Mobile Agents Model for Optimising the Performance of Mobility Assistance Information System

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Abstract—**Rapid increasing in information and communication technology, gives effect to current mobility assistance information system. From a traditional delivering transportation information (face to face), it progresses into web based delivering transportation information. Passengers are interested to provide sufficient information in context of certain alert or information published by a given site, in these cases passengers are necessary visit the web site frequently and wait for an occurrence. To raise the effectiveness of the mobility assistance information system, we relied on a multi-agent system technology for taking advantage of all the characteristics of the agents. In this present article, we will propose the use of mobile Agent techniques as a promising model for the delivery of information to the user by sending him a Short Message Service (SMS) or a mobile Email Message, through Intelligent Notification System.**

Keywords-Information; Multi-Agent System; Notification System; Mobility Assistance Information System; Passenger; SMS

I.   INTRODUCTION

Today, the progressive evolution of the transportation systems and the increasing people's demand of the mobility make this field more attractive, which require decision makers to keep and develop this attractive by profiteering a new technologies. It must provide to passengers a many tools but also efficient passenger information, to prepare to move in good conditions.

The passenger information is a primary base for the transportation company. Its efficiency is a significant asset to enhance the attractiveness of a transportation network. Indeed, it makes it possible to simplify the use of transportation by allowing the passenger to find himself easily in the services offered on the networks. The information is the first step allowing a customer to organize his travel; therefore, its quality is of utmost importance. The information is not intended only for occasional passengers of the network, but to all passengers, these latter have different origins; it must be adapted to different types of passengers who will have different expectations. Firstly the regular user knowing his usual route, secondary the occasional user who knows the network only partially because of a specific use, finally the foreign user who does not know at all the network that he will take. To make the information accessible to anyone, in any place and with total availability, it is important to benefit of rapid advancement of ICT in the largest distributions of personal mobile devices that can play an important role in improving transportation relationship.

Taking advantage of the effective impact of information and communication technologies (ICT) on Intelligent Transportation System (ITS) can increase the data flow while allowing real-time data exchange in transportation systems and traffic networks [1]. MIS [2] is one of the proposed mobile agent based Multimodal Information System that can answer the passengers' requests. Although these systems inform passengers in real time, they do not allow the personalization of the information provided. Accordingly, the use of mobile devices notification system consists of creating a new type of automatic information and communication by giving passengers complete personal information, indicating the changes. In other hand, to bring the passengers closer to the transportation service and engage more effectively with it, by raising the quality and accuracy of the information provided to them, especially in disturbed situations. Contrary to Web technology which offers very limited support for distributed information systems [3] where requires a physical presence of the passenger to consult it.

In this paper we present an agent based framework as a solution to the problem of distribution information on time by using a push approach. The agents will notify the passengers for any new preference information updating

II.   ADVANTAGE OF MOBILE PUSH NOTIFICATION SERVICE

When the user lances an initiate request for information and gets it from the server, it is called pull communication. Pull is the more traditional approach, in which a user or software client makes the initial request for info. On the other hand; when the user register at a service, push notification is the delivery of content from a software application to a computing device without a specific request from the client as short

message (SMS), email or mobile app-notification on the environmental conditions which is reducing load on network[4].

The portability of mobile devices make it easy to deliver information anywhere and anytime even with asynchronous communication. The advantage of delivering a simultaneous notifications to a wide user base is provide timely information (Push technology delivers instantly notifications on users mobile device) that encourages users to exploit the services offered, on the other hand encourage decision-maker to develop and improve their service.

Due to the bandwidth limitations of wireless networks, the most advantage of mobile push notification service is notifying only list users which matching event. Users can modify the notification settings and specify what they want to know, this prevents receiving notices that do not concern them.

- Encourage users: generalizes the transport notification service to a wide user base, it will provide timely information (Push technology delivers instantly notifications on users' personal device) that encourages users to exploit the services offered, and on the other hand encourage suppliers to develop and improve their service.

- User comfort: To ensure user comfort. The Users can modify the notification settings and specify what they want to know, this prevents receiving notices that do not concern them.

III. MULTI AGENT TECHNOLOGY

A. Agent Technology

An intelligent agent is a piece of software that can migrate from machine to machine in a heterogeneous network [5][6] and it is capable to learn new knowledge instead of relying on its internal knowledge. With its cognitive models that guide actions in an environment, the agent will affect its environment and vice versa. It have been used in the applications of distributed systems based on publish/subscribe communication protocol [7]. In Transportation environment, if an announcement available, or an alert mark, agent reacts to these changes. It will inform the passengers by notifying for all news. To complete the tasks successfully, agent have several characteristics added from other software: mobility, autonomy, interactivity with other agents group, processing information from external environments, etc [8].However, the mains property on which the proposed framework is based [9]:

- *Autonomous*: Agents have the capabilities of task selection, acting independently, decision maker without human intervention.

- *Reactivity*: An Agent is called reactive when it responds to changes that occur in its environment (The time of responds is very important).

- *Cooperative*: Agent can work on cooperates, interact and share their knowledge with other agents to achieve certain objectives

To assure interoperability of agents in different platforms, there are standardizations: KQML (Knowledge Query and Manipulation Language) is a language and protocol that can be used for information and knowledge exchange [10][11], it allows agents to cooperate and share information with other agents to solve a problem [12]. There is another language called FIPA, which are based on an Agent Communication Language (ACL) to complete interaction process, or by Remote Procedure Call (RPC) or Invocation of Remote Method (RMI).

B. Multi Agent System

A multi-agent system is a set of autonomous intelligent agents which have property of communicate and cooperate with other agents, in order to achieve their goals. The objective of this system is to decompose a complex system into several simpler agent systems.

IV. THE PROPOSED ARCHITECTURE

A. Basic Idea

The problem in the Transportation System (TS); especially passenger transportation system is adhered to time; that any information or new announces frequently occur as verbal or appear on advertising board inside the passenger station or on website. Typically, the collect of this information requires either moving to the station, so additional expenses and physical fatigue, or permanent visit to the website just to discover that the travel is canceled or postponed. Or to know that some offers (discount in prices of travels during the period, organization of special travels...) might be announced, started, and finished without the passenger being notified. Consequently, there is no method to notify passengers early.

The use of mobile agent concept in Push notification offers the mean to enable the delivery of information about immediate transportation events from server to passengers mobile. To exploit the properties of Agent (autonomous, reactive, cooperative …), we adopted (proposed) event-based classification. Our Idea is to divide transportation events into a set of sub-events. Correspondingly, users can also be divided into lesser groups according to transportation events.

Let us suppose T_e is a Transportation event, it can be divided into sub-events TS_e. So, we can get in "(1)":

$$T_e = TS_{e1} U\ TS_{e2} U\ ...\ U TS_{en} \qquad (1)$$

This provides the agents an uncomplicated and interactive environment, where each Transportation Sub Events TS_{ei} has a set of information noted (I) prefer by group of passengers (P) of Transportation events.

If an announcement available or an alert mark, our agent will be react to these changes.

$$\forall i, if\ I_{i(TSe)} \cap I_{i(P)} \neq \emptyset \qquad (2)$$

If there is information common between published and demanded information"(2)". Therefore, the launch of an automatic notification system (MANST) is necessary in these cases to have true information on time.

B. MANST Framework

The proposed MANST framework is an agent based mobile event notification system that benefits from using software agents to push interesting events to the target passenger on their mobile devices. It is a middleware between:

- The passenger (P) who must subscribe to the system and chooses his preferences information (I_p), the combination (I_{pi},P_i) will be handled by the agents.
- Publishers are a responsible of create events; they are who publish Transportation Events (I_{ci},TSe_i).

The transportation event service that manages publish information (I_{ci},TSe_i) and preferences information (I_{pi},P_i) and delivers events to subscribers.

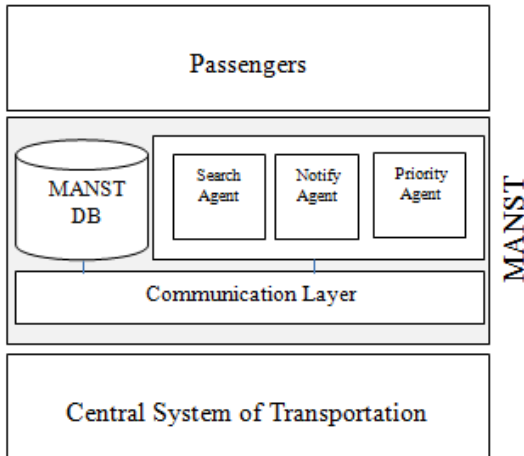The architecture of MANST is presented in "Fig. 1" It consists of:

Figure 1.   The System Architecture

- *Central System of Transportation*: Is the main source, which collects and provides information on transportation. It is responsible for the event data. Whether resulting from ITS or Transportation Companies.

- *MANST*: Is an intermediary between the database transportation server and passengers. It makes the searches in the Database to retrieve information on behalf of the user and deliver it to their mobile device. Unlike the conventional client-server scenario, in which processing vast volumes of data stored at remote locations. Mobile agents allow the processing to be done locally, instead of transmitting the data over a network [13]. This is one of the features that make agents effective.

- *Passengers*: A new passenger registers with the system, where having the choice to select a travel areas favorite, to receive all that new.

C. MANST scenario

This scenario "Fig. 2" illustrate on how the agents coordinate their actions to achieve the designated tasks of automated notification.
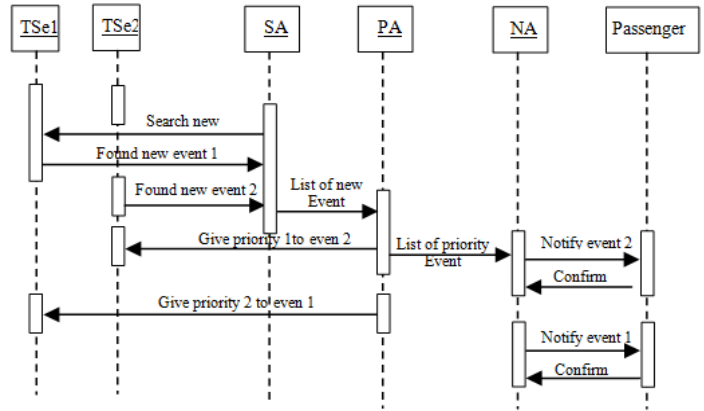

Figure 2.   Notification Process

When any new information is found "(3)", the search agent (SA) will create an interaction with the priority agent (PA). The main role of PA is prioritizing which events should be notified first to the passengers.

$$\forall t, TSe \ if \ TSe(I)_t \neq TSe(I)_{t+1} \qquad (3)$$

According to the urgency of the events, priority agent will rank validation events as first priority, followed by alert as second priority, and in the last the announcement. When all the events found has been ranked accordingly, priority agent will interact with notify agent (NA) to get confirmation from the passenger. Notify agent is crucial in push technology stage in which it will reduce the amount of information distributed, and reduce the broadcast time T_{max}.

V.   DISCUSSION

The mobile agent paradigm is used to process networked data. We can show better performance than the classic client/server paradigm. Si we suppose that T_{max} is the maximum time between the moment when there is a transport event publish and the communication to the last user preferring to know all updating about this event.

With this definition, we can deduce that T_{max} will be the sum of the time devoted to the service of each user appeared in notification list (T_i), divided by the number of agents exported "(4)".

$$T_{max} = \frac{\sum_{i=1}^{u} T_i}{N} \qquad (4)$$

Where u is the number of users in notification list in an instant determined.

T_i is the sum of waiting time T_w until the new publish added to the number of steps performed Nb for the maximum time of one step communication T_c, we can obtain "(5)".

$$T_{max} = \frac{\sum_{i=1}^{u}(T_w + Nb \cdot T_c)}{N} \qquad (5)$$

The time spent in informing all users subscribed to the system. It has a direct relationship with the number of agents and the techniques of Analysis and Collaboration which implemented to take charge of Change Notification management mainly.

VI. CONCLUSION

This article has presented architecture for sending notifications to passengers about any updating in their favorite information, and allowing establishing a distribution of notification before deadlines. Since the process of publishing and notification is done automatically by the agents. The system helps transporters to reach passengers and inform them about the incoming, urgent and sudden events, through using devices more interactive than before.

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