R-Tourism: Applications and Incorporation of Robotics and Service Automation in Tourism and Hospitality

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Abstract: Artificial intelligence, Robotics and service automation are already visible in the tourism and hospitality industry, in addition to providing a typology for R-tourism applications, this paper aims to make a comprehensive literature review for the incorporation of this interdisciplinary area into mainstream tourism research. This paper reviews literatures which include robotic service (R-Service) research, Robots Service Automation, Autonomy and Human Robot Interaction (HRI), Robot Autonomy, Capabilities and Design, and the Uncanny Valley Theory to emphasize the importance of autonomy and human robot interaction, and provides tourism and hospitality examples and then to explore the anthropomorphic features in service robots. Furthermore, this paper explores the current state and the potential adoption of service automation and robots in tourism and hospitality industry, incorporates tourism and hospitality literature and examples. Finally, this paper constructs an integrated model of R-Tourism. This paper gives academics and practitioners a foundation for envisioning the current and future state of robots in tourism and hospitality.

Key words: R-tourism, robotics, service, automation, tourism and hospitality.

1. Introduction

In recent years, the world has witnessed significant progress in artificial intelligence, robotics and service automation [1]-[5]. According to World Economic Forum's [6] report: "The greatest societal impact may be the effect of digital transformation on the travel workforce, which could represent as many as one in every 11 jobs worldwide by 2025. Intelligent automation will change the nature of some travel jobs and eradicate others altogether." Tourism 4.0-related technologies such as: cloud computing, mobile internet, robotics, artificial intelligence, autonomous vehicles and even 3D-printing are expected to have a considerable impact on the skillset-requirements, as well as on the composition of the global tourism workforce within the next 5 years [7]. Surfacing in hospitality and tourism, Japan has a robot hotel [8] and robotic information agents [9]. Robotic floor cleaners [10]-[12] and assisted ambient living services—i.e., home-care and smart homes—keep improving [13]. Furthermore, toy manufacturer Lego has robot features in many of its products, and robot competitions—i.e., navigating a restaurant or delivering food orders—are

emerging [11], [13].

Artificial intelligence, service automation and robots are entering travel, tourism and hospitality as well [14], [15]. For example, Henn-na hotel in Japan (http://www.h-n-h.jp/en/), is completely automated and the guests do not encounter any of the employees. Wynn hotel in Las Vegas has announced in December 2016 that it will introduce in all its rooms Amazon's Echo voice- controlled speaker, equipped with the Alexa digital assistant, while Aloft Hotels use Siri [16]. A completely automated restaurant is also forthcoming in New York [17]. While the application of artificial intelligence in travel, tourism and hospitality companies has received some, although not sufficient, attention by scholars [18], research in the field of service automation and the adoption of robots by them is extremely scarce [19]. Also, there is such few integrated model for the Robots-Tourism (R-Tourism). Therefore, this paper aims to makes a comprehensive literature review for the incorporation of this interdisciplinary area into mainstream tourism research; reviews literatures to emphasize the importance of autonomy and human robot interaction, and provides hospitality and tourism examples in service robots; explores the current state and the potential adoption of service automation and robots in tourism and hospitality industry, incorporates tourism and hospitality literature and examples; constructs an integrated model of R-Tourism to give academics and practitioners a foundation for envisioning the current and future state of robots in tourism and hospitality.

2. Literature Review

2.1. R-Tourism

According to Japan National Tourism Organization, it is expected that the arrival of robotics in this area will offer the tourism industry interesting new business opportunities, branching from the overall concept of R-Tourism (Robot-Tourism): new or better services, novel experiences, customization and improvement of access to activities for different customer segments. These are just some of the elements that will go to create the future scenario for tourism assisted by robots [20].

2.2. R-Service

Services marketing's concern with technology diffusion and technology's customer impacts [21]; Lam & Shankar [22] for two recent examples helps bridge HRI and service robots research. Services scholars developed the eService paradigm—providing service over electronic networks [23]—and its impact on customers (i.e., [24]-[26]). Almost all e-service studies, whether looking at innovation adoption or implementation, focus on software that runs on an inert device such as a desktop computer or a mobile phone. To the authors' knowledge however, just two articles examine robotic service—R-Service—and both draw on HRI [9], [27]. An experimental study in Japan that tested hotel lobby robots as an alternative to information on digital signs found that robot head movement and direct greetings worked best [9]. The second article, introduced the concept of automated social presence (ASP), developed a typology of different automated and human social presence with customers and conceptualised relationships between ASP and key service and customer outcomes [27]. The authors noted that a major limitation of their study was ignoring the Uncanny Valley theory [28]-[31], which suggests a non-linear relationship between a robot's anthropomorphic features such as General Mobility, Task Mobility, Communication: Robot-Robot, Human-Robot, Robot-Human, Sociality: Human-Robot, Robot-Human, Memory, Sensory Processing, Symbolic Processing and emotional responses to that robot.

2.3. Robots Service Automation

Robots may be described as "intelligent physical devices" [32] with a certain degree of autonomy, mobility, and sensory capabilities that allow them to perform intended tasks [33]-[35]. The degree of autonomy in

this case refers to the robot's ability to perform its tasks without a human intervention. Such autonomy may be influenced by the complexity of the environment where a robot operates, as well as by inherent characteristics of a robot, such as intelligence, mobility, and sensory abilities [36]. Sensors are the built-in devices that allow a robot to learn about its environment and interact with it. The key tasks of a robot usually determine the need for certain sensors [37]. Such sensors often resemble human's senses and may include light sensors (vision), pressure sensors (touch), taste, and hearing sensors [38].

Based on the intended application, all robots may be grouped into two major categories: industrial robots and service robots [33]. Industrial robots are used for performing industrial tasks, such as welding, palletising, and other related tasks in manufacturing and production [39]-[40]. In contrast, service robots are designed to support and service humans through physical and social interactions. Furthermore, service robots may be classified into professional service robots (the ones employed by companies) and personal service robots (the ones used by individuals for non- commercial tasks) [34]. According to the International Federation of Robotics (2016), the use of industrial and service robots continues to grow. As a services industry, the hospitality and tourism field has attracted the use of professional service robots.

2.4. Autonomy and Human Robot Interaction (HRI)

Two key robotic elements are Human Robot Interaction (HRI) and decision-making, a continuum from quasi-autonomous to autonomous [29], [41]-[43]. Quasi-autonomous robot decisions usually stem from their programming or teleoperation via a remote human operator. Fully autonomous robots—a goal "since the emergence of the field, both in product development and science fiction" [41]—exhibit agency, or an ability to accommodate environmental variations without further input [43]. Autonomy opens the door to HRI such as awareness, trust and acceptance [29], [41], a double-edged interaction. Robots in charge could make users feel isolated [44]. Human-robot interfaces should follow familiar social rules and conventions, the ideal robot would be machine-like in speed and precision, adhere to social norms and maintain human attributes such as empathy, while avoiding mood swings, mistakes and biases [43], [44]. Paradoxically, humans might be impolite with robots [44]. Service dominant logic, whereby the firm and customer co-create value seems, applicable to HRI [44], [45]. Drawing on value co-creation helps understand the dynamic HRI social environment [10].

2.5. Robot Autonomy, Capabilities and Design

It is appropriate to consider autonomy, robot capabilities and robot design in determining which theories might suit anthropomorphism. As these engineering achievements will condition the consumer or demand side of the robot story, it makes sense to understand what the consumer will encounter [34]. Autonomy, critical to the notion of a robot, helps distinguish among devices that make decisions with or without human input. Rather than a dichotomy, robot autonomy ranges from basic levels of manual teleoperation to full autonomy [46]. In addition, the key robot capabilities have two interpretations. First, robots vary in their capabilities; there are and will be many specialised robot types with different capabilities. Second, with the addition of each row robots become more adept and more capable [32], [47]. Design relates to how robots move and interact. For example, robots' arm/leg-like sub-systems vary in the degrees of freedom of translation and rotation, i.e. the degree of humanness. Robots also vary in their surface composition. Designers may use plastic or metal, or create a skin-like look. Robots may also be much smaller or larger than human-scale [48].

2.6. The Uncanny Valley

According to [28]-[31], a popular theory, the Uncanny Valley suggests that a robot's degree of human likeness relates to feeling comfortable with the robot. Rather than a linear relationship, the feelings become

eerie as the robots almost resemble humans—the Uncanny Valley. The relation again becomes positive as the likeness becomes even more human. Uncanny valley research often draws on perceptual, cognitive, and social mechanisms and studies human faces [49]. Other robotic factors include touch, movement, materials and speech [31], [47]. Furthermore, a verbal warning decreased the favourablity [34]. A human-like rather than robotic voice led to lower switching intentions [34]. Teasing out the Uncanny Valley is a difficult, complicated and ongoing quest [27]-[29];

3. The Integrated Model of R-Tourism

According to above comprehensive literature review, this paper constructs an integrated model of R-Tourism as Fig. 1:

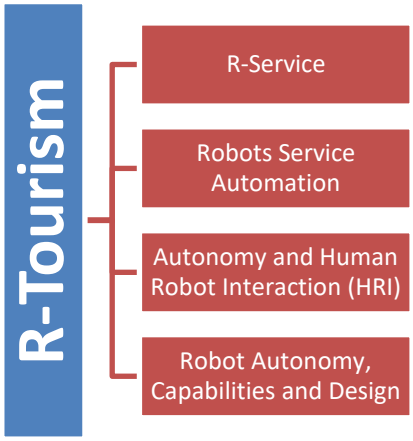

Fig. 1. An integrated model of r-tourism.

(1) R-Service: hotel lobby robots as an alternative to information on digital signs [47], automated social presence (ASP), different automated and human social presence with customers and conceptualised relationships between ASP and key service and customer outcomes [27].

(2) Robots Service Automation: Robots may be described as "intelligent physical devices" [32] with a certain degree of autonomy, mobility, and sensory capabilities that allow them to perform intended tasks [33]-[35].

(3) Autonomy and Human Robot Interaction (HRI): Autonomy opens the door to HRI such as awareness, trust and acceptance [29], [41], a double-edged interaction. Robots in charge could make users feel isolated [44]. Human-robot interfaces should follow familiar social rules and conventions [43]. The ideal robot would be machine-like in speed and precision, adhere to social norms and maintain human attributes such as empathy, while avoiding mood swings, mistakes and biases [43], [44]. Paradoxically, humans might be impolite with robots [44]. Service dominant logic, whereby the firm and customer co-create value seems, applicable to HRI [44], [45].

(4) Robot Autonomy, Capabilities and Design: Autonomy, critical to the notion of a robot, helps distinguish among devices that make decisions with or without human input. Rather than a dichotomy, robot autonomy ranges from basic levels of manual teleoperation to full autonomy [46]. The key robot capabilities have two interpretations. First, robots vary in their capabilities; there are and will be many specialised robot types with different capabilities. Second, with the addition of each row robots become more adept and more capable [32], [47].

4. Conclusions

Firstly, this paper makes a comprehensive literature review to providing a typology for R-tourism

applications and for the incorporation of this interdisciplinary area into mainstream tourism research. This paper reviews literatures which include: robotic service (R-Service) research, Robots Service Automation, Autonomy and Human Robot Interaction (HRI), Robot Autonomy, Capabilities and Design, and the Uncanny Valley Theory to emphasize the importance of autonomy and human robot interaction, and provides tourism and hospitality examples and then to explore the anthropomorphic features in service robots [34]. Secondly, this paper scratches the surface of robots in tourism and hospitality, explores and evaluated the current state and potential adoption of robots and service automation in tourism and hospitality. Thirdly, this paper incorporates tourism and hospitality literature and examples such as Japan that tested hotel lobby robots as an alternative to information on digital signs [47]; Automated social presence (ASP), developed a typology of different automated and human social presence with customers and conceptualised relationships between ASP and key service and customer outcomes [27]. Finally, this paper constructs an integrated model of R-Tourism to give academics and practitioners a foundation for envisioning the current and future state of robots in tourism and hospitality.

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