Activity-Led Travel Recommendation System

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Abstract

With the outstanding number of tourist destinations all over the world, all the information that comes with each destination can be extremely overwhelming and be finding the perfect destination that meets all of one's requirements can be exhausting. Recommender systems can help people find items that best fits their personality and needs when they are presented with an overload of information. Recommendation Systems have been used in the travel and tourism sector to assist users in acquiring their travel goal based on their preferences. Many Travel Recommender Systems require the users to know beforehand the continent or sometimes country they wish to travel, making the recommendations generalised. This project delivers a more personalised approach, as the holiday destinations are generated according to the user's activity preferences and needs. Users will choose their ideal holiday, through selecting what activities they would like to participate in during their holiday and the system will generate a personalised ranking of the appropriate destinations for the user to visit. For example, if beach & sun, carnival, traditional, sea adventures have been selected one of the ranked places to visit would be Trinidad and Tobago.

Keywords

Travel Recommender system, Recommender system, Content-based filtering.

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Introduction

Tourism is an important social, cultural and economic phenomenon that includes the movement of millions of people around the world with a big impact on the economy of many countries. It is defined as the activities of persons travelling to and staying in places outside their usual environment for no more than one consecutive year for leisure, business and other purposes not related to the exercise of an activity remunerated from within the place visited The generation of tourism-related tools tends to have a huge impact on society. In many countries, tourism has become a fast-growing sector, in some tourism generates a large sum of the country's gross domestic product (GDP). In the Maldives tourism directly accounts for 39.6% of GDP in 2017 (World Travel & Tourism Council, 2018). Tourism widely contributing to regional and national economic development. The Internet has become an important travel information source and the number of travellers who use the Internet for travel planning has grown rapidly. However, it is often difficult for trip planners to find relevant information in digital environments **(**Pan & Fesenmaier, 2002) and too much information can cause confusion, information overload.

Problem

There has been an exponential increase in the amount of available digital information on the internet and through other digital media over the years (Ghazanfar, Prugel-Bennett, 2010). In this day and age, many prospect travellers rely heavily on online services when planning a trip away. However, they are usually faced with the problem of the overwhelming amount of information, which can be daunting. Consequently, they would have to invest a great deal of their time researching and reviewing many websites, to decide where to go, what adventures to take part in etc. With the huge amount of possibilities available to them makes it difficult for users to determine the most suitable destination. Also, many travel recommender systems available online are not activity-driven, the tools require the users to already have an idea of where he/she would like to visit beforehand, continent or sometimes even the country itself. This makes it difficult for spontaneous individuals who have no idea where they would like to visit but know the activities and experiences they would like to gain from their trip.

Intended Audience

The purpose of developing a recommender system (RS) is to overcome information overload and address the problem of online users feeling overwhelmed by excessive and messy information (Cho, et al. 2002). This Travel recommendation system aims to use information filtering techniques are used to assist users by giving personalised product recommendations. By helping users manage with the information overload and offer personalised recommendations to the users. The system will help users gain inspiration and come to reach a solution quickly on what their next trip will be. In order to do this the system will need information of the travellers, travel preferences such as the list of activities he/she would like to apart in while in the said destination, or even weather preferences such as it being cold and snowing. Then it will generate a custom list of countries the traveller can visit depending on their preference.

Background

Usually, when planning a holiday, one of the main things taken into consideration is the activities one will part take in while on holiday. Majority of the time, travellers will fail to find a destination that satisfies all activities the travellers wishes for, concerning that destination. There may be a factor of reasons for the failure; firstly, it may not be feasible with the selected city. Secondly, the travellers' preferences may conflict with another e.g. outdoor snowboarding and a safari trip. Lastly, insufficient research has been carried out by the traveller and all the activities can be achieved in a different destination. Travel Recommendation systems can be used to solve problems of such sort. As it helps users to make fast and concise decisions in these complex information spaces.

As we are now in the digital age, and the impact of technology, the way holidaymakers book and plan their holidays has dramatically changed from how it would have been done ten years ago. Travel planning and booking would typically consist of several steps such as; choosing the destination, choosing the accommodations, selecting tourist attractions, deciding routes, deciding the best time and date to go etc. All that was mention can all be done online and the majority can even be done on one website for example Expedia.co.uk. With this new way of doing things, it has caused a switch in power from the travel agents to the everyday man. The fuss of being on the phone for hours to travel agents and accepting whatever deal they provide you is no more, as many websites provide similar services with many deals and

packages. Web sites such as Expedia even provide incentives to consumers such as nectar point's rewards and using the points in exchange for money and cash back rewards. As with that being said, many websites offer up-to-date information, this is extremely valuable as the tourism industry evolves daily to give consumers the best experience possible. However, this given freedom to the consumers comes at a cost, as it can become extremely time-consuming finding the most suitable deals and cheapest. As there are now many websites that act as an online travel agent, and prices will be changing by the minute, the consumers will have to be on top of it in order to get the best deals. Due to this, tourists of today have become very demanding and have developed complexed multi-layered desire and needs. They are flexible often experienced in travelling and demand both perfection and diversity. In consequence developments in tourism should be multi-optional and of high quality and standard to meet and exceed their needs.

Aim

The aim of this project is to develop a system that will provide assistance to consumers by providing suitable travel destinations based on the user's preferences. The users will be able to effectively choose the activities they would like to engage in and the personalised results will be ranked to the user's preferences. It will be displayed in a web application, which can be used on a desktop and mobile to present the results in an easy and useable fashion. It aims to help users who are struggling with inspiration on where to travel or users who don't know where to travel and don't necessarily want to do the research that comes with it. This travel recommendation system will link what they want to do with the location that best fits their preferences. It will provide personalised recommendations.

Literature Survey

The aim of a travel recommender systems (TRS) is to assist users to filter their way through large databases or catalogues, by suggesting relevant items taking into account or inferring the users' preferences. A recommendation system (RS) is a tool for screening information and providing personalised services (Chiang, 2015). It is a personalisation tool that attempts to provide people with a list of information items that best fit their individual tastes. RS are used in a variety of applications such as for online shopping, music, movies to name a few. They are extensively used in e-commerce websites, where it is used to suggest products to customers and provide them with information to help them decide which products to purchase. An example being Amazon, users are recommended different items to purchase

based on items in their basket or past purchased items. RS has proved to improve the decision-making process and quality (Pathak, et al, 2010). It is often used by websites as a marketing tool to increase revenue by presenting products that the customer is likely to buy. "Customer who bought this item also bought …" is what is normally stated by Amazon to customers who wish to buy any product from the website.

Recommender systems can be grouped into four major filtering types, which are; Collaborative filtering, Content-based filtering, Knowledge-based filtering and Hybrid. In this project, both collective based filtering and content-based filtering will be used. As a result, if combining the two approaches it is known as a hybrid system. Content-based filtering techniques allows the integration of widely available information into the system e.g. textual descriptions of destinations, restaurants and other points-of-interest. While Collaborative filtering allows the use of feedback, to create assumptions. The combination of both can be used to achieve the aims of the project.

Content-Based Filtering

The content-based filtering (CBF) technique learns the model of the user's interests based on the features of the objects rated by the user (Lops et al, 2011), items which are rated as interesting either by implicit or explicit feedback are used into order to build the user's preference profile. Keywords are used to describe the items and a user profile is built to indicate the type of item this user likes. In other words, these algorithms try to recommend items that are similar to those that a user liked in the past or is examined in the present. The main characteristic of the system is that it can personalise recommendations to each user interacting with the system. CBF can be found mainly in recommendation techniques applied to text documents such as web pages or newsgroup messages for example. Personalisation involves the design of enabling systems to capture or infer the needs of each person and then to satisfy those needs in a known context (Riecken, 2000).

CBF is used to find features of a particular item and the user's profile. If the case occurs that the item features are not directly available, it can be retrieved by analysing textual descriptions of the items and extracting keywords from them. However, this approach has shown to deliver often irrelevant or overly obvious features (Pessemier, 2017). The approach that will be taken for this project is the idea to characterise travel destinations into categories and keywords linked to point-of-interest (POI) at the destination. Mostly these POIs tend to

work as an incentive for travellers to visit a particular destination. Term Frequency-Inverse Document Frequency (TF-IDF), describes the item profile based on terms. These can be keywords from a document or tags applied to the item (Dhondt, 2015). The item is then described by the TF-IDF vector, which gives to each key term by multiplying the term occurrences in the document (term frequency f,td) by the inverse of the percentage of documents d this term appears in the (document frequency) to the total of documents D.

$$tf\ idf(t,d,\mathrm{D}) = tf(\mathrm{t},\mathrm{d}) \times idf(\mathrm{t},\mathrm{D}) = ft,d \times \log \frac{N}{\{\mathrm{d} \in \mathrm{D} : \mathrm{t} \in \mathrm{d}\}}$$

Equation 1: TF-IDF

Tags representing t of destination d, part of all destinations D. N being the number of destination in D and ft,d is the frequency of the tag t in destination d, multiplied by the score of the location. The location score is gathered by the user's reviews this will be covered in the implementation section.

CBF faces the challenges of a limited content system, this occurs when content-based techniques have a limit in the number of features that are associated with the system, resulting in unsuitable suggestions (Pazzani and Billsus, 2007). This limitation can be in the form of keywords. Keywords alone may not be a sufficient judgment of quality, the content provider may be too short or limited. The over-specialised problem occurs when a user has only rated items similar to previously made purchases or past rated items. For example, if a user purchases a phone from the Amazon website then later decides not use the website again for a long period of time, then returns after years. All the recommendations will be centred on the previously purchased phone and nothing else, it will contain accessories, gadgets which can be used alongside the phone. The problem then becomes that the user has been poorly read, as their interests would have moved on. Thus the over-specialised problem has occurred and no useful recommendations have been made to the user unless the user searches or purchases another item. With that being said the computational cost of content-based filtering can be very low, based on the projected accuracy and functionality.

Collaborative Filtering

Unlike Content-based filtering, collaborative filtering (CF) aims to predict the utility of items for a particular user according to the items previously evaluated by other like-minded users. CF is the exploration of techniques for matching people with similar interests (Chang, 2015). This filtering system relies on past behaviours such as previous transactions or product

reviewing; popular websites that use this approach include eBay, Amazon, Netflix and Twitter. They incorporate collaborative filtering with recommendation engines to recommend jobs, friends, groups and/or companies in which users might be interested (Schafer et al, 2007). Due to this characteristic, it is usually applied to software holding communities of users who express their preferences for items, recommendations are then made based on the preferences of similar users. This approach computes the similarities among the users based on their feedback. Recommendations cover a wider range, users are not restricted to the number of items referred (Hinze and Annika, 2005). This filtering system is based on assumption that people who agreed in the past will agree in the future and that they will like similar kind of objects as they liked in the past. The nearest neighbour approach is used on each user. Users found with the past ratings nearest to the current user has the strongest correlation. The scores for the unseen items are predicted based on a combination of the scores known from the nearest neighbour (Balabanović and Marko, 1997). CF can be split into two types, namely, 'User-based collaborative filtering' and 'item-based collaborative filtering' (Deshpande and Karypis, 2007**).** Although user-based is known and proved to produce better results, it is highly computationally expensive and does not scale well with an increase in the number of users. Thus, item-based has been favoured over user-based.

The main challenge in CF is that the underlying rating matrices are sparse (**book**). Considering an example of a destination recommender system, where the application recommends the user a travel destination and users of the system specify ratings indicating their like or dislike for a particular location. Most users would not have travelled to all the cities and countries in the world, as a result, most of the ratings are unspecified. The system would then face the problem of sparsity, thinning the collection of recommendable items (Balabanovic and Shoham, 1997), as the number of users relative to the volume of items do not equate to each other. Thus, leading to poor recommendations to users who may have different preferences to the majority of the users on the system. An additional limitation of this filtering method is the cold-start user problem. Cold-start user problem occurs due to the need for generation recommendations for a user that has yet rated any item or rated very few items. The RS is unable to compare target user with other users to find similar uses for generating recommendations due to insufficient reviews or ratings (Chen et al, 2011, Guo, 2013).

Knowledge-based Filtering

This filtering system relies on the explicit representation of knowledge, usually as collections of statements, ontologies or other forms of rule systems. Applications that require inference and reasoning will benefit from knowledge-based filtering (Berka and Plößnig, 2002). While high performance and flexibility makes this filtering process suitable for most tasks, applications which a strong focus on content can benefit from using more respective specialised approaches.

Hybrid

A hybrid recommendation filtering system is composed of two or more diverse recommendation techniques, which can include, collaborative filtering, content-based filtering, knowledge-based filtering and demographic filtering (Jannach et al, 2010, Melville and Sindhwani, 2010, Pathak et al, 2013). The hybrid recommendation technique combines the best features of two or more traditional filtering systems into one hybrid approach. The combination of two different filtering techniques takes the advantages of the positive aspects of each technique and uses this to over the downfalls of each recommender technique if used in isolation.

User Profile

A user profile indicates the information needs or preferences on items that users are interested in (Li and Kim, 2004). User profiles play an important role in the recommendation process since their models represent the user's needs. Most personalised systems need to build a user profile or model of user preferences in order to identify the needs of individual users (Wanvimol, 2016, Jannach et al, 2010). The initial step in providing personalised recommendations is to learn about user interest and preferences in order to generate a user profile. User's preferences can be extracted from their past interactions with the system (Rendle et al, 2009). These user interactions consist of either explicit or implicit information about the user's preferences or interest in items. The user profile allows users to be modelled, which can be described as the process of building personal preferences (Bhowmick et al, 2010). An implicit model is constructed by the user directly, the user will provide the system with their interest, and this could be in a form of a questionnaire or surveys. An implicit model has constructed the system itself on the basis of feedback it receives from the user. These observations provide evidence about the user's interests on specific items. Machine

learning techniques can be used to combine this evidence with information about the items to create an implicit model (Systems, 2012). This can be typically collected by web clicks, page views, time spent on a page etc. User profiles can represent the interests or preferences of both an individual user and group users: an individual user profile provides only one user's interests and information, whereas a group user profile describes the common interests or goals of a group of users (Liang et al, 2010). The critical aspect of user profiles is their ability to represent user's current interests. According to (Gauch et al, 2007) the users profiling process consists of three main phases:

1. The first phase involves data collection.

The first step to create an RS is to gather information about the user. A basic requirement of such system is that it must be able to uniquely identify users. To generate the user profile, the system needs relevant information about the user's preferences or interests. There are different types of user information sources and techniques that can be used to discover user's preferences or interests. It can be achieved implicitly gathered by a software agent or explicitly through direct user interaction.

2. The second phrase is profile construction

User profiles can be represented as sets of keywords, topics, concepts, or ratings (Wanvimol, 2016). The most common representation is set of keywords, they can be extracted from the contents of the system such as web documents or can be directly provided by the user. Each keyword representing a topic of interest to the user or they can be grouped to display user's interests. The degree of user interest in the keywords can be weighted using the TF – IDF method (term frequency-inverse document frequency) in the vector-space approach (Lops t al, 2011, Gauch et al, 2007).

3. The final phrase involves exploiting information in a user profile to provide personalised services.

After a user profile is constructed, it is then used to provide personalised services in different areas, such as personalised recommender systems, personalised searches, queries, and trust-aware recommender systems (Wanvimol, 2016).

Rating Recommenders

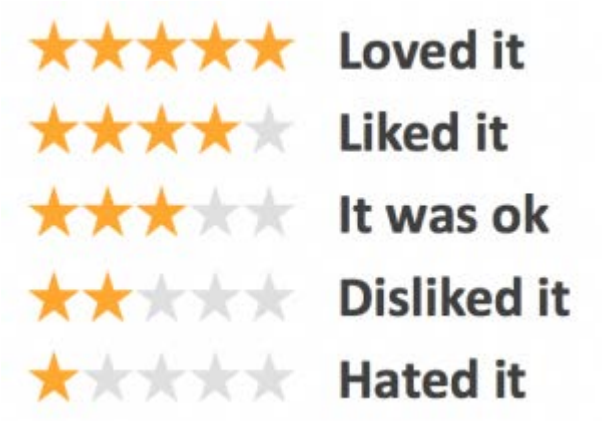

Figure 1 Example of 5-point rating

Ratings are often specified on a scale that indicates the specific level of like or dislike of the item at hand. It is possible for ratings to have continuous values in which the ratings can take on any value between 0.0 and 1. Ratings can be interval-based, where a discrete set of ordered numbers are used to quantify like or dislike, the use of numeric values between intervals allows the ratings to be quantifiable (Tracy, 2017). Such as the 5-star rating system illustrated in Figure 1. For example, a five-point rating system might be drawn from the set {-1, 0, 1, 2, 3}, in which the rating of -1 indicates an extreme dislike, which 3 indicates an extreme liking for the item. While other systems might draw the ratings from the set {1, 2, 3, 4, 5}.

The intention of this is to give validity to the locations and to provide users with stronger recommendations. The recommendations become stronger because now, it is not only solely depending on what is provided, it shows that others too will recommendation, for example, Venice, Italy if they would like a romantic getaway where they can also partake in sightseeing activities and amazing architecture

Related Works

The first step in the research is to look at existing sites and their features. This gives an indication of what works well and what features need to be changed in order to make a successful travel recommendation application. As the name suggests, the system's task is to recommend or suggest items or products to customers based on their preferences. In the past, different approaches to designing a recommender system have been propped. While some

strategies allow to directly recommend a list of items, most systems offer a different approach. E-tourism recommender systems are designed to provide suggestions to tourist. Some systems offer on tour packages that include transportation, restaurants and resorts, while others focus on attractions and destinations. However, there are very few that would give personalised recommendations based on what the user wants to do, in a city which is unknown to the user. Some have come close such as iTravel, SigTur/E-Destination and TripAdvisor however they have their shortcomings.

The websites:
https://www.itravel.com/
http://gotur.pct-turisme.cat/pages/index.html
https://www.tripadvisor.co.uk/Inspiration

SigTur/E-Destination is a personalised tourism recommendation system for activities in the region of Tarragona. SigTur/E-Destination integrated several types of information and recommendation techniques. The information used in the recommender includes demographic data, details that define the context of the travel, geographical aspects, information provided explicitly by the user and implicit feedback deduced from the interaction of the user with the system. The SigTur/E-Destination employs many recommendation techniques, such as the use of stereotypes (standard tourist segments), CB and CF techniques, and artificial intelligence tools including automatic clustering algorithms, ontology management, and the definition of new similarity measures between users, based on complex aggregation operators. This system is very limiting as it only provides recommendations in the region of Tarragona, in Spain and nowhere else.

iTravel is a web application that allows users to plan their ideal holiday by them picking a continent, theme and type of experience. Experience being in categories such as adventures, culture, and relaxation, then further sorted into subcategories such as Animal encounters, Hiking and adrenaline. Themes being the reason for travelling which can be for honeymoons, roundtrips, social etc. The subcategories all-inclusive resorts, family trips, villas etc. The results displayed are ranked in the accordance with how similar the destinations are to the user’s profile. It also displays a short description of the destination and the costings of it. This application then allows the user to book from the website. A pro to this system is that it inspires and recommends the ranked destination to the user. The options are very open as it

has five different categories which are then split into subcategories. By doing this it becomes more personalised and it really does get a feel for the user's preferences. The section of ‘Travel themes' allows the results to become even more personalised and it get the reasons of why one wants to travel. For example, where it is for camping, safaris, social etc. However, the downfall of the system is that to date it only provides for 39 countries across the world, which is very limiting. As there are 195 countries in the world which could equate to over a thousand potentially travel destinations. With that being said it does cover a fairly good range of countries each continent is cover with the minimum three countries excluding Oceania. Another downfall is that the system requires the users to pick a continent, this does not account for users who don’t mind anywhere. iTravel really does account for individuals who would know what experiences they would like to gain on their travels but do not know where to go. It also gives individuals personalised results which are ranked to the closer to the preferences, 100% being it completely matches the user's preference.

TripAdvisor is a web application that helps users to plan and book their trip, as it compares hotels and flights to assist the users to find deals and offers. It will then direct the user to the right websites to furthermore complete their booking. TripAdvisor has an ‘Inspire me’ section which the user can only select one category from the list. The category includes items such as beaches and sun, family fun, casinos, snow etc. Only one category can be selected by the user and a selection of a continent. The results then show destinations where the destinations that relate to the selected preferences. The downfall of the system is that it is very limiting there are only nine categories for the user to choose from and only one can be chosen. What happens if the user wants more than one category such as casinos and shopping? In reality when people travel aboard with the aim the explore they tend to partake in many different activities. For example, if one traveller to the Caribbean he/she can partake in activities such as going to the carnivals, going to the beaches and relaxing, or even in sea life activities and shopping etc. Many things can be achieved during a trip and TripAdvisor’s “Inspire Me” section limits all the possibilities of this.

Requirements

This section will highlight all the requirements for this project in order for this project to be a success.

Software requirements

The software specifications needed for the execution of this project.

- Operating System: Any operating system
- Language: Python
- User Interface: HTML 5 and CSS

Requirements analysis

Requirements analysis is the process by which customer needs are understood and documented, and express what is to be built but now it is to be built. These requirements serve as a contract between the client application developer and the library developer. They will serve to specify the project goals and plan development iterations. They will also be used as a basis for developing the test plans.

Functional requirements define the actions that the system must be able to perform (Ralph, 2003) or the required function of the system. On the other non-functional requirements define the qualities and attributes of the system itself. It can include performance requirements such as efficiency, maintainability and flexibility within the software (Chung, 2000).

A prioritisation method called MoSCoW, was developed by Dai Clegg, it is a simple but effective task prioritisation method **(**DSDM, 2014**).** It is a method of prioritising requirements in order to ensure completion of the project. It is broken down into four categories: Must, Should, Could and Won't (Clegg, 1994). It identifies four priority levels; *MUST* (highest level priority- these tasks must be completed otherwise the system is considered a failure), *SHOULD* (medium level priority- these tasks should be complete if at all possible), *COULD* (lowest level priority- these tasks could be completed, if not it does not affect anything else) and lastly *WONT* (no priority at all- these tasks will not be completed this time, but they may in the future). The requirements are sorted into functional and non-functional requirements and prioritised using the MoSCoW method.

The functional requirements describe the core functionality of the application. It describes how the system should react to particular inputs and how the system should behave in particular situations. Functional system requirements should describe the system services in

detail. While the functional user requirements are statements of what the system should do (Sa, 2016)

Functional System Requirements

ID	Summary	Priority	Rationale
FS1	The System should gather information about the user's travel preferences	Must	Storing and collecting users preferences
FS2	System updates matrix from user feedback	Should	City matrix is updated from the user's feedback adding credibility
FS3	The system displays ranked results	Must	The destination results ranked in percentage
FS4	The system should be easy and simple to use	Should	To allow users to easily interact with the system and understand the displayed information
FS5	Purchase flights and bookings	Won't	Purchasing of flights or hotels should not be possible
FS6	Hotel, flights and activities offer	Won't	No display of prices of hotels, flight and activities should not be shown

Table 1: Functional system requirements

Non-functional requirements specifies how the system show behave, it is also the quality attributes for a system. It covers all the remaining requirements which are not covered by the

functional requirements. They specify criteria that judge the operation of a system, rather than specific behaviours (Eriksson, 2015).

Non-functional system Requirements

ID	Summary	Priority	Rationale
NFS1	Portability	Must	It can be view on any sized screen display
NFS2	Speed	Should	The system should not crash or freeze and display results in a timely fashion
NFS3	Documented	Could	Documentation about how the system works.
NFS4	Reliability	Must	The system should respond to user requests.
NFS5	Non- Rigidity	Could	The system is hard to change because of co-dependency

Table 2: Non-functional system requirements

Functional User Requirements

ID	Summary	Priority	Rationale
FU1	The user should be able to select series of items to obtain create a recommendation	Must	Collect the information the users provide, in order to create user preferences
FU2	The user should be able to give feedback	Should	Option for user to give feedback on if said activities can be done in said cities
FU3	The user must be able		To allow users to select

	to select activities from the list	Must	activities from activities list
FU4	Book recommended destination	WONT	The user would not be able to book the holiday through the system

Table 3: Functional user requirements

Use Case Diagram

Use case diagrams illustrate the usage requirements for a system. During development uses cases provide significantly more value because they describe the requirements of the system. Each use case provides a set of scenarios that convey how the system should interact with a human user to achieve a specific goal. The diagrams do not describe the internal workings of the system, nor explain how the system will be implemented. Instead it shows the steps needed to perform a task (Sa, 2016).

Actors who interact with the system are identified and use cases are developed to model the system requirements. The actor represents the human in the role, in this case, it will be anyone using the system, the potential traveller, the box represents the whole system and lastly, the ovals represent the individual use cases of the system.

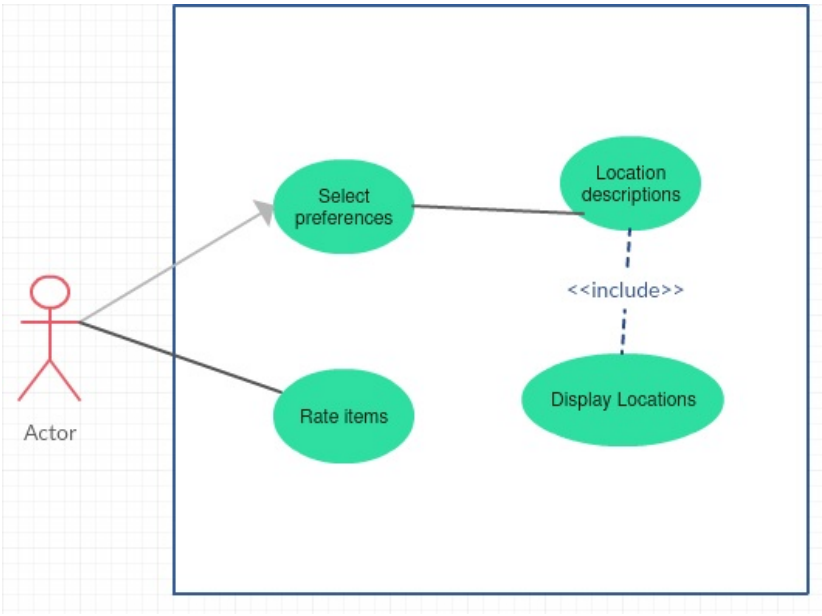

Figure 2: Use case diagram

Select preferences use case description:

1. User: selects category tab
2. System: displays clickable items according to category

3. User: selects preferred items
4. System: adds items to list, and displays selected items
5. User: clicks the finish button
6. System: Confirms selected items with user preferences listed
7. User: confirms selected items
8. System: uses all selected items to create user profile.

Extensions:

6a. User cancels or no selected items

- System: return to home page

Rate items use case description:

1. User: Selects destinations to leave feedback on
2. System: provides 5-star ranking system on the activities that destination allows
3. User: rates activities according
4. System: Records ratings and uses scores to adjust location matrices
5. System: Thanks customer for feedback

Display destinations use description:

1. System: retrieves user's user profile
2. System: uses content based filtering to recommender locations destinations.
3. System: orders locations according to user profile
4. System: Displays ordered locations

Methodology

This section outlines the processes and methodologies that been and will be implemented during the lifecycle of the project.

The plan-driven approach identifies separate stages in the software process with outputs associated with each stage, the outputs from one stage are used as a basis for planning the following process activity, taking this approach will not be appropriate for this project agile will be used instead. The agile approach is based on iterative development, where the requirements, design, implementation and testing will be done in parallel and iteratively.

In plan-driven iterations occurs within activities with formal documents used to communicate between stages of the process. While the agile approach iterations occur across activities, meaning that the requirements and design are developed together not separately. This allows change and growth of the system as it is not rigid and incapable to change. When a roadblock appears in a system, it tends to be noticed and rectified earlier on in the development process as development and testing works hand in hand. Below illustrates an iterative development idea.

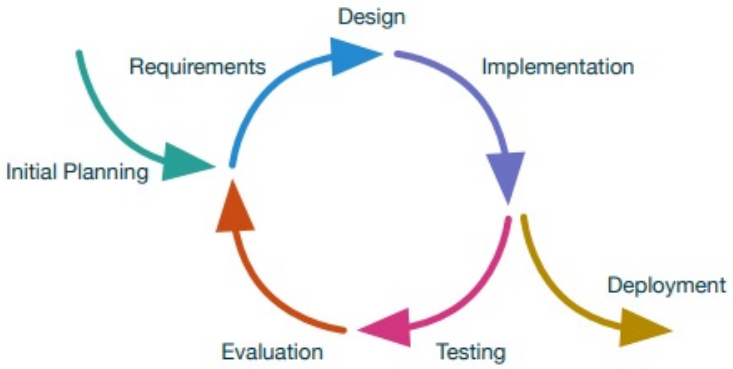

Figure 3 iterative development methodology (Salmon, 2014)

Project Plan

Stage	**Planned period**
Generating of ideas and initial research	September 2017
Creating of requirements	October 2017
Design application and development of the prototype	November 2017
Review application, test, development of prototype 2	December 2017
Review application, test and development of prototype 3	January 2018
Testing and completion of the final development	February 2018
Complete report	March 2018

Table 4: Project plan

Iteration 1

This will lay the foundation for the first implementation. The functional tasks such as creating the layout of the web page and creating the dataset. This will form the first prototype.

Iteration 2

The second iteration implementation of the matrices and the completing for the web page. An example development of the system is expected to begin at this point.

Iteration 3

The web application should show be completed and fully functioning and should be giving recommendations with the rankings.

Basic Notation

A focus on the destination recommender system is the user-rating data of the system. As it will increase the credibility of the system and it allows the system to become be adaptive. Related terms are listed below:

- User: A user the person who will use the system and the system will suggest items to that person.
- Item: An item is an entity in the RS which is the location of a destination.
- Rating: Rating is the number given by the user to a particular item on the scale based on the users liking.
- User Profile: The profile that represents the user's preferences.
- User-item Matrix: the matrix which contains ratings given by the user to an item.

Design

A software design is a description of the structure of the software to be implemented, the data models and structures used by the system, the interfaces between system components and, sometimes, the algorithms used (Sommerville, 2011). As the requirements of the system have been decided upon, the system needs to be designed to make sure that all of the features are included.

System Architecture

A systems architecture is the conceptual model that defines the structure, behaviour and more views of a system (Jaakkola and Thalheim, 2011). It is the overall structure of the system, the principal components and how they are distributed.

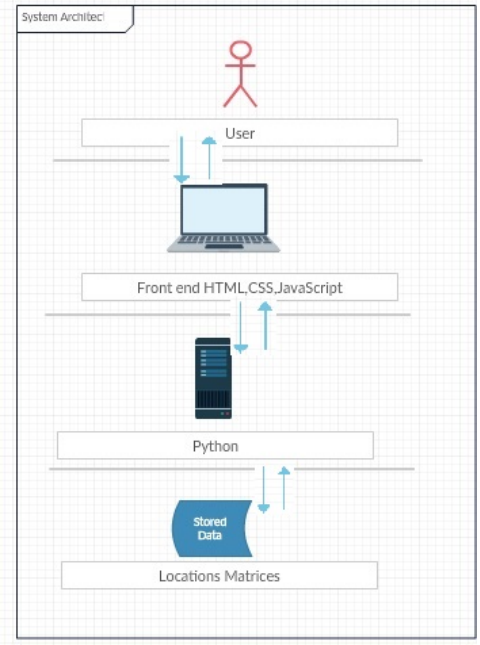

Figure 4: System architecture

The architecture of the entire system is shown in the figure 4. This project is developed using Python, HTML, CSS and JavaScript.

Front-end

The technologies used in order to display the contents of the page to the use is HTML and CSS. The display the users sees id known as a graphical user interface (GUI), this is the first thing the users will see and will use to interact with the system. HTML and CSS were used to create and design the front end. HTML stands for Hypertext Mark-up Language, which will be used to render the content of the pages to be displayed on the World Wide Web. Advantages of using a mark-up language include simpler and faster development, accessibility, forward compatibility, and faster download display **(**Robbins, 2006**).** Alongside using HTML, CSS will be used to accompany it. CSS stands for Cascading Style Sheets, it is used to beautify the deployment of HTML pages, it is used to control the colour of text, sizing of fronts and how the webpage will look in terms of layout and structure. CSS defines how the HTML elements will be present of the page (Wordpress.org).

Backend

For this, the programming language Python will be used to implement the system. Python is ideal when working in the field of data science as it comes with many powerful packages and folks such as Panda and Numpy. Also, many of the accompanying packages are open source which comes with a bonus, and with an open source community that never seems to stop contributing to more Python packages.

Locations Matrices

In order to have destinations to the recommendation of the users, a dataset must be created. This process can be extremely time to consume, as information of various activities has to be gathered. Research must be done on what activities can be achieved to certain locations; this dataset can be represented in a binary table. Figure 5 shows a snippet of the created dataset, in the form of ones and zeros. Ones indicating the item from the category in the columns can be achieved in the locations in the rows.

	england	France	Italy	Spain	Portugal	Malta	Germany	Switzerland	Netherlands	Greece	Poland	Ukraine	Austria	Sweden	Belgium
Shopping	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Biking	1	0	1	0	1	1	1	0	1	1	1	1	1	1	1
Partying	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1
Culture	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1
countryside	1	0	0	0	1	1	1	1	1	1	1	1	1	0	1
city	1	0	0		0	0	1	1	1	0	1	1	0	1	1
sightseeing	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1
sky-diving	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0
Canoeing	1	0	1	0	1	0	0	0	0	1	0	0	0	0	1
Kayaking	1	0	1	0	1	0	0	1	0	1	0	0	0	1	1
Surfing	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Ballon Rides	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1
concerts & Musicals	1	1	1	1	0	1	0	1	1	1	1	1	1	1	1
Mountains	0	1	1	1	0	0	0	1	0	1	1	0	0	0	0
Zoos	0	1	1	1	0	0	1	1	1	0	1	0	1	0	1
Beaches	0	1	1	1	0	1	0	0	0	1	1	1	1	1	1
hiking	0	0	1	0	0	0	0	1	0	0	1	1	1	0	1
Boat Tours	1	0	1	1	1	1	0	0	1	1	1	1	1	1	0
Off Road Tours	0	0	1	1	1	0	0	0	1	0	0	1	0	1	0
Ski/Snowboarding	0	0	1	0	0	0	0	1	0	0	1	1	1	1	1
Dolphin watching	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0
Horse Riding	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0
Parasailing/Paragliding	1	0	1	0	0	1	1	1	0	0	0	0	1	0	0
Museums	0	1	0	0	1	0	1	1	1	1	1	1	1	1	0
Water parks	0	1	0	1	1	0	1	0	1	1	1	1	1	0	0
Amusement Parks	1	1	0	1	0	0	1	0	1	0	0	0	1	0	0
spa & Wellness	1	1	0	1	1	1	0	1	1	1	0	1	1	1	0
Wine Tasting	0	0	1	1	1	0	0	0	0	1	0	0	0	0	0
Casinos	1	0	0	1	1	1	0	1	1	0	0	0	1	1	1

Figure 5: Activity-destination matrix

Context of System

Figure 6 shows the first thing the user will see when using the system. The user starts with three tabs, where they have different options to choose from. The tabs are split into themes, experiences and activities, containing checkboxes alongside images to show the different items. The themes tabs contains items of the type of themes of the holiday, such as whether the sole purpose of the holiday is for shopping and luxuries, a family trip or for the city life.

The experiences tab is for what experiences the user would like to gain from the holiday such as whether they want the holiday to be relaxing, full of culture or wild and fun. The activities tabs consisting of different activities to engage in such as balloon rides, parasailing to name a few. The user is given different options to create their user profile of the type of holiday they would like in order to get personalised recommendations of location to visit. It will be clickable pictures displaying the items, so if the item is about shopping the item will show shopping bags. Once the mouse hovers or clicks the items the name of the item will show and the checkbox will be checked.

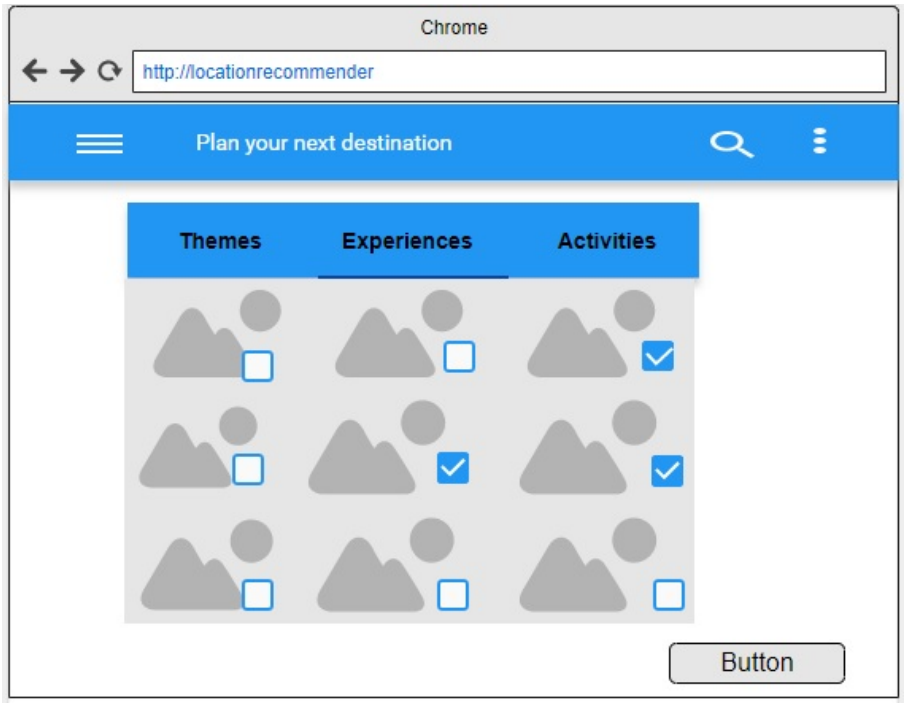

Figure 6: System wireframe 1

Once the users have made their preferences and clicked the submit button another page will appear displaying the list of items the user has selected, this wireframe can be seen in figure **7.** The user is given an opportunity to confirm the selected items and make changes to the list if needed. Once this has been confirmed, the items are then used to create the user profile and begin the recommendation process. Lastly the ranked locations will be displayed for the user and once clicked a brief description of the destination is given. The personalised recommendations are ranked according to the locations that are the most suitable for the user, 100% being it matches all the user's requirements.

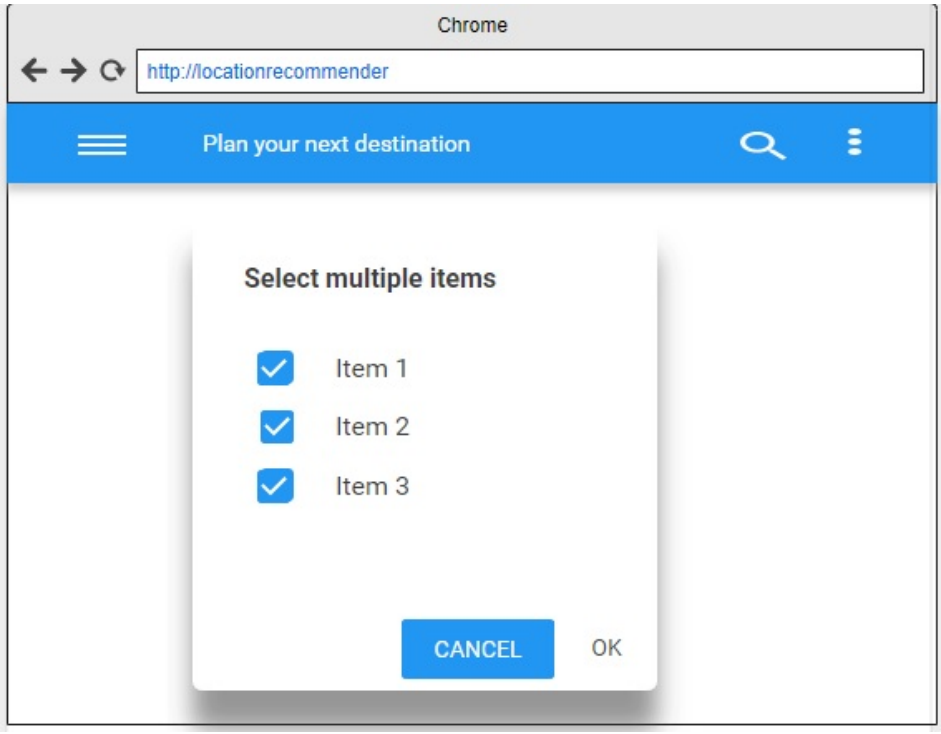

Figure 7: System wireframe 2

Sitemap

A site map is the model of the web application context design to illustrate how users will navigate the site. The figure 8 shows the sitemap of the application. The about us, contact us, destinations, and the reviewing destination sections can be selected from the menu dropdown of the application. The first page/ main page will be the holiday builder page, where the user is able to retrieve destination inspirations via recommendations shown on the results page.

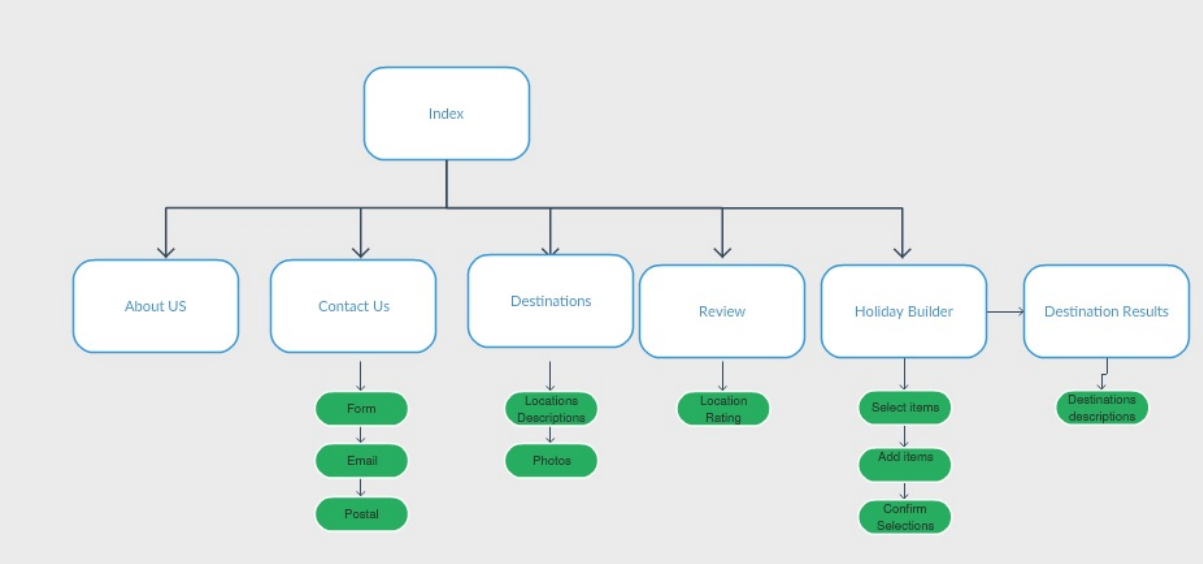

Figure 8: Sitemap

Activity Diagram

Activity diagrams are typically used for business process modelling, it models the logic captured by a single user or usage scenario. Activity diagrams represent the business and operational step-by-step flow workflows in a system. It shows the overall flow of control. In many ways, UML activity diagrams are the object-oriented equivalent of flow charts and data flow diagrams from structured development. A very common use of activity diagrams is they enable you to depict both the basic course of action as well as the alternate courses.

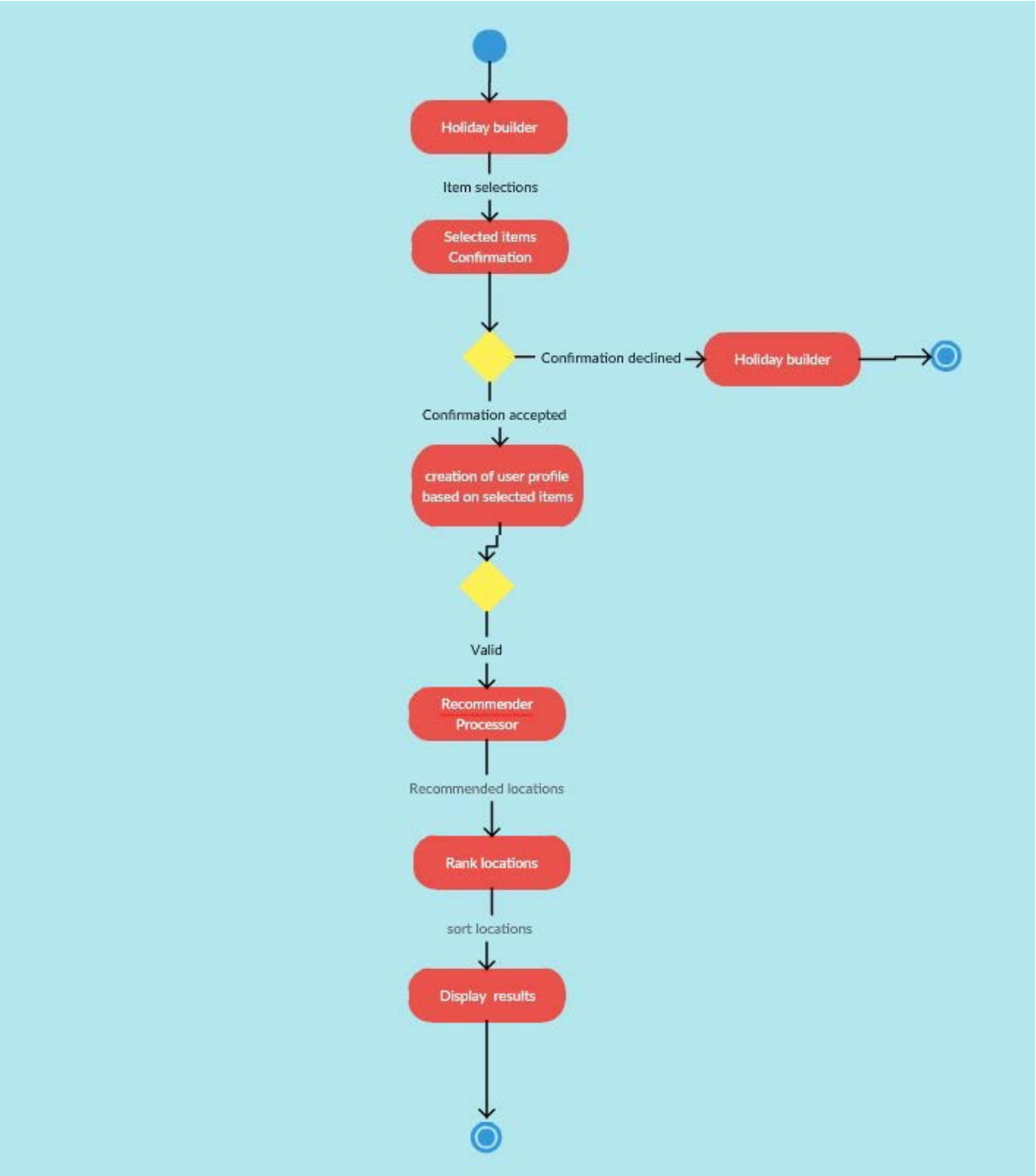

Figure 9: Activity diagram for holiday builder

Figure 9 shows;

1. The holiday builder; this is where the user makes their selection to build their user profile and where the users ranking the locations. The inputs are captured and is then used to create the user profile.
2. The system displays the user's selected items, once confirmed the recommendation process begins.
    a. If declined to make adjustments or to cancel the holiday builder page is shown again.
3. From the user's inputs, their user profile is to be created, containing their preferences.
4. The TRS's core component, the "recommendation processor" does the processing of the result set;
    a. Preference processor: this does the computation of the total counts of the travel preferences. This processor uses content-based filtering method, which was explained in implementation section using the TF-IDF method**.** It takes the first item in the result set and determines the range of the preference attributes. This is then compared to the user profile to obtain the matching tags, to determine which matches the tags. Once the locations corresponding the tags has been identified. It keeps track of all the preferences and the respective locations.
5. The scores obtained from the recommendation processor are ranked in the sort results processor, thus generating the final ranked results. It will take the number of preferences in the user profile and calculate that against the possible locations associated with it to determine the percentages ranks.
6. The ranked destinations are then displayed for the user to see. With a short description alongside with an image of the ranked destinations.

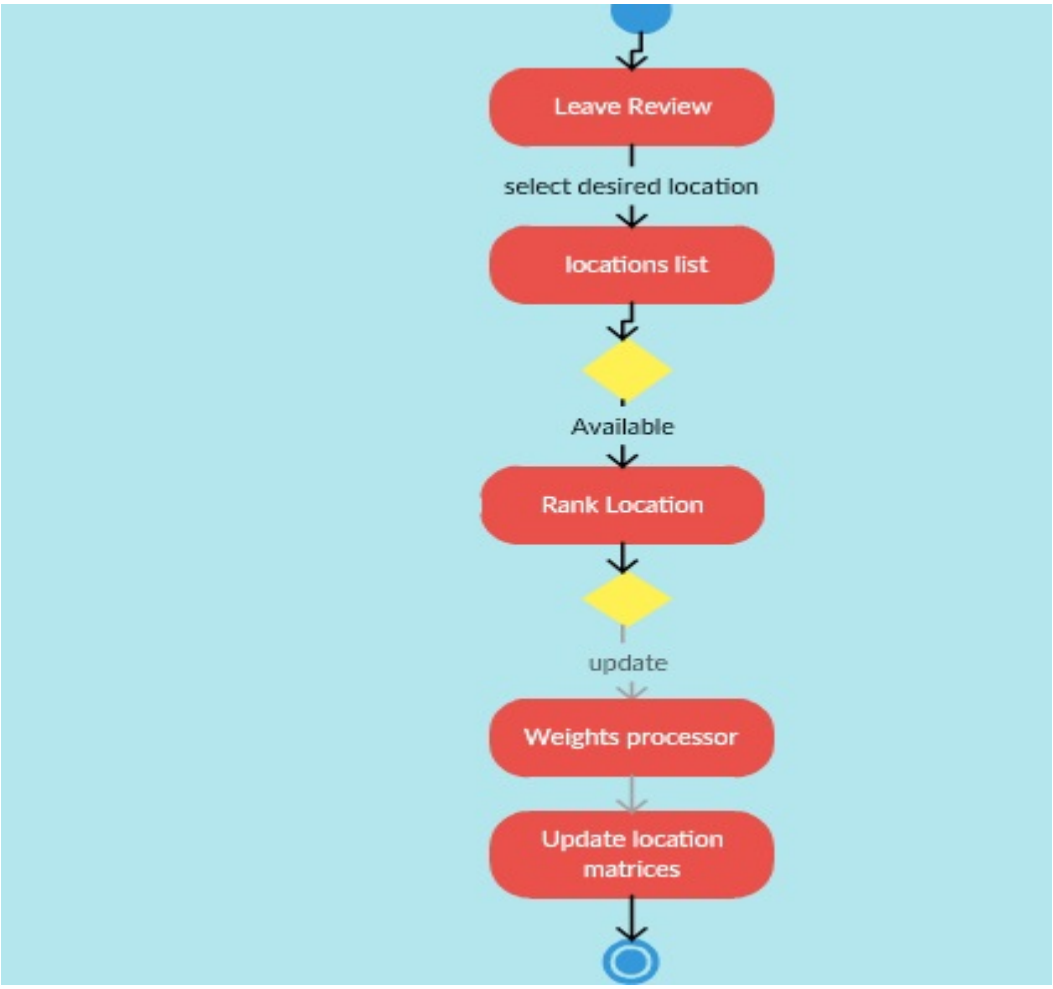

Figure 10: Activity diagram for feedback

The process when the user uses the rating system part of the TRS, shown in figure 10.

1. Locations are displayed for the user to choose a location to review.
2. A 5-star rating system is used so the user can rate a location.
3. Weights processor: It fetches the weights associated with each activity and updates the weights cumulatively every time the user gives their ranking. At the same time decrements the weights of poorly rated activities in certain locations. This adds a significant feature to the system differentiating from other travel recommendations systems such as iTravel. Over time certain activities linked to a location will have a significantly higher weight over some others, allowing them to have an advantage during the preference processor process. The highest possible weight being 1 and lowest being 0.0 the weights are stored in decimals and will increment in decimals opposed to integers.

4. The ranked location results are collected and analysed. Weights are associated with the ranks locations depends on the score from the 5-star rankings. The data is then sent off the preference-weighted data storage, to be updated.
5. The system thanks to the user

Sequence Diagram

Sequence diagrams model the flow of logic within the system in a visual manner, enabling us both to document and validate your logic, and are commonly used for both analysis and design purposes. Sequence diagrams are the most popular UML artefact for dynamic modelling, which focuses on identifying the behaviour within the system. The sequence diagram captures the flow of logic in the current application. Figure 11 models the flow of logic where the user uses the system to retrieve a recommendation.

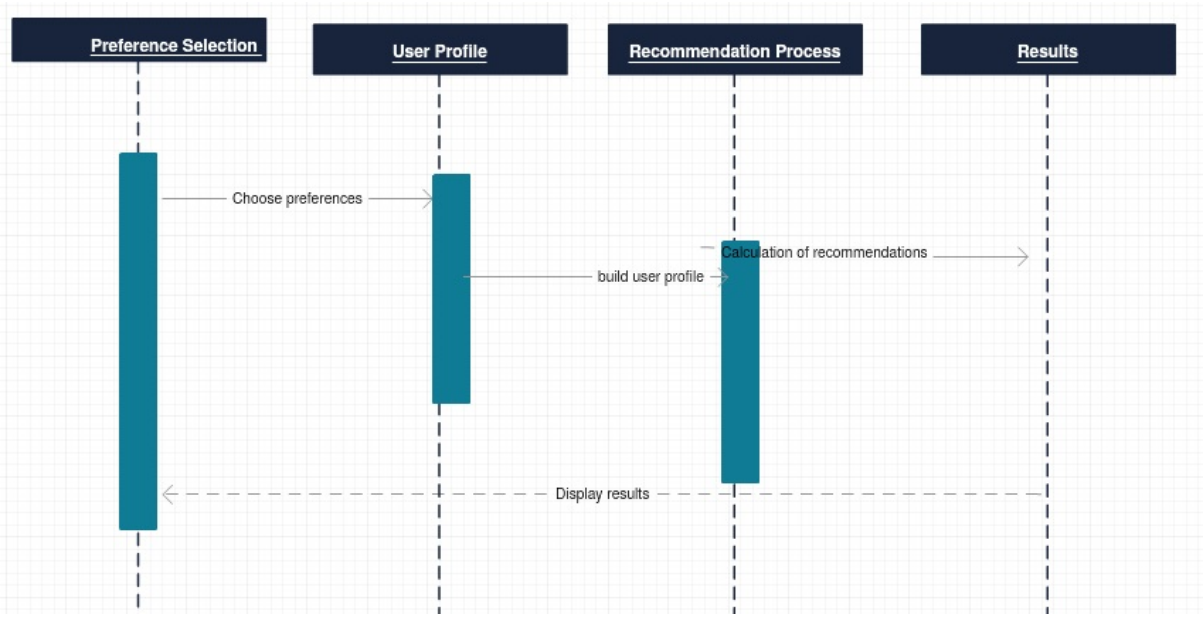

Figure 11: Sequence diagram

Implementation

The implementation stage of software development is the process of converting a system into an executable system.

Software

The development environment software's used to compile and test the system were all available as open source, thus reducing the cost of production. Atom is a text editor that can be used to execute and execute code. Anaconda is a commercial web development

application. Conda, for short, enables installation and updating of packages completely independent of system libraries, it installs binary packages. The packages come with Numpy, Scipy and PyQt which can be very useful.

Recommendation Process

The personalisation process is divided into three stages; compiling of user information, recommending items and satisfaction degree. Compiling user information involves building the user's profile, in order to know them better. This is achieved by allowing the users to select from a selection pool of items-of-interest. This pool is made up of items that can be checked that correspond to activities, theme or experience such as snowboarding, kayaking, relaxation etc. These categories act as tags of attraction which are chosen from a fixed set of attraction categories and are restricted to nodes. Using the example of London as a destination. London is famous for its world range of landmarks across the city such as the 'Buckingham Palace', 'Big Ben'. That being categorised into points-of-inters, landmarks, sightseeing, historic sites. The British museum being; history, culture, POI, and the Westminster Abbey being religious sites, sightseeing, landmarks. These key attractions and their associated tags give an overview of what London has to offer to the tourist.

Once the user profile has been created the system becomes aware of the users travel preference and can know use it to make recommendations.

User profile

The initial step in creating personalised recommendations is acquiring user preferences, each profile describes the users travel interests and preferences. The user profile will be generated explicitly collecting information from the selected checkboxes. By extracting information in such way allows users to express their opinions by selecting values from a range. Keywords are associated with each checkbox; the keywords represent a topic of interest and are grouped into categories to reflect a more standard representation of users' interest. This can be seen in the text bar in Figure 12, these are keywords which will be used to create the user's profile.

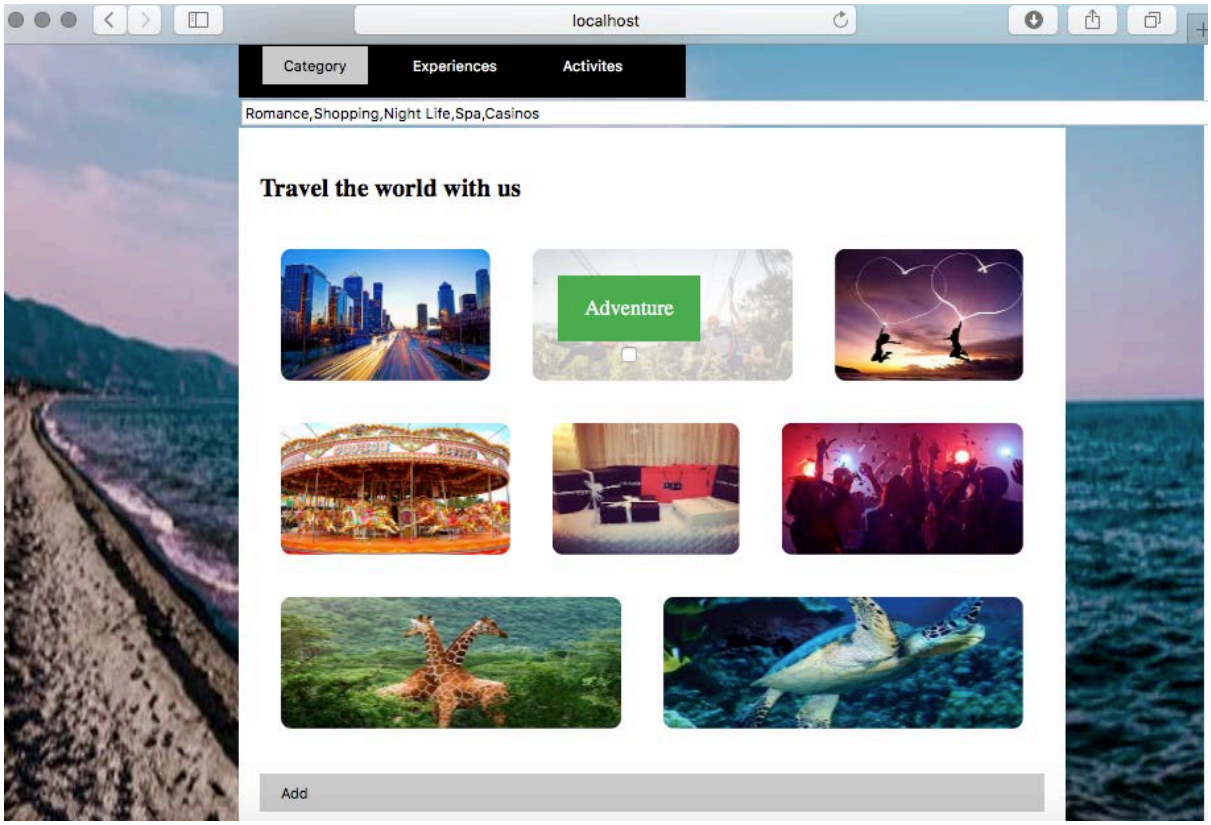

Figure 12: Holiday builder

Rating of the destinations

The users of the will be given the opportunity, to review/rate whether certain activities can be called out in certain locations. The feature is has been added to improve and ensure the reliability of the recommendations given to users. Allowing the system to revolve and learn over time.

Feature Weighting

This is associated with assigning weights to the features of the system. When the user has rating a location this gives the location added weights. For example, if a user visits a location and they would not recommend that location for a specific activity, the user rate that activity in that location poorly. Thus, reducing the weighting of that activity in the location. Let's say the activity is kayaking in Venice, Italy with a current rating of 0.5, a poor rating will reduce it to 0.4. Meaning one can still do kayaking in Venice, but it may not be the best location to carry out said activity in and the locations with a higher rating for that activity will be recommending above Venice. The higher the weight the higher the chances of the location being recommended.

Testing

Software should be of high quality and bug-free. In order to accomplish the task of developing such software, robust testing must be carried out. Software testing is a process of verifying and validating that a software application meets the requirements stated during the design and development process. Testing is an iterative process that is carried out in conjunction with implementation. System testing follows the completion of the implementation. Software testing can be classified as static (white box testing) and dynamic (black box testing). Black box testing falls under static testing, the tester interacts with the system by providing various inputs to check validations without considering the internal workings of the system. While on the other hand, dynamic testing (white box testing) the tester will have knowledge of the internal workings of the system and test cases can be created to ensure the system meets the requirements.

Test number	Test Cases	Expected Outcome	Actual Outcome	Fixtures(if needed)
1	To test the homepage to check fluid layout.	On different browser sizes homepage should be formatted well.	When resized some structures became out of place	All absolute padding, width and height sizes were changed to percentages.
2	To test linking of all pages.	All navigation links are working.	All navigation links to pages worked	N/A
3	To test if the user can select their preferences	The user should be able to select from the different categories and all the selected items shown.	As expected. Shown in figure 12.	N/A
4	To test if the user can remove already selected items	The user should be able to remove items from selected items.	As expected, the user has to uncheck the checkbox	N/A
5	To test contradictions in items.	The users should not be able to select contradictions in the system e.g. beach and snow.	Once one opposite has been selected the other becomes disabled.	N/A
6	To test if the user can	To display selected	User preferences	Made sure it was

	see selected preferences	preferences that the user has chosen.	were shown, however not in order as user selected. Shown in figure 12.	in the user's selected order.
7	To test if results are ranked accordingly	The destinations are ranked according to the user's profile	Destinations have a percentage ranking	Remove ranking that is below 50%
8	To test that brief description of destination is shown	The resulted destinations should have a picture and brief description of the destination.	Picture and description were shown	More description was added so that activities the user selected are addressed in the description.

Table 5: Test table

Screenshots

Figure 13 shows the webpage in a resized layout. This demonstrates how responsive the layout is. The images become blurred, however, they are still recognisable and keep the same layout of then it is in its normal size. This allows it to pass the first test.

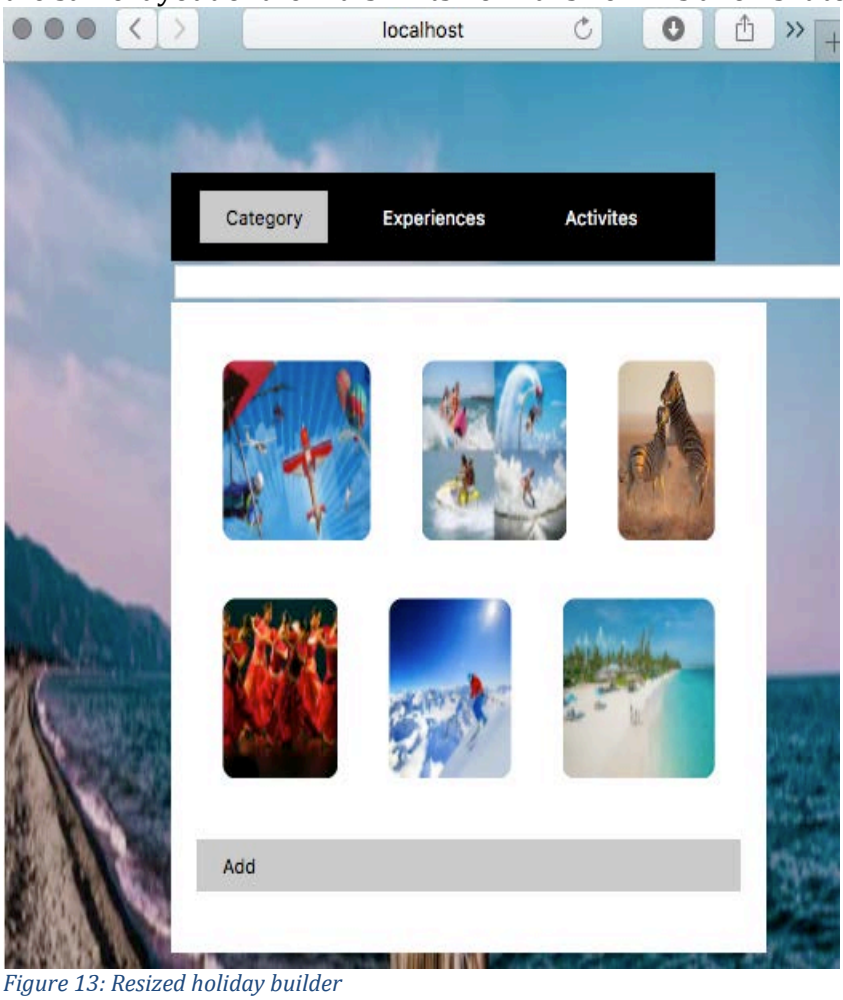

Figure 13: Resized holiday builder

Figure 14: Contact Us page

Figure 14 displays the contact us page, the menu icon demonstrates that the pages are interlink and different pages can be navigated, thus passing the second test.

Project evaluation

Reflections

Before starting the author undertook this project, the author had no knowledge in coding with Python and limited knowledge in HTML and CSS. However, the author was open to learning new technologies and the author is pleased that she took on the project with those programming languages, from research it also transpired that Python is the most suitable learn to complete my project in. The author states that she feels fairly confident in taking on different projects in those languages and what I can do with them in the nearest future. A lot of online tutorials were used to help the author along the way to aid the learning in the languages. The author feels a sense of accomplishment in her current programming skills compared to my previous works, with that being said there is always room for more improvement and development in my skills.

The author understands the time estimated and the time actually taken to most elements of the project was under estimated, as most steps overran. Due to this extra time was spent completing and refining each section. As would be expected the implementation of the system took the most time as the author not too familiar with the programming languages and had to learn as the author progressed.

Upon reflection the author found the managing of the project to be quite difficult, due to the juggling of the authors other modules. The project had be isolated on till the February, problems and unforeseen circumstances in the author personal life arose which effected the work process of the project. With that being said the author has learnt a lot about time management and learnt how to program in new languages during the time taken to complete the project. These lessons has taught the author that spending the work lot and completing smaller sections at a time would be more beneficial.

Future Work

The travel recommender system application is limited to only a few destinations, the number of holiday destinations could be increased significantly. The system could be extended to account for group travellers. The system could be further extended by allowing the user to be able to log in. This will be beneficial as the user does not have to remember their preferences when trying to reviewing the system, this will also make it easier for when the group travel extension has been implemented. Users will also be able to redefine their user profiles to make adjustments.

Conclusion

This report describes the Travel Recommender system, an application that inspires users and gives them personalised travel recommendations based on their selected preferences using the systems tool. This project has been successful in the sense that all the aims had been achieved. This project has taught the author many lessons from time management to learning new programming languages such as Python and JavaScript and putting developing greater skills in HTML5 and CSS.

If time was at the authors hand more locations would have been added to the travel recommender system application allowing the system to be beneficial to the tool mases. The author plans on further developing this project to one day help and truly inspire others across the world.

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