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Review Article

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A Scoping Review of Artificial Intelligence Applications in Airports

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Keywords

Artificial Intelligence,
AI Application,
Airport,
Scoping Review,
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Abstract

This paper aims to synthesize the literature on the application of artificial intelligence for airports. The selected methodology was based on the PRISMA Extension for Scoping Reviews (PRISMA-ScR), a recognized framework for systematic reviews. Authors searched the Scopus and Web of Science databases for articles that met the following criteria: (1) publication in peer-reviewed journals, (2) English language, and (3) relevance to airport operations, demonstrated by either (a) the use of airport datasets for showcasing AI applications or (b) the use of airports as case studies. Articles were assessed by two reviewers, and data were extracted on the articles' keywords, publication year, and origin country. After screening and checking for eligibility, 121 unique articles were examined. Upon assessment, the included articles were categorized into seven main themes. Each category and its specific subtopics were individually discussed within this paper. Results indicate that the most extensively studied category belongs to airport administration and management. Security and air traffic control (ATC) were the second and third most studied categories, respectively. Notably, a significant portion of the articles focused on optimization techniques, scheduling strategies, and developing decision support systems (DSS) tailored to various airport departments. This paper not only highlights current research trends in the field of AI for airports but also identifies gaps in the existing literature. The paper proposes future research directions to enhance the effective implementation of AI technologies within airport environments.

1. Introduction

In recent years, the airport industry has undergone a profound transformation fueled by artificial intelligence (AI). As airports worldwide deal with increasing passenger volumes, growing security concerns, and the demand for enhanced efficiency, the imperative for innovative solutions has never been more crucial. In this context, AI offers a transformative potential, revolutionizing various aspects of airport management, from passenger experience and security screening to baggage handling and air traffic control [1–3]. With the help of AI-driven technologies, airports can streamline operations, optimize resource allocation, and minimize disruptions, which ultimately enhance safety, efficiency, and overall passenger satisfaction [4]. In addition, airports are evolving into indispensable elements of smart cities, seamlessly integrated into interconnected urban landscapes where data-driven technologies play a pivotal role in optimizing building efficiency [5], fostering sustainability [6], and elevating the overall quality of life [7]. More importantly, with the advancement of AI, its applications in airports will continue to evolve, and there will be numerous and surprising developments in more aspects.

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Scholars across diverse disciplines study the application of AI more each day, and the aviation industry is no exception. This growing interest necessitates the development of comprehensive systematic review papers to understand the current research landscape and future directions. However, a critical gap exists in the research on AI applications within the aviation sector, calling for a comprehensive meta-analysis of the literature. While the potential of AI in aviation is widely acknowledged in the literature, surprisingly, systematic analysis of the existing papers and identification of future research directions is currently lacking. The current landscape of papers identifying the main concepts for AI applications in the aviation sector is extremely limited. Beyond a handful of conference papers, the number of existing research articles within this domain scarcely surpasses five [3,8–10]. Even within this restricted body of literature, existing studies either adopt a narrow approach, reviewing solely specific papers for particular applications of AI in airports or, conversely, take an overly broad perspective, offering minimal contributions to the conceptualization of the topic.

To date, only two reviews have explored the topic of AI for the aviation industry, yet neither review explicitly explored applications of AI in airports. Zaoui et al. [10] recently conducted an industry-wide review through the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) protocol for the impact of AI on the aeronautic industry. Their study focused more on the use of AI for airline and aircraft manufacturers, while they narrowly discussed airports. Similarly, Sadou and Njoya [9] conducted a bibliometric and systematic literature review for applications of AI in the air transport industry. The remaining literature consists of conference papers or studies with a narrow focus on the use of artificial intelligence for specific applications for airports, such as Air Traffic Management [3] or IoT for smart airports [8].

This scarcity presents a significant barrier to understanding the current state of knowledge for the application of AI in airports, hindering the identification of key research trends and the formulation of focused research agendas. This study aims to address this gap by conducting a comprehensive scoping review of AI applications and their potential impact on the airport industry. This paper maps and categorizes different AI applications for airport activities. In addition, it identifies areas that have received significant research attention and highlights those requiring further exploration, providing a comprehensive overview and valuable guidance for future research endeavors.

As a result, the following research questions were formulated for this study: What are the known applications of AI in the literature for airports? In which areas of airports these studies were conducted? And finally, what are the existing gaps and directions for future studies in this context? To address these questions, we conducted a scoping review to answer this question, focusing solely on peer-reviewed articles published in prominent databases up to date.

The paper proceeds as follows: Initially, we outline the search strategies employed in the scoping review in Section 2. In Section 3, we classify and map all articles included in the study. Each category is addressed separately, followed by delineating subcategories and their associated articles. Lastly, Section 4 synthesizes existing research by pinpointing existing gaps and proposing potential future work.

2. Methodology of Research

Scoping reviews are becoming increasingly popular as a method of synthesizing research evidence [11]. They offer a holistic overview of the current research landscape, providing a foundation for future investigations. A scoping review is a valuable tool for meta-analysis and systematically mapping the existing literature on a specific topic, making it invaluable for both researchers and practitioners.

The methodology selected for the scoping review of this article is based on the framework outlined by Arksey and O'Malley [12]. One of the most reliable protocols for conducting systematic reviews and meta-analyses is PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analysis). As a result, this paper followed the protocol and checklist of PRISMA Extension for Scoping Reviews (PRISMA-ScR) developed by Tricco et al. [13] to enhance the reliability and transparency of the research.

2.1. Search Strategy

This paper's protocol was drafted using the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) protocol (http://prisma-statement.org/), which was developed to help scholars to conduct a comprehensive systematic review. The searches were conducted to identify relevant literature using the main keywords 'artificial intelligence', 'AI', and 'airport.' The search was conducted for the title, abstract, and keywords mentioned in the articles. In order to find the most relevant articles, the following subject areas were selected: engineering, computer science, social science, mathematics, business and management, environmental science, and decision science. A literature search was conducted through databases that index all fields, including Scopus and Web of Science (WOS). These databases were chosen for their comprehensive coverage of peer-reviewed literature across multiple disciplines, including engineering, computer science, transportation, and aviation. ChatGPT The advanced search functionalities and citation tracking capabilities offered by Scopus and Web of Science played a crucial role in methodically gathering, integrating, and scrutinizing the relevant literature essential for conducting an exhaustive scoping review on this paper. Although the topic of AI is a relatively new topic, the authors decided not to set a specific date range in the search in order to demonstrate how specific applications evolved over time. Scoping reviews aim to map the existing literature comprehensively rather than adhere to strict temporal constraints. In addition, peer-reviewed literature on AI in airports may vary in publication frequency and accessibility across different disciplines and regions. A timeline-free approach allows for the inclusion of relevant studies published at different intervals, ensuring a balanced representation of the available literature.

2.2 Study Selection

The following criteria were considered when selecting articles: (i) the article discussed a method or application of AI that is related to any airport activities; (ii) the article used airports as a case study or airport dataset for demonstrating AI applications; (iii) the article was published in peer-reviewed journals; (iv) the language of the article was in English. Articles that did not meet the following criteria were removed: (i) the article did not directly discuss AI applications for airports (e.g., the paper commented on the potential or future use of AI in airports or reviewed other articles without contributing original research); (ii) used airports just as crowded place without any specific application of AI for airports (iii) the full text of the article was not found or accessed.

2.3 Data Extraction and Analysis Plan

In each article, authors looked for: (i) the research goals (i.e., what the study aimed to achieve), (ii) where in the airport AI was used (specific areas/department/tasks), (iii) the exact function and capabilities of the AI for airports, (iv) the authors' country of origin, (v) the academic discipline the research belonged to, and (vi) the year the article was published.

3. Results

The PRISMA flowchart of this study is illustrated in Figure 1. The stated search strategy for this study initially identified 1221 items. After removing duplicates, 311 unique research articles remained for screening.

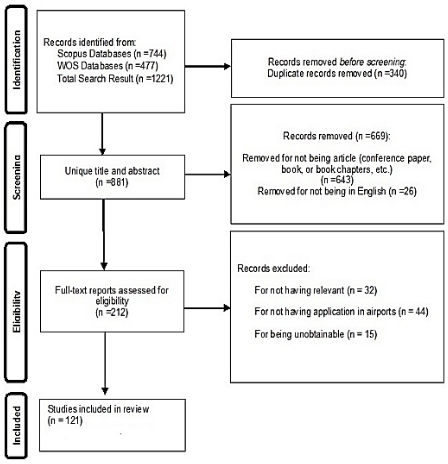

Figure 1. Flowchart of the study based on PRISMA protocol

3.1 Overview of Article Characteristics

The 121 identified articles were published over a period of 30 years, and their publication rate has increased dramatically over the past four years. The span of publication years ranges from 1997 to 2023 (Figure 2), with a mean publication year of 2016 (standard deviation 7.2). The median publication year was 2020, and the highest number of publications was in 2023 (n=26). No time restrictions were applied in the search to cover all the topics studied to date. The pioneer studies for utilizing AI in airports were for tracking baggage [14] and scheduling gate allocation [15].

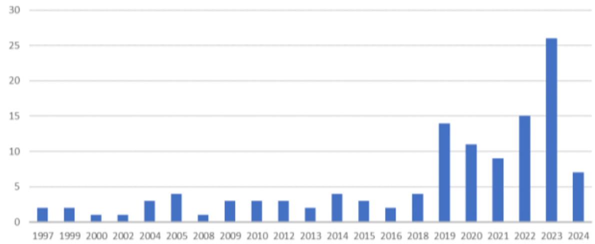

Figure 2. Published articles by years

The geographical distribution of included articles is illustrated in Figure 3. In total, 121 articles were distributed among 35 countries, with China and the United States as the leading countries, contributing 39 and 15 articles, respectively. Another dominant region is Europe, which contributed 32 published articles. The United Kingdom, Austria, and the Netherlands each published four articles, while Italy, Spain, Germany, the Russian Federation, and France each contributed three articles.

Figure 3. World-map distributions of contributing countries

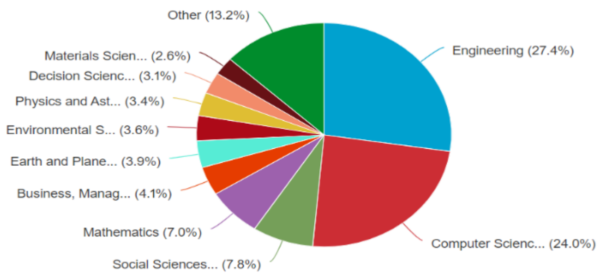

Figure 4. The subject area of included articles

The majority of articles in the study belong to the fields of engineering (n=32) and computer sciences (n=28), comprising more than half of the included studies. The distribution of subject areas of the articles is illustrated in Figure 4.

3.2. Applications of AI in Airports

After analyzing 121 included articles, eight main topics were identified, each comprising various subcategories showcasing unique applications of AI for airports (Table 1). These main categories are as follows: Security, Management and Administration, Airport 4.0, Passengers, Air Traffic Control, Weather and Climate, and Safety. The most studied areas were Management and Administration (n=43) and Air Traffic Control (n=27), while the least topic was regarding Passengers (n=6). The rest of the topics were almost equally studied, including security (n=13), safety (n=14), Airport 4.0 (n=9), and Climate and weather (n=9).

Table 1. Categorization of articles studying applications of AI in airports

Category	Topics	Applications
Security	Airport Checkpoints	Automated decision-making Checkpoints [16], Improving the accuracy of X-ray security inspection [17–20], Baggage-tracking system [14], Randomizing checkpoints on the roadways entering the airport and canine patrol routes within the airport terminals [21], Predicting incoming passengers at the airport's security checkpoint [22]
	Verification	Human Footsteps Biometric Verification [23]
	Radio Communication Networks (RCN)	Protecting RCN from external electromagnetic interference [24]
	Unmanned Aerial Vehicles (UAV)/Drones	Distinguishing between drones and birds [25], Identifying and tracking unauthorized drones in large numbers [26], Counter-drone systems [27]
	Cyber Security	Detecting DDoS cyber threats for 5G aviation environment [28]
	Surveillance	Detecting unexplained individual activities [29], Detecting deception from facial cues [30], Privacy-preserving video surveillance [31]
Administration and Management	Traffic Prediction	Airport aircraft capacity prediction [32,33], Multi-Airport traffic flow prediction [34], Monthly number of flights prediction [35], low-cost passenger carrier demand prediction [1], Forecasting air travel demand [36,37], Passenger index prediction [38]
	Planning	DSS for total airport operations management and planning [39], Operational aircraft maintenance planning [40], Predicting the required resources for each flight [41], Precise prediction of arrival times at the gate [42]
	Ground Operations	DSS for efficient and safe management of apron traffic [43], Scheduling aircraft ground handling operations [44], Controlling ground operations [45], Baggage handling system [46], Tracking ground equipment and vehicles [47], DSS for ground handling management [48], Aircraft turnaround control system [49]
	Terminal Management	Terminal capacity planning decision support [50], Designing optimal check-in policies [51], Explaining the dynamics of airport terminal operations e.g. throughput of security checkpoints and passenger expenditure on discretionary activities [52], Energy efficiency [53][54], Gate allocation scheduling and optimization [55–59], Baggage carousel allocation [60], Tracking the condition of multiple conveyor belts of a baggage handling system located at check-in [61]
	Administrations/Facilities	Infrastructure expansion [62], Developing airport pavement maintenance strategies by automatic detection of road stress [63,64], Accessing the sustainability of an airport [20], DSS in collaborative infrastructure planning between airport and its surrounding [65], Noise analysis and identification of airport [66,67], Overall airport efficiency on sustainable development [68], Modeling dynamic financial scenarios for airport infrastructure development [69]
	Human Resource Management	Staff shift planning and Scheduling [51,70,71], Airport staff burn-out identification [72]
Airport 4.0	Automation	Types of service robots for airports [73], Exploring the possibility of having a fully automated security system [74], Ideas for automatic garbage collection [75]
	Internet of Things (IoT)	Smart maintenance system for baggage carts [76], Presenting a framework for provisioning AI in IoT and 6G environments [77], Investigate types of cyber defense tools including AI and data mining techniques for IoT in the context of the smart airport [78], Cyber twins security-oriented Industrial IoT testbed [79]
	Smart Cites	Human-centered paradigm for cooperative hybrid cities [7,80], Real-time crowd recognition and management system [81]
Passengers	Passenger experience	Customer experience toward smart service solutions [82], Transportation and ground accessibility to airport [83]
	Passenger Perspective and Mindset	Qualitative research on passenger needs and perspective [84], attitudes and attractiveness of AI-based transport services [85], Frequent flyers behaviors [86]
	Passenger Satisfaction	The effects of big data-based services on satisfaction and repurchase intention [87]

Air Traffic Control (ATC)	Aircraft Sequencing	Minimizing total tardiness [88], Sequencing and scheduling arrival flights [89], Take-off scheduling [90], Optimizing the flight turnaround [59]
	Air Traffic Management	Integrating Unmanned Aerial Systems (UAS) into the airport airspace [91], Analyzing and optimizing Air Traffic Flow Management[92,93], Predicting flight delays [94]
	Flight Plans	Urgent automatic flight plan generation [95], Improving route planning activities [96], Air route network optimization [97], Integrating all available schedule recovery options during aircraft ground operations [98]
	Traffic Management Strategies	Decision-making support for traffic management initiatives under uncertainty [99], Integrating strategic Air Traffic Management (ATM) decision support tools with tactical ATC [100]
	Runway, Taxi, Apron	Aircraft taxiing path planning and guidance [101,102], Aircraft taxi time prediction [103], Scheduling aircraft parking [15,104], Aircraft take-off runway scheduling [105], Optimization of airport runway resources [102], Predicting abnormal runway occupancy times based on unique radar data patterns [106], Scheduling tow and pushbacks for airplanes [104,107], Planning and coordination to the resilience of airport surface movement operations [108], Controlling data collection of airport flight aid light [109]
	Aircraft Detection	Detecting aircrafts in synthetic aperture radar (SAR) images [110], Monitoring flights taking off [111]
Weather	Meteorological Services	Weather forecasting [112–115], Predicting the hourly visibility of airports [116], Predicting visibility and ceiling base height [117], Wind forecasting [118,119], Predicting hot/cold waves [120]
Safety	Safety Assessment System	Predicting the possible incident scenarios and determining preventative actions [121], Runway crack detection/Runway condition [122,123], Identifying latent topics and trends in aviation incidents [124], Bird detection [125]
	Emergency Management	Emergency rescue management decision support system [126,127], Emergency situations simulation [128], Emergency evacuation modeling [129]
	Pandemics and Diseases	Mask detection [130,131], Social Distancing [31,132], Preventing the spread of disease by determining airport routes taken by infected people [133]

The analysis of keywords, titles, and abstracts of articles by the Vosviwer program also suggested similar categorization. The results for keywords analysis with at least four times appearance demonstrate four clusters (Figure 5). Again, it can be observed that topics such as airport security, air traffic management and control, weather forecasting, and airport safety appeared in the analysis, as previously mentioned.

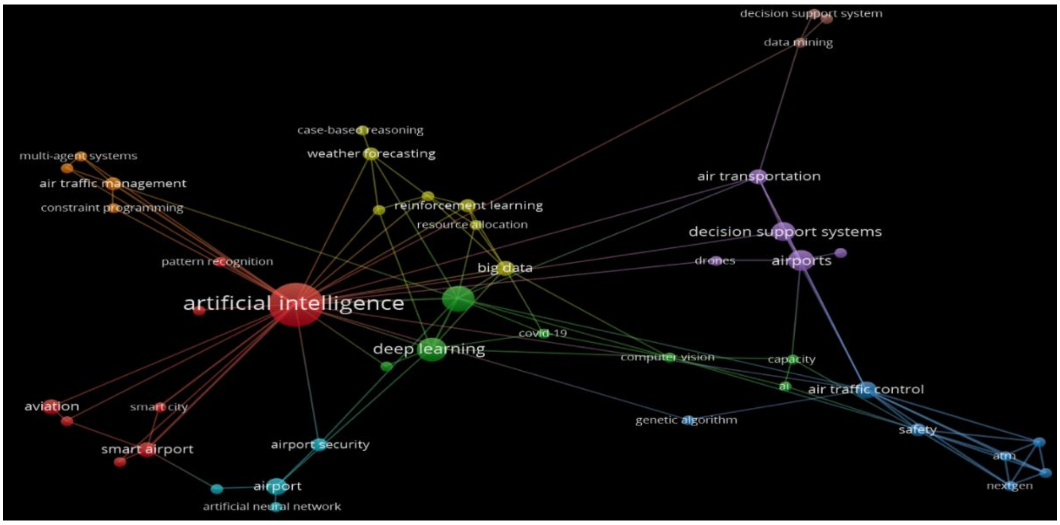

Figure 5. Analysis of keywords of articles with at least four appearances in the Vosviewer program

3.2.1. Security

The articles for this category cover topics such as airport checkpoints, drone detection, radio communication networks, cyber security, and surveillance. The most studied topic for this category was airport checkpoints, with eight articles. AI-powered baggage scanners, equipped with deep learning algorithms, can meticulously analyze X-ray scans in airport checkpoints with superior accuracy and efficiency compared to traditional methods [18,19]. This not only significantly reduces false alarms, minimizes passenger inconvenience, and expedites security checks but also allows security personnel to focus their expertise on anomalies flagged by the system. Surveillance is another popular topic among researchers. AI-driven video surveillance goes beyond passive monitoring. Autonomous detection of suspicious objects or activities with the help of AI, such as erratic movements or attempts to avoid security checks, can significantly enhance the security of airport terminals [29]. Additionally, analyzing real-time footage can identify individuals on watch lists with facial recognition, enabling a swift response [30]. This empowers security personnel to intervene and investigate potential threats proactively. Finally, airports are faced with new security challenges as unmanned aerial vehicles (UAVs), also known as drones, have gained popularity for entertainment and commercial purposes. Unauthorized drones can disrupt airport operations, causing delays and cancellations. Collisions of drones with aircraft, especially during take-off and landing, can be catastrophic. Additionally, drones could be used for terrorist attacks by carrying weapons or explosives. AI-powered systems can detect drones in large numbers with high accuracy [25]. Early detection and tracking of drones allow authorities to identify potential threats and take necessary steps to countermeasure actions.

3.2.2. Administration and Management

The most studied category was related to the management of various departments and facilities in airports. It includes topics such as traffic prediction of passengers in airports, terminal management and planning, ground operation management, human resource management, and administration of facilities. Artificial intelligence has emerged as a game-changer in airport management, particularly in predicting passenger traffic patterns [32,33]. By harnessing vast amounts of historical data, AI algorithms can analyze factors such as flight schedules, weather conditions, holidays, and events to forecast passenger numbers accurately [35–37]. Moreover, AI-powered passenger traffic prediction facilitates better resource allocation, helping airports anticipate peak periods and allocate resources accordingly, ensuring a seamless travel experience for passengers. In fact, gate allocation and scheduling based on the terminal traffic and available resources was one of the most studied topics [55–59]. This predictive capability enables airports to optimize staffing levels, streamline security procedures, and improve overall efficiency prediction [34,50]. AI-based workforce management systems can also optimize shift scheduling, taking into account factors like employee preferences, labor regulations, and peak traffic times, ensuring adequate staffing levels while minimizing labor costs [51,70,71]. Additionally, AI-driven insights empower airport authorities to make informed decisions regarding infrastructure development and capacity planning, ultimately enhancing the overall operational resilience of airports [62,65].

Artificial intelligence is also revolutionizing ground operations at airports by optimizing various aspects of the process. From aircraft movements on the ground [43,44] to baggage handling [45,46,48] and ground vehicle management [47,48], AI-powered systems are streamlining operations and enhancing efficiency. Additionally, AI-driven predictive maintenance systems monitor the condition of pavement ground vehicles and equipment, anticipating maintenance needs before they cause disruptions [61,63,64,76].

3.2.3. Airport 4.0

One of the understudied categories was airport 4.0, also known as smart airports. This category involved only nine articles, four of which were qualitative. Topics such as robots and automation, the Internet of Things (IoT), and smart cities were included in this category. Through automation, airports can streamline various processes [73], from check-in and security screening [74] to cleaning [75] and maintenance [76]. IoT devices embedded throughout the airport infrastructure, such as sensors and cameras, collect real-time data on passenger flow, terminal conditions, and equipment status [77][134]. AI algorithms then analyze this data to optimize operations, predict potential issues, and improve resource allocation. By integrating with city-wide IoT networks, airports can facilitate seamless multimodal transportation, enabling passengers to transition between air travel and other modes of transportation seamlessly [81].

3.2.4. Passengers

The least studied category, with only six articles, is related to passengers and their point of view toward AI. It is worth noting that two of these six articles encompass qualitative studies. In this category, three parallel topics related to AI were discussed: passenger experience, passenger mindset, and satisfaction. The first topic, passenger experience, delves into how passengers interact with AI systems during their air travel journey [82]. It explores aspects such as ease of use, convenience, and overall satisfaction with AI-powered services or solutions integrated into the travel experience [83]. Studies on the passenger's mindset focus on understanding passengers' attitudes, beliefs, and perceptions regarding AI technology in the context of air travel [85]. It aims to uncover passengers' thoughts on the integration of AI, their trust in AI systems, and any concerns or reservations they may have [86]. Finally, the study regarding passenger satisfaction examines the extent to which passengers feel fulfilled, content, or pleased with their AI-enhanced travel experiences. It considers factors such as meeting expectations, delivering value, and providing a seamless journey, ultimately aiming to gauge overall satisfaction levels among passengers using AI in air travel [87].

3.2.5. Air Traffic Control (ATC)

Another category that has been studied in great numbers is related to operations and tasks of the Air Traffic Control department in airports. Integrating artificial intelligence (AI) into air traffic control systems promises a transformative shift in aviation operations. By leveraging AI algorithms, air traffic controllers can access real-time insights and decision support tools, enhancing their ability to manage complex traffic scenarios efficiently and safely. The topics for this category include air traffic management, aircraft sequencing, flight plans, establishing strategies for traffic management, runway and taxiway management, and aircraft detection.

One of the critical tasks of airport control towers is to safely and efficiently manage air traffic [92,93]. AI showed great potential for assisting the control tower with scheduling [90], sequencing [89], predicting [94], and optimizing [59,88] upcoming and ongoing aircraft traffic. In addition, there are also air route planning and optimization [96,97] and integration of other aerial systems and airspaces with airport ATC [91,98,100].

Management of the runways, taxiways, and apron of an airport is another critical task that takes up a significant amount of time for air traffic controllers in an airport. Artificial intelligence systems can analyze vast amounts of data from radar, weather forecasts, and flight schedules to optimize paths [101,102,106], parking, sequencing [105], allocating resources [104,107] and spacing and parking of aircraft [15,104], ultimately reducing delays and increasing airspace capacity for all three areas [101,102]. Moreover, AI-driven predictive analytics can anticipate potential safety hazards and operational disruptions in these three dynamic areas of an airport, enabling proactive risk mitigation measures [106].

3.2.6. Weather and Climate

The articles for this category only focus on the use of artificial intelligence for meteorological Services. AI has revolutionized meteorological services in airports by offering unprecedented accuracy and efficiency in weather forecasting and analysis [118,119]. Through advanced machine learning algorithms such as anomaly detection and hierarchical clustering, AI systems can process vast amounts of meteorological data from various sources such as satellites, radar, and weather stations in real-time [112,113,115]. This enables airports to anticipate weather patterns with greater precision, improving safety and operational efficiency. AI-powered predictive models can forecast weather conditions hours [116] or even days in advance, allowing airports to make informed decisions regarding flight schedules, runway operations, and ground services [117]. Additionally, AI algorithms can detect and predict severe weather events, enabling airports to implement proactive measures to mitigate potential disruptions and ensure passenger safety [120].

3.2.7. Safety

Three main topics were discussed for this category. The first topic was related to Safety Assessment Systems (SAS). SAS refers to comprehensive frameworks and processes designed to evaluate, manage, and mitigate risks within various contexts, including airports [123]. These systems encompass various procedures and technologies aimed at identifying and mitigating potential hazards and risks within airport operations. AI plays a significant role in enhancing safety assessment systems by leveraging advanced algorithms to analyze vast amounts of data collected from security cameras, sensors, and other surveillance systems. AI algorithms can analyze historical data to identify patterns and trends, enabling airports to proactively address potential safety concerns before they escalate [121]. For instance, the AI-based SAS systems showed a significant improvement in the automatic detection and evaluation of the runway surface for cracks and other hazards with the help of drone imagery [122,123].

Another prominent application of AI for improving the safety of airports is for Emergency Management Systems (EMS). AI offers transformative capabilities to enhance EMS in airports. By leveraging predictive analytics, AI algorithms can forecast potential emergency scenarios [129], enabling airports to allocate resources efficiently and prepare preemptive response strategies [126,127]. AI-powered surveillance systems enhance detection capabilities, swiftly identifying anomalies or security threats in real-time. Additionally, AI-driven analytics facilitate post-incident assessment, enabling airports to optimize recovery efforts and strengthen resilience against future emergencies [128].

The spread of COVID-19 in 2020 accelerated the use of AI to enhance airport safety for the fights against pandemics. AI-driven predictive models can analyze various data sources, including travel patterns, passenger health records, and epidemiological data, to forecast the spread of diseases and identify high-risk areas or individuals [133]. In addition, AI-powered surveillance systems can detect symptoms or violations of precautionary measures such as wearing masks [130,131] or social distancing [31,132] in real-time, enabling airports to implement targeted screening and quarantine measures.

4. Conclusions

The global aviation industry is expanding tremendously. This increases the opportunities for upward growth and the need for proper management. Therefore, the aviation industry must change beyond its current practices and seek better opportunities to optimize resources, control costs, and pay more attention to environmental responsibilities.

Artificial intelligence presents a wide variety of solutions with tons of opportunities for airports, promising a future of smoother operations, enhanced security, and a more positive passenger experience. By streamlining processes, optimizing resource allocation, and leveraging data for predictive capabilities, AI can significantly improve airport efficiency. As AI technologies continue to evolve, their integration within airports has the potential to revolutionize air travel.

This study presented a scoping review of previous articles regarding the application of artificial intelligence in airports. The result of this study states that the most studied categories belong to administration and management, air traffic control, and security respectively. This result indicates that most research focused on the fields that have the potential to optimize airport operations, enhance safety, and improve the overall performance of airports. Theoretical topics such as passenger perspective toward the use of artificial interleague or airport 4.0 were given less attention by scholars. Interestingly, these two categories were the only ones that involved qualitative studies. The perspective of passengers has remained in the shadows. Neglecting passengers and their preferences risks rendering many AI applications for airports irrelevant and ineffective.

Consequently, there is a pressing need for further research to delve into the passengers' viewpoint regarding AI-based solutions, ensuring that such innovations are tailored to their needs. For example, AI-based solutions like smart kiosks or chatbots present promising avenues for researchers to explore passengers' mindsets and the factors influencing their adoption of these solutions in airports. By understanding passengers' attitudes and behaviors, researchers can inform the design and implementation of AI technologies that align more closely with passenger expectations and requirements.

Conflict of Interest Statement

The authors declare no conflict of interest.

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