The role of chatterbots in enhancing tourism: a case study of Penang tourism spots

Vinothini Kasinathan[1], Aida Mustapha[2], Mohamad Firdaus Che Abdul Rani[3], Salama A. Mostafa[4]
[1,3]School of Computing, Asia Pacific University of Technology and Innovation, Malaysia
[2,4]Faculty of Computer Science and Information Technology, Universiti Tun Hussein Onn Malaysia, Malaysia

Article Info

ABSTRACT

Chatterbots have been widely used as a tool for conversational booking assistance mainly for hotels such as the Expedia. This paper extends the use of chatterbot beyond booking by presenting the proof of concept of a chatterbot expert system called the VIZARD. The proposed VIZARD is developed using an expert system shell called verbot. The core of Vertbot 5 is the natural language processing (NLP) engine based on pattern matching. The core Verbot 5 engine is responsible for finding matches to a given user input string and firing the appropriate rule. The findings from the user acceptance test concluded that majority of the respondents agreed that the VIZARD expert system stands at an unbiased state while being more aligned on supporting the usefulness of the system.

Corresponding Author:

Vinothini Kasinathan
School of Computing
Asia Pacific University of Technology and Innovation
Technology Park Malaysia, 57000 Kuala Lumpur, Malaysia
Email: vinothini@uthm.edu.my

1. INTRODUCTION

Chatterbots are changing the travel industry. Chatterbot or chatbots (short of robots) have been widely used as a tool for conversational booking assistance mainly for hotels such as the Expedia at booking.com. According to the IBM Watson's blog, the use of virtual agents and chatbots is able to reduce the costs of customer service by up to 30% by implementing conversation-friendly solutions [1]. Chatterbot works like a decision tree, where users can select variation of options hence the potential is very promising in the area of customer services. Chatterbot is a computer program designed to interact with people by simulating human conversation [2-4]. The bot works best when maintaining a conversation within a specific domain and is sophisticated enough to control the current age concepts such as semantic parsing and sentiment analysis. However, one shortfall for the contemporary chatterbots is that they are unable to observe and analyze the context of conversations.

Three main concerns in creating a good chatterbot conversations includes the content, semantics, and evaluation. Content is basically knowing what to say, semantics is knowing how to express it through a conversation, and lastly the evaluation which is mainly having a standard benchmark to grade the conversation produced. There is a method to validate whether a chatterbot is truly an artificial intelligence that is named Grice's Maxims [5]. Grice's Maxims is the cooperative principle that describes how people interact with one another in making contribution to a series of exchanged talk, by the accepted purpose or direction of the talk exchange in which the user is engaged. It has been demonstrated that evaluating chatterbots using this method is one of the most effective ways to compare to other chatterbots competing for

the Loebner Prize [6] as the maxims provide a scoring matrix, where every chatterbot is able to be graded for a specific criteria against one another [7]. As for the knowledge engine, when chatterbots engage in dialogue with users, it is able to capture certain pieces of information or also known as keywords within the conversation so that it may be able to progress with the conversation. The user may also alert the chatterbot that there has been a misunderstanding.

The literature has shown that a wide variety of chatterbots and question-and-answer (Q&A) systems have been proposed over the past decades, each with strength that make them appropriate for particular applications. Accompanying the decades are numerous advances in information construction, where researchers increasingly aim to communicate with computers using natural language to make it artificially intelligent. One example of a successful chatterbot is PAL, a domain-specific chatterbot that answers non-obstructive psychological questions which gains its knowledge base by learning from the Q&A pairs derived from an online forum using several extraction strategies [3-4].

Chatterbots can also be packaged as an expert system (ES) with natural language as interface. The conversational expert system (CES) plays the role of a human expert whereby it may solve complex situations that would usually require the help of a human intelligence of a particular domain, which would also run for 24 hours a day and still be able to have a less margin of making any errors. CES is able to offer advice on a wide range of topics [8]. Some basic examples of the advice expert system utilization are the locations with the highest success rate on power systems [9], pain or foot disease diagnosis and management [10-11], credit scoring systems [12] or behavioral management in education [13-14]. Meanwhile, examples of the use of natural language in various systems include the accounting systems [15], auditing systems in medicine [16], injury reporting in construction business [17] and many others. Apart from offering advices, CES can provide another two important avenues of an ES, which are diagnosis and planning. Typical example of CES in diagnosis include diagnosing medical problems, machine faults, industrial plant fault analysis or instrument failures on the International Space Station. In planning, CES can take the form of real world expert systems major in planning such as in the PlanIT system used by the KLM airlines to plan their staffing rotes [18].

This paper aims to develop a functioning CES with the proficiencies to answer any tourist directed questions using the existing and manageable knowledge base, which would enhance the quality of conversation between the system and the users. The main motivation is to provide a natural, user-friendly chatbot that will be able to make good recommendations and conclude inferences not only by simple Yes/No questions but by natural conversational answers. The proposed CES will be able to provide suitable information to the users on the locations as well as best timings for planning. The remaining of this paper proceeds as follows. Section 2 presents the architecture and the user interface of the proposed VIZARD chatbot. Section 3 presents the evaluation of VIZARD and discusses its benefits to Penang tourism industry and finally Section 4 concludes the paper.

2.   RESEARCH METHODS

This paper presents the proof of concept of a chatterbot expert system called the VIZARD. This chatterbot is designed to solve issues on Penang tourism, which resolves around three mains issues; destination, communication, scheduling, as well as safety and security.

2.1. Prototype architecture

VIZARD is developed using an expert system shell called verbot [19]. A Verbot (Verbally Enhanced Software Robot) combines natural language processing, experts system, and real-time animation with voice synthesis to create a chatterbot as a virtual personality. The particular version used in this project is Verbot 5 developed by conversive (available from http://verbots.sourceforge.net/). Verbot 5 has the setup package of 9.5 MB (9,957,376 bytes) when downloaded on PCs running on OS Windows 7 (SP1) as well as Windows 10. VIZARD will make sure the tourist is able to gain precise information about tourism spots in Penang.

Based on the communication structure of VIZARD as shown in Figure 1, the core of Vertbot 5 is the NLP engine based on pattern matching. The core Verbot 5 engine is responsible for finding matches to a given user input string and firing the appropriate rule. Basically, the engine loads a compiled knowledge base from a specific file path and the reply class finds the best match of the output string from the available knowledge base and fires the matching rule. Basically, the reply class represents the results (output/reply string) to the engine. The input to the reply class is the input string and the state class. The state class represents the current state for the engine including the previous user input string, the last rule fired, the current variables values, and active knowledge base.
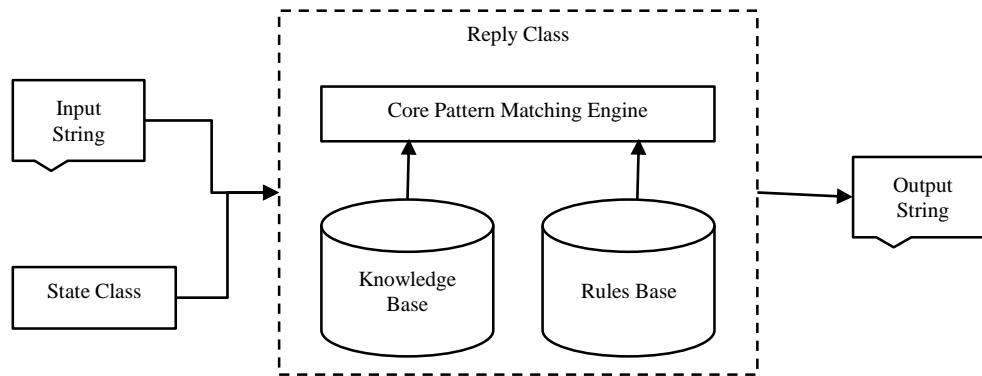
Figure 1. Communication structure in Verbot 5

2.2. User interface

Figure 2 shows the user interfaces for VIZARD during starting up and during conversation. When the user start up VIZARD, VIZARD will introduce itself and will ask the user name for to address the user during the conversation. Next, the VIZARD interactively communicate with users on the topic of Penang tourism spots, which has been installed in the knowledge base. The conversation continues until the user asks to quit.
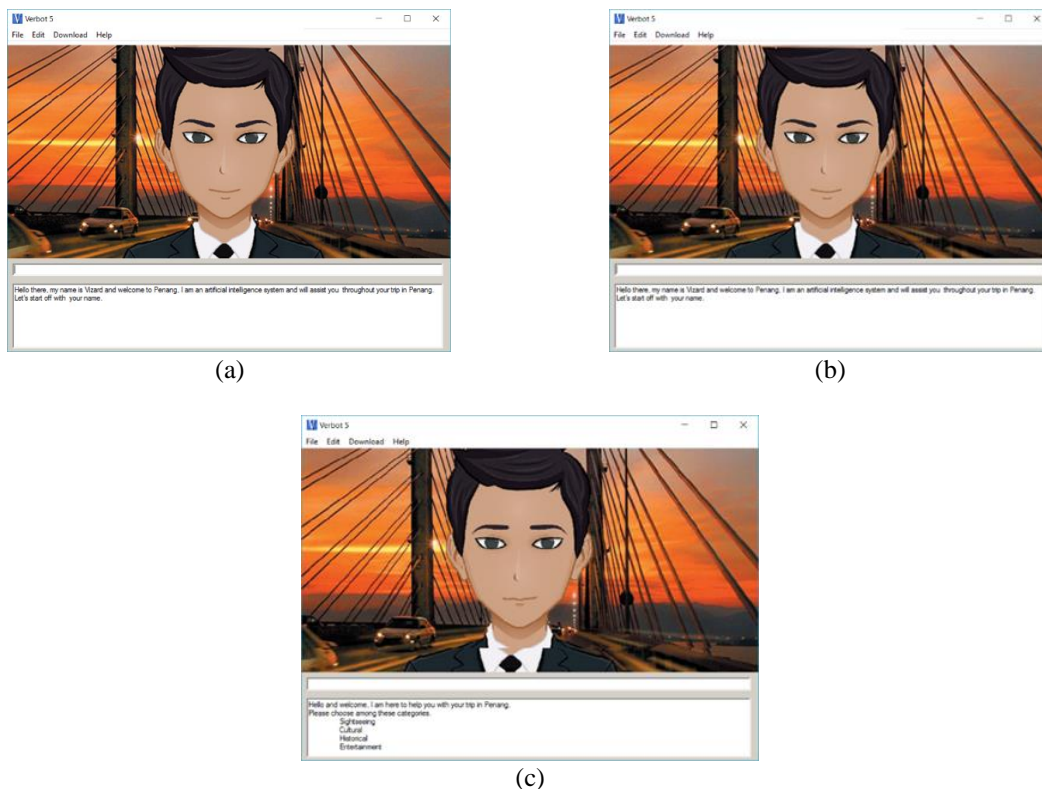

(a)

(b)

(c)

Figure 2. User interface of VIZARD, (a) Start up, (b) Name input, (c) Name output and options given

VIZARD is also linked with external resources such as from an Internet browser or external file. For example, when VIZARD is explaining a particular tourism spot in Penang such as Batu Ferringhi beach, users can extract a PDF file or access the beach location via the Internet browser. This allows the user to track their own location and have the direction to the particular spot. Figure 3 shows the dialogue box to open a file and Figure 4 shows two examples of external resources; from the browser and file.
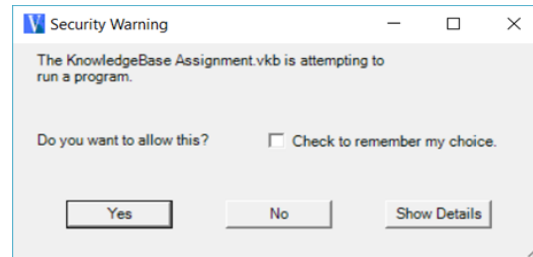
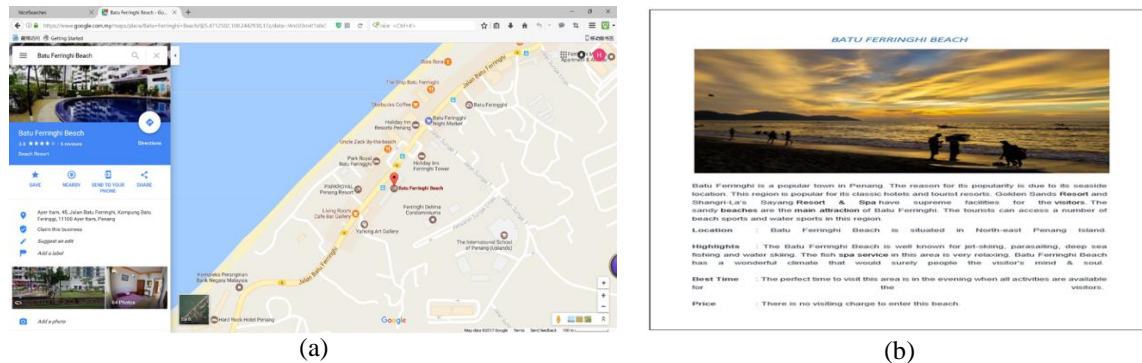Figure 3. Dialog box for user request for allowing external files to open

| (a) | (b) |

Figure 4. External resources, (a) Browser open, (b) File open

3.　RESULTS AND DISCUSSION

Once the system, VIZARD, has been completed, a user acceptance test (UAT) was carried out. VIZARD will also be evaluated from the perspective of real issues it is attempting to solve, which are destination, communication, scheduling, as well as safety and security.

3.1.　User acceptance test

The UAT for VIZARD was performed via a questionnaire set distributed to 40 random participants based on their experience using the system. Figure 5 shows the demographic information of the participants. 67% were locals, indicating that more national citizens are travelling to Penang as opposed to international. Figure 6 shows the percentage of user acceptance towards VIZARD in terms of usefulness. The findings showed that majority of the respondents have come to a conclusion that the VIZARD expert system stands at an unbiased state while being more aligned on supporting the usefulness of the system.
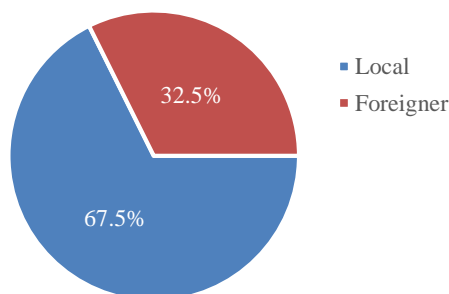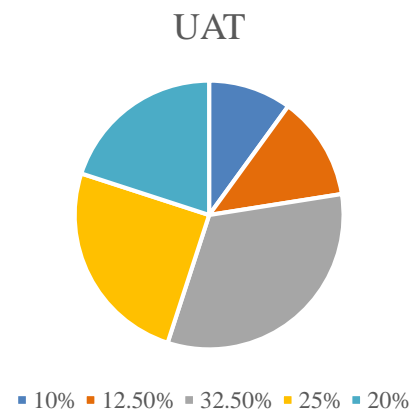

Figure 5. Demographic information

Figure 6. Results from UAT for VIZARD chatterbot

3.2. Discussions

The following subsections discuss the current tourism issues in Penang that VIZARD has solved in terms of destination, communication, scheduling, as well as safety and security.

3.2.1. Destination

Amenities are one of the things that are crucial to be clear and precise when it comes to travelling in different countries. In tourism, amenity is said to be the quality of pleasantness and agreeableness for certain places that tourists would stay or visit [20]. The problem that Penang is facing now is the lack of the availability of amenities and the over-charging for the use of the current amenities. Research shows that there is a lack of simple amenities in many locations all around the world. A notable example of the lack of amenities range from these clean and portable water toilets and rest rooms in public areas to the well-maintained hotel lavatories. Tourists would constantly face the challenge of finding simple public services that are still in good condition. In addition, it is important to also look at signage where it is often unaccustomed to the foreign tourists, meaning that to find a parking lot may be very problematic, even harder to read the road signs. As indicated previously, there are too many good quality hotels that charge their visitors an expensive fare just for use of the internet service although it may seem very hard to believe.

VIZARD is able to solve this problem by giving an updated tourism infrastructure digitally from Google Maps. As explained earlier, the system would also make the job easier for the tourists as well as the locals by providing an accurate and reliable information of the tourist attraction to the user's such as the best time to visit, the location, and other information. Besides VIZARD would also provide a route to the user desired destination by calling Browser Open to use Google Map. By having this, the user will know their current location and where is the nearest tourist attraction around that area.

3.2.2. Communication

Statistics from Tourism Malaysia have shown that Malaysia's tourism has increased in a steady rate throughout ten years since 2005, where the amount of tourists that entered Malaysia were 16.43 million, whereas in 2018, the amount of tourists have gone up to 25.70 million [21]. Communication is guaranteed to be an issue for tourists whom are visiting foreign countries which they are unacquainted with its national language. This would cause a problem where they would not be able to converse with a local to ask for directories and guidance, resulting in a communication barrier [22]. This problem would usually happen in Penang, Malaysia, where majority of the locals tend to speak the local languages of Bahasa Melayu, and Hokkien. Although there are still a select few of locals who are fluent in the English language, but the amount of them in rural areas compared to the city are very scarce.

VIZARD solves this communication problem by focusing on the English language due to tourism activities in Penang. The tourists may choose to ask questions to VIZARD for the specific details needed instead of choosing to communicate with a local. Another significant aspect of CIZARD is that communication is performed in natural language, where users would input queries and wait for VIZARD response.

3.2.3. Scheduling

To define the problem statement more clearly, a small interview was conducted to travelers in Penang during a Chinese new year 2020 holiday. Most of the travelers decided to travel to Penang do not know the opening and closing times of the popular locations such as the famous eatery site, Penang Chendol that only opens for a limited time. It is common for some travelers to be unaware of its timings so they would not miss their chance to visit the popular tourism sites, nor wasting the time finding the locations. VIZARD solves this by providing the user with reliable information of operating hours and exact location of the tourist attractions, with the assistance of external resources such as Google Maps and website information. Such external information will give up-to-date news such as the availability of a specific service as well as options to different tourism spots.

3.2.4. Safety and security

Several studies have revealed that security and safety of a tourist are two of the biggest challenges towards the tourism and travel industry [23]. To further elaborate on that point, the last two decades had an increase on terrorist acts, local wars, natural disasters, epidemics and pandemics [24]. In the case of Penang, the security and safety main hazard occasionally happens on the road, where over 6,000 people are killed annually due to road accidents. Foreigners who decide to drive have to face heavy traffic, and if unlucky, road rage which could lead to an accident [25]. As indicated in a previous problem, tourists would once again have to go through the difficulty of the language barrier when conversing with a local policeman to explain the details if an emergency had occurred. This becomes a big problem for tourism and travel agencies that

could result in a great economic loss when tourists are not keen in entering the country when there is a high risk rate, unless they make it so that a visitor's safety becomes a primary focus of concern. Not only that, mid-age travelers tend to go for "thrill seeking" activities which could lead to all sorts of safety and health issues.

VIZARD is able to aid on improving the security and safety of the tourists by providing information such as weather alerts and locations of nearby hospitals or clinics along emergency notifications. This will help users to reach their desired location safe and sound.

4. CONCLUSION

This paper presents a chatterbot expert system for Penang tourist spots called the VIZARD. VIZARD acts as a virtual assistant for Penang by giving users reliable answers when they are travelling to the destination. Development of VIZARD was based on Verbot 5 platform but the knowledge base is unable to capture the vast knowledge of localities in Penang, hence the scope of knowledge down to accommodation, cultural sites, entertainment, historical sites, and sightseeing locations. Aside from that, the system is only available at information kiosks in certain outlets of Penang so it restricts the accessibility of the system for users whom want to utilize the system. At present, VIZARD is not integrated to a server, which restricts the opportunity of enabling the system to operate on a web browser or a mobile application. In the future, VIZARD is hoped to be improved by implementing speech recognition instead of having to converse the system through text in order to enhance the user experience. VIZARD will also be made mobile and portable by integrating it into a website and a mobile application. This can greatly assist the users as they would be able to use the system at any given time of the day.

REFERENCES

[1] T. Reddy, "How chatbots can help reduce customer service cost by 30%". Available from https://www.ibm.com/blogs/watson/2017/10/how-chatbots-reduce-customer-service-costs-by-30-percent/
[2] M. Mauldin and P. Plantec, "Verbot®. Conversive™ Press Release", 2000.
[3] C. Chakrabarti, G.F. Luger, "A framework for simulating and evaluating artificial chatter bot conversations", in *The Twenty-Sixth International FLAIRS Conference* 2013.
[4] Y. Liu, M. Liu, X. Wang, L. Wang, J. Li, "PAL: A chatterbot system for answering domain-specific questions", in *51st Annual Meeting of the Association for Computational Linguistics: System Demonstrations*, pp. 67-72, 2013.
[5] B.L. Davies, "Grice's cooperative principle: meaning and rationality", *Journal of Pragmatics*, vol. 39, no. 12, pp. 2308-31, 2017.
[6] H.Y. Shum, X.D. He, D. Li, "From Eliza to XiaoIce: Challenges and opportunities with social chatbots", *Frontiers of Information Technology & Electronic Engineering*, vol. 19, no. 1, pp. 10-26, 2018.
[7] E. Ferrara, O. Varol, C. Davis, F. Menczer, A. Flammini, "The rise of social bots", *Communications of the ACM*, vol. 59, no. 7, pp. 96-104, 2016.
[8] P. Leith, "The rise and fall of the legal expert system", *International Review of Law, Computers & Technology*, vol. 30, no. 3, pp. 94-106, 2016.
[9] E. Styvaktakis, M.H. Bollen, I.Y. Gu, "Expert system for classification and analysis of power system events", *IEEE Transactions on Power Delivery*, vol. 17, no. 2, pp. 423-8, 2002.
[10] S.S. Naser and R.M. Al-Dahdooh, "Lower Back Pain Expert System Diagnosis and Treatment", *Journal of Multidisciplinary Engineering Science Studies (JMESS)*, vol. 2, no. 4, pp. 441-6, 2016.
[11] S.S. Naser and A.O. Mahdi, "A proposed expert system for foot diseases diagnosis", *American Journal of Innovative Research and Applied Sciences*, vol. 2, no. 4, pp. 155-68, 2016.
[12] B. Mehdi, C. Hasna, E.-K.Ahmed, O.Tayeb, "Intelligent credit scoring system using knowledge management", *IAES International Journal of Artificial Intelligence*, vol. 8, no. 4, pp. 391-398, 2019.
[13] Y. Benhadj, M.E. Messaoudi, A. Nfissi, "Artificial Intelligence in Education: Integrating Serious Gaming into the Language Class ClassDojo Technology for Classroom Behavioral Management", *IAES International Journal of Artificial Intelligence* vol. 8, no. 4, pp. 382-390, 2019.
[14] H. El-Mostafa and F. Benabbou, "A System for Ideas Plagiarism Detection: State of art and proposed approach", *IAES International Journal of Artificial Intelligence,* vol. 9, no. 1, 2020.
[15] I.E. Fisher,M.R. Garnsey, M.E. Hughes, "Natural language processing in accounting, auditing and finance: A synthesis of the literature with a roadmap for future research", *Intelligent Systems in Accounting, Finance and Management*, vol. 23, no. 3, pp. 157-214, 2016.

[16] R. Middleton, A. Lacey, W.O. Pickrell, B. Fonferfko-Shadrach, O. Pearson, M. Marta, G. McDonnell, S.E. Thompson, D.V. Ford, and R. Nicholas, "Automating clinical audit in neurology", A18-A18, 2019.
[17] A.J.-P. Tixier, R. Matthew, M.R. Hallowell, B. Rajagopalan, D. Bowman, "Automated content analysis for construction safety: A natural language processing system to extract precursors and outcomes from unstructured injury reports", *Automation in Construction*, vol. 62, pp. 45-56, 2016.
[18] A. Jain, D. Das, J.K. Gupta, A. Saxena, "PlanIT: A crowdsourcing approach for learning to plan paths from large scale preference feedback", in *2015 IEEE International Conference on Robotics and Automation* (ICRA), pp. 877-884, 2015.
[19] G.L. Gorby, "Use of Verbot™ Technology to Enhance Classroom Lecture", *Academic Medicine*, vol. 76, no. 5, pp. 552-3, 2001.
[20] D.C. Ukpabi, B. Aslam, H. Karjaluoto, "Chatbot Adoption in Tourism Services: A Conceptual Exploration", *Robots, Artificial Intelligence, and Service Automation in Travel, Tourism and Hospitality*, Emerald Publishing Limited, pp. 105-21, 2019.
[21] M. Benson and L. O'Reilly, "Residential Tourism and Economic Development: Imagineering Boquete and Penang", in *Lifestyle Migration and Colonial Traces in Malaysia and Panama*, pp. 81-110, 2018.
[22] A.R. Mohamed, "Multi-Cultural Communication is Essential for Tourism Industry: Global to Local Perspective", *Contemporary Human Resources Management in the Tourism Industry*, IGI Global, pp. 211-236, 2019.
[23] C.H. Tan, X.W. Chong, S.B. Ho, "Significance of safety and security issues on tourism industry in Malaysia", *Sci Int*, vol. 29, no. 2, pp. 471-475, 2017.
[24] B.W. Ritchie, Y. Jiang, "A review of research on tourism risk, crisis and disaster management: Launching the annals of tourism research curated collection on tourism risk, crisis and disaster management", *Annals of Tourism Research*, vol. 79, pp. 102812, 2019.
[25] S. Pratt, D. Tolkach, K. Kirillova, "Tourism & death", *Annals of Tourism Research*, vol. 78, pp. 102758, 2019.

BIOGRAPHIES OF AUTHORS

Vinothini Kasinathan is a currently as Senior Lecturer at Asia Pacific University of Technology and Innovation (APU) Malaysia. She obtained her Master in Software Engineering – Real Time System from UTM as the Dean's Merit award. She has been in the academic industry for the last 18 years. Presently pursuing her Ph.D. in Computing. Her research interest includes educational technology, text mining, presentation mining and other areas.

Aida Mustapha received the B.Sc. degree in Computer Science from Michigan Technological University and the M.IT degree in Computer Science from UKM, Malaysia in 1998 and 2004, respectively. She received her Ph.D. in Artificial Intelligence focusing on dialogue systems. She is currently an active researcher in the area of Computational Linguistics, Soft Computing, Data Mining, and Agent-based Systems.

Mohamad Firdaus Che Abdul Rani is a lecturer at Asia Pacific University of Technology and Innovation (APU), Malaysia. His research interest includes Semantic Web, Web Accessibility and Knowledge Management.

Salama A. Mostafa is currently a Lecturer at the Department of Software Engineering, Faculty of Computer Science and Information Technology, Universiti Tun Hussein Onn Malaysia (UTHM). He obtained his BSc. degree in Computer Science from the University of Mosul, Iraq in 2003. He obtained his MSc. and Ph.D. degrees in Information and Communication Technology from Universiti Tenaga Nasional (UNITEN), Malaysia in 2011 and 2016, respectively. His research interests are in the area of soft computing, data mining, software agents and intelligent autonomous systems.