

SanTour: Towards Personalized Hiking Trails Adapted to Health Profiles

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Abstract. Health tourism represents a promising niche still insufficiently exploited in Europe and Switzerland. Hiking has been a popular tourist activity for years and staying healthy is an important motivation for hiking. However, physical and psychological limitations in potential hikers often represent an unsurmountable barrier to complete a particular path. This mismatch between trail and user results in a poor visitor experience, affecting negatively both the user and the touristic destination. This paper presents SanTour, a novel concept in health tourism centered on the needs of visitors by considering their physical capacities and limits, as well as their expectations. SanTour exploits two main knowledge bases: one centered on the user, including a health profile, and another centered on the hiking trails. In a pilot phase, the concept has been prototyped and tested on a limited scale, with support from a tourist office in Switzerland. We plan to further develop this application that will provide an innovative service to hikers by cross-referencing their physical abilities and the characteristics of the hiking trails.

Keywords: Health tourism · Health recommendation · Tourism knowledge base.

1 Introduction

Outdoor activities are a key part of the touristic offer in Switzerland. Hiking trails, with a varying degree of difficulty, and accessible under different conditions depending on the season and weather, attract both local and foreign visitors alike. Their popularity among the population is due in part to their accessibility, the direct contact with nature, relatively low price, and perceived benefits to health and wellbeing. Even if these benefits are generally acknowledged, there are still important barriers for segments of the population, especially those who have physical or psychological limitations. These limitations refer not only to highly vulnerable segments (e.g. people suffering chronic diseases, arrhythmia, and/or disabilities), but also to visitors having varying degrees of endurance, fear

of heights, lack of balance, difficulties walking through rough trails, vertigo, etc. In fact, features of a hiking trail that may seem attractive to some visitors, such as a suspended bridge, or a cliff-facing path, can be unsurmountable obstacles for others. The limited amount of detailed information about these difficulty points, and the lack of appropriate means to match them with the personal conditions of the visitors, leads to poor user experience and even the abandon of hiking trails as preferred choice for leisure and health-related activities.

This paper introduces SanTour, a novel concept for health tourism that relies on knowledge bases centered on two main aspects: the visitor’s health profile, and the hiking trail profiles. The main idea is that a system can be built in order to match the health profile with the available trails, so that a set of recommendations can be provided. The concretion of this idea is not straightforward. It lies in the intersection of disciplines that include tourism, health and wellbeing, and knowledge acquisition and management. Therefore, it requires a careful analysis of needs, requirements, and perception from the different stakeholders involved in the topic, including: regional tourism offices, local development authorities, health professionals, mountain guides, and potential hikers.

In this work we present the general concept of SanTour (Section 2), and an analysis of needs performed through focus groups and questionnaires with relevant stakeholders (Section 3). We then describe the knowledge base for SanTour, which includes the characterization of hiking trails, and user health profiling (Section 4). Section 5 describes the prototype Web and mobile application⁴. We describe related work on this area (Section 6), and discuss future challenges and open points in Section 7.

2 SanTour: a novel concept in Health Tourism

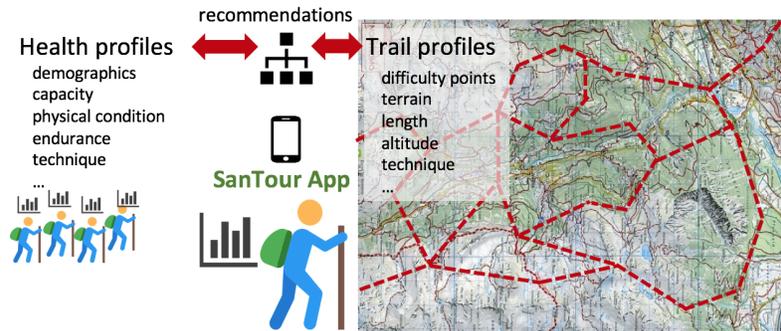


Fig. 1. The SanTour concept: recommendations based on health profile and the characterization of hiking trails.

Health tourism is a promising trend that could boost the attractiveness of mountain destinations during all seasons. The vast variety, both in terms of the offers and the targeted visitors, makes it a suitable choice for different types

⁴ SanTour proof of concept: <http://santour.ch>

of scenarios. These offers can be developed, for instance, as part of a tourism office strategy, or as a health-care-oriented offering complementary to patient treatment, or as a wellness program sponsored by insurance companies, etc.

SanTour positions itself as health tourism solution for hiking trails targeting the general population, with a special focus on those users who may require tailored advice for their choices. SanTour adopts the goals of adapting the hiking offer to the physical condition and limiting factors (e.g. vertigo, lack of balance, etc.) of the users, and is positioned as an instrument of prevention, and not of care, rather intended for healthy people, but also considering people with reduced mobility and affected by chronic diseases. The project takes into account that in Switzerland, individuals are increasingly aware of the relationship between a healthy lifestyle and the reduction of risks linked to the appearance of certain pathologies. Also, the regular practice of sports activities tends to increase strongly and explains the current boom in outdoor tourism and the initiatives taken by tourist destinations that seek to expand, diversify and segment their offer. In this context, hiking is an interesting and popular tourist product that has enjoyed great success for several years. This is confirmed by current statistics: 44% of the Swiss population is engaged in this type of activity and the number of hikers has increased by 7% compared to 2008, in addition to 300,000 foreign tourists (Fischer, Lamprecht & Stamm, 2015). The use of hiking trails comes in many forms ranging from short easy walks to running in the mountains, in tours over one or more days.

In Switzerland, there is a wide range of hiking trails, covering more than 65,000 km². Many actors, at several levels, are concerned. The task of the municipalities is to maintain the roads, to guarantee their quality and to approve them. The paths are then listed or promoted by various organisations such as SuisseMobile, Switzerland Rando or Switzerland Tourism on a national level. At cantonal level, the cantonal hiking associations, the cantonal services concerned and the tourism promotion bodies are responsible for promoting and communicating this tourist offer.

Germany is also encouraging its development, as the Ministry for Economics and Technology has published numerous documents aimed at facilitating the development of innovative health tourism. The development of tourism products is also recommended in Switzerland, particularly in the guidelines for health tourism proposed by the University of Applied Sciences in Chur. However, these studies and reports point to serious shortcomings in the proposed offer in terms of cooperation between tourism and medical players and under-utilisation of the potential for innovation. This is why the SanTour project aims to create favourable conditions for the creation of a modern and innovative product linking health and tourism and to evaluate its potential.

3 User exploratory study

In the context of the project, we launched an on-line questionnaire, targeted at hikers in Switzerland, with the goal of assessing their needs, and analyz-

ing their behavior regarding hiking activities. The quantitative questionnaire is centered on the understanding the following aspects: behavior in outdoor/hiking activities, motivations for pedestrian walks, satisfaction regarding trail offer, support and information technologies. The questionnaire was responded by over 300 people, 91% Swiss, half of them of age between 51 and 70, 40% retired, and respecting gender equality. The results, as summarized in Figure 2, show that the consulted users are active in hiking activities, either alone or in groups. Interestingly, the top reasons for hiking are reported to be (i) for general wellbeing, (ii) to be in contact with nature, and (iii) to be in good health. Therefore, it is clear that the health aspect is of special importance for the contacted users. Furthermore, there is actually a high interest in the concept proposed by SanTour, and most users would agree to communicate their health information or physical capabilities to benefit from adapted recommendations.

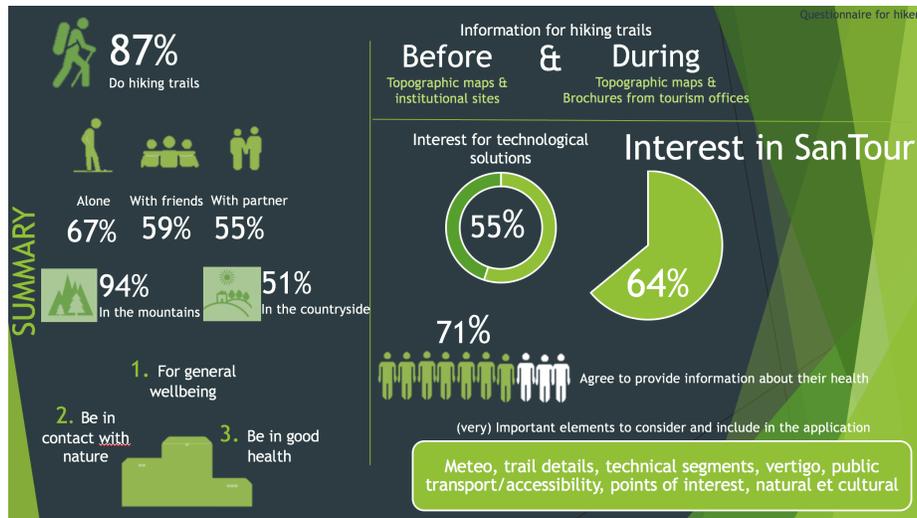


Fig. 2. SanTour. Results of an exploratory survey.

The results of this survey provide a strong indication that the concept proposed in SanTour touches relevant aspects for a population that is used to hiking and outdoor activities. Furthermore, it is evidenced that the health axis has a pivotal role in these activities, to the extent that users are generally open to share basic data about their conditions and limitations. Last but not least, users also consider important not to isolate the health aspect, but to link it to others such as points of interest, transportation, weather, and other types of information.

4 SanTour Knowledge Base

As described previously, SanTour recommendations are based on mainly two types of data: user health profiles and hiking trails. these two constitute the

central knowledge base used by SanTour, and we briefly present them in the following sections.

4.1 Characterization of Trails

Although tourism offices, commune administrations and hiking associations make available information about trails and pedestrians paths. This information includes a general description, duration, distance, altitude, gradient and general difficulty of the route. Some applications, such as SuisseMobile, allow the journey time to be modulated according to the walking speed. In addition, some offer GPS navigation or statistics on the “performance” of the hiker (speed, time, etc.). However, there is still a lack of information linking the technical characteristics of a trail with the physical requirements necessary for a safe and enjoyable hike. Indeed, general indications of difficulty (signposts with a color code and indicative walking times) do not make it possible to know, before going through them, whether the proposed routes are adapted to the physical aptitudes of the hiker as well as to any limiting factors (for example, fear of emptiness or sensitivity to vertigo).

To fill this gap SanTour requires the implementation of a knowledge-based for trails, which includes this type of data. To do so, each trail needs to be cataloged, including its different features and difficulty points. The methodology followed the guidelines provided by the French Federation of Hiking (FFRandonnée⁵), which establishes three main types of difficulties. The first is related to the *effort* required for the trail, and its associated physical difficulty. The second is linked to the technical difficulty, and the third to the risks and psychological difficulties of a given point or segment. In order to test and prepare the data acquisition phase for the trail information, an series of on-site visits were effectuated to the region of Zinal, Valais, in partnership with the local tourism authorities of Val d’Anniviers⁶. Under the supervision of a trained guide, and the advice of a physiotherapist, an assessment of 5 different trails was performed in the region: the Clautis path, the trail of La Lée, the path of the Arolles, and both the ascent and descent roads to the Cabane du Petit Mountet. The duration, altitude, ascent, descent, length, description, and geographical information was provided by the tourism offices, and cross validated in the on-site visit. Furthermore, the GPS coordinates of the full paths was recorded using the hiking mobile application SNUKR⁷, which is an external partner in the SanTour project. This information was necessary to construct the basic profile of each path, as exemplified in the Lisitng below. The data is represented using JSON-LD, annotated using mainly the schema.org vocabulary. The example presents an excerpt of the description of the Clautis path, including its basic information details.

⁵ Fédération Française de la Randonnée Pédestre <http://www.ffrandonnee.fr>

⁶ <https://www.valdanniviers.ch>

⁷ SNUKR: <http://snukr.ch>

```

{
  "@context": "http://schema.org/",
  "@type": [ "HikingTrail", "TouristAttraction" ],
  "name": "Les Clautis",
  "description": "Randonee des Clautis",
  "touristType": {
    "@type": "Audience", "audienceType": "Beginners"
  },
  "address": {
    "@type": "PostalAddress",
    "addressCountry": "CH", "addressLocality": "Zinal"
  },
  "publicAccess": true,
  "altitude_max": 1720,
  "altitude_min": 1675,
  "duration": 1.5,
  "distance": 3.55,
  "image": "https://d25u9ndbhiciz.cloudfront.net/points/59d8a48b798c500bf04bbf54-1-m.jpg"
}

```

However, as previously noted, this information is insufficient to create a profile that can be used for personalized recommendations according to health profiles. To complement the basic information, the data acquisition phase also contemplated the annotation of difficulty points. In each path, at least four people with different physical abilities and walking habits annotated the different difficulty points encountered in the way, such as rocks, roots on the path, steep climbs, bridges and obstacles, vertigo points, narrow passages, etc. Each of these points is associated to a particular geographical point, and is assigned a difficulty score. Examples of such difficulty points, represented as JSON-LD are presented in the Listing below. They represent respectively a rocky passage, and the presence of a bridge.

```

[[
  {
    "@context": "http://schema.org/",
    "@type": [ "DifficultyPoint", "Stone", "Place" ],
    "name": "ClautisPoint32",
    "description": "Gros cailloux",
    "difficulty": 10,
    "geo": {
      "@type": "GeoCoordinates", "latitude": "49.8852515", "longitude": "2.5106436"
    }
  },
  {
    "@context": "http://schema.org/",
    "@type": [ "DifficultyPoint", "Bridge", "Place" ],
    "name": "ClautisPoint35",
    "description": "Small bridge",
    "difficulty": 5,
    "geo": {
      "@type": "GeoCoordinates", "latitude": "49.777315", "longitude": "2.6106436"
    }
  }
]]

```

4.2 Health Profile

Having defined the methodology and the data model for the trails, the second elements to consider is the profile of the users, including their health profile, as

well as physical abilities and/or limitations and preferences. Users may have different types of interactions within the SanTour environment. It may happen that they are foreign visitors and only require a single or sporadic recommendations. Or instead, they can be local hikers that regularly look for hiking options. For this reason, SanTour adopts a questionnaire-based data acquisition approach, which needs to be quick and simple to fill up, while comprehensive enough to gather the necessary information. In the example below we present an example of a person details in JSON-LD, using schema.org. The person has reported diabetes as a medical condition.

```
{
  "@context": "http://schema.org/",
  "@type": "Person",
  "name": "Marie Dupont",
  "healthCondition": {
    "@type": "MedicalCondition",
    "alternateName": "Diabetes Type 2"
    "code": { "@type": "MedicalCode", "code": "E11.9", "codingSystem": "ICD-10"}
  }
}
```

Listing 1. A Question item described with the MedRed ontology

This example is only for illustrative future purposes, as currently SanTour relies on anonymized surveys, and health conditions such as chronic diseases are not taken into account for the moment. In the future this information can help adapting the recommendations also according to limitations in this regard. Instead, SanTour requests mainly two types of data: The first is a self-assessment of physical and psychological capacity for aspects including:

- General physical activity.
- Help needed to walk.
- Walking speed and endurance.
- Climbing capacity.
- Balance.
- Fear of falling, and of void.
- Pain.

The questions are prepared in such a way that the user can self-describe her situation. There is unavoidable bias and/or degree of inaccuracy in this respect, but the approach was chosen in order to rely as much as possible on a self-controlled assessment. The example below is a representation of one of the questions in RDF Turtle format, using the MedRed ontology. The question refers to the user's perceived speed in comparison with those of her peers.

```
ex:santourQ3 a medred:Question ;
  medred:isItemofSection ex:santourHealthSection1 ; dcterms:identifier "santourQ3" ;
  dcterms:title "Par rapport a la vitesse de marche moyenne (celle de vos proches),
  pensez vous marcher habituellement ..." ;
  medred:choices ( ex:muchSlower ex:slower ex:equalSpeed
  ex:faster ex:muchFaster ) ;
  pplan:hasOutputVar ex:santourQ3_var .
```

Listing 2. A Question item described with the MedRed ontology

The other type of data requested to the user, is focused on preferences on types of features/elements present in a hiking trail. This is important in order to have an idea of the features (which can have certain degree of difficulty) that the user is comfortable with. For instance, a user may enjoy hiking in stony trails, but would prefer to avoid suspended bridges, because of vertigo. An example is presented in the listing below. It is represented in JSON-LD, and show a rating for stony trails. The preference is represented as a rating, using the schema.org vocabulary.

```

{
  "@type": ["Review", "TrailPreference"],
  "author": "Laure",
  "datePublished": "2011-04-01",
  "@id": "laureCaillouxReview",
  "description": "Evaluer de -10 (je deteste), 0 (ca m'est egal), a +10 (j'aime). Cailloux.",
  "reviewRating": {
    "@type": "Rating",
    "bestRating": "10",
    "ratingValue": "7",
    "worstRating": "-10"
  }
}

```

Listing 3. A Question item described with the MedRed ontology

5 Implementation

A first proof-of-concept implementation of SanTour has been developed, in order to evaluate and collect feedback, as well as to show the potential of this idea to stakeholders such as local tourism offices or hiking organizations. The implementation is a Web application, also available for mobile devices, which displays the health questionnaire as well as the hiking trail preferences form to the user. This part of the application serves as an entry point for the health profile and trail preferences described in previous sections. A screenshot of the application can be seen in Figure 3, displaying some of these questions. For the moment the application works on an anonymous fashion and no personal information is stored. In future versions of SanTour, it is expected that previous preferences can be combined with feedback information in order to provide more precise and tailored recommendations.



Profil santé

Activité Physique

Est-ce que vous avez une activité physique régulière?

oui non

Est-ce que vous auriez envie de reprendre une activité physique plus importante dans les prochains mois?

oui non

Marcher sans aides

Quels dispositifs d'aide à la marche utilisez vous?

aucune une canne deux cannes déambulateur
 cadre de marche j'ai besoin de l'aide d'une tierce personne

Fig. 3. SanTour Application.

The application also provides visualizations of the health profile and the preferences, which can provide a quick idea of the type of user (Figure 4). More advanced visualizations are planned in the future, especially for those cases that may require human intervention. This might be the case, for example, if health professionals are interested in using SanTour for their patients, in order to suggest them outdoor activities or specific trails adapted to their needs, therapies, rehabilitation, etc.

With this information, the application applies similarity measures between the entered information and the existing trail profiles, providing a score. The hiking trails are ordered according to the score, and if necessary, targeted suggestions or warnings are provided, e.g. a warning if the user reported to have pain in the knees, it can be suggested to be extra careful in steep descents. Figure 5 displays the recommendation pane, showing the ordered trails according to the score. For demonstration purposes the SanTour prototype only contains a handful of hiking trails.

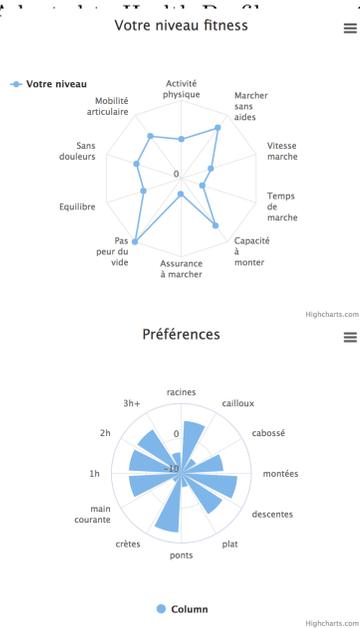


Fig. 4. SanTour charts.

Recommandations

parcours	distance	temps	lien	score
Les Clautis	3.55km	1h	Snukr	0.74 score
La Lee ▲	3.73km	1h	Snukr	0.71 score
Attention si douleurs importantes	6.8km	2.75h	Snukr	0.46 score
Zinal-Petit Mountet chemin d'été ▲	10.8km	3h	Snukr	0.41 score
Zinal-Petit Mountet Chemin d'hiver	12.6km	3.5h	Snukr	0.29 score

[RECOMMANDATION](#)

Fig. 5. SanTour recommendations.

6 Related Work

Hiking is a popular outdoor activity that requires little infrastructure, equipment or even training in its simplest form. Maintaining or improving the physical fitness of hikers is a popular factor for this popularity, as confirmed in recent international studies [6, 5]. Moreover, hiking also combines movement and social contacts, as well as appreciation of nature culture and landscape [7, 9].

In terms of health and physical fitness, hiking allows significant improvements likely to break the undesirable effects of inactivity, including increased calories burned, decreased stress and increased well-being [16, 7]. Despite its many advantages, hiking also carries risks not to be neglected. According to BPA (Swiss Accident Prevention office)⁸, nearly 20,000 people are injured every year while hiking in Switzerland. In 2015, the Swiss Alpine Club counted some 1200 situations requiring the intervention of rescue organizations and 64 fatal accidents due to hiking⁹. A study carried out in the Italian Pre-Alps leads [4] notes the increasing rate of hikers requesting intervention due to late return, fatigue or bad weather. First aid reports also point out that poor assessment of physical abilities leads to excessive effort on the part of hikers whose physical fitness is insufficient, resulting in fatigue leading to falls.

The problem of the frequent subjectivity of the evaluation of hiking trails is highlighted in [8], proposing to evaluate their difficulty on the basis of the standardized energy expenditure they cause. In [3] a good overview of the methodology and difficulties in the characterization of hiking trails is presented. This work emphasizes that parameters such as altitude or slope are simple to calculate, while others are more complicated to characterize, or require the use of substitutes to do so. This work shows the interest and feasibility of crossing biophysical factors with pleasure or difficulty, by determining coefficients applicable to each biophysical factor whose addition establishes the expected level of difficulty. SanTour precisely goes into this direction, establishing a first concrete implementation.

In parallel with the characterization of the hiking trails, it is key to assess the physical fitness of the hiker. This can be estimated using a questionnaire, according to the transtheoretical model in [13]. More detailed methods have been studied for the evaluation of physical activity by self-reported questionnaires [2].

Concerning recommendation systems and algorithms, several choices exist, depending on the characteristics of the data [14], particularly those related to the user context [11]. Contextual aspects may include location, season, weather, etc. These systems also consider user preferences and profile, which create a model that can then be used by machine learning and artificial intelligence algorithms to generate tailored and personalized recommendations [1]. However, tourist recommendation systems do not take into account the health aspects of users or their psychomotor abilities.

Beyond the health dimension, hiking also has an economic role to play, particularly in mountain tourist regions. While the use of roads as such does not generate direct income because they are free, activities related to hiking represent an economic potential that is too often under-exploited. Yet, the exploitation of collaborations in tourism promotes the prosperity of the entire destination. The

⁸ http://www.bpa.ch/fr/Documents/03_Fuer-Fachpersonen/02_Betriebe/SafetyKit/Wandern/2016-05-11_factsheet_randonne_FR.pdf

⁹ <http://www.sac-cas.ch/fr/en-chemin/securite/urgences-dans-les-montagnes.html>

relevance of the industrial cluster model [12] to tourism has thus been noted [10, 15]. This vision of the functioning of a destination highlights the need to develop strong interactions between the various companies or entities offering complementary tourism products in order to create a competitive advantage for the destination as a whole.

7 Discussion & Conclusions

The SanTour project aims at bringing the world of health and tourism closer together. Cooperation and mutual understanding between these actors is still largely lacking. An improvement in this area will increase the credibility of health tourism offers, starting with the one proposed by our project. Although this first step provides a concrete implementation of a proof-of-concept, there are still several open points that need to be explored in the near future, especially concerning the outreach and potential ways of exploitation:

- Determine what data are desired by tourism promotion organizations so that they can best adapt their offer to hikers and target them more precisely.
- Determine what data are useful for a better understanding of hiking for scientific purposes, but also for destinations.
- Determine the expectations of the health-care community regarding accident prevention and the promotion of physical activity.

The mobile application developed in SanTour may also facilitate the sale of products related to hiking, such as the sale of local products or catering, by integrating them into its business model through partnerships with service providers. However, in order to identify clearly the potential opportunities in this respect, we intend to present the SanTour concepts to relevant potential partners:

- Mountain guides.
- Tourism promotion organizations.
- The service providers of the partner destination.
- Actors in the health sector, including health promotion institutions.
- Hiking trail managers in the municipality of the pilot destination.

In the near future, the SanTour project will launch pre-tests with a limited number of people to check the general functioning of the pilot and make the necessary corrections. Furthermore, satisfaction tests will be conducted by making the pilot available to visitors and mountain guides of the partner destination, then by gathering their opinions.

The SanTour project responds to the need for better prevention and personalized recommendations for hiking, by taking particular account of the physical fitness and limiting factors of hikers when proposing routes for them to follow. Our system of route proposals adapted to hikers aims to combine the beneficial effects of hiking and risk reduction. To achieve this, we base our approach on

a dynamic and semantic knowledge-base that includes health profiles and characterization of hiking trails. The SanTour project is expected to increase the quality of the tourist offer, since the quality and credibility of the information play a key role in customer satisfaction, as does the match between the hikes on offer and the hiker's abilities.

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