Automated tourism package configurator – first results

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Abstract— When the customer wants a product that fits their personal requirements, they are facing the challenge of whether to spend a huge amount of time and cognitive energy on choosing or configuring the desired product, or to settle for a predefined one. In the case of tourism packages, the customer can choose from predefined ones both online or offline, or they can use numerous specialized web pages that can be of lesser or greater complexity. Most of them configure a package from a series of lists which the customer should pick an option from. This can often be rather time-consuming and annoying, especially if the customer has no real knowledge about the options available. Therefore, this paper presents an automated solution for a tourism package configurator, accompanied with a case study.

I. INTRODUCTION

Customer centricity has become a necessity in recent years because the product offer overload has forced companies to fight for each individual customer. One result of this attempt to retain as many customers as possible is that companies now organize their activities around customers [1]. In order to address the individual needs of customers, mass customization has been introduced as an approach. One implication of this approach is that the variety and complexity of the product offers rises, both for the company and for the customer [2,3]. Mass customization changes the role of the customer from the consumer of a product to a partner in the process of adding value [4]. Active customer participation is crucial for the successful incorporation of customer needs into the product, but it is also important to satisfy the user’s experience-related requirements, because experience is created through a chain of human cognitive activities. Therefore, active customer participation is an important design driver for the whole process, which directly influences the final product offering [5,6,7].

In order to be able to incorporate the customer needs into the product, a system is needed that can translate the customer needs into product specifications, i.e., a specification system is necessary. Therefore, product configurators are used which translate customer needs into product designs in order to deliver a final solution based on product realization knowledge [8].

The involvement of the customer into the configuration of the final product raises several questions that have to be answered, one of which is that despite customers nowadays being knowledgeable in general, they are still far from being experts who can really co-create a product or a service [9]. The fundamental challenge is to avoid the abortion of the configuration process by the customer. In many cases, the customer aborts the configuration on their own due to a lack of customer-desired option values regarding a specific attribute within the system, as well as the inability of the customer to create definite preferences among certain option values. As a result, the customer does not even reach the orders-sales phase. Furthermore, if customers are overwhelmed by the configuration task, there is a chance that they may abort the configuration process. Customers usually only want the product alternatives that meet their requirements perfectly; if too many choices are offered, customers may feel frustrated or confused, and therefore become incapable of making proper decisions.

This overload of information is sometimes called external complexity. This external complexity is caused by the limited information processing capacity of humans, the lack of customer knowledge about the product, and customer ignorance about his or her real individual needs [10]. Based on problem analysis regarding customers’ involvement in the configuration process, the main areas of investigation to be considered are the minimization of the complexity experienced by the customers and the reduction of the cognitive overhead, considering not only the extent of choice, but the customer’s lack of understanding of which solution meets their needs, and also the uncertainties about the behavior of the supplier and the purchasing process [11].

The fact that the number of IT users is steadily increasing, and that more and more people rely on the Internet to find information and solve their problems, suggests that the Internet is a suitable environment for providing customers with the appropriate products.

The results of analyzing available tourism services on the Internet yielded the conclusion that the offers of tourism packages are extensive, but that they are also far from being a personalized service to the customer [12].

The previously described aspects call for the development of an on-line product configurator that can generate a personalized and automated tourism package offer in a short period of time, without much effort from the customer.

The remainder of the paper is structured as follows: First, a brief background is given on previously defined structures of the tourism package and customer profiling. Following that, the algorithm developed for the tourism package configurator is presented, as well as the information technologies used for implementation of the product configurator. Next is a case study showing the results of the developed configurator implemented in the wider area of Subotica, Serbia. Finally, a discussion of the results and conclusions is presented.
II. BACKGROUND

A. Defined structure of the tourism package

If one wants to configure a tourism package offer, the approach is to define this product as a complex object. Then, the package generation is made by combining a subset of components from a set of predefined ones, while meeting the customer requirements, and other predefined constraints.

The previously developed general product structure described in [13] is adapted to meet the requirements of the automated tourism package configurator. The adapted product structure is shown in Fig. 1.

The tourism package complex object consists of one or more ‘day’ objects, which are complex components, as well. The range of the possible cardinalities for the duration of the tourism package is expressed by the interval (1:4). That means that the tourism package could last from one to four days. The ‘day’ complex component consists of four different type components. Components are places, sights, museums/galleries, and restaurants. Cardinalities for ‘lunch’ and ‘dinner’ are 0 or 1, which means that there can be a restaurant component if the customer asks for it. Cardinalities for the other components range from 0 to \( m, n \) and \( k \). 0 means that there is no component at all in the configured package, whereas \( m, n \) and \( k \) depend on constraints and requirements defined by the customer and by the developed solution.

The structure of the components is defined as a hierarchical classification. The overall structure is previously defined [13]. At this time, for the purpose of this particular solution, only a part of the structure is used, which is shown in Fig. 2.

B. Customer profiling procedure

In order to be able to have an automated tourism package offer, the customer needs to be profiled first. Not only is an accurate customer profile needed, but the profiling process also has to be as quick and easy as possible, to make sure that the customer does not feel obliged to spend a considerable amount of time on this activity before a solution is offered.

The developed solution uses the previously developed two-level fuzzy reasoning general customer profiling algorithm [12,14]. In this way, the customer profile can be defined in a very short period of time, and ideally by only two input variables.

If the output of the first level of fuzzy reasoning is not satisfactory for the customer, they can adjust that output, by changing the output values, which then serve as adjusted input into the second level of fuzzy reasoning. Whether or not the mid-level values are changed, they are analyzed by the second-level fuzzy logic. The output from this fuzzy reasoning is a set of constraints on the values of attributes of the components which will form the tourism package. This two-level fuzzy reasoning is used to avoid the potentially conflicting values of the output that could occur if the customer enters values such as high expectations, but very low budget, etc.

III. OBJECTIVE AND METHOD

The paper aims to present a developed solution that provides an automated tourism package offer. The developed approach uses a previously developed procedure that takes into consideration the customer’s requirements by profiling them before the beginning of the package configuration [13]. Also, based on the previously defined general product structure of the tourism package [12], an adapted product structure is used. With that used for basis, the detailed algorithm for the solution generation is developed and coded to be used by the tourism package configurator. The solution is tested using a case study with variations of input parameters to collect data needed to guide the development following in the future.

IV. DEVELOPED ALGORITHM AND INFORMATION TECHNOLOGIES USED FOR THE TOURISM PACKAGE CONFIGURATOR

A. Developed algorithm

The structure of the developed algorithm for the tourism package configurator is shown in Fig. 3. The first predefined process selects the places, sights, and museums/galleries based on the input parameters obtained from the customer, and data from the components’ database. The selection is made by picking the components one by one, until the time frame is filled. The second predefined process is used for choosing the appropriate restaurants that serve as a basis for the inclusion of restaurants into the final itinerary. Restaurants
are also selected based on the input parameters obtained from the customer, and data from the components’ database. The number of chosen restaurants is larger than needed for the customer to be able to select the appropriate restaurants which are not too far away from selected components. After all components for the tourism package are defined, the package generator activates the final predefined procedure. This procedure optimizes the order of the components. As the result of the final procedure, the generated tourism package, i.e., the detailed itinerary is presented to the customer. It contains all the necessary data (sequences of events, durations, travel routes, travel durations, etc). All procedures function in a way that one component can be selected only once.

B. Used information technologies for implementation

In order to be able to implement an on-line configurator for the automated tourism package, several information technology tools have to be used. The overview of the used technologies is presented in Fig. 4. PHP is used for data manipulation from the input and from the MySql database. The manipulated data is then transmitted to javascript. Javascript communicates with Google maps through Google maps API v3 to visualize the transmitted data to the map. In addition to mere visualization, there is a need for trip optimization. The used tool is Optimap [15]. The tool calculates the best possible roundtrip route and displays it on the map. During the restaurant insertion, the Haversine formula is used to make the decision, which restaurant to insert from the set of selected ones [16].

V. CASE STUDY

The tourism package configurator is tested by configuring a package for the wider area of the city of Subotica, Serbia, to attain feedback on the developed approach. The case study tested three variations of input parameters that are presented in Table 1. The data whose values were varied are shaded. The output from the second-level of profiling for the input parameters is presented in Table 2. This output is not visible to the customer.

Table 1. Input parameters

<table>
<thead>
<tr>
<th>Input parameter</th>
<th>1st var.</th>
<th>2nd var.</th>
<th>3rd var.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age of the customer [Y]</td>
<td>40</td>
<td>40</td>
<td>20</td>
</tr>
<tr>
<td>Type of the customer</td>
<td>Couple</td>
<td>Couple</td>
<td>Alone traveler</td>
</tr>
<tr>
<td>Budget</td>
<td>Auto. (0.58)</td>
<td>Auto. (0.58)</td>
<td>Auto. (0.17)</td>
</tr>
<tr>
<td>Expectation</td>
<td>Auto. (0.64)</td>
<td>Adapted (0.9)</td>
<td>Auto. (0.17)</td>
</tr>
<tr>
<td>Duration</td>
<td>Auto. (0.56)</td>
<td>Auto. (0.56)</td>
<td>Auto. (0.50)</td>
</tr>
<tr>
<td>Activity level</td>
<td>Auto. (0.64)</td>
<td>Auto. (0.64)</td>
<td>Auto. (0.83)</td>
</tr>
<tr>
<td>Have lunch</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Have dinner</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Begin activities [hour]</td>
<td>08:30</td>
<td>08:30</td>
<td>08:30</td>
</tr>
<tr>
<td>End activities [hour]</td>
<td>20:30</td>
<td>20:30</td>
<td>20:30</td>
</tr>
<tr>
<td>No. of days</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>GPS of accommodation</td>
<td>46.099067, 19.773417</td>
<td>46.099067, 19.773417</td>
<td>46.099067, 19.773417</td>
</tr>
</tbody>
</table>

The component database currently consists of 79 records. 24 records are ‘Places’, which have attribute values for ‘Budget’ between 0.0 and 0.5, values for ‘Quality’ between 0.2 and 0.8, and for ‘Activity level’ between 0.2 and 0.9. 21 records are ‘Sights’, which have attribute values for ‘Budget’ between 0.1 and 0.9, values for ‘Quality’ between 0.2 and 0.8, and for ‘Activity level’ between 0.1 and 0.8. 12 records are ‘Museums/Galleries’, which have attribute values for ‘Budget’ between 0.1 and 0.7, values for ‘Quality’ between 0.3 and 0.9, and for ‘Activity level’ between 0.2 and 0.8. 22 records are
‘Restaurants’, which have attribute values for ‘Budget’ between 0.4 and 0.9, values for ‘Quality’ between 0.2 and 0.9, and for ‘Activity level’ between 0.1 and 0.3.

The selected components in the case of the 1st variation of input parameters are shown in Fig. 5, while the selected components in other cases are presented in Fig. 6 and Fig. 7 respectively.

Table 2 Output from the second-level of profiling for input parameters

<table>
<thead>
<tr>
<th>Output parameter</th>
<th>1st var.</th>
<th>2nd var.</th>
<th>3rd var.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budget</td>
<td>0.56</td>
<td>0.82</td>
<td>0.28</td>
</tr>
<tr>
<td>Quality</td>
<td>0.56</td>
<td>0.82</td>
<td>0.26</td>
</tr>
<tr>
<td>Duration</td>
<td>Medium</td>
<td>Medium</td>
<td>Short</td>
</tr>
<tr>
<td>Activity level</td>
<td>0.52</td>
<td>0.52</td>
<td>0.50</td>
</tr>
</tbody>
</table>

As an example, the final automatic configuration, i.e., the configured itineraries in case of the 2nd variation of input parameters are shown in Fig. 8, Fig. 9, Fig. 10, and Fig. 11 respectively. The final configurations in other cases are not presented in the paper due to constraints regarding the length of the paper, but can be accessed on a test web page: http://tourismproject.vts.su.ac.rs/. The web page can be used for testing purposes only, and does not represent a solution that will be displayed to end users.

VI. DISCUSSION OF THE RESULTS

The results of tourism package configuration depend on the input parameters defined by the customer, on customer profiling, data from the database, and on rules defined by the predefined processes.

Different results for customer profiling in the cases of the 1st and 2nd variations of input parameters due to variation of the parameter ‘Expectation’, results in differences regarding the chosen components (Fig. 5 and Fig. 6). ‘Places’ selected are more or less similar. This can be explained by the fact, that for ‘Places’, the values in the database for attribute ‘Budget’ are between 0.0 and 0.5, because of which, in spite of differences in customer profiling, similar components are chosen, as the predefined process in the first pass selects the components based on the attribute values for ‘Budget’. However, other components differ to a greater extent because the attribute values for other component types are defined in wider ranges. The same result can be observed in the 3rd variation of input parameters, but due to the output result for ‘Duration’ the number of selected components in this case is considerably higher than in the 1st and 2nd case.

The results for restaurant selection show differences in each case, because the attribute values for restaurants are defined in wide ranges.

The insertion times of the restaurants for lunch are 14.25h for the first day and 12h for the second day (Fig. 8 and Fig. 10). Differences occur because the predefined optimization process does not allow for lunch to start before 12.00h. Regarding the dinner this limit is set to 19.00, therefore the restaurants are inserted at 19.50h for the first day and at 19.20 for the second day.
The end of the activities is set to 20.5h, but the configured itineraries are finished at 23.2h and at 21.45h. The set time is only theoretical, because it occurs before the component selection, when the information about the duration of both the components and of traveling from one to another component is not known. Apart from that, travel durations times are rounded up to 15 minutes, and that can lead to significant prolongation of time, especially if the number of selected components rises. This problem could be reduced by rounding up travel times to the nearest five minutes.

In the case of the itineraries, at first, it appears that the final configuration for Day One is not optimized (Fig. 9). However, the presented itineraries are in fact the optimal solutions, keeping in mind the restrictions defined by the configurator. The problem lies in the fact, that the selected restaurants are located somewhat farther away from the components. This problem could be solved by defining a wider range of available restaurants in the area.

### VII. CONCLUSION

The idea and need of being able to offer each customer a product, in this case a tourism package, that fits their individual needs, but without much effort and time spent on the customer’s side on the configuration, resulted in the development of an on-line product configurator. The presented solution for an automated tourism package configurator is based on a previously developed product structure, and customer profiling procedure. The developed solution generates a detailed itinerary for each day of the package, based on inputs from the customer and procedures, which are developed for the configurator.

The developed configurator is tested on a case study for the wider area of the city of Subotica, Serbia, to attain the first feedback on the automated configuration results, which will serve as a guide for future development.

Based on configuration results, it can be concluded that, by defining a very small number of input parameters, a complete tourism package can be configured automatically. If the customer is satisfied with the profile
defined after the first-level of profiling, and if they accept the default values of the package, the number of input parameters is only three. These are information about the age and type of the customer, and the location of accommodation.

The refined configurator is to be implemented into an overall internet service for tourism offerings of the area, to serve as a means of facilitating the selection of the appropriate tourism offer in a captivating, easy, and quick way. It is assumed that, in this way the interest of tourists in a given region will increase and that the increase of interest will lead to increased profits from tourism.

Certain issues arise from the fact that the presented configurator generates an automatic tourism package. One of the problematic points is that an automatic configuration does not take into consideration, whether the customers have specific requests regarding some tourist attractions or restaurants. Furthermore, customers do not have the opportunity to suggest new and adapt existing components, which could be used for new tourism package configurations. Also, at this time, there is no possibility for any feedback or customer profiling, nor for configuration results. In terms of directions for possible future research, efforts will be made towards the incorporation of the possibility for co-creation activities. These activities should be oriented primarily towards the involvement of customers in defining new and adapting existing components, by suggesting, grading, or voting. Also, feedback on customer profiling and on configuration results should be considered. This would likely turn this configurator into a comprehensive solution for tourism package offers.

REFERENCES