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TOURISM EXPERT SYSTEM WITH CLIPS USING PFC

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***Abstract*—This paper describes the research and development of Tourism Expert System (TES). A prototype system has been designed and developed with a knowledge base containing more than 20 cities and 150 rules for helping tourists to choose best destination town have maximum matching with their important requests. This paper without using fuzzyCLIPS presents a novel pseudo fuzzy counter (PFC) that has the most important rule of adding uncertainty to the system. Another feature of TES is using several individual experts. TES results are in accordance with the user requirements and offer user the percentage of compliance of all cities in knowledge base.**

Keywords-expert system; tourism domain; CLIPS

I. INTRODUCTION

Tourism is an activity which, in some form or other, mankind has undertaken for a very long time. However, only in relatively recent time tourism has been recognized as an important social and economic phenomenon. Its effects are increasingly being felt both at the indivisual level and through its impact on society. At the World Conference on Tourism, held in Manila in 1980, the importance of tourism and its widespread effects were recognized in the Manila Declaration on World Tourism which stated,

"Tourism is considered an activity essential to the life of nations because of its direct effects in social, cultural, educational and economic sectors of national societies and on their international relations."

Because of its increasing and widening impact on societies and the consequent need to research and understand, it is necessary to define what tourism is, which is particularly important from the statistical point of view. For statistical measurements to be meaningful, it must be clear what is actually being measured. Tourism has traditionally been defined either in terms of the activities of tourists/visitors, i.e. in either demand side terms or supply side terms. At the 1991 WTO Ottawa Conferense on Travel and Tourism Statistics, the demand side concept was accepted as the appropriate approach, and "tourism" was defined as:

"The activities of persons traveling to and staying in places outside their usual environment for not more than one consecutive year for leisure, business and other perposes [1]."

In relation to a given country, the following forms of tourism can be distinguished: (1) Domestic tourism, involving residents of the given country traveling only within this country, (2) Inbound tourism, involving non-residents traveling in the given country and (3) Outbound tourism, involving residents traveling in another country [2]. With only a minority of countries still have to report full year data, worldwide intenational tourism receipts are estimated to have amounted to US$ 852 billion (euro 611 billion) in 2009 [3].

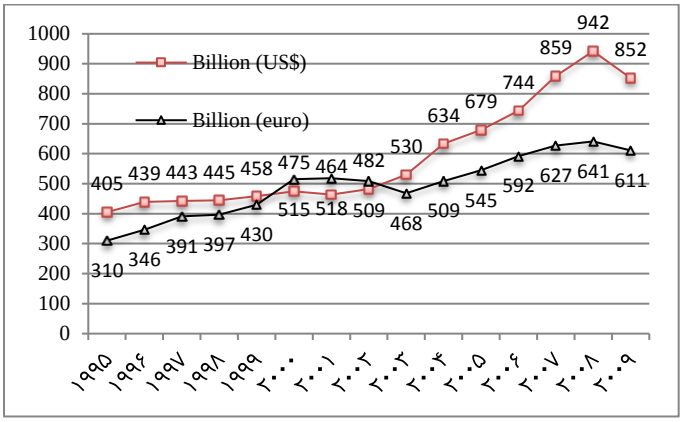

Fig. 1. International inbound tourism receipts

Figure 1 shows that revenue from tourism for countries is very high. This indicates the importance of tourism in each country. Hence, using an expert system can help users select a city with maximum compliance with their requirements.

An expert system is an intelligent computer program that uses knowledge and inference procedures to solve problems that are difficult enough to require significant human expertise for their solution. It is a computer system that emulates the decision-making ability of a human expert. An expert is a person who has expertise in a certain area. Expert systems are best suited for situations in which there is no efficient algorithmic solution. Such cases are called ill-structured-problems. Choosing a town for tourism is an ill-

structured-problem that needs the expertise of more than one expert to solve. Because the tourism domains have so many features and make decision at all domains need more experts [4]. Hence, TES uses more experts that each is experts in a particular field. Also with using a novel Pseudo Fuzzy Counter (PFC), TES considered uncertainty in tourism domain.

The reminder of this paper is organized as follows. Section II briefly summaries tourism expert system related works. Section III then describes 20 important parameters in tourism domain and explains each of them. Next, Section VI shows the architecture of TES with using PFC and 20 important parameters. Conclusions are finally drawn in Section V, along with discussions over future works.

II. LITERATURE REVIEW

Many studies have been done on application of expert system in tourism domain. Low et al. [5] design an expert system for tour advisory (ANESTA) which could act as tourist information station for generating self-guided tour schedules as well as detailed transportation information to tourists. The system objectively and systematically captured and manipulated tourists' requirements and preferences. Niknafas et al. [6] used Case-Based Reasoning (CBR) techniques in E-Tourism. They just considered three provinces "Isfahan, Fars and Kerman" in IRAN. To find the best suggestions of travelling schedule for new groups of tourists, they constructed a case base including the old tour experiences, used for the former group, according to their specifications then using an adaptation criteria and similarity function. An intelligent support system for tourism development presented by Wei Min [7] was designed based on multi-intelligent techniques. Using this expert system, tourism enterprises could develop new service products in a more efficient way with minimal cost.

Except these mentioned works there has been lots of other researches in the hotel domain and hospitality. McCool [8] showed some useful considerations in developing expert systems for the hospitality industry with an extensive feasibility study. Also an overview of research in strategic management in the hospitality industry was considered by D. Olsen [9] that covered the two year period of 2002-2003. At hotel domain, E.W.T. Ngai et al [10] described the research and development of a fuzzy expert system for hotel selection called Hotel Advisory System (HAS) to assist tourists in conducting hotel selection using fuzzy logic. Using HAS makes hotel selection simple because it can incorporate the linguistic terms which are normally produced by tourists.

III. MAIN PARAMETERS IN TOURISM

Everyone has special features to select a town to travel. So the system should consider parameters that are perfect and satisfy all users' demands.

20 parameters have been briefly considered for TES in this section. Note that some of these parameters are dependent on the place we are using TES for and they could be omitted or added. Each one of these parameters and their description are listed in table 1.

Except from those parameters shown in table 1, "age" of the user also has effects on the result of TES. This parameter is considered at four intervals: (1) Lower than 25, (2) Between 25 and 40, (3) Between 40 and 55 and (4) Upper than 55. As user enters his\her age, TES gives a few more chance to those towns that are suitable with user's age. For example if user's age is under 25, TES gives a few more chance to those towns having amusement park, ski and university. Also the system with attention to user's age will not ask some of the questions (see figure 3). So a number of rules are declined. These parameters and questions should be defined by the experts and could be different depend on the area we use TES.

The other important parameter in TES is MoneyPerDay parameter. MoneyPerDay slot for any town stores the minimum cost of staying at a town for one day. TES asks user two questions: (1) How many days do you want to stay at destination town? And (2) How much money do you want to spend at all? Now for example if the user want to stay "D" days and spend "C" dollars, the value of MoneyPerDay for all towns is compared with the value of "C/D" and the chance of those towns having MoneyPerDay less than "C/D" will increase. Note that the chance of any town is changed by PFC. In fact; any of these 20 parameters has effect on the chance of all towns in knowledge base and any town has its own PFC. As user answers the questions, PFC value of all towns will be updated. In section IV we will give more explanation about PFC and its usage.

Table 1

TES parameters description

Parameter name	*Description*
Climate	*5 types are considered in TES; cold, temperate, hot, dry and humid.*
Nature	*Any city might have some of these natures; sea, jungle, river, desert or none of them.*
Location	*Includes hotel, motel and tent.*
Vehicle	*Contains; airplane, train, bus or taxi and personal car.*
Historical Places	*Relates to the countries with ancient culture.*
Traditional-Bazaar	*Only ancient cities have these kinds of bazaars which attract tourists.*
Shopping Centers	*Most of tourists would like to buy some souvenir.*
Industrial Cities	*Is related to businessman.*
Dam	*Attracts tourists.*
Cave	*Attracts mostly Archaeologist and other tourists.*
Ski	*Suitable for people from tropical area and sportsmen.*
Amusement Park	*For people wanting more excitement.*
Metropolis	*Could be omitted for tourists who need comfort.*
Seaport	*Attracts tourists who do business and want to travel by the sea.*
Island	*Most people like staying at islands, because they have special climate and nature. In this paper we have considered two most important islands of IRAN, Kish and Qeshm*
University	*For whom want to do some researches in addition to have fun.*
Museum	*Because it is a symbol of the country history.*
Pilgrimage Places	*Is mentioned mostly by religious tourists.*
Subway	*Some tourists care about the transportation system of destination city.*
MoneyPerDay	*Is an important parameter that computes the cost for each person in a day with attention to destination cities.*

All of mentioned parameters construct the deftemplate structure of TES in CLIPS. Then all the towns are defined by deffact structure in CLIPS. The example of deffact structure for one town in TES is as follow:

```
(deffacts town-available
(town    (name Kish)
         (climate temperate hot humid)
         (nature sea)
         (metropolis no)
         (railway no)
         (cave no)
         (dam no)
         (historic-place no)
         (traditional-bazaar no)
         (industrial-city no)
         (ski no)
         (pilgrimage-place no)
         (moneyPerday 120)))
```

Note that the default value of any slots that accept "yes" or "no" answer in deftemplate structure is "yes". So when defining a town we just fill slots that need "no" answer. In former example, Kish is an island in IRAN and we didn't fill the island slot for it.

IV. DESIGN AND IMPLEMENTATION OF TES

In this section we describe the internal design of TES. It is composed of three main parts; knowledge base, inference engine and user/developer interface and two optional blocks; external data base and external expert systems that are shown in figure 2.

Knowledge base is one of the important parts in every expert system. In TES, knowledge base contains facts and rules. This system has about 150 rules which are implemented by CLIPS. Some example of these rules is shown as follow:

```
(defrule t-age-lessthan-25
         (choice 1)
         ?f2 <- (age 1)
         ?f1 <- (town (PFC ?PFC) (status off))
         =>
```

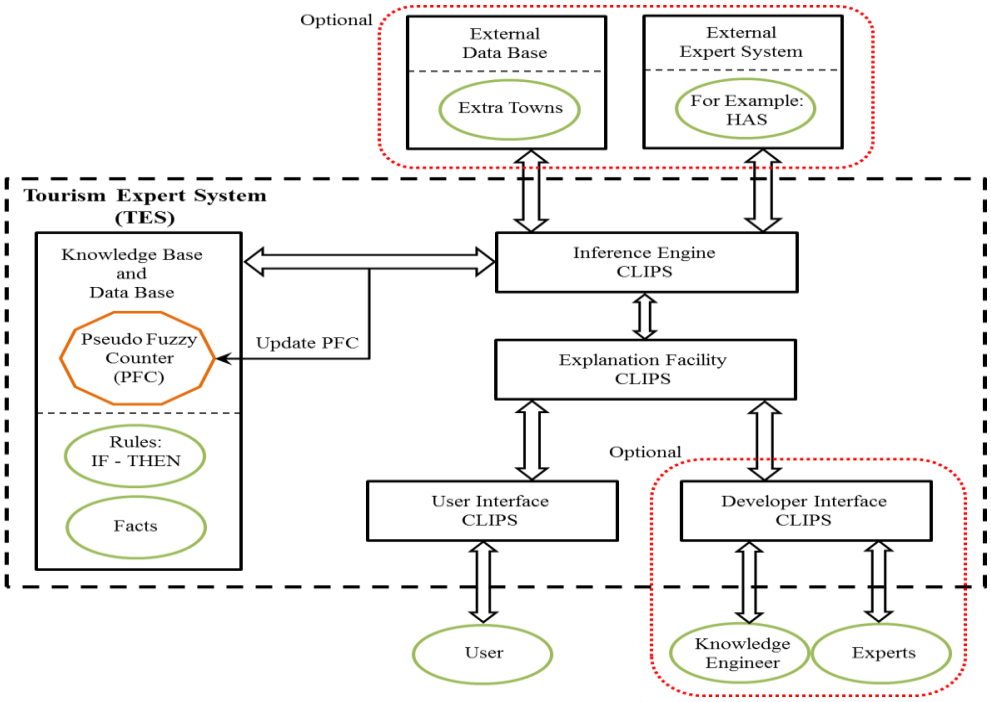

Fig. 2. Block diagram of TES

```
(bind ?answer (random 0 30))
(do-for-all-facts ((?f1 town))
(and (or (eq ?f1:amusement-park yes) (eq ?f1:ski yes) (eq
?f1:university yes)) (eq ?f1:status off))
(modify ?f1 (PFC (+ ?f1:PFC ?answer)) (status on)))
(retract ?f2)
(retract ?f1)
(assert (reset on)))
;-------------------------------------------------------------------------------
-
(defrule t-airport
        (choice 1)
        ?f2 <- (vehicle 1)
        ?f1 <- (town (airport yes) (PFC ?PFC) (status off))
        =>
(printout t crlf "What percent having the airport is important for
you? (enter just a number between 1 and 100)" crlf "pay attention, If
you choose 100, we will give 50% more chance to the towns having
airport.")
(bind ?answer (read))
(assert (airport ?answer))
(while (or (< ?answer 1) (> ?answer 100))
        do
        (printout t crlf "Please enter a correct number! (1 until
100)" crlf)
        (bind ?answer (read)))
        (assert (airport ?answer))
(do-for-all-facts ((?f1 town))
(and (eq ?f1:airport yes) (eq ?f1:status off))
(modify ?f1 (PFC (+ ?f1:PFC ?answer)) (status on)))
(retract ?f2)
(retract ?f1)
(assert (reset on)))
;-------------------------------------------------------------------------------
-
(defrule t-cold-yes-100
        (choice 1)
        ?f2 <- (cold 100)
        ?f1 <- (town (weather $? cold $?) (PFC ?PFC) (status
off))
        =>
(do-for-all-facts ((?f1 town))
(and (member$ cold ?f1:weather) (eq ?f1:status off))
(modify ?f1 (PFC (+ ?f1:PFC 50)) (status on)))
(retract ?f2)
(retract ?f1)
(assert (reset on)))
```

One of our novelties in TES is using PFC. For each of those parameters mentioned in section III, TES asks user to enter a number between 0 and 100 to show the importance of that parameter for him. The entered number for any city having that parameter is added to the towns PFC value. It is the same for any rule and all the parameters. At last the most appropriate city closest to the users' demands will be selected with respect to the obtained sum from PFC. Figure 3 shows the number of PFC along a complete run of TES just for two cities, "Kish" and "Arak".

Note that entering 100 shows certainty about those parameters, so we add up PFC more than 100 if it is entered.

Slot	Items	User Answer	Percent	PFC (Kish)	PFC (Arak)
Age	1. Under 25 | 2. 25-40 | 3. 40-55 | 4. upper 55 | 5. Help	2. 25-40	none	28	0
MoneyperDay	none	Money = 550$ | Days = 5Days => 110$ per day	none	28	50
Vehicle	1.Airplane | 2.Train | 3.Bus or Taxi | 4.Personal Car | 5.No-matter | 6.Help	1.Airplane	90	118	140
Climate	1.Cold | 2.Temperate | 3.Hot | 4.Humid | 5.Dry | 6.No-matter | 7.Help	2.Temperate	90	208	230
Nature	1.Jangle | 2.Sea | 3.River | 4.Desert | 5.No-matter | 6.Help	2.Sea	90	298	230
Location	1.Good hotel | 2. Motel | 3.Tent | 4.No-matter | 5.Help	1.Good hotel	100	398	230
Island	1.Yes | 2.No | 3.No matter | 4.Help	3.No matter	none	398	230
Metropolis	1.Yes | 2.No | 3.No matter | 4.Help	Not asked (because of age)	none	398	230
Historical Place	1.Yes | 2.No | 3.No matter | 4.Help	1.Yes	80	398	310
Traditional-Bazaar	1.Yes | 2.No | 3.No matter | 4.Help	Not asked (because of age)	none	398	310
Store	1.Yes | 2.No | 3.No matter | 4.Help	1.Yes	80	478	310
Industrial City	1.Yes | 2.No | 3.No matter | 4.Help	Not asked (because of age)	none	478	310
Musuem	1.Yes | 2.No | 3.No matter | 4.Help	1.Yes	80	478	380
Pilgrimage Place	1.Yes | 2.No | 3.No matter | 4.Help	3.No matter	none	478	380
Cave	1.Yes | 2.No | 3.No matter | 4.Help	3.No matter	none	478	380
Dam	1.Yes | 2.No | 3.No matter | 4.Help	3.No matter	none	508	410
Amusement Park	1.Yes | 2.No | 3.No matter | 4.Help	Not asked (because of age)	none	508	410
Seaport	1.Yes | 2.No | 3.No matter | 4.Help	3.No matter	none	520	410
Ski	1.Yes | 2.No | 3.No matter | 4.Help	2.No	50	570	460
Subway	1.Yes | 2.No | 3.No matter | 4.Help	3.No matter	none	570	460
University	1.Yes | 2.No | 3.No matter | 4.Help	1.Yes	60	630	460
RESULT				630	460

Fig. 3. PFC value along a complete run

In addition to TES pseudo fuzzy structure, another novelty here is inspired from evolutionary computing. In fact PFC is acting like a fitness function for any city and the city plays the role of chromosome. The population is never killed and just the chance of choosing them is increased or decreased.

As shown in figure 3, except from mentioned answers for any slot, user can select two other answers; "No matter" and "Help". If user select "Help" TES gives him more detail about that question and guides him. In the former examples of rules, one of these guides has been shown. If user select "No matter" TES found that this parameter doesn't matter to him but for some parameters add a random number to their PFCs. These parameters are defined by experts and the random number is between 0 and 30. Finally user can see the PFC value for all towns in knowledge base and with attention to this number, select a town for travelling to. Then TES gives him a complete detail about all of the features of selected town.

User interface block is the mechanism by which the user and the expert system communicate [4]. In TES we use the CLIPS simple user interface.

Inference engine block makes inference by deciding which rules are satisfied by facts, prioritizes the satisfied rules and executes the rule with the highest priority [4]. In TES this block determine which rule antecedents are satisfied by the facts. The method used here for TES is forward chaining. It is reasoning from facts to the conclusions resulting from those facts [4].

V. CONCLUSIONS AND DISCUSSIONS

In this paper we have presented a Tourism Expert System (TES) that helps users to select a city for travelling. A novel Pseudo Fuzzy Counter (PFC) is used to add uncertainty to the system. Another view of PFC is inspired from evolutionary algorithms and sees the PFC as fitness function that keeps the fitness of any city in knowledge base and the cities are chromosomes. In TES, when user answers, the PFC value will be updated and for most of questions system gives a percentage of how important they are for user. If user enters 100, TES means that certainty about that parameters and gives more chance to the cities have that parameter. Another way is to omit the cities doesn't have the parameters selected with certainty from user. For example if the user select jungle for nature slot with 100 percent of important, we can omit cities don't have jungle.

One of the most important problems of TES is its lack of having a good user interface. We used CLIPS user interface but it discusses about creating a good user interface and use of linguistic variables on it, also about creating TES with fuzzyCLIPS with mentioned parameters and compare the results.

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