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Abstract. Smart Cities are evolving in a rapid way and the fields of actuation are normally: Energy, Transport, Home Automation and Weather. In this research we address a particular component of Smart Cities, the Smart Tourism and in the tourism a particular branch, the Health and Wellness Tourism. We propose as an exploratory study based on design science research with two iterations: lab experiment, presented here and has future work the real context experiment, vital signs monitor system for smart health tourism that allows to the tourist to visit to local interest points without neglect the health treatments and medical monitoring. Thus, the system operates inside and outside health facilities in order to be possible to get the vital signs of the health tourist. Since the data will be acquired outside health facilities an information security risk assessment was made and the security measures were promoted. The system is composed by many technologies, such as: smartwatch, raspberry pi, wireless sensor networks, among others and software. The vital signs acquired are Temperature, Blood Pressure, Heart Beat, Blood Oxygen level and, finally, the accelerometer will be used to detect falls. Beside this an adaptive artificial intelligence system will be used to predict health problems of the health tourist.

Keywords: Smart Tourism, Health and Wellness Tourism, Smart Cities.

1 Introduction

The preference for a tourist destination depends largely on its ability to enchant, make tourist's dream and contribute to their wellbeing, especially in the times where we live. Travelling for the purpose of receiving health care is not exactly new. How-ever, in the past, the term Health and Wellness Tourism have been used to refer primarily to trips made in order to receive therapeutic treatments using thermal waters.

The change in the concept of health, considered by the World Health Organization (1947), cited in Fernandes [1], as a state of total physical, mental and social wellbeing, also represents a new dynamic given to society, within a holistic perspective, with the aim of providing high levels of well-being in the population, as well as the adoption of healthy lifestyles. In fact, today there is a greater desire to travel in order to improve the individual's health and well-being [2, 3].

In recent years there has been an increase in the flow of tourists seeking to undergo medical treatment or receive health care, for various reasons, including the high costs in the countries of origin or long waiting lists for certain treatments or surgeries, and the term Medical Tourism has emerged to better describe this new tourist reality. Currently, Health and Wellness Tourism is a composite tourism sub product, of great complexity, which covers various products such as Medical Tourism, Thalassotherapy, Thermalism, SPAs, Health & Wellness Resorts, among others, with associated medical support and health care. In Portugal, this type of tourism has not yet reached significant dimensions such as those seen in consolidated destinations. However, promotion efforts have been visible, both in the public and private sectors. With a top quality and recognized competitive health care system and an excellent value-for-money alternative it's an interesting option along with the climate, quality hotel, spa and wellness offer and, of course, the Portuguese hospitality.

There are already many applications of information systems concerning the Medical Tourism [4, 7], although, an integrated system that combine the real data and artificial intelligence in order to prevent Emergences with non-intrusive data capture devices such as smartwatch and extending the functionality of the system outside of health facility's allowing more mobility to the medical tourist without compromise the health monitoring. In the second section, we presented a literature review about health tourism, in section three, we present the research plan and development, section four, we described the preliminary, in laboratory, results and next validations, finally, in the section five, we present the conclusions and the next steps of the research.

2 Literature review and research methodology

2.1 Literature review

The preference for a tourist destination depends largely on its ability to enchant, make tourists dream and contribute to their well-being, particularly in the times in which we live. Travelling for the purpose of receiving health care is not exactly new. However, in the past, the term Health and Wellness Tourism was used to refer mainly to trips made with the purpose of receiving therapeutic treatments using thermal waters. The change in the concept of health, considered by the World Health Organization in 1947, cited in [1], as a state of total physical, mental and social well-being, also represents a new dynamic given to society, within a holistic perspective, with the aim of providing high levels of well-being in the population, as well as the adoption of healthy lifestyles. In fact, today there is a greater desire to travel in order to improve the individual's health and well-being [2, 3]. In recent years there has been an increase in the flow of tourists

seeking to undergo medical treatment or receive health care, for various reasons, including the high costs in the countries of origin or long waiting lists for certain treatments or surgeries, and the term Medical Tourism has emerged to better describe this new tourist reality. Currently, Health and Wellness Tourism is a composite tourism sub product, of great complexity, which covers various products such as Medical Tourism, Thalassotherapy, Thermalism, SPAs, Health & Wellness Resorts, among others, with associated medical support and health care. The attempt to define the concept of health and wellness tourism is a complex task as there are several interpretations of the concepts associated with this theme. The concept of health and wellness tourism is relatively recent (early 1980s) although the health component in tourism is old. Smith and Puczko [8] suggested that health tourism can be viewed from two different perspectives, which are medical and wellness. Health Tourism can be defined as the act of travelling, the main motive being to receive care or undergo treatment that benefits the tourist's health, improving physical and mental well-being, allied to the tourist component in its most conventional sense [9]. The dimension of this state can be achieved through various healthy life habits, among which physical exercise, diet, self-esteem, social contacts, as well as leisure and idleness stand out. At this point it is possible to articulate the concept of health with tourism. The concern is no longer only about physical health, but also about well-being, physical appearance, and this concern with personal image is now a developing concept [10].

It is important to establish the difference between "medical tourism" and "health and well-ness tourism." The Global Spa Summit report [11] proposes the following distinction for the referred concepts: i) "medical tourism involves individuals travelling to a particular location in order to receive treatment for an illness, a physical or mental problem or to undergo a cosmetic procedure"; ii) "health and wellness tourism involves individuals travelling to a particular location in order to proactively participate in activities that preventively maintain or improve personal health and wellness" [11]; iii). Health tourism is often marketed as an umbrella term that refers to both wellness tourism and medical tourism and this has caused confusion between the sectors [2]. Medical and wellness would both fall under the scope of health but when it comes to tourism, the Global Wellness Institute (GWI) specifies that wellness tourism and medical tourism are separate entities and should be valued and marketed as such. If we reinforce this concept with a practice of providing vital signs monitor system for smart health tourism, we will certainly benefit the tourist user and at the same time create attractiveness to the destination.

Health and wellness tourism, in a more comprehensive universe, aggregates non-thermal offers, other types of services and programs, also associated with the recreational offer and has as its fundamental objectives the satisfaction of prophylactic health

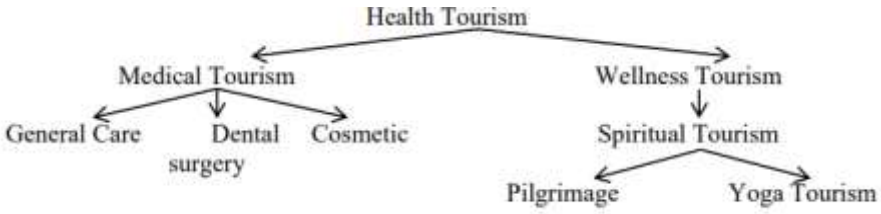

Fig. 1. Typology of Health Tourism [12]

care (preventive medicine), the provision of therapeutic services (curative medicine) and the performance of recovery treatments (rehabilitation medicine) [11].

Thus, in summary, health and wellness tourism extends to two fundamental segments: i) those who travel mainly for medical reasons and whose dominant motivation is healing or recovery; ii) and those who do so for reasons of prevention, wellness or fitness recovery, although the care provided may intersect [13].

In a market study related to health and wellness tourism by the Global Wellness Institute (called the Global Spa and Wellness Economy Monitor), states that this industry accounted worldwide for about USD 3.4 trillion in 2013. According to the same report, health and wellness tourism accounts for about 6 % (586.5 million) of all domestic and international travel and represents about 14 % of global tourism revenue. In 2013, the number of trips for health and health and wellness is highest in Europe (216.2 million), followed by North America (171.7 million) and Asia-Pacific (151.9 million)[14].

It should be noted that the profile of the health and wellness tourist is characterized by a diversity of age groups, higher education, medium-high incomes, with an increase of the overnight stays, so they become more interesting for destinations [14]. However, they are increasingly demanding, whether in the search for quality information, or in the search for efficacy in treatments, personalized monitoring, quality demand in infrastructures, tranquility and new and innovative wellness programs.

2.2 Design Science Research (DSR)

Design Science Research is a common research framework in the field of Information Systems. Typically, this kind of research complies a set of activities with different focus problem centered - Initiation, objective centered – Solution, Design and Development – Artifact, Demonstration – Proof of concept, Evaluation – increase performance and Communication – results. This research is the first of two DSR iterations and this paper materializes the first stage of communication, since we only had been validated on laboratory basis. Thus, a real context research will be made as the second iteration that we'll describe here, too.

3 Research Development

3.1 Problem identification

Since we need to monitor the vital signs of the health of the tourist inside the health facilities as long as outside, typically, we'll need a smart city WSN in order to get the information outside the facilities. Since, "Smart cities" is an ongoing at an early stage and the access to that kind of infrastructure is not global, we need to develop a prototype that uses inside facilities a private IoT Sensor Network and outside the GSM (5G) to cover the data gathering of the vital signals.

3.2 Solution (lab experiment)

To address this problem, we need to use the knowledge and techniques from different areas of Information Systems and Technologies, such as: Internet of Things, Wireless sensor networks, Software development, Mobile Communication. These technologies have to be orchestrated in order to comply the objectives. From the problem identification we can define its functionalities that could describe as: Design and develop a personal area network (PAN) that is responsible for data acquisition of the subject.

- Set up a wireless sensor network to read the values of the PAN.
- Submit to the server and populate the data in a dashboard.
- Analyze the data with the AI model from previous data and classify it from the worst to the best label as Severe, Dangerous, Normal and abnormal.
- Update the dashboard with the new classification and alert if above normal label.
- Validate the acquired data with manual reading of vital signs.

Based on these objectives, we start the design and development of the system.

3.3 Artifact

At this point of the research plan, we need to design the system architecture, see figure 2, in order to develop its components.

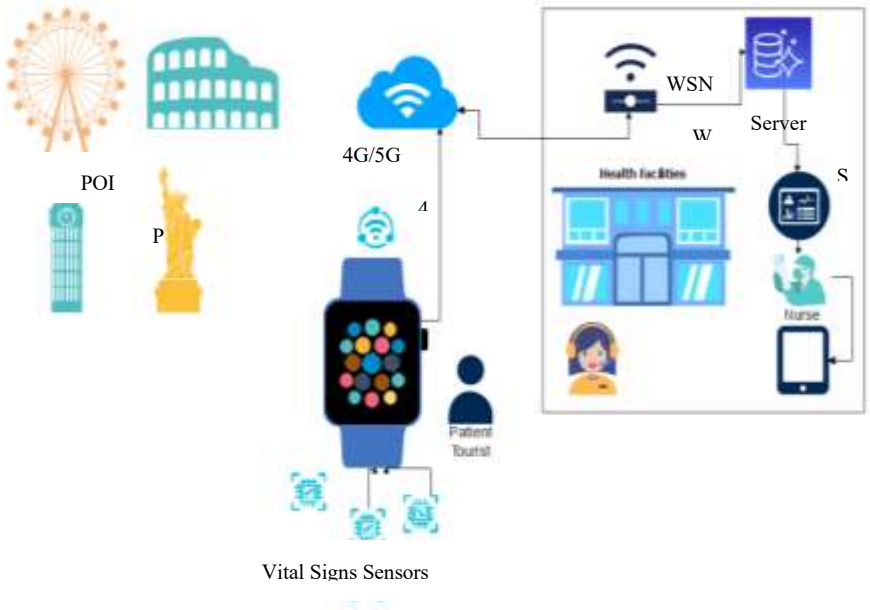

Fig 2 - Health Tourist Monitor System Architecture

The architecture has two distinct parts: inside the health facilities and outside health facilities. This kind of architecture leads us to interoperate between two communication systems one dedicated to the inside and other to outside.

The inside health facilities system has fixed wireless sensor network that are capturing the vital signs from the smartwatch of each health tourist. This deidentified data is send to the central system (server) where is stored and streamed to the artificial intelligence classification system that should alert [15, 16] in case of health abnormality.

The outside health facilities system operates in the same way, but the acquisition of data is made by mobile network (4G/5G). Ideally, it should be by the WSN of a smart city infrastructure, but at this moment is not possible to achieve that. The mobile network could be a backup communication of the inside health facilities system.

3.4 Proof of concept

Technology applied

In order to achieve the proof of concept we've developed a prototype of the system and since the architecture is composed of two components, we'll describe the technology used in both inside and outside health facilities:

Inside Health Facilities

Personal Area Network (PAN) - The technology used to capture the vital signs is a smartwatch 4G/5G enable that has the ability to measure heartbeat, blood pressure, temperature, blood oxygen and an accelerometer that will be used to detect falls. The reason of the use of smartwatch is that people, especially the elder ones, are already used to using watch. Thus, this solution is non-intrusive.

Additionally, in case of diabetes of the subject and if it has a wireless sensor of diabetes is possible to get its measurements. All of this technology will be part of the Personal Area Network.

Still inside health facilities, we've set up a wireless sensor network (WSN) in order to read the values from the smartwatch and store them in the server. The technology used in WSN was an Arduino ESP32 that has enabled Bluetooth Low Energy and WIFI capabilities. Each node will forward the data until server.

Finally, the server will show the data in a real time dashboard that identifies each room and based on adaptive artificial intelligence more concretely deep learning the system is able to alert in case of abnormalities on the values of the vital signs. Since at the beginning, we don't have much data, we've used datasets with the same sensor values to allow the classification of alert. With the gathering of real time data from the health tourists the system will be adapted to new data/situations.

Outside Health Facilities

The system outside the health facilities doesn't because at this moment we haven't a smart city with an infrastructure of WSN, thus, a 4G/5G network will be used in order to push the data from the smartwatch to the health facilities server. To explore the use of this communication technology, we can have video calls between the health tourist and the medical staff.

4 Evaluation

At this moment, the first iteration on Design Science Research, we only have the laboratory evaluation with the purpose of testing the communication system of all the components. We tested the communication between the smartwatch and the WSN. Then we tested the communication between the central node of the WSN and the server. At the same time, we've set up the deep learning with the datasets. Next step, the second iteration on Design Science Research, will be the application of real context in a hotel clinic. Beside the measurements of smartwatch of the vital signs a manual measurement will still be made by the medical staff in order to evaluate the accuracy of the system.

5 Conclusion and Future Work

Destination image is a basic component in the development of tourism destination attractiveness, since a destinations success depends on the characteristics that distinguishes it from another. When planning and developing experiences for the segment of

health and wellness tourism it is important to identify the main role of the given segment. With the increasing trend of wellness tourism, it´s important to highlight the awareness that needs to be created for the healthcare professionals to integrate wellness tourism into the existing system and natural forms of well-being that are prescribed to their patients. While most acknowledge the benefits but also in fact the need for the 'rest and relax' state of removing oneself from familiar surroundings and 'switching off' it is not yet very clear for the professionals how they can navigate this information to verbalize it to their patients. It is through the use of events and campaigns that can introduce both sectors together and create awareness. Health and wellness tourism is currently one of the tourism products with the greatest growth potential. However, it is necessary for the different Partners/Stakeholders (public, private and associative) of training/research/innovation, health and hospitality to network with each other in order to develop synergies and an economy of scale.

In this ongoing research we've started to define a model of a vital signs monitor dedicated to the tourism. The architecture and the technology were selected and we already have the first evaluation of system focused on communications. Following, we'll instantiate the system in real context at a clinic hotel where we can evaluate the accuracy of the system on reading vital signs and on classification of health abnormality scenarios. This work is a response to actual needs of this specific health tourism area, in the context of Health IoT.

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