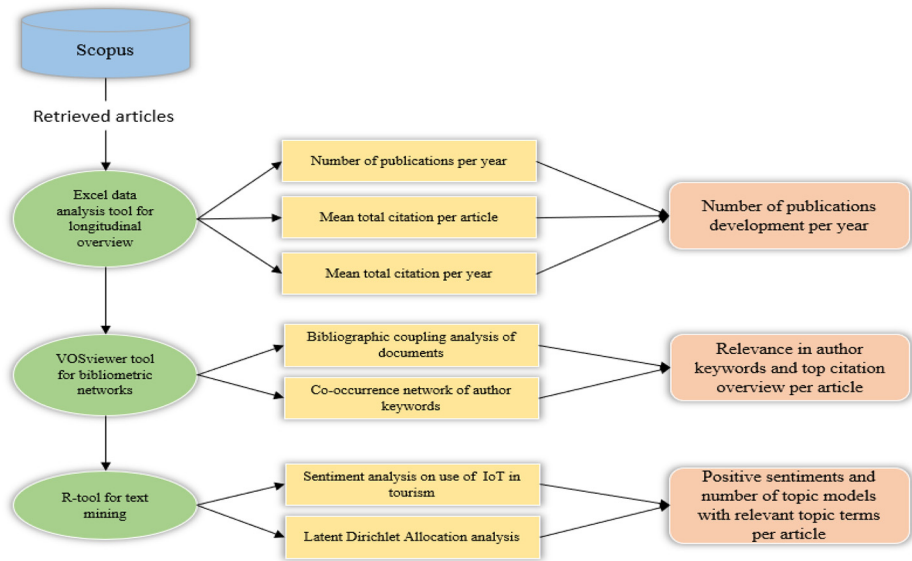
Figure 1. Selection of papers

considering only the 469 papers that were in English. We looked at articles on text mining approaches by Loureiro *et al.* (2020) and Quatrini *et al.* (2022) and noticed that there were less of them because LDA is a time-consuming technique. These articles were also published in prestigious publications, so as a result, we decided to follow their lead and attempted to sort and minimize the number of documents, deciding to analyze 36 studies. It took 20 h to analyze these 36 publications.

After the selection of papers, the methods used in this literature review paper are presented in the form of a tree in Figure 2. Here the tree is divided into four parts: source of the documents, techniques used to do the analysis, indicators included in the techniques and the result of the analysis. The tree first takes the retrieved articles from the Scopus database and reveals that Excel is used for the documents' longitudinal overview, which includes the number of publications, mean total citation per article and year. The result shows the development of the number of publications per year. Second, VOS-viewer is used for Bibliometric Networks, including bibliographic coupling analysis and co-occurrence network, and the result shows relevance in author keywords and top citation overview per article. Finally, the main focus of this paper, the R-tool for text mining, is used to do sentiment analysis and latent Dirichlet analysis, and the result shows the positive sentiments and topic models with relevant topic terms per article.

**3. Analysis**

Next, some analyses on the papers selected are discussed, including the trending topics of the documents per year. Taking the term frequency (freq) levels from 2012 to 2021, the trending topics are found with the help of biblioshiny of R tool. The motive behind finding the list of trending topics is to know which words used by the authors were trendier at the time of the publications of the papers so that we could understand the depth of the topic



**Figure 2.**  
Logical tree presentation of the methods used

relevant to the importance of IoT use in tourism management. The words are counted from the year 2013 to the year 2021, and their trend is represented in the given frequency level of 50, 100, 150 and 200. The higher the frequency, the more the topic is trendy. For example, from 2012 to 2014, the frequency level was less than 50, which proves the topics were less trendy. Gradually in recent years, the topic gets trendier as the frequency level increases. Noteworthy trendy topics were “IoT”, “information management”, “AI”, “tourism”, “big data”, “leisure industry”, “privacy by design” and so on, which proves the necessity and effort of developing smart tourism to attract the tourist more.

### 3.1 Longitudinal overview

The longitudinal overview of the documents selected is discussed, which includes the mean total citation per article and per year of the papers selected, along with the number of publications. Excel was used to find the data for this discussion. The result shows that the highest number of mean citations per article and per year was reached in 2015. In total, 15 articles were published that year. The papers discussed that a smart tourist spot is a connection of stakeholders and their digital depictions that prove smart tourism to be more efficient and effective (Del Chiappa and Baggio, 2015). There is also a platform called smart scenic spot service that will improve tourist visits, make tourism management more scientific and standard, and boost tourism enterprise profits (Yin and Wang, 2015). Though in the early years, the number of publications was less, the numbers began to rise gradually beginning in 2016 and the number was highest in 2020.

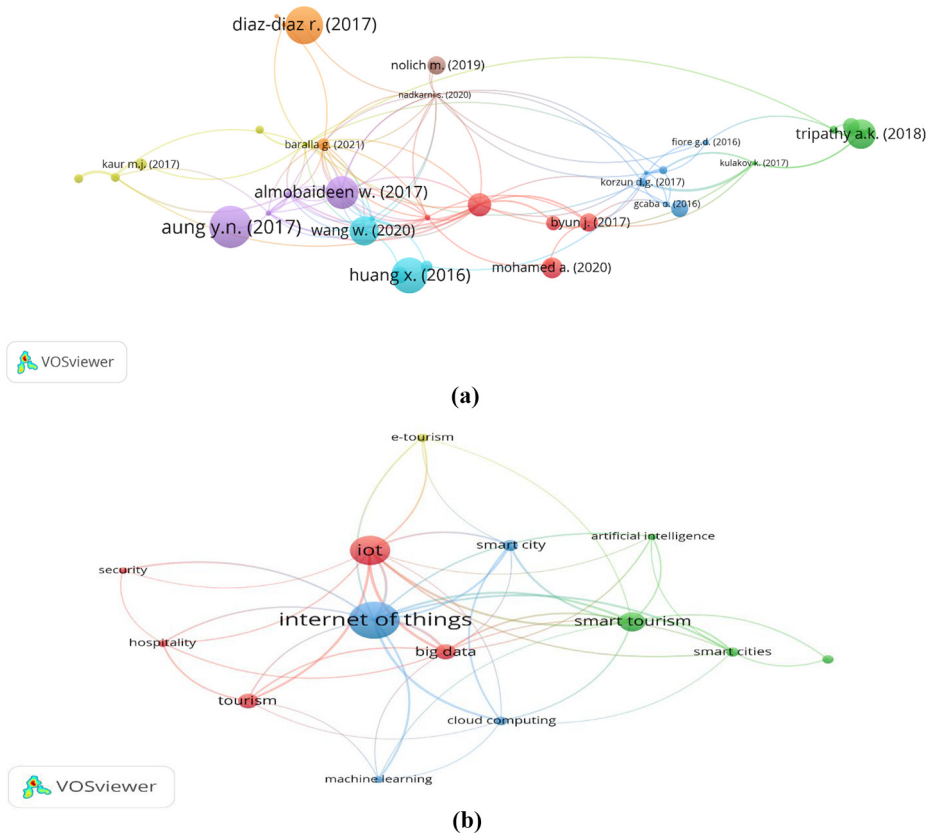
### 3.2 References network analysis

The bibliometric technique is used to provide an overview of the information for IoT in the tourism industry to provide a faster and more effective literature review. For this, references of published papers are gathered to undertake a network analysis of the document

relationships. The references were acquired from the Scopus library’s reference section, and the network analysis of the associated papers was performed using VOS-viewer software.

Bibliographic coupling is a similarity metric that uses citation analysis to build a similar relationship between texts. Figure 3(a) shows a document-based bibliometric coupling analysis. When the minimum number of local citations is 3, only 40 documents out of 390 matches the criteria. The bibliographic coupling resulted in 40 nodes divided into nine clusters. The size of the node represents how many times the papers have been cited. Red, green, blue, yellow, purple, cyan, orange and brown are the eight clusters available here.

Co-occurrence networks are a set of graphs that show the probable connections between persons, organizations, concepts and other entities depicted in the textual content. The co-occurrence network of author keywords is presented in Figure 3(b), which shows keywords used by authors in documents that are similar but not identical, and are based on the same topic showing the relation with the papers in Figure 3(a). Here, when the least number of occurrences for a keyword is seven, 14 out of 1,002 keywords meet the criteria. The co-occurrence network of using IoT in the tourism industry may be described as a total of 14 nodes of 4 clusters with 46 links and 142 link strengths. The term “clusters” also refers to the interconnection of research streams. The keyword occurrence number is determined by the size of the node. The four clusters (red, green, blue and yellow) explain why similar-themed



**Figure 3.**  
 (a) Bibliographic coupling analysis of documents; (b) co-occurrence network of author keywords

keywords appear in the same color nodes. Figure 3(a) and (b) presents that the findings are in accordance.

In Figure 3(a), cluster 1 (red) deals with the digitalization of the tourism industry. Mohamed *et al.* (2020) were curious to learn more about existing big data platforms and their applications in the tourism industry, along with the benefits and drawbacks of big data tools, big data analytics methodologies and new research opportunities in the future development of big data systems. Pencarelli (2020) intended to present a point of view on the impact of the digital revolution on tourism along with parallels and contrasts between tourism 4.0 and smart tourism using a conceptual technique and focusing on the tourism business. Cluster 2 (green) in Figure 3(a) indicates the attributes and evolution of smart tourism. Tripathy *et al.* (2018) offered iTour, an IoT-based framework for independent tourist mobility, as a potential IoT-based solution. They examined the challenges in efforts and lessons learned, as well as IoT's potential possibilities. Kulakov (2017) discussed a method for evaluating the effectiveness of services with smart qualities. For each attribute used, the execution situation, conventional (nonsmart) service for comparison and the estimates used are presented. The method shown here may be used for smart services that take advantage of big data analytics. Cluster 3 (blue) in Figure 3(a) discusses the smart space of IoT. A smart space improves a networked computing environment by allowing digital devices to share information. The role of wireless communication and mobile participation becomes critical in the rising case of IoT ecosystems. Korzun *et al.* (2016) investigated the smart places that may be generated by using a semantic information broker. The primary terms in Cluster 3 (blue) IoT – 83 times; smart city – 15 times) in Figure 3(b) are related to Clusters 1 (red), 2 (green) and 3 (blue) in Figure 3(a).

Cluster 4 (yellow) in Figure 3(a) deals with the smartness of e-tourism and the development of smart tourism. Social network, content marketing and wearable IoT devices will all be required in IoT big data tourist applications. Wise and Heidari (2019) presented practical foundations for destination organizers and stakeholders in this new smart tourism paradigm after establishing a basic understanding of the IoT and its promise for smart cities. Hamid *et al.* (2021) offered a cutting-edge e-tourism data management categorization taxonomy based on smart concepts, and they assessed works in many disciplines against it. In Figure 3(b), the primary terms in Cluster 4 (yellow) (e-tourism – 10 times) are related to Cluster 4 (yellow) in Figure 3(a).

Cluster 5 (purple) in Figure 3(a) discusses smart homes and health care vicinity for smart tourism destinations. Aung and Tantidham (2017) outlined a private Blockchain deployment strategy for a smart home system (SHS) to address its privacy and security concerns. Based on smart contract capabilities for network access, storage systems and data flow control, they assessed Ethereum Blockchain solutions for SHS. Almobaideen *et al.* (2017) provided a novel method for determining which geographical routes were best supported by nearby medical clinics. Their method, known as Geographical Routing for Mobile Tourists, chooses a route that is well-served by medical clinics and follows the shortest path possible in terms of distance. In Figure 3(b), the primary terms in cluster 1 (red) (IoT – 60 times; big data – 24 times; tourism – 23 times; hospitality – 9 times; security – 7 times) are related to Cluster 5 (purple) in Figure 3(a).

The security framework and potential of IoT for smart tourism with fifth-generation (5G) and AI are discussed in Cluster 6 (cyan) in Figure 3(a). The 5G wireless system will support the IoT, increasing the interconnectivity of electronic devices to support a variety of new and promising networked applications. There is still no proven technique for creating security frameworks with device authentication and access control. Huang *et al.* (2016) tried to solve the problem by creating a prototype security architecture that provides reliable and

transparent security protection. Cluster 7 (orange) and Cluster 8 (brown) in [Figure 3\(a\)](#) both discussed the smart city ecosystem that is IoT equipped. Few research studies have addressed the accompanying business models because the IoT and other enabling technologies are still in their early stages of adoption around the world. [Diaz-Díaz et al. \(2017\)](#) intended to fill this void. Their main goal was to learn more about actual business models that can be integrated into a real-world smart city ecosystem. [Nolich et al. \(2019\)](#) showed how the proposed system works in a demo cruise cabin where the E-Cabin application can be used to create different atmospheres based on the users and activities in the cabin. In [Figure 3\(b\)](#), the primary terms in Cluster 2 (green) (smart tourism – 33 times; smart cities – 12 times; artificial intelligence – 7 times) are related to Cluster 6 (purple), 7 (orange) and 8 (brown) in [Figure 3\(a\)](#).

## 4. Text mining

### 4.1 Sentiment analysis

The opinion expressed in constructive comments, criticism and critiques can be used for a variety of reasons. These feelings can be classified into two groups: positive and negative or on a Likert scale including very good, good, neutral, bad and very bad ([Prabowo and Thelwall, 2009](#)). Sentiment analysis is used in this section to detect positive and negative sentiments stated throughout the review to evaluate the overall sentiment trend of the IoT's impact on tourism management. As previously stated, sentiment analysis was performed on the 36 papers that were selected for final evaluation, which were converted into text files manually and a corpus was created with the files. The cleaning of data in the corpus was done using the statistical package R's string, tm and topic model tools. After cleaning the data, the retrieved text was assessed for positive and negative emotions by comparing it with the lexicon reference using the R tool. The relevance of the Lexicon used in the process includes 2,006 positive terms and 4,783 negative words, which are referred to in the summary of positive and negative emotions. A few examples of positive words (reference) are accommodative, beautiful, delighted and freedom, whereas a few examples of negative words (reference) are absurdness, cheating, exaggerate and hypocrite.

The sentiment scores for each document were calculated separately. The quantity of matching positive and negative terms per document is displayed, demonstrating the papers' positive and negative feelings. Then the final score shows the difference between the positive and negative sentiments of each document. The score shows that there is only one document with a negative score and the rest are positive. For example, the highest score is (246) for a document ([Li and Cao, 2018](#)) which expresses a more positive sentiment. This suggests that using IoT in tourism might be one of the greatest ways to attract tourists and improve a country's tourism sector economically according to them. The lowest score is (–4) for a document ([Prandi et al., 2021](#)), which is the only negatively scored document. These sentiment scores prove that the authors support the use of smart technology more since their studies focused on the positive aspects.

### 4.2 Latent Dirichlet allocation analysis

One of the most powerful text mining approaches for data mining is latent data discovery while detecting links between data and text documents is topic modeling. Topic modeling can be done in a variety of ways, with LDA being one of the most prominent ([Jelodar et al., 2019](#)), which is the main focus of this research. The number of latent themes was determined through the R tool using the measures of log-likelihood and perplexity ([Arun et al., 2010](#); [Cao et al., 2009](#); [Griffiths and Steyvers, 2004](#)). Perplexity is a measure that shows if “the model predicts the remaining words in a given subject after witnessing a portion of it”, whereas

log-likelihood evaluates how well the latent topics represent the data observed (Guerreiro *et al.*, 2016). The list of possible topics evaluated in the current work spanned from  $K = 2$  to  $K = 60$ , generated by the R tool. The findings of the models suggest that the measure has a first inflexion on  $K = 9$ , and the documents used  $K = 9$  to evaluate the groups given that the variance described has the first inflexion and to use a small cluster for the explanation (Cao *et al.*, 2009).

Then the corpus is analyzed using R packages (tm, topicmodels, LDAvis, stringr and stringi) to find the posterior probability and word frequency in each document using LDA. Where  $K$  is the topic model number, and the rest are functionality parameters, the values used were  $K = 9$ ,  $\alpha = 1$ ,  $\eta = 0.001$  and iterations = 1,000. Nine topic models were generated, each with its own set of topic terms, which are the most frequently used words in each document that are separated into topic models according to their relevance (Ramage *et al.*, 2009). Then the connected papers of the topic terms are determined using the posterior probability calculated for each document under each topic model.

#### 4.3 Text mining experiments, result and analysis

The parameters for LDA functionality are chosen when the sentiment analysis is complete. The functions of the parameters chosen ( $K = 9$ ,  $\alpha = 1$ ,  $\eta = 0.001$  and iterations = 1,000) are listed above. The computer runs the instructions given with the help of the R tool, selects the most frequently used phrases, and distributes them across the nine topic models ( $k = 9$ ) according to relevance. There are a maximum of nine co-related words in each topic model (lda fit. terms [1:9,]). Table 1 depicts the subject phrases in each document's topic model.

R programming commands for obtaining the posterior probability of each article using the same parameters are provided while generating the topic models. The R software ran for about 20 h and produced an accurate posterior probability result for the publications. The topic models are given names based on the topics that they cover. Table 1 shows the linked documents of the topic models created with the generated post. Prob. (posterior probability) and manually identified the journal, impact factor and paper type. The optimal number of clusters/topics is identified when the variability justification does not change significantly when more clusters are added. The present profiles only contain subjects having at least two publications related to them (posterior probability > 0.1327) to have a discourse based on themes embracing a broad spectrum of research available. Case studies and phenomenology (e.g. focus group) research are examples of qualitative methods, whereas experimental methods are examples of quantitative procedures.

Table 1 shows the LDA results, which reveal nine key topics. First, "Technological application" reveals the implementation of e-tourism with the help of the digital revolution. Dickinson *et al.* (2014) (post. Prob.=0.162) assessed the existing functions in using the domestic tourism travel domain and identified the areas where the most significant changes were likely to occur. On a more theoretical level, the article looks at how the smartphone governs tourism travel and what role it may play in more cooperative and flexible travel decisions to promote sustainable travel. A cutting-edge e-tourism data management classification taxonomy based on smart concepts, as well as a review of works in many domains in comparison to that classification, were presented by Hamid *et al.* (2021) (post. Prob.= 0.1399). They looked through the ScienceDirect, IEEE Xplore and Web of Science databases to do this. Buhalis *et al.* (2019) (post. Prob.= 0.206) used a value co-creation lens to look at significant technical breakthroughs and provided insights into service innovations that have an impact on ecosystems. As an information-dependent service management setting, the study uses examples from the tourist and hospitality industries.

Topic name	Topic terms	Correlated papers	Post. Prob.	Journal (impact factor)	Method of study
Technological application	Tourism, smart, data, tourist, system, services, information, destination	Hamid <i>et al.</i> (2021)	0.1399	<i>Computer Science Review</i> (7.872)	Quantitative
		Buhails <i>et al.</i> (2019) Pencarelli (2020)	0.206 0.150	<i>Journal of Service Management</i> (4.662) <i>Information Technology and Tourism</i> (2.449)	Quantitative Quantitative
e-tourism services	Tourism, network, data, IoT, based, information, services, industry, communication	Dickinson <i>et al.</i> (2014) Almobaideen <i>et al.</i> (2017)	0.162 0.186	<i>Current Issues in Tourism</i> (4.147) <i>Technological Forecasting and Social Change</i> (5.846)	Quantitative Quantitative
		Mehrliyev <i>et al.</i> (2019)	0.176	<i>Journal of Hospitality and Tourism Technology</i> (4.64)	Quantitative
Smart tourism application	Tourism, data, system, nodes studies, mobility, different park, sink	Li and Cao (2018)	0.204	<i>Procedia Computer Science</i> (2.09)	Quantitative
		Navio-Marco <i>et al.</i> (2019)	0.219	<i>Journal of Hospitality and Tourism Technology</i> (4.64)	Mixed
		Suhud and Allan (2020)	0.2295	<i>Journal of Environmental Management and Tourism</i> (1.36)	Qualitative
		Lin <i>et al.</i> (2019)	0.222	IEEE Access (3.367)	Quantitative
		Prandi <i>et al.</i> (2021)	0.200	<i>Journal of Big Data</i> (2.501)	Quantitative
Tourist review on e-tourism	Tourism, sports, blockchain, data, information, service, chain, technology	Babli <i>et al.</i> (2016)	0.190	<i>Ceur workshop proceedings</i> (2.694)	Quantitative
		Belka <i>et al.</i> (2021)	0.154	<i>Sensors</i> (3.576)	Quantitative
		Baralla <i>et al.</i> (2021)	0.204	<i>Concurrency Computation</i> (1.447)	Quantitative
		Tripathy <i>et al.</i> (2018)	0.146	<i>IEEE Consumer Electronics Magazine</i> (3.789)	Quantitative
		Chang <i>et al.</i> (2019) Zheng <i>et al.</i> (2021)	0.163 0.221	IEEE Access (3.367) <i>Security and Communication Networks</i> (1.791)	Quantitative Quantitative
Smart tourism management	Tourism, data, information, internet, development, method, things	Psiha and Vlamos (2017)	0.133	<i>Advances in Experimental Medicine and Biology</i> (2.45)	Quantitative
		Neidhardt and Werthner (2018)	0.138	<i>Information Technology and Tourism</i> (2.449)	Quantitative
		Del Chiappa and Baggio (2015) Bevolo (2019) Tung <i>et al.</i> (2019)	0.155 0.224 0.154	<i>Journal of Destination Marketing and Management</i> (6.952) <i>Journal of Tourism Futures</i> (2.03) <i>Tourism Review</i> (5.947)	Quantitative Quantitative Quantitative

(continued)

Table 1. Latent topics

Table 1.

Topic name	Topic terms	Correlated papers	Post. Prob.	Journal (impact factor)	Method of study
e-tourism progress	Tourism, data travel, time, information, service, used, mobile	Zhang and Dong (2021) Wei (2021) Li (2019)	0.2095 0.189 0.175	<i>Microprocessors and Microsystems</i> (1.525) <i>Journal of Ambient Intelligence and Humanized Computing</i> (7.104) <i>International Journal of Distributed Sensor Networks</i> (1.64)	Quantitative Quantitative Quantitative
User friendly Smart services	Tourism, smart, data, tourist, plan IoT, user, time, information	Gao (2021) Byun <i>et al.</i> (2017)	0.151 0.251	<i>Tourism Review</i> (5.947) <i>Multimedia Tools and Application</i> (2.313)	Quantitative Quantitative
Big Data and AI evolution	Tourism, smart information, studies, articles, literature, analysis, model knowledge	Gretzel <i>et al.</i> (2015) Peng <i>et al.</i> (2020) Wang <i>et al.</i> (2020) Sun <i>et al.</i> (2021)	0.167 0.144 0.178 0.198	<i>Electronic Markets</i> (3.818) <i>Electronics</i> (2.397) <i>IEEE Network</i> (10.693) <i>Sustainability</i> (3.251)	Quantitative Quantitative Quantitative Quantitative
Sustainable e-tourism	Smart, data, digital, technology business, development, information,	Mariani (2019) Nitti <i>et al.</i> (2017) Zubiaga <i>et al.</i> (2019) Gomez-Oliva <i>et al.</i> (2019) Klimova <i>et al.</i> (2020)	0.193 0.231 0.193 0.181 0.212	<i>Tourism Review</i> (5.947) <i>Mobile Information Systems</i> (1.508) <i>Sustainability</i> (3.251) <i>Sustainability</i> (3.251) <i>International Journal of Supply Chain Management</i> (4.725)	Quantitative Quantitative Qualitative Mixed Quantitative

“e-tourism services” indicates the smart services provided toward tourists. [Lin et al. \(2019\)](#) (post. Prob. = 0.222) investigated the 3D deployment of an IoT system in a forest recreational area with ideal service management benefits depicted as a weighting factor of service quality index, and managerial setting attributes index so that the framework collected data from tourists wearing wearable devices and applied it to tasks such as physiological sensing and placement. The purpose of [Navio-Marco et al. \(2019\)](#) (post. Prob.= 0.219) was to examine the evolution of wireless technology in tourism and hospitality. Wireless technologies are a group of information and communication technologies (ICTs) that involve radio transmission, such as mobile or satellite technologies and are widely used in the tourist and hospitality industries. The goal of [Mehraliyev et al. \(2019\)](#) (post. Prob.= 0.176) was to undertake a quantitative and comprehensive review of published articles on smart tourism. The paper seeks to define the smart tourism research life cycle, collaborative trends, main social structure, disciplinary methods and foundations, research themes and methodological approaches in more detail.

“Smart tourism application” deals with implementing smart tourism through various technological revolutions in a dynamic environment. [Prandi et al. \(2021\)](#) (post. Prob. = 0.200) presented the design and development of a real-world experience in which a low-cost cooperative platform allowed local communities to feel and display tourist flows and urban data in a rich interactive map-based visualization. [Babli et al. \(2016\)](#) (post. Prob. = 0.190) described a smart tourism system that creates a tourist itinerary and monitors its execution. A recommendation system provides a list of sites that best suit the tourist’s specific tastes, and a planner creates a customized itinerary or plan that includes visit dates and durations. In the context of a Smart Tourism Region, [Baralla et al. \(2021\)](#) (post. Prob. = 0.204) suggested a blockchain-based network for ensuring the origin and provenance of food items. Local food and drink can, in fact, be a fantastic combination for attracting tourists and promoting the area if their provenance is clearly documented.

“Tourist review on e-tourism” describes the opinion of the visitors or travelers about e-tourism services. [Chang et al. \(2019\)](#) (post. Prob.= 0.163) proposed a text mining-based approach for identifying nonrevisit characteristics in online textual evaluations on social media. As detecting whether a passenger plans to return is impossible, this study created a text mining-based approach that determined the passenger’s motivations by analyzing the mood of text reviews. [Tripathy et al. \(2018\)](#) (post. Prob.= 0.146) introduced iTour, a potential IoT-based solution for tourist autonomous mobility. In the process, this paper examined the challenges of initiatives and lessons learned, as well as the potential roles of IoT. To accomplish the tasks of sports tourism service internal management control, external collaboration and information release, [Zheng et al. \(2021\)](#) (post. Prob. = 0.221) developed a sports tourism service application model based on Internet technology. The two tiers of feature words were used to identify the similarity of sports tourism resources as well as the context in which sports tourism resources may be discovered.

“Smart tourism management” indicates the proper management of e-tourism. By applying a network analytic technique to the instance of three tourism locations, [Del Chiappa and Baggio \(2015\)](#) (post. Prob. = 0.155) contributed to the scientific debate on this topic. According to their findings, efficient knowledge-based destination management studies should consider both the virtual and physical components of the destination’s network structure. The goal of [Bevolo \(2019\)](#) (post. Prob. = 0.224) was to provide a conceptual basis for architectural design transformations while also informing the reader about some new trends in placemaking and digital destination management. The aim of [Tung et al. \(2019\)](#) (post. Prob. = 0.154) was to examine smart mobility’s past and future prospects in the context of destinations and reached the conclusion that smart mobility will

transform tourism management in ways never seen before, notably in terms of tourist travel patterns and decision-making.

“e-tourism progress” deals with the development of e-tourism based on IoT. By examining neural networks, this research investigates the growth and use of large data. The primary goal of [Gao \(2021\)](#) (post. Prob. = 0.151) was to improve the big data system and platform. In big data, several technical and software requirements increasingly adjust to the consistency of the data platform and data system. The increase in people’s living conditions has assisted tourism’s rapid growth. The demand for tourism has risen significantly. The fast growth of ICTs such as cloud computing, the internet, the IoT and mobile intelligent terminals has resulted in intelligent tourism. [Zhang and Dong \(2021\)](#) (post. Prob. = 0.2095) wanted to accurately extract the image monitoring data of tourist sites, generate the correlating tourism routes using all of the applicant destination sets, generate all of the locations formed by the location sets and return the recommendation results to the visitors to overcome the issue experienced in the growth of tourism.

“User friendly smart services” describes the foundation developments of smart tourism to make it easy for the customers to adopt feasibly. The goal of [Byun et al. \(2017\)](#) (post. Prob. = 0.251) was to make it easier for IoT mobile virtual network operators to gain access to the market to provide the IoT services needed to implement more intelligent tourism in the tourism sector. This is inspired not just by the internet but also by information and communications technology in the most recent generation of long-term evolution networks. [Gretzel et al. \(2015\)](#) (post. Prob.=0.167) defined smart tourism, discussed current smart tourism trends and laid out the technological and business underpinnings for smart tourism. A small review of the benefits and downsides of smart tourism followed. The study also emphasized the critical necessity for research to guide smart tourism growth and management.

“Big data and artificial intelligence (AI) evolution” discusses the evolution of big data and AI in 5G smart tourism. The purpose of [Mariani \(2019\)](#) (post. Prob. = 0.193) was to examine the progress of Big Data and Analytics in the tourist and hospitality industry. It examined the significant role that Big Data has played in tourism and hospitality research thus far as well as how it may evolve in the future. Based on visitor selection behavior, [Peng et al. \(2020\)](#) (post. Prob. = 0.144) presented a human-guided machine learning categorization method that can effectively aid travelers in deciding which tourist attraction to visit. The results of cross-validation trials and performance evaluations showed that this method is effective. For smart tourism, [Wang et al. \(2020\)](#) (post. Prob. = 0.178) outlined 5G and AI-powered IoT technologies. To enable IoT-based smart tourism applications, effective data communication based on 5G technology and smart data analysis based on AI innovation are critical.

“Sustainable e-tourism” deals with the emerging sustainable tourism concept. [Nitti et al. \(2017\)](#) (post. Prob = 0.231) conducted the first examination of the viability of using an IoT method for a sustainable tourism application and offered a specific architecture. The architecture was designed to optimize cruise ship passenger mobility in Cagliari, Italy, by considering aspects such as transportation information and queue waiting periods. [Gomez-Oliva et al. \(2019\)](#) (post. Prob = 0.181) discussed the goal of creating an innovative communication channel between a tourist and a point of interest, which enabled the production and delivery of flexible experiences as well as the expanded distribution of cultural heritage through new technologies, all while considering the regions’ real-world demands and the needs of new digital visitors. To solve these issues, this paper suggests *Be Memories*, an innovative and co-created progressive Web-app for visitors that aims to share the intangible history of a tourist site through material co-created by local residents.

These nine topics created different types of opinions about tourism management through IoT for smart tourism, although most of them gave their opinion in favor of smart tourism.

Now the nine topics are divided into three groups manually on the basis of relation to representing the previous research information.

Group 1 consists of “Technological application”, “Smart tourism application” and “Big Data and AI evolution”. Model 1 introduced the technological applications to be used and how to use technology in managing the tourism sector positively. Model 3, however, did state a few negative aspects of IoT, describing that smart tourism applications can also cause loss of data security and data infrastructure if not properly used. Model 8 is somewhat related to Models 1 and 3 through the evolution of Big Data and Artificial Intelligence in e-tourism, making the technology system more advanced.

Group 2 consists of “e-tourism services”, “e-tourism progress” and “User friendly smart services”. Model 2 introduced e-tourism services using IoT, which advanced the tourism sector one step ahead. Model 6 normally discussed the progress of e-tourism and how it is developing day by day due to the introduction of new technology every day. Model 7 ensured whether e-tourism is being a user-friendly application or not, as the development mostly depends on the use of the application system.

Group 3 consists of “Tourist review on e-tourism”, “Smart tourism management” and “Sustainable e-tourism”. Model 4 introduced the fact that tourists are satisfied with using e-tourism as they have to face less hassle now. Model 5 discussed the management of e-tourism, which is a must to maintain the development of this sector as this attracts more tourists and the economy is impacted. Finally, Model 9 made awareness to maintain all these management systems to maintain the sustainability of e-tourism.

Here the models built different opinions about e-tourism management to create awareness about the tourism sector. The suggestions for future research for these three groups are shown in [Table 2](#).

## 5. Implications and future research directions

The current study’s results prove to contribute to the appropriate direction for this research’s goal. The posterior probability in nine latent topics is calculated here, allowing future investigations on any of these topics to be undertaken in a way that catches researchers’ attention. The articles on Topic 7 (user-friendly smart services) and Topic 9 (sustainable e-tourism) have the highest posterior probability, which is larger than 0.22, proving that these two subjects have a good possibility of being chosen for additional research. Researchers can review the smart tourism services that are user-friendly or not for maintaining sustainability. Whether the smart devices are user-friendly or not, whether they

Topics	Future Research Suggestions
1. <ul style="list-style-type: none"> <li>● Technological application</li> <li>● Smart tourism application</li> <li>● Big Data and AI evolution</li> </ul>	Whether evolution technological applications such as Big Data and AI are making the tourism sector smart and digital to attract more tourists or not
2. <ul style="list-style-type: none"> <li>● e- tourism services</li> <li>● e-tourism progress</li> <li>● User-friendly Smart services</li> </ul>	Whether e-tourism services are progressing enough to be user-friendly or not
3. <ul style="list-style-type: none"> <li>● Tourist review on e-tourism</li> <li>● Smart tourism management</li> <li>● Sustainable e-tourism</li> </ul>	Whether the tourists’ review on e-tourism is helpful for the management and sustainability of e-tourism or not

**Table 2.**  
Future research suggestions

are being properly or easily used or not, can be a better direction for future research. Again, proper maintenance of e-tourism is a must to keep it sustainable. These topics having the highest posterior probability indicate that the application of IoT in tourism has many advantages. These topics will be interesting to do additional research on as quality maintenance of e-tourism services toward valuable tourists is very important.

The relevance between the overall bibliometric analysis and trend topics allows researchers to focus on terms such as “internet of things”, “information management”, “AI”, “tourism”, “big data”, “leisure industry” and “privacy by design” for future research. Again, researchers can emphasize the techniques of developing e-tourism in their papers as many developing countries are still forming e-tourism but may not apply the principles properly. If e-tourism is not created correctly, it may cause a hassle for tourists, but if the entire e-tourism administration impresses the tourists, they will leave positive evaluations and urge other tourists to return. This will impact the economic condition of the country also. So, the future research impact of proper e-tourism on tourists and the country itself can also open exciting perspectives.

## 6. Conclusions

Tourism is becoming more and more popular as economic progress opens up new options for it to be consumed as a lifestyle across cultures (Holden, 2016). So, considering this demand, the tourism industry should be driven through a proper management system, and all these hassles can be solved through smart tourism (Sebastia *et al.*, 2009). According to the conclusions of this study, smart tourism using IoT would attract more visitors, including a smart hotel with a smart communication system and all of the fundamental necessities in a smart management system. This has already become easy for developed countries in this century, and the developing countries are trying to get better at this. This research paper used both bibliometric analysis and a text mining approach to bring this impact of applying e-tourism to the people. This study’s findings include LDA, sentiment analysis and citation mapping of the publications chosen.

The most frequently used words are shown in the topic trend, which includes more technology, showing that technological advances play a significant part in smart tourism in making a country’s tourism business more advanced and developed to attract tourists. Following that, a bibliometric analysis assists in gaining a thorough understanding of document bibliographic coupling analysis and author keyword co-occurrence network. The findings, in this case, had to do with connected authors, papers and keyword co-occurrence. The document’s sentiment analysis was used to describe the overall positive and negative sentiment of the articles, with the bulk of positive opinions being noted. Finally, LDA was used to determine the frequency level of the terms used the most and assign them to topic models on the basis of the relevancy of the papers using posterior probability.

The VOS-viewer software could not support other databases other than Scopus, so other databases could be used in future studies to ensure the review of more papers. Future research can also be done on the trend topics found with the help of the R-tool because the significance of the topics is not elaborately explained. Smart tourism is shown to have overwhelming positive opinions, which leaves interesting scopes for researchers to have thoughts of future research on this.

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