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Advent of Automation in Tourism

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Abstract: Tourism is a very flourished and celebrated industry of the modern world as it presents a plethora of advantages to the tourists as well as the facilitators of the industry, a large stake of those being the people native to tour-friendly locations. Each location has an exclusive array of beauty, history, culture, cuisine and community associated with it. Such a diverse range of parameters offers a dimension of complexity to the tour planning process. As the world advances towards automation, the tourist sector also seen to undergo profound changes through integration of various technologies. This paper describes evolution of tourism sector with increase in automation. The study investigates how inculcation of AI technologies can help in reforming the tourism landscape. By synthesizing insights from academic experts and various research papers, this research aims to provide a comprehensive overview of ongoing state of automation and technologies in this domain. Understanding these dynamics is necessary for sustainable development and improvement of automated systems to help grow and enhance the traveler experience.

Keywords – Artificial Intelligence, Automation, Machine Learning, Natural Language Processing, Tourism.

I. INTRODUCTION

Tourism is a rapidly developing industry as it constitutes a significant portion of the service sector and serves as a crucial source of income for many countries. Pinpointing the country where tourism originated is challenging as tracing back to the 17th century people travelled around their country to soak up the artistic and cultural essence of their heritage. The post World War II world witnessed a drastic change in this sector as people experienced a post-war economic recovery and reconstruction, rising the standard of living and allowing people to afford leisure travel. Later, the tourism sector suffered recession in the 1970s due to global economic downturn, rebounding again in 1980s emerging as mass tourism with technological advancements. The pioneer of first travel agency was Thomas Cook & Son offering travel packages for groups including all itineraries. Later on in 2020 this rapidly developing industry faced a profound setback because of the Covid-19 pandemic. This pandemic caused reassessment in travel strategies, with great focus on safety measures, digital innovation and integration of Artificial Intelligence technologies to adapt as the new normal to revive the industry. Automation in tourism revolutionized with online booking systems becoming cornerstone of the travel industry enabling customers to optimize prices and explore multiple options to choose from various websites and applications. It also simplified the work of the service providers as storing data of customers, processing requests of reservation and cancellation become automated. While automation has made a remarkable stride, still achieving fully automated travel experience is a complex process. It is important to strike a balance between leveraging automation and maintaining a human touch. Still advancements in technologies are helping to achieve the same. With hike in advance technologies and adaptive Artificial Intelligent techniques people are working towards creating fully automated technologies while remembering the unique aspects of the travel experience one should receive. With continuous development in technologies the tourism sector holds a bright future in seamlessly blending AI technologies with enriching aspects of exploration, ensuring a memorable experience for all the travel enthusiasts.

II. METHODOLOGY

In this research paper we followed the literature survey methodology. The analysis method applied for this study can be segregated into two types: Subjective analysis and objective analysis. Subjective analysis was done through the literature study with identification of points of interests in individual research papers and presenting them in a tabular format. Comprehensive review of existing papers was done to analyze the advent of automation in the tourism sector. The objective analysis was carried out through numerical methods, for which the data was sourced from reputed stores studied in this process. The Karl Pearson correlation coefficient was used to examine the relation between number of tourist and rise in the capital investment over the years. Generation of the two parameters and their tests are explained in detail in the results chapter.

III. LITERATURE SURVEY

Elettra D'Amico, Alessandro Destefanis, and Emilio Paolucci [1] conducted a survey among numerous startups operating in the AI tourism sector, examining the utilization of AI technologies across various domains including reasoning, planning, learning, communication, perception, integration, interaction, services, ethics, and philosophy. These startups exhibited diverse focuses within AI tourism based on these domains. Through correlation analysis, compelling statistical findings emerged indicating a predominant presence of males from STEM backgrounds in these startups, with a notable surge in activity observed from 2015 to 2017. Venture capitalists emerged as the primary financial backers of these initiatives. Notably, domains such as Learning, Interaction Sciences, and Services, encompassing Big Data Analysis, ML, and NLP, garnered substantial support, indicative of a burgeoning interest in AI-driven solutions within the tourism sector and a notable acceleration in automation within the industry.

Tomas Gajdosik and Matus Marcis [2] in their research specified and elaborated on the development of special Artificial Intelligence components for intelligent tourism solutions. These tools were examined through case studies taken from corporations such as Expedia, Booking dot com and TripAdvisor. Custom Big Data platforms were identified to be used for their tour recommending systems. Analysis of several cases suggests the components of AI fueled automation are mainly classified as Chatbots and Virtual Assistants using various conversational techniques such as Voice, Text based communication and Face to Face communication (object detection and classification). The process of a tour is also discretized as the Plan generation phase, actual tour phase and the post-tour analysis phase. The Plan generation phase demands tools such as recommender systems. Actual tour phase requires tools like AI chat systems and VA and the post-tour analysis phase uses tools such as tourist feedback analyzers. Each of these tools are explained with examples of popular services that take advantage of them to improve the complete tour process that they may provide to their customers.

Maobin Ding [3] proposed a system which is an AI integrated route generator using wireless technology. The purpose of this system would be to make the on-route travel plans more efficient and identify the needs of the tourists which are based on their personal preferences and consumption habits with the characteristics of a dynamic distribution. This system would also reduce operating costs and improve the tourist experience. It highlights how AI and big data can be used to personalize tourism services, streamline operations, and enhance safety. Also, a factor of self service is built into the system which adds a level of independence for the visitors. Additionally, technical considerations like fault tolerance and scalability in WSN are explored and it discusses optimization models for tourist routes, such as the Traveling Salesman Problem.

Fatemhalsadat Afsahhosseini and Yaseen Al-Mulla [4] employed the applications of Machine Learning based systems in tourism. Their research identified the need for Machine Learning technologies in tourism. The proposed system essentially focuses on the statistical data of tourists from all regions published in UNWTO which can be used for forecasting purposes. However, their system also analysed the data such as tourist photographs, maps to make a better recommendation system that helps the tourist in essentially all phases of the tour. Machine learning techniques are employed for tasks such as demand forecasting, recommending personalized travel itineraries, and analyzing tourist sentiments. The author also delves into machine learning methods specific to each stage of the trip: pre-trip, during the trip, and post-trip. Recommendation systems, sentiment analysis, and forecasting models are highlighted as essential tools for improving tourism services and infrastructure.

Ping-Tsan Ho [5] presents the Smart Tourism Recommendation, a system that focuses specifically on Southeast Asian regions. The research elaborates on the popularity of self-guided travel in Southeast Asia. The

study assesses the effectiveness of the smart tourism recommendation model by analyzing three aspects: tourists' experience and satisfaction, the scale of tourism transactions and revenue growth, and the allocation of tourism resources. The Large volume Data Analysis and smart AI solutions presented in this system are run through multiple algorithms such as Particle Swarm Algorithm, Greedy Algorithm, Ant Colony Algorithm, Linear Regression and Genetic Algorithm. For testing and analysis purposes, the Genetic Algorithm is preferred in this paper. It is also proven through the data analysis that the revenue generation in the SEA countries for the tourism sector is contributed to more by 'smart' tourism systems as opposed to more traditional tourism institutions. Another noteworthy statistic is the increase of tourism under the influence of these 'smart' systems.

Xiaoyin Yin and Jiangnan He [6] proposed A Tourism E-Commerce Platform which was based on AI system algorithms. It aimed to address the underdevelopment of tourism e-commerce and proposed using modern information technology, cloud computing, BDA and K-means algorithm to build an e-commerce platform. The platform was designed to provide travellers with personalized travel plans, improve customer satisfaction, and promote the tourism e-commerce industry's growth. Various modules and components to be a part of the system are explained such as the ticket ordering system. Furthermore, an Artificial Intelligence algorithm is presented for error analysis. The system also applies algorithms for the different modules such as K-means clustering and Apriori algorithm for more accurate functioning.

Wouter Souffriau, Pieter Vangsteenwegen, Joris Vertommen and Greet Vanden Berghe [7] presented a path generation algorithm which is individualized for roaming persons. This system and its supporting algorithm present a method for information retrieval techniques to be applied for calculation of wandering node routes in a non-static context. The locations and their individualized interest marks help in formulation of the tour mapping problem. The algorithm functions to assign physical locations as indexes in vector spaces through the documents based on those locations. Further, the score generated by the algorithm for each location becomes the heart of tour mapping. This algorithm mathematically considers the personal choices of each individual tourist when designing a tour program for them. For a larger testing dataset, the algorithm presented in this paper performs significantly better than the DLS algorithm in both computation quality and speed.

Joan Borrás, Antonio Moreno and Aida Valls [8] did A Survey on Intelligent Tourist Recommender Systems. The survey included any tourism systems that employed the Artificial Intelligence tools at any point. These ranged from systems that analysed the user's behaviour to learn, automatic planners that scheduled a trip, to complex planning systems which took account of various parameters such as closing/opening times, detailed timetables etc. The survey also technically classifies the recommender systems as Content based, Collaborative and demography based. The methodology, advantages, and disadvantages of each of such methodologies is discussed briefly. There were also examples of hybrid systems being applied instead of an individual approach. This collective method was of three types. Either being of choice, following a sequential use or being integrated together. The use of collaborative filtering techniques, especially in the hybrid approach was noted to be on a rise by almost 75%.

Francesca Alessandra Lisi and Floriana Esposito [9] created a tool for coalesced tour construction with the help of machine learning which focused on the local level that added a more detailed tour plan with connections to local resources, activities, production, and community. It also included the development of an Information Mining Tool for populating the ontology with data automatically extracted from the internet. The use case was illustrated for Apulia, Italy. The application is called WIE-OnTour where the WIE stands for Web Information Extraction. The system is then run in the city of Bari, Apulia. A region in Italy. The tool was noted to extract significant information with regards to tourism such as number of hotels, B&Bs, distances, locations etc. A Machine Learning tool was also applied to consider user feedback as a layer upon locating accommodations. Essentially sorting out the good ones and the bad ones separately to enhance the user experience the process of the tour. The authors further state that the technical developments in this system are general enough to be applied at any geographical level as opposed to just being limited to one specific region.

The research paper by Lixia Zhang and Zhongli Sun [10] focuses on the domination of AI in Jinan based tourism. The main focus of the research is AI in tourist attractions, to replace the human assistance with that of robots and digital platforms but it also integrates the system of a tour planner which is less hectic and more comfortable for the tourist. Tourist Safety is also taken well into consideration as the most important factor of the use of Artificial Intelligence in the industry. Smart tourism integrates traditional tourism with technologies like the Internet, Internet of Things (IoT), cloud computing, and AI, aiming to meet tourists' needs effectively while optimizing resource management. China's rapid advancement in AI technology is driving

innovation in the tourism sector, with applications ranging from speech recognition to intelligent scheduling. In Jinan, AI is transforming tourism experiences through mobile app tour guides, AI-driven marketing, and enhanced safety mechanisms. Overall, the integration of AI into smart tourism promises to revolutionize the industry, offering improved efficiency, personalized services, and enhanced visitor experiences.

Chao Yu and Mengli Yang [11] have introduced a system aimed at clustering individual tourists with similar interests based on their tour specifications. This clustering method brings numerous benefits to the tourism industry. By grouping tourists with similar interests and planning similar itineraries, overall itinerary costs can be reduced, and tourist management can be more effectively handled. Additionally, individuals with common interests have the opportunity to connect with each other, resulting in increased user satisfaction, as evidenced by previous outcomes. With the prevalence of online resources providing pre-knowledge about travel destinations, user customization according to their interests aids the tourism industry in understanding current market trends and planning future endeavors more effectively. Travel companies must also consider factors such as travel time, stay duration, and transportation time between destinations. Furthermore, this paper provides comprehensive solutions and formulas for clustering and calculating similarities between individuals with similar itinerary customizations.

Kevin Meehan, Tom Lunney, Kevin Curran, and Aiden McCaughey [12] explore the intricate landscape of tour planning and destination selection, shedding light on critical factors that demand consideration in today's tourism industry. In an era characterized by an abundance of information sources, the authors confront the challenge of information overload, which often leads to user dissatisfaction. Amidst this backdrop, they advocate for a nuanced approach to tour planning, leveraging the wealth of data collected through sensors and responders embedded in users' handheld devices. These data serve as the foundation for personalized tour recommendations, tailored to the unique preferences and needs of individual travelers. Central to this discussion is the concept of user sentiment, a crucial yet often overlooked determinant of tour satisfaction. By incorporating several contextual variables, users can refine their recommendations, ensuring a more personalized and fulfilling experience for travelers. Looking ahead, the authors propose the development of an innovative application that harnesses user contexts to suggest nearby attractions, promising to enhance the overall tour experience and adapt to evolving traveler preferences in the dynamic tourism landscape.

Junliang Lu and Gaojian Sun [13] have highlighted the burgeoning trend of location-based services (LBS) in various industries, particularly emphasizing its significance in sectors like tourism and public security. LBS offers a plethora of utilities, including yellow pages, positioning, path searching, and address lookup, among others. The term "intelligent" is ascribed to LBS in this paper, signifying its capacity for autonomous decision-making and more advanced functionalities. Recognized as an essential component of daily life, LBS is increasingly indispensable. The paper proposes a mobile-based application system capable of executing multiple tasks seamlessly. Its features encompass location information retrieval, mobile guidance, mobile marketing, location-based social networking, and tourism rescue. Leveraging technologies such as path searching, geographical analysis, geocoding, and map publishing, this system aims to enhance the provision of LBS by harnessing comprehensive knowledge and functionality.

IV. ANALYSIS

The analysis table below aims to distill insights of the literature survey, providing a comprehensive overview of intersection of automation and tourism sector.

Table 1: Analysis Table

Title of Study	Summary	Advantages	Technology	Future Scope
Artificial Intelligence (AI) for tourism: an European-based study on successful AI tourism start-ups [1]	It presents a survey of tourism startups in Europe that use AI based systems on the basis of several parameters.	A satisfactory statistical result is presented concerning the usage vs creation of such systems.	Statistical analysis of Big Data, Machine Learning and Natural Language Processing based	The parameters of the analysis can be improved alongside broadening the

			systems.	location of the study.
Artificial Intelligence tools for Smart Tourism Development [2]	This study focuses on AI tools that are used for Intelligent Tourism systems.	Several tools such as Big Data platforms, chatbots, etc. were identified to be used by major companies.	Analysis of tools such as Chatbots and virtual assistants and feedback systems.	Such AI tools can be evaluated for a better and in-depth understanding of the same.
Research on tourism route planning based on Artificial Intelligence Technology. [3]	A system to create an AI based wireless sensor travel route planning is proposed.	The proposed system is understood to reduce operating costs and employ self-service for the end users.	Wireless sensor-based tool for route planning with systems such as fault tolerance and user preference analysis.	The hardware technology used in the system can be simplified.
Machine Learning in Tourism [4]	Tourism crowd forecasting with the help of Machine Learning as a system is discussed.	The system also provides a tour recommendation system based on the forecasts.	Recommendation system using tourism forecasting and diverse media inputs such as photographs and statistics.	A more detailed case study can be considered for future reviews.
Smart Tourism Recommendation Method in Southeast Asia under Big Data and Artificial Intelligence Algorithms [5]	Research is conducted on tourist trends pertaining to South East Asian Regions focusing on smart tourism systems.	A rise in popularity of smart tour recommendation systems can be noticed.	Region specific smart tour recommendation system based on multiple parameters.	A more in-depth exploration done from multiple perspectives can be expected.
Construction of Tourism E-Commerce Platform Based on Artificial Intelligence Algorithm [6]	The development of an E-Commerce tourism platform based on AI with modern technologies is discussed.	Several modules are considered to make a complete Tourism platform.	An E-Commerce platform focused on tourism that applies AI to enhance several components including error analysis.	A more genuine result can be presented in the future pertaining to the same system.
A personalized tourist trip design algorithm for mobile tourist guides. [7]	The development of an algorithm to design tourist trips is discussed.	The process of tour planning is significantly impacted using the algorithm.	An algorithm to calculate tourist routes by indexing physical locations in vector spaces.	Integration of user-profile and employment of better information retrieval techniques can be expected.
Intelligent tourism	A survey of	The survey is	Analysis of	A more

recommender systems: a survey [8]	intelligent tour recommender systems focusing on user behaviours was conducted.	very detailed consisting of systems, techniques as well as tools.	context-based, collaborative and demographic techniques for tour prediction.	contemporary survey can be conducted to keep up with the latest technologies.
An AI Application to Integrated Tourism Planning [9]	An AI integrated tourism application focused on a local region of Italy was created.	Due to the local level, the tour plans can be much more detailed and focused.	WIE-OnTour, a web information extraction tool is developed for detailed local recommendations of tours.	User feedback can be considered to make the system better.
The Application of Artificial Intelligence Technology in the Tourism Industry of Jinan [10]	This paper focuses on the use of AI in the tourism industry of the Jinan region of China.	The systems in the region function to reduce human assistance.	Proposal and analysis of the application of AI to automate physical and software-based tourism tools in the Jinan Province.	Similar research can be conducted on other regions of the country.
Co-Existing in Differences: Tailoring Travel Itineraries for Tourists With Similar Interests [11]	This paper states a method for creating customized travel itineraries for groups with similar interests.	Customized group travel allows for easier negotiation with suppliers, resulting in lower prices.	A system utilizing clustering algorithms, online information resources, and negotiation strategies for group travel itinerary customization.	Further research and collaboration with tourism companies are needed to refine the grouping method and enhance its practical application.
Context-Aware Intelligent Recommendation System for Tourism [12]	The research proposes a context-aware tourist application, utilizing several parameters to offer personalized recommendations.	Integrating various contextual factors allows for more personalized and relevant recommendations, reducing information overload.	A context-aware recommender system leveraging smartphone sensors.	Further research will focus on refining machine learning techniques for recommender systems.
Location-based Intelligent Services of Scenic Areas [13]	A mobile phone application system designed to offer tourists personalized and intelligent location-based services is presented.	Enhanced communication of location-related information and accessibility to personalized services.	A mobile phone application system leveraging smart phone OS, GIS, Internet, and communication technologies to deliver personalized and	Advancements in Mobile GIS and LBS technology can be brought, promising higher accuracy and better location

			intelligent location-based services.	information.
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V. RESULT

Through the survey, we examined 13 separate cases of automation being brought about in the tourism industry. At the core of the automation process however, is the field of artificial intelligence, which is accelerating the process at unprecedented levels. Our analysis of this trend also includes a statistical result that was calculated through the Pearson method.

Noteworthy data was collected in the analysis which we have considered for the test. Our calculations consist of finding a correlation between two parameters, those being the number of tourists recorded around the globe (in millions) and the capital investment in tourism related Artificial Intelligence programs (in billions USD) and contest the hypothesis that the increase in tourism is independent of the growth in AI related automation in the industry. The range of time we have selected to be relevant to the test is from the year 2009 to 2019 so as to not cause a calculation bias that could occur from the skew recorded during the Covid-19 pandemic.

Table 2: AI's Impact Over Years on Tourism

Year	Number of Tourists recorded globally (in millions)	Capital Investment in tourism related Artificial Intelligence programs (in billions USD)
2009	901.29	1.101
2010	962.56	2.364
2011	1014.99	6.783
2012	1060.75	7.685
2013	1108.65	5.632
2014	1151.45	8.969
2015	1203.54	9.747
2016	1245.17	18.692
2017	1337.22	23.441
2018	1412.36	41.001
2019	1462.27	41.606

- 1) Assuming a null hypothesis (H_0): The increase in tourism is independent of the growth of AI related automation in the industry.
- 2) The coefficient of correlation 'r' is calculated to be 0.9339 which indicates a strong correlation between the two tested parameters.

The t-statistic 't' is calculated to be 7.8418 through the formula

$$t = \frac{r \times \sqrt{n-2}}{\sqrt{1-r^2}}$$

Where 'r' is the correlation coefficient,

'n' is the number of pairs (n=11).

- 3) The degrees of freedom D.F is 9.
 - 4) The p value is calculated based on the t-statistic and D.F to be 1.29769×10^{-5} .
 - 5) The calculated p value suggests strong evidence against the null hypothesis H_0 assuming a level of significance to be 0.05.
- Hence, H_0 is rejected in the favour of the alternate hypothesis.

This proves that there is a strong dependency of the increase in tourism on the growth of AI related automation in the tourism industry.

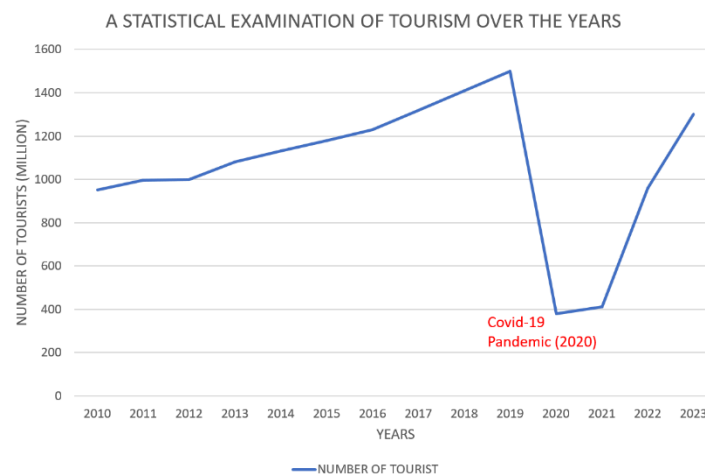


Figure 1: number of tourists over the years (as per data obtained from UNWTO)

VI. CONCLUSION AND FUTURE SCOPE

Automation has been a stepping stone of success for humanity and the evolution of our society as a whole. The reduction of manual labour has loomed as a daunting fate over the working class. However, efficient and ethical automation promises the advent of a new phase of convenience for mankind. Artificial Intelligence has been the pioneer of this automation in more than several ways. For all of known history, tourism has been an industry dominated by the human touch in all of its components. The purpose of this study was to highlight a turning point that is fast approaching in regards to this ideology and the adaptations that have already begun to accommodate this new phase. This study considered 10 distinct surveys and systems that showed appreciable results to confirm the advent of this accelerated automation. From local regions, to global prospects and from physical systems, to software solutions, Artificial Intelligence is taking over the simplification process that is too significant to ignore. Our analysis of the systems in this study also helped us in providing a simple correlation that is observed in the relevant data. However, the results may be too general for more concrete evidence as our data is limited to a 11-year range and the most significant spike in the usage of Artificial Intelligence that occurs in the 2020s is not considered due to the negative bias that Covid-19 posed against the tourism industry. A revised and more detailed analysis will be conducted in the future and more statistical tests will be considered for a more accurate result.

This study was conducted as a part of our ongoing project that incorporates the usage of Artificial Intelligence, Natural Language Processing and promotes automation in the process of tour planning for any potential tourists. The function of this system is to provide a web-based solution to a user who may prefer planning their tours independent of any corporations that may have vested interests when constructing a tour plan for their clients. Our proposed system is under development and takes into account the solutions obtained alongside the challenges faced in the process by the systems studied in this paper. Current iterations of this system have returned satisfactory results and we hope that future iterations do the same.

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