Artificial intelligence in the tourism sphere

A N Kazak, P V Chetyrbok and N N Oleinikov

V I Vernadsky Crimean Federal University, Prospekt Vernadskogo 4, Simferopol, Republic of Crimea, 295007, Russia

E-mail: kazak_a@mail.ru

Abstract. The times of travel agents selecting tourist routes in the office seem to be finally passing. The potential of artificial intelligence (AI) technologies in the tourism industry exceeds the capabilities of traditional search engines and real people. Some travel services have already begun to use elements of artificial intelligence, which help to analyze large volumes of data and learn from their own and other people's experience of fulfilling customer orders. Currently, the main goal for travel brands is to "learn" using personalized customer experience. Personalized services that are most suitable for a particular client are a strong competitive advantage. It is AI that helps choose such services, since it allows processing a lot of data and creating a personalized product much faster than traditional search technologies.

1. Introduction

Large companies such as GuestU and SnapTravel track search queries and messages on the Facebook social network messenger (FB, NASDA). The hotel reservation service provider Booking.com has launched its smart chat. This chat can give the client the same information as the agent provides the travel person with, but much faster. Booking.com is currently testing the integration of its chat with the Facebook messenger. Expedia Inc., a major tour operator, plans to use artificial intelligence to serve customers [2, 3].

Thus, AI technology is the next stage in the development of the tourism industry. For example, 75% of Booking.com customers prefer to search for travel tickets and book accommodation according to individual parameters. Of course, people of the tourism industry will continue to work, for example, on compiling expensive unique trips or interacting directly with people. However, the role of a person in trips will gradually decrease, and technology and travel companies will receive additional income due to new opportunities. The study of the possibility of using artificial intelligence with neural network analysis for the concept of forecasting within the industries of hospitality and tourism. During the research, an agent technology that uses a neural agent model in the form of a neural network module is considered [1, 4].

2. Using personalization algorithms

Travel services and large companies are increasingly using artificial intelligence (AI) technology in their work. Travel start-ups thrive around the world, attracting large investments, and technology giants are investing billions of dollars in the development of AI technology. Indeed, in the past few years, a favorable environment for the use of such technologies has appeared: processor power allows analyzing large amounts of data, research in the field of machine learning has achieved great success and is utilized in many areas. The tourism industry is also trying to keep up: the Hilton hotel chain has
launched an online concierge, Facebook is analyzing data to offer users accommodation options through contextual advertising, and Booking.com has introduced a booking service Experience that helps tourists organize leisure time and buy tickets using AI without queues in popular world capitals using a zR code. Let us review the examples where AI-based solutions can provide a significant advantage and become massive.

When a customer chooses a package tour, he or she relies on three components: affordable price, assortment and convenience. Often, a person has to spend several days to find the perfect option. According to the authors’ data, a tourist spends from 5 to 7 sessions on the websites of online travel agencies (OTAs; the Travelata travel company utilizes this model – Forbes) in order to choose a trip. In this situation, personalization algorithms that analyze behavioral data on the platform can be useful: what the person was looking for, what the sequence was, what he or she added to the favorites and how many times he or she returned to the website. After gathering together all the information about the user, the service offers the most suitable options [5].

The program is able to determine the statistical probability of higher ticket prices based on the data collected. This allows tourists to stop random booking. Such technologies, of course, are still in their infancy. However, the Hopper Canadian startup already offers such a service, informing the user about the best time to buy tickets through the mobile application. The developers claim that the application can forecast prices for the year ahead with an accuracy of 95%. Hopper now sells its services in more than 120 countries. Today, travel companies spend a lot of money on call centers, which, in one way or another, solve recurring problems. AI is capable of giving advice to managers in real time, while improving the quality of service. In addition, it saves a company’s budget by simplifying the processes of staff training and hiring less qualified employees.

Some are trying to go even further and completely replace travel agents with tourist robots. The American startup Lola is training its program using a database of remote call center employees. However, a complete replacement of people did not happen: a startup faced a typical problem when tourists did not want to pay for the services of a travel consultant. Many enjoyed communicating with a specialist, received comprehensive information and a selection of offers, but then went to popular resources for online booking of air tickets, hotels and tours to book everything on their own. Therefore, some time ago, Lola switched to servicing business travelers who often fly along difficult routes, and their company pays for services [4].

Another “robot agent” project was created by Sergei Burkov. According to the developer, Alterra is the first tourist bot on the Slack platform (a collaboration platform that combines several machine learning technologies, including neural networks), which participates in a conversation with a user without human interference. Undoubtedly, the approach to solving issues by teaching a mathematical model based on a large amount of real data (which is exactly what is meant under the mysterious artificial intelligence) has huge advantages over the classical approach to creating an expert system by understanding the subject area of the problem and finding possible solutions or a legal adviser. However, there are certainly limitations that prevent it from conquering the market and completely replacing a person.

Lack of convenient communication interfaces. Bots in messengers are no longer “cool”. In general, there are currently many interfaces, but the tourism industry has not yet reached such a level and those are used in other areas. A good example is Google Home and Amazon Alexa – voice assistants for homes and apartments that can communicate with the user and fulfill their requests simply by voice, without learning special commands. Unpredictable result. The AI result directly depends on the data set, the set of input data on which the algorithm was trained. It is often impossible to understand why the bot had made such a decision. There are no universal data sets in the tourism industry today. Simply put, if the learning algorithm included only beach tours, AI would not be able to pick up a cruise along the Norwegian fjords. The recognition principle here is similar to the human one: it is not possible to understand how the child recognizes his mother, but the system works. The same thing happens with machine learning. The psychological barrier. Not all people want to communicate with bots. Indeed, communication between people remains the most convenient option for agency clients.
As for AI coming to the Russian tourism business, it is important to identify a few more issues.

First, the tourism market in Russia is still offline: according to the data for 2018, online booking of tickets amounted to 20%, in the hotel segment – 10-14%, and online sales of tours – only 3-5%. Second, the financial crisis. It is simple: no money, no travel, which means there is no demand for high technology. It must be added that Russia has a strong mathematical school, the demand for specialists is very high, and such specialists often receive interesting offers abroad. Nevertheless, the future of the tourism industry is in AI. Why? If it becomes more convenient or cheaper for customers to buy tours by virtue of AI technologies, and the business benefits from this, there will be demand for them. It is only a matter of time [6, 7].

The modern consumer is constantly evolving. With the growing interest of consumers in digital technology, the market for services offered is growing. However, technology is not able to fully satisfy the needs of the consumer. Many people need live communication, obtaining a specialist's advice, the opportunity to discuss any details, to be heard and understood. Also, for many modern companies offering goods and services, the use of digital media in interaction with the client is a new direction. This is especially true for tourism services.

Thus, it becomes vital for travel agencies to provide fast and efficient delivery of products and services, as well as the most convenient transaction experience both digitally and non-digitally, in order to "acquire" new customers. Today, companies investing in expanding their technological capabilities do this primarily to provide first-class services to consumers, and then to compete in the tourism business market.

However, the role of technology in interacting with customers does not end with a simple "acquisition" of a customer. Rather, this is only the initial step in a long and continuous service delivery process. Brands must retain customers and build trust, creating additional benefits through constant and relevant communication.

AI, chatbots and multi-channel delivery service: an indispensable triplet for new technology brands in the 21st-century tourism industry.

The advantage of using the technology is that although algorithms can scan large amounts of information and extract the necessary data from it, artificial intelligence tools can use predictive analytical algorithms to identify patterns in these data sets. This allows travel companies to create micro-targeted marketing campaigns that are more likely to receive a higher return on investments.

Analyzing customers’ behavior online or offline in the past can help travel companies choose the most effective ways and channels to use in the future, which allows travel brands to create added value for customers using individual offers based on their preferences. Machine learning tools, such as Natural Language Processing (NLP), combined with predictive analytics and deep learning algorithms, can analyze customers' online activity using non-traditional data sources such as social networks. Any image or publication of a user, for example, on Facebook or Instagram, or the pages that he or she visits, can provide information about the interests of the client. Using such methods, the company can develop an appropriate proposal.

The use of such solutions can turn new users into regular customers, showing the customer his or her value in the form of a unique pre-offer, as well as an excellent after-service. For example, OTAs can send travelers personalized offers of any travel arrangements based on an analysis of a customer’s profile, preferences and location data. A huge number of OTAs and travel platforms use chatbots to help the customer make a pre-purchase, providing him or her with a number of packages and offers.

Virtual assistants such as Google Assistant, Amazon Alexa, and Siri by Apple can complete tasks for humans using voice, graphic, or text input. It is very likely that in the near future the virtual assistant will be able to scan a client's calendar to determine the events that will require travel plans and flight reservations based on one's preferences and past booking information. Soon, the impact of such technologies on the tourism industry will be significant. They will become the only intermediaries between travelers and service providers [3].

For users who already have existing relationships with autonomous agents, a travel company can also offer the necessary technological support, thereby improving customer service.
Researchers and analysts in the hospitality and tourism industry use mainly quantitative causal methods of analysis and forecasting, as well as time series analysis in practice. However, neural network analysis allows studying the relationships and the influence of various factors on the state of a given sector of the economy, exploring large volumes of data and revealing hidden patterns that are not always determined by traditional methods.

The presence of distributed processes in the hospitality and tourism industry is becoming increasingly evident, which makes it necessary to use intelligent management. One of the important areas to apply such intelligent control is the detection and correction of the maximum number of negative events in the industry automation using modern software and hardware computer systems. The use of artificial intelligence in combination with cloud technology allows creating learning advisory situational systems that can quickly respond to changing business conditions and offer options for overcoming emerging negative economic situations.

The World Tourism Organization recommends a fairly limited set of methods for predicting tourism performance. This approach is applicable in macroeconomic studies at the level of national economies, where indicators behave quite consistently and the accuracy of the forecasts obtained is quite high. At the microeconomic level, this approach is not always as effective as possible.

In this regard, a forecast development concept is proposed, based on the following: the key to predictive management in the hospitality and tourism industry is to identify a number of conditions that consistently lead to other known conditions. To implement this approach, it is possible to use the so-called agent technology, which can be implemented using various tools, including artificial neural networks. In this case, they are called neural agents.

There are a number of issues in the economy where the implementation of such technologies can be beneficial. These include the analysis and forecast of all kinds of economic information at different levels of management, demand forecast based on multi-factor models, identification of non-standard economic situations or the occurrence of economic threats, unusual risks, analysis of their possible consequences.

A neural agent is able to analyze a large amount of information, including huge databases collected both at the level of the economy as a whole and at the level of specific enterprises, segments of enterprises or competitors. As a result of this analysis, the neural agent is able to determine explicit and hidden dependencies in the data, models of economic behavior in order to detect unexpected or implicit changes and receive a development forecast.

In order for the neural agent to function successfully, it needs training. Such training consists in running a certain amount of data characterizing certain patterns of behavior of the economic system. This is done in order to recognize the models existing in their basis, as well as to determine cause-effect relationships. This learning process is continuous: when new data appears, the neural agent adds them to the training database, which leads to the updating or correcting of models and relationships. It may happen that a neural agent reveals a situation that was previously unknown to it. In this case, it will again update its internal model, increasing analytical abilities. Ultimately, the neural agent uses more and more adaptive learning, which only leads to the growth of its abilities. In this sense, neural agents can be used as a kind of predictive system that identifies possible problems before they actually occur [8, 9].

3. The neural agent model
Thus, the neural agent predicts certain critical conditions of the economic system, which allows managing them and taking the necessary actions to prevent them before they show a negative impact on the economy as a whole or on the activities of a particular enterprise. A neural agent does not require large tangible or intangible resources; it does not become a problem itself, it does not need the presence of highly qualified employees, as is necessary when applying classical forecasting methods. The neural agent can be configured for certain conditions under which the system goes into an alarm state. In addition, there is no need to revise forecast models in the event of any new, previously unknown data or situations, since when they occur, the neural agent updates existing economic
profiles, while improving the quality of the forecasts developed. The neural agent learns very quickly, but supercomputing power is not required for its operation. In addition, a neural agent can be loaded with data on new factors affecting economic activity [2, 6].

The neural agent model is implemented as a vector machine. Let a machine be given that can classify m+1 classes g0, g1, ..., gm (machine states are vector recognition criteria for typical representatives of classes) and a natural series of numbers N. Let us assign to ai a certain configuration λ1=g0a1a2...an, where ai € N, i=1,2,...n. If there is a calculation for the machine (it recognizes the image – it belongs to a certain class), starting in the configuration λ1 and reaching the final configuration λf, then the number p € N, which is mapped to λf, determines the class number. For a Turing machine, if there is no such number p that the configuration λf is final, then it works infinitely. For the machine in question, such a p number (class number) always exists, that the configuration λf is final (that is, there is always a class to which the machine assigns the recognizable configuration λf). If the number of classes is limited and objects that differ significantly in input parameters fall into the class, then new classes must be introduced. Differing objects are characterized by vector criteria, which are vectors of the measure of difference of recognized objects in the error space. The smaller the vector criterion, the worse the object is recognized. For such objects, it is necessary to create additional classes with typical representatives of these objects. This can be done automatically, setting the conditions for creating a class according to the vector criterion, which means the machine is a self-learning system. The machine is implemented as a module of a neural network (NN) [5].

4. Conclusions
In the new digital era, AI works in tandem with human feelings and intelligence, offering customers convenient interaction both online and offline. This approach leads to increased efficiency, productivity and a better understanding of services. Computer technology also contributes to the progression of a component, such as marketing, to optimize the entire travel process, focusing on the wishes of customers rather than on what competitors do. Therefore, new AI technologies and various methods of their application will soon be widely used in the tourism industry. The study allows drawing the following conclusions: a lot of attention is paid to the use of neural network technologies in analysis and forecasting in the hospitality and tourism industry.

The modern hospitality and tourism industry is very susceptible to the influence of a large number of factors, often of a non-linear nature, which complicates the use of classical statistical analysis and forecasting procedures. One of the solutions to the issue of multifactor and data complexity is the use of neural network technologies. Neural agents, as an integrated method for forecasting and decision making, can be a good solution when analyzing hidden relationships and finding the optimal response to emerging market threats. Neural network analysis is considered, which allows conducting research using agent technology which utilizes a neural agent model in the form of a neural network module. Studies have shown that neural agents can be used as a kind of predictive system that identifies possible problems before they actually occur. As a result of the research, a forecast development concept is proposed, based on the following: the key to predictive management in the hospitality and tourism industry is to identify a number of conditions that sequentially lead to other known conditions.

References
[1] Artificial Intelligence. Definition, Examples, and Applications Encyclopaedia Britannica. Accessed September 24. https://www.britannica.com/technology/artificial-intelligence
[2] Borràs J, Moreno A and Valls A 2014 “Intelligent Tourism Recommender Systems: A Survey.” Expert Systems with Applications 41 (16) 7370–89
[3] Burger C.J.S.C, Dohnal M, Kathrada M and Law R 2001 “A Practitioners Guide to Time-Series Methods for Tourism Demand Forecasting —a Case Study of Durban, South Africa.” Tourism Management 22 (4) 403–9
[4] Candela G and P Figini. 2012 “The Economics of Tourism Destinations Journal of Tourism History 2 (3) 245–46
[5] Kazak A N, Lukyanova Ye Yu, Chetyrbok P V 2017 Crimean region resort and spa sphere sustainable development modeling Proceedings of the 2017 International Conference "Quality Management, Transport and Information Security, Information Technologies", IT and QM and IS 2017 (Saint-Petersburg: Saint Petersburg Electrotechnical University 'LETI') pp 533–5

[6] Kazak A N, Lukyanova Ye Yu, Chetyrbok P V 2017 One of the region of the southern federal district touristy flows dynamics modeling IEEE II International Conference on Control in Technical Systems (Saint-Petersburg: Saint Petersburg Electrotechnical University 'LETI') 103–5

[7] Kazak A N, Buchatskiy P 2018 Perspectives for smart city technologies in the resort region Proceedings of the 2018 International Conference "Quality Management, Transport and Information Security, Information Technologies", IT and QM and IS 2018 (Saint-Petersburg: Saint Petersburg Electrotechnical University 'LETI') pp 845–7

[8] Khaikin Simon 2006 Neural Networks: Full Course, 2nd Edition. Transl. from English. Moscow: Williams Publishing House p 1104

Kozlov D A 2016 Neural agent technologies in the hospitality and tourism industry ITportal 3 (11)