# TKGS: Tourists Keeping and Guiding System

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## ABSTRACT
Tourism is an important economic pole in developed countries. Many countries devoted their expert efforts to absorb more tourists by focusing on attractive and historical aspects of their civilization and good planning on facilities and services. Nowadays rapid grows of information technology affected the way of our life and tourism as a part of this revolution benefits from its advantages. In this study we aim to integrate some of the up-to-date information technologies in order to develop an automated, intelligent and reliable decision making system for tourism industry. Some E-tourism context-aware systems have been made so far based on location and tourist's characteristics. In this paper we propose a distinct one which named Tourists Keeping and Guiding System or simply TKGS. It considers tourist's physiological condition, priorities, location and visit histories in order to offer best services. It guides tourists through their trip and gives them medical cares while they are travelling and it reserves hotel, entertainment and tourism places for them. The idea is integration of the following subsystems; context management, geographic information, feedback management, tourism places, transportation control and medical cares.

## General Terms
Pervasive computing system

## Keywords
Ubiquitous Computing System; Context-aware Systems; Tourism; Knowledge Base; Decision Tree

## 1. INTRODUCTION
Tourism industry is one the main sources of revenue for many countries. In these countries a large amount of incomes bring in through this section every year. Many research studies have been focused in this area and many time and cost consuming plans has been made to improve the quality of tourism. Researchers believe that new technologies can help basically to the tourism industry. Globalization of new technologies and internet in the mid-1990s and invent of web 2.0 or social web (O'reilly publisher, 2005) increased the electronic tourism (e-tourism). E-tourism is a new developing topic in the world which has a growing speed in recent years. Now about 70% of tourism services at international level offer through internet network. E-tourism means offering required subsystems to interested visitors through the internet. The aim of this study is to offer quick and easy electronic tourism services in an intelligent environment for 24 hours in a day with awareness of context. Main tourist's needs can be recognized and handled with respect to their location, local time and physiological condition automatically without human interfering in every moment of their travelling. Our proposed system benefits from up-to-date telecommunication technologies. It is a comprehensive, efficient, dynamic, rapid and intelligent system. It offers many notable services to travel agencies and tourism places so they can save time and money.
The reminder of this paper organized as follows. Section 2 is a general review on pervasive computing systems as context-aware systems along with decision making algorithms. Section 3 introduces TKGS as our proposed solution. This section includes TKGS specifications, scenario and proposed architecture. Section 4 is conclusion and section 5 gives future works.

## 2. State-of-the-art
High impact of tourism industry on societies result in many efforts to make easier the process of decision making for tourists and resolve their problem in an unfamiliar city. To accomplish this goal, the attentions turned to electronic tourism systems. Unfortunately some of the available systems do not offer customized, reliable and precise guides to tourists.

### 2.1 Pervasive Context-aware Systems
Pervasive computing system is an intelligent system that all tools and equipment in its environment interact and communicate with each other. Their communications do via wireless computer networks and they can control the environment without human interfering. There is some kind of electronic sensors which consume a little power so they are advantageous tools and have benefits for their mobility in the environment. In different time and local conditions and/or with changes in the environment they can automatically explore the environment and gather required information. They can deliver information to selected receivers which at the end point will be delivered to human or expert systems. A system expert can do every day works and routines without having to attend at the environment physically. He receives control reports of pervasive computing systems and then decides for changes or improving the quality of services by solving the reported problems.
In this research pervasive computing system introduces as a fundamental for e-tourism system and its capabilities will use in various fields. Available communication, software and hardware platforms with respect to different needs will use and some new capabilities will apply when is necessary.

## 2.2 Recommender Systems

Many attempts have been made to develop context-aware applications for tourism in the framework of pervasive computing systems. The primitive utility of such system is giving guides and advices to tourists according to places information which will be delivered through a digital assistant [1]. COMPASS is a kind of context-aware software which offers some services to tourists [2]. Because of the high impact that tourism industry has in the society, different pervasive approaches has been made to produce decision-making systems. Each of them based on the extracted algorithm has different recommendations for tourists and the main goal of all of them is to ease the decision making process for them and solving their problems in a strange city [3]. To the best of our knowledge some of the decision making algorithms for tourism systems are as follows.

- First category of decision making algorithms is based on places information [1]. City guide website with name sightseeing4U [11] is an example of this algorithm which sends place information of tourist's current location to system via a multimodal user interface that installed on tourist's cell phone [3].
- Second category is filtering decision making algorithm based on user profiles, priorities and preferences for visiting. Gulliver Genie [10] is a primitive case of a context-aware program which offers innovative information services according to tourist's preferences and location [3].
- Third category algorithm is social filtering [4]. This approach assumes users priorities and habits for decision making.
- Forth category algorithm is content-based filtering [5]. This is a distinct approach which uses machine learning techniques. Having focuses on the nature of items, it categorizes information and then integrates them for system usages. In this algorithm content semantics have higher priority than real social interactions or user behaviors.
- Fifth category algorithm is knowledge-based filtering [6]. It uses knowledge about users in order to infer decisions and offer required services. This method has high flexibility to perform related tasks and produce applications [7]. It emphasizes on clear and explicit use of knowledge.

  MAIS project [8] is a decision making or knowledge-based recommender system which is categorized in context-aware e-tourism systems. This project is based on semantic web technologies and it defines a semantic domain. In order to offer local solutions, it also structured as a subsystem-oriented architecture. MAIS do not consider the knowledge of user visit tracks.
- Sixth category algorithm is hybrid algorithm. It uses a combination of previous technologies to generate a recommender system [9]. Berka in [7] used a hybrid approach that contains all prior described algorithms. Each application which is established on an algorithm produces a collection of possible recommendations for tourists [7]. The collection of those applications makes a recommender system. This system emphasizes on clear and explicit use of knowledge.

In the most of context-aware tourism applications [2], [10] & [11] there is no method to develop pre-defined context data or storing data in a customized format so as a software application they are designed rough vertical [12]. Consequently context data management both in gathering and delivery is not extendable. In this systems also tourist's social aspects, information of place and content delivery does not maintain generally [3]. Most of them do not consider tourist's personal characteristics or other unique information. Our proposed algorithm differs in some aspects from previous related works. Witch the main is that considers tourist's physiologic signs in addition to his/her profile information. Developing context data not only gives decision making ability to users but also gives the ability of keeping and guiding tourists to system. It also can be used for management of tourism places and travel agencies efficiently, reliably with extendibility.

# 3. TKGS

We propose Tourists Keeping and Guiding System or simply TKGS as a decision making system for tourism which differs in some aspects from previous related work. This system aims to respond tourist, travel agencies or tourism places needs automatic and quickly without human interference while, before and after of tourist's travel via a pervasive computing system. To reach the mentioned goal, system activities perform in three phase.

First phase–It evaluates tourist's health conditions before starting trip/tour and diagnoses their potential disease(s) as well as finding its severity.

Second phase –It offers medical care and maintenance for tourists while they are travelling and also recommends best services for management of hotels and tourism places.

Third phase–It offers some services for tourists after finishing their trip/tour.

The proposed system architecture is a combination of following subsystems; pervasive context management, geographic information, feedback management, tourism places, transportation control, health and medical caring. Features, functionality, architecture and case study of our system discussed in the next sections.

## 3.1 Features

TKGS offers effective services for decision making, management and improving the quality and quantity level of tourism places, hotels and travel agencies services which lists as follows.

### 3.1.1. Effective planning for tourists and travel agencies

The system offers long and short-term planning for tourists and travel agencies based on information of tourist's location, visits histories, physical condition and personal characteristics and knowledge derived from former tourists' visits through reasoner which is likelihood to satisfy them. Hence it cause to prevent too crowd of people in a tourism place and to make quiet and attractive places for their excursion. Tourists will visit places efficiently and enjoy their trip with saving time. They will experience neither fatigue nor impatience while they go around for vising. Long and short term planning for each tourist are deduced by a reasoner. There are three types of reasoners which identified as static, real-time and dynamic planning and decision making.

### 3.1.2. Effective planning for tourism places

Reasoner makes reasoning according to all information gathered by a feedback subsystem. It gets feedback from tourist's satisfaction about different aspects of a place like decoration or things. The reasoning output is used to make good planning and management for the place and the final results can be shown to its manager via a graphical user interface. This plan increases availability of favorite places which were satisfied tourists and they were interested in. It also helps to improve the quality of things, decorations and

different parts of tourism places. Furthermore the designed plan can be used to eliminate or reduce things or parts which couldn't persuade tourists. Consequently the tourism place environment can be used efficiently and total amount of their costs will decrease. Finally it can help to predict and plan for future.

## 3.2 Scenario

Our system makes an efficient travelling for tourists with any language, sex, age, disease, social class or physical condition by good advices, guides and solutions for their tour or health problems while they are travelling. Tourists with almost every physical condition at any time are able to connect to internet and register in TKGS website via their cell phone, portable computer or personal digital assistant in order to take part in tours or individual travels. TKGS application receives personal characteristics data, illness history and visit history of users then it saves all the data in a specific profile for each user. User profile transfers to the reasoner via a graphical user interface subsystem and then records in a knowledge base. Hereafter users known as agency tourists and their profile information save in a RFID bracelet which fastened around their hands at the beginning of the trip and will accompany them to end of the trip. The system identifies users through their RFID bracelet during the trip and it can easily access their information. According to the system rules tourist's physical condition is under control by TKGS one week prior starting their trip. During this week each user wears special clothes that equipped with sensors which measure user's health factors like heartbeat (pulse rate), blood sugar, breathing (severity of breath), blood pressures, body temperature regularly while users are doing routine and daily works everywhere (home, work, picnic, etc.) they are without being noticed. Next all gathered physiologic information by sensors send to a central server via a wireless network several times in a day. Figure 1 shows intelligent areas (at home, work, picnic, etc.) and receivers that send user information to the central server automatically via a wireless network.

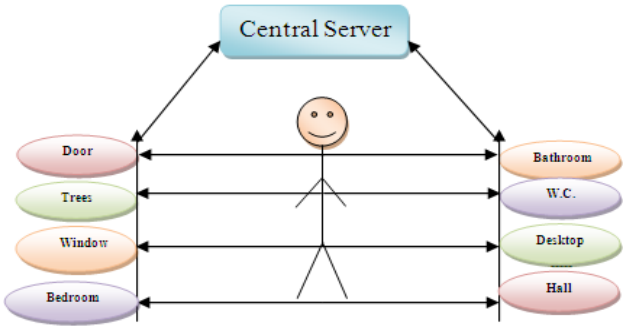


**Fig1: Intelligent environments and their connection with central server**

All different data gathered by sensors receive by a context manager middleware then it processes the data and gives information to the reasoner. According to received information and user disease's history and medical information stored in knowledge base the reasoner infer statements about user physical condition. Those statements send to a physician for verification. After taking to account the physician opinion and verification, final report may implies one of three states listed below:

State 1: User is completely healthful and need not to be under health control while travels. Users in this state fasten RFID bracelet for sake of identification, receiving good and real time services and some sensors embedded in their clothes.

State 2: There is no special issue about user's health but user needs care and attention while traveling. The system must control tourist's diet, visiting and residency places. For example tourists with palpitation disease should not eat those foods that boost their disease or should not go to places that increase their excitement and cause they fear [4].

State 3: Tourist is not in an acceptable physical condition. The tourist has special and serious health problem and needs more care and attention prior and during the trip. As an example for those who have diabetes disease sensors check their blood sugar and send reports to the system regularly [13]. The reasoner prescribes those foods and places that do not boost their disease. It also recommends them some exercises which control their blood sugar. Clearly it forbids what intensify their illness.

## 3.3 Architecture

To offer appropriate services TKGS composed of some modules that each of them doing specific tasks. The collection of all modules form TKGS structured architecture. Structured architecture has advantages in easy management and development. Figure 2 shows TKGS architecture. Each module tasks describe as follows.

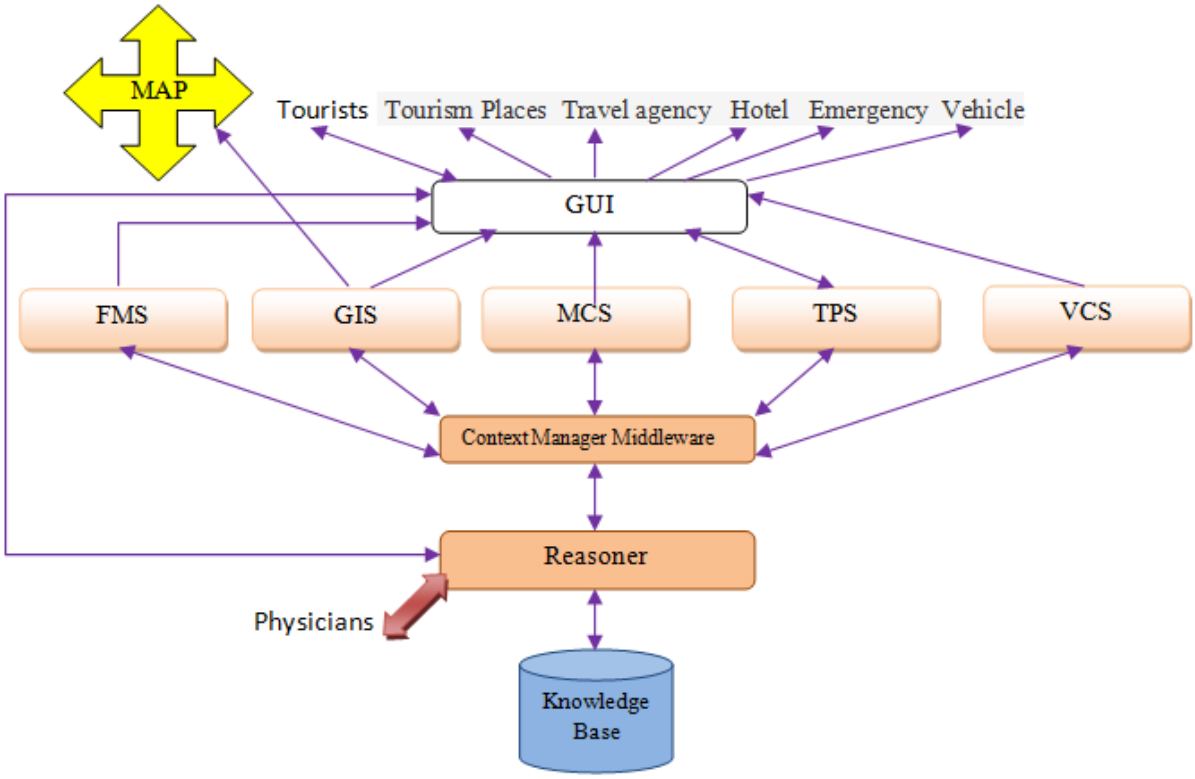


**Fig 2: TKGS architecture**

### *3.3.1 Graphic User Interface (GUI)*

This is the only way that all subsystems interact with users and offer their services.

### *3.3.2 Context Management Middleware*

This module receives data from heterogeneous resources such as GPS, Sensors or RFID. It processes data and send information to reasoner. It also receives information and instructions from reasoner as a medium and will deliver them to other subsystems.

### *3.3.3 Feedback Management Subsystem (FMS)*

The feedback information from tourist's satisfaction level of visiting different tourism places, hotels and etc increases the accuracy and reliability of decision making process by reasoner. The system asks a set of standard questions of tourists after visiting a tourism place in order to find their satisfaction level.

Ranking different types of services, tourism places and even different parts of a tourism place according to tourist's satisfaction level carry out by feedback management system. This system also generates efficient and accurate results according to feedbacks information so it gives useful information to travel agencies, tourism places and tourists for better management and it can be used to improve the quality of services. It also sends the results to reasoner for storing and generating reliable decision trees in the knowledge base.

### *3.3.4 Reasoner*

Reasoner has an important role in TKGS and does different tasks. It is responsible for information management and information inferring in/from knowledge base. It must store, delete, append, update data in knowledge base and retrieve information from knowledge base. It also generates static decision tree based on information of location, tourism places and tourist's personal characteristics, satisfaction level and physical condition which results in a comprehensive analysis. Real-time decisions make on information of tourist's physiological condition and local time and place. The system controls tourist's physical condition to offer medical care instructions when is needed. The system warning shows to the tourist by an alarm or a message on his/her cell phone or PDA. Having no real-time reaction of system in critical cases, the tourist may be threatened by experiencing a serious health problem.

In this study we extracted some effective factors on tourist's satisfaction level then we did a case study with questionnaire to investigate effects of those factors on tourist's satisfaction level. The case study carried out in a Luna-park witch absorbs many tourists as an entertainment place.FMS gathered feedback data after completing questioner by volunteer tourists. Then FMS sends information to the reasoner witch it generates a decision tree based on received information to determine relations between tourist's satisfaction level and personal characteristics.

### *3.3.5 Knowledge base*

Reasoner regularly update knowledge base according to new information received by related resources such as feedback management, health information networks, driving laws, tourism services and mechanics of vehicles. Knowledge base contains different information which is namely as follows:

- Medical information in a table structure that classification of physical and mental illnesses, constraints and medical rules for their treatment is included in.
- Information of tourism services and regulations on tourism places visiting.
- Ranking of tourism services and places based on visitor's satisfaction level which provides by Feedback Management subsystem.

- Information of driving laws.
- Information of mechanics of vehicles.

### *3.3.6 Geographic Information Subsystem (GIS)*

Geographic Information Subsystem finds physical coordinates of each place by a GPS sensor. By using comprehensive maps available on the internet, it sends geographical map of surroundings to travel agencies, tourism vehicles, emergency services, tourism places and tourists. It sends a city map with respect to tourist's current location to his/her PDA or cell phone. It also tracks tourist's geographical position and gives information of alley, street and city to tour guides, friends or etc.

### *3.3.7 Tourism Places Subsystem (TPS)*

Tourism Places Subsystem interacts with reasoner, GIS and GUI to offer right services at right time automatically. Reasoner applies regulation of tourism places which is stored in knowledge base to infer constraints of a place for visiting then it sends these results to TPS. TPS sends an information message to tourist's PDA or cell phone automatically which flashes with a red light. If tourists break laws, system warns local guards and they will receive fine. TPS also serves as an information service and reminds tourists their visiting programs at the right time according to their tour plan. It offers an information package consist of information of things, souvenir products and stores, city or areas in video, audio, image or text format which delivers to visitors prior and while travelling. These information packages are customized according to every tourist's native language and will send appropriately to individual's PDA or cell phone. This package also contains geographical information gets from GIS.TPS sends information of local souvenirs to tourists and they can buy online. The purchase prices reduce from tourist's bank account by online system and they will inform of their bank account transactions when receive a message to their PDA or cell phones.

### *3.3.8 Medical Care Subsystem (MCS)*

Medical Care Subsystem interacts with reasoner, GIS and GUI to be able to give online medical cares to patient or unwell tourists. It also gives appropriate real-time services to tourism places, hotels, travel agencies and emergency medical service automatically. Sensors measure tourist's physiological signs and then send gathered data to context management middleware. After processing data the achieved information sends to reasoner. Subsequently the reasoner analyses information in the following ways:

- It searches in knowledge base for a similar condition to tourist's current physical condition and after finding related information it makes an appropriate decision for medical cares. If the tourist is in a critical condition it will send a request alarm to MCS for information of tourist's current location, physical condition and system-ID which MCS must send them immediately to a physician of emergency medical service with a special alarm. The physician will decide urgently about appropriate reaction.
- MCS is responsible to remind specific tourist's exercises, drugs and foods that physician prescribed him/her for taking them at right time by sending alarms to his/her PDA or cell phone. TKGS lists name and address of those restaurants are near tourist's current location and serves tourist's permitted foods. To do so reasoner sends mentioned information to MCS based on tourist's ID, location and prescribed diet. Furthermore in tours MCS sends list of each tourist's diet to hotel's chef prior they arrive in hotel.
- MCS also checks the environmental conditions like temperature, humidity, light, heat or cold and in a hotel room it changes them automatically to a customized condition. Reasoner makes decision according to tourist's current environmental and physical condition, medical considerations and knowledge base information. Then it gives some commands to MCS for appropriate changes. Subsequently MCS finds related adjustments and sends this information besides tourist's ID and hotel room number to hotel central control or staff section through a GUI. As a result every tourist will have customized environmental condition in room. For example if room temperature is low by default the system should enable heater except that tourist has a respiratory system problem so the system should keep the room air moist. It also plays tourist's favorite music when tourist requests it. Depend on tourist's heart rate [14] their favorite music unicasts to their cell phone or PDA via Bluetooth. Tourist's heart rate regularly measure by MCS and favorite music changes appropriately.

### *3.3.9 Vehicle Control Subsystem (VCS)*

Sensors regularly sense location, motor and mechanical status of tourist's vehicle and then send the gathered data to Context Management middleware. Thereafter Context Management Subsystem processes the data and sends achieved information to reasoner. Reasoner searches in knowledge base to find similar information to current status of the vehicle then it derives some results from all information and makes suitable decision for controlling and fixing the vehicle. The commands send to VCS by reasoner and it notifies tourist or driver of vehicle by a special alarm on GUI. For example driver arrives in a one-way street from opposite side. In this case GPS finds information of location such as coordinates and sends them to reasoner. So the reasoner finds related information in knowledge base and besides received geographic information derives that this is a one-way street and the vehicle is in its opposite direction. Reasoner sends this information to VCS immediately. At the end VCS informs driver by sending an alarm to his/her cell phone or PDA. If the driver was not aware of this fault with this alarm will change his way otherwise if doesn't pay attention to alarm VCS will responsible to control the vehicle.

## 4. CONCLUSION

The aim of Tourists keeping and Guiding System (TKGS) is a forwarding effort that aims to offer adequate services to tourists, travel agencies and tourism places management with using pervasive intelligent systems. TKGS is a context-aware intelligent system based on similar previous works in this field and statistical information of a use case. The idea behind TKGS makes it efficient, reliable, comprehensive and extendable system which aims to make an enjoyable trip for tourists. It works automatically, rapid without human interfering.

In comparison to other similar systems TKGS assumes more factors for decision making. It is a modular, distributed and integrated system and has a structured architecture so it can easily develop and manage. It is introduced as a horizontal program that it is independent from place or application. Tourist's major needs in medical field and information of different tourism places cover by this system. Offering appropriate and real-time services is one the most important

advantages of this system. The implementation cost of this system is high. Also introducing such a system in society needs people training which consumes a lot of time and money.

## 5. FUTURE WORKS

Reasoner can be generated with other methods like ontology, neural networks, fuzzy logic and so on. The Reasoner can make desion for every new tourists with especial characteristic by creating dynamic desion tree based on available static desiocn trees stored in knowledge base.

## 6. REFERENCES

[1] Schafer J.B., Konstan J., Riedl J., 2000, Recommender systems in E-commerce, Inproceedings of the first ACM Conference on Electronic Commerce, pp158–166.

[2] Van Setten M., Pokraev S., Koolwaaij J., Context-Aware Recommendations in the Mobile Tourist Application COMPASS,2004, In proceedings of Adaptive Hypermedia and Adaptive Web-Based Systems, Third International Conference, Eindhoven, The Netherlands, August 23-26, 2004, pp 235-244.

[3] Garcia-Crespo A., ChamizoJ., Rivera I., MenckeM., Colomo-Palacios R., Gómez-Berbis J.M., 2009, SPETA: Social pervasive e-Tourism advisor.

[4] Breese J.S., Heckerman D., Kadie C., 1998, Empirical analysis of predictive algorithms for collaborative filtering, Inproceedings of the 14th Conference on Uncertainty in Artificial Intelligence, pp 43–52.

[5] Billsus D., Pazzani M., 1999,A hybrid user model for news story classification, In proceedings of the Seventh International Conference on User Modeling, Banff, Canada, pp 20–24.

[6] Burke R., 2000, Knowledge-based recommender systems, In Kent A. (Ed.) Encyclopedia of Library and Information Systems, vol 69, Marcel Dekker, New York, NY.

[7] Berka T., Plnig M., 2004, Designing recommender systems for tourism, In The 11th International Conference on Information Technology in Travel and Tourism, ENTER, Cairo, Egypt.

[8] Corallo A., Lorenzo G., Solazzo G., 2005, A semantic recommender engine enabling an e-Tourism scenario, In proceedings of the International Semantic Web Conference.

[9] Popescuil A., Ungar L., PennockD., LawrenceS., 2001, Probabilistic models for unified collaborative and content-based recommendation in sparse-data environments, In proceedings of the 17th conference on Uncertainty in Artificial Intelligence, Seattle, WA.

[10] O'Grady M.J., O'HareG. M.P., Gulliver's Genie: agency, mobility & adaptively, In Computers & Graphics, V 28(5), 2004,pp 677-689.

[11] ScherpA., Boll S., mobileMM4U - framework support for dynamic personalized multimedia content on mobile systems, In proceedings of Techniques and Applications for Mobile Commerce Track of Multi Conference Business Informatics, 2004, Essen, Germany.

[12] Schwinger W., Grün C., Pröll B., Retschitzegger W., Schauerhuber A., Context-awareness in Mobile Tourism guides - A Comprehensive Survey, In Technical Report, 2005.

[13] Konstantinou A.V., Florissi D., Yemini Y., Towards self-configuring networks, In Proc.

[14] DESIGNING FOR A PERVASIVE INFORMATION ENVIRONMENT: THE IMPORTANCE OF INFORMATION ARCHITECTURE.

[15] Yoona Y., Uysalb M., An examination of the effects of motivation and satisfaction on destination loyalty: a structural model, Received 14 November 2001, accepted 29 August 2003.