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iGenda: an event scheduler for common users and centralised systems.

Ângelo Costa, Juan L. Laredo, Paulo Novais, Juan M. Corchado and José Neves

Abstract The world is walking towards an aged society as a consequence of the increasing rate of longevity in modern cultures. With age comes the fact that memory decreases its efficiency and memory loss starts to surge. Within this context, iGenda is a Personal Memory Assistant (PMA) designed to run on a personal computer or mobile device that tries to help final-users in keeping track of their daily activities. In addition, iGenda has included a Centralised Management System (CMS) on the side of an hospital-like institution, the CMS stands a level above the PMA and the goal is to manage the medical staff (e.g. physicians and nurses) daily work schedule taking into account the patients and resources, communicating directly with the PMA of the patient. This paper presents the platform concept, the overall architecture of the system and the key features on the different agents and components.

1 Introduction

The current tendency on the growing of the population size is to decline in addition to a decreasing on the mortality rate [1]. This means that in the future there will be more elderly than young people (children and teenagers). This fact leads to the increasing of people with memory loss. Our memory is what make us who we are and help us do our everyday tasks, helping us remember the tiniest details of each

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task and keeps track of what we have done and what needs to be done. It is also a known fact that when people retire their days are filled with free time. This free time can be more harmful than beneficent. The filling of playful activities in the everyday routine can contribute to a more active ageing thus creating more interesting experiences at an old stage of life.

To cope with some of these issues (e.g. free-time management, task management,...), we have created a platform based on a Multi-Agent System that recurs on modular and collaborative agents that work on solving the Memory related problems. On top of such a platform a Personal Memory Assistant and a Social Enabler were developed and are here presented, as well as a Centralised System Manager that can manage several services that schedule several user's agenda taking into account some restrictions such as the availability of resources or the health conditions of the user. We are also going to present a validation of our choice that a distributed agent system approach is adequate for developing multi-agent systems, focusing on the PMA paradigm.

2 Ageing Factors

Nowadays because the increased quality of the health care services and the advances in the social care system the life expectancy tends to increase. In fact the United Nations (UN) stated in their last survey that "By 2050, the world as a whole and every continent except Africa are projected to have more elderly people (at least 60 years of age) than children (below 15)", in 2050 there will be twice the elderly people than nowadays [1]. There are several consequent problems inherent to the ageing of population, being the loss of memory one of the most common and often one of the most underrated. At the age of 50 the human beings begin to be affected by it, being the forgetfulness of more recent events, one of the most occurred symptoms [2]. The severity can be variable but if a person does nothing to stop it can progresses to a case of dementia. The memories lost are not recoverable and the lost capacity of memorizing is irreversible but any further loss can be prevented. Through the exercising of the brain the prevention can be done.

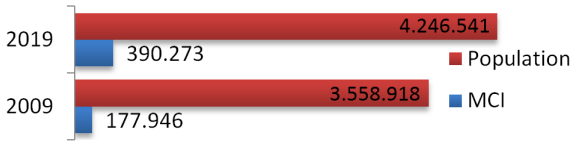

Fig. 1 Portuguese population Mild Cognitive Impairment incidence and expectancy.

In fact not only the elderly people get affected by memory loss, people in a younger age range are affected too. There's not still a known way of reversing the loss of information by the human brain, so a possible solution may be the use of

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computational systems to store and retrieve all that data. Through the use of an agenda and/or calendar, we may reach the goals set to this work. The current technologies fail in this point, by underachieve or misinterpret the actual needs of the users or the directions to be taken in order to approach the problem [3, 4].

3 iGenda

The main objective in this work is to provide an intelligent scheduler that organizes all the user day, a Personal Memory Assistant (PMA), and a Centralised System Manager (CMS) that manages the agenda of an institution and his attendant users, and managing also the available resources. The system is in fact a two modular parts that are meant to be connected seamlessly through agents and be supported by a Multi-Agent System [5].

The PMA aims to help persons with memory loss, by sustaining all the daily events and warning the user when it is time to put them into action. It will be able to receive information delivered by any source and organise it in the most convenient way, according to predefined standards and protocols, so that the user will not need to manually plan or schedule specific events and tasks [6, 7, 8].

The CMS is aimed to manage the agenda of activities of e.g. a hospital. The management will be done taking into account the resources such as beds or offices. Every day, the CMS updates the physicist agendas with the daily planning of visits and consults. The objective is to optimize the resources and minimize the time in order to provide a better attendance to the users. The CMS is compatible with the iGenda system, it means that it is totally modular and can adapt to new events or the changing of the already appointed and if can recalculate the next consults, if the physician marks all the beginning and end of the consults.

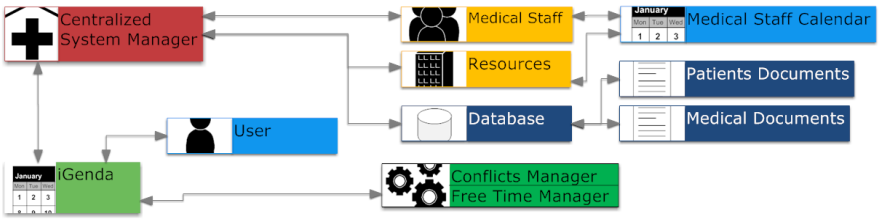

Fig. 2 Block Structure representation of the project.

In addition, we present an intelligent scheduler that will help the user to remember relevant information and events, via interacting with the user through computational means, a PMA. The aim is to help specially people with memory loss, by sustaining all the daily events and remember the user to execute them.

With the capacity of receiving information delivered by any source, it proves to be a fairly modular and adaptable to any operating conditions. It takes the events

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received and organises them in the most convenient way so the user has to interact the least possible, having the hard work for iGenda.

The overall architecture of the system is composed by the following set of agents: the Agenda Manager (AM), the Free Time Manager (FTM), the Conflicts Manager (CM) and the Interface Manager.

The communication between agents is established by Ethernet, WIFI, GSM, UMTS, among others. The communication protocol complies with the FIPA- ACL (Agent Communication Language), being the platform JADE used to build the iGenda and the CMS architecture and using the XMLCodec in the content expressions [9]. All the agents are compliant with this standard since they are all JADE implemented agents. The agents developed in JADE-Leap [10] comply with the needed availability on mobile devices. There is also a plan of implementation of agents in JADEX platform, though in still a concept. The messages must be encrypted and secured, because agents will probably run in a low security device.

The Agenda Manager connects and controls the remaining parts of the manager system and the scheduling one, using the communication infrastructure available to receive and send requests. As result the AM stands for the communication and security of the whole systems. The AM is a two way application agent, it manages the incoming events to be scheduled and programs the time that triggers the FTM. It is also the communication relay with the rest of the system.

The AM ensures also that the user's friends and relatives can keep in touch with him and know what activities he is or will be doing.

The Conflicts Manager agent is intended to assure that there is no overlap of activities and events. This module schedules or reorganizes the events that are relayed from the Agenda Manager, insuring that they are in accordance with the rest of the events. When a collision of different events is detected, the outcome will be decided by methods of intelligent conflict management. In case of overlapping events with the same priority level, the notification of overlapping is reported to the sender, so he/she may try to reschedule to a different time slot. In case of delays the CM can ”push” the events to a later hour.

The events follow a hierarchy system. Every event has a value that is defining of his priority or urgency. Most of the conflicts will use the priorities value to be solved. This agent has also the capacity to manage all the connections with the other users as well as with the user relatives. The CM has a CLP ”engine” that takes care of all the logical and intelligent decisions, assuring the choices are mathematically correct.

The Free Time Manager will schedule playful activities in the free time of the user. These activities configure an important milestone for an active ageing on the part of the user, once it promotes cultural, educational and conviviality conducts, based on an individualized plan. The FTM has a database that contains information of the user's favourite activities, previously verified by the decision support group or a medical committee. The FTM connects to an activities filled database so he can retrieve the available events, relegating all the decisions to a logic engine.

The FTM uses a distribution function that decides the activity that is inserted into the user's free time. It is also important to keep in mind that the activities are merely suggestive, it comes to the user to decide to execute them or not.

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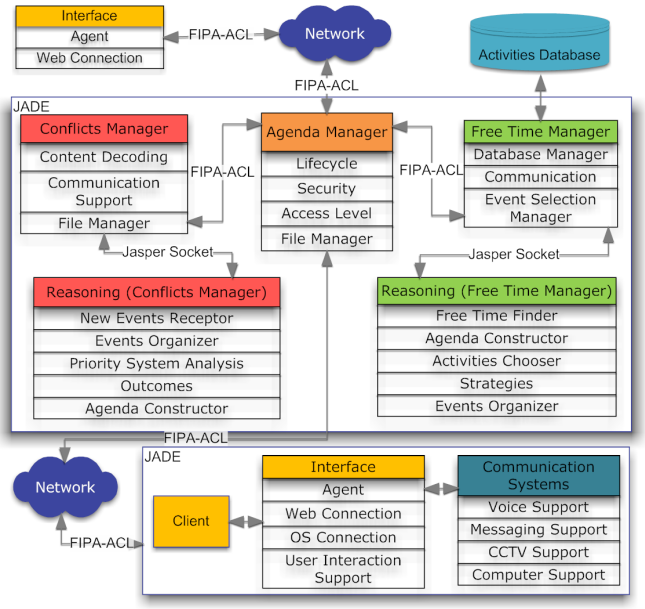

Fig. 3 Scheme of the Structure.

The interface intends to be intuitive and easy to use. Large buttons are used and only the necessary information is displayed. When an event is triggered or accomplished, the user is informed. This agent assures that the information reaches the user, by computer or mobile phone, so the user is always connected to the system. The information warnings and content can be textual, in audio format (pre-recorded messages) or both. In terms of functionalities it supports the communication between the iGenda and supports also the distribution of the information through the already mentioned devices [11].

4 Centralised Management System

The CMS is designed to be capable of the integral management of an institution agenda in a Centralised way. In its current status of development, the CMS is a specification of the following requirements.

Firstly, the system has to be able to manage several agendas such as the physicists and medical staff. In addition, it has to count on the allocation of the resources, such as beds available, monitoring and operative devices. Finally, such results have to be synchronized with the final-user agendas.

Therefore, in a larger picture the iGenda will have to manage several agendas minding the fact that several resources have to be allocated to each user and they

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have to be available in the right moment. Hence, such a problem can be classified as a resource-constrained scheduling problem in non-stationary environments in which CMS has to react to changes in real-time.

This type of problem has been already tackled in the literature ([12]) and there are compounds of techniques that can be applied, including exact solution methods or heuristics such as Simulated Annealing. Nevertheless, most of that techniques are infeasible in large problem instances since the memory and time requirements scale in non-linear orders of complexity. In this context, Genetic Algorithms (GA) use to be one of the most common approaches finding sub-optimal (if not optimal) solutions in reasonable time [13, 14].

The GA allow constructing several hypothesis to solve the problem and choose the best case scenario, it also supports the use of restriction to module the desired goal. The problem could be solved by using heuristic search algorithm to find an optimal solution but this would only work in simple problems, in most of the cases it would take a considerable time to solve or be even impossible. The GA can solve these problems is an acceptable time of execution and find the best solution, considering all the conditionings.

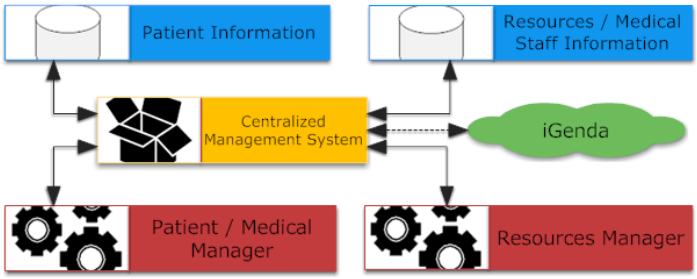

Fig. 4 CMS structure.

The problem addressed will considerate feasible and infeasible requirements. The feasible are the soft requirements and the infeasible are the hard requirements. The hard requirements are:

- The health condition of the user (e.g. a heart condition).
- The available room (e.g. if the ECG room is available on a period of time).
- The available physicist (e.g. if the desired doctor is available on that day).
- The basic medical devices (e.g. the movable medical devices are available on time).

The soft requirements are:

- The available nurses.
- The preferred time (e.g. the time the user prefers to have the appointment).
- The preferred room (e.g. if the correct room is not available but a similar is).

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- The time distribution (e.g. if the schedule is not optimized but serves best the most important items).

Although the main objective is to optimize the agenda in terms of minimizing the time loss and to attend the most possible patients in the least time, an important fact is not reduce the quality of service and take the desirable time with the patients, so the approximated time of attendance has to be considered to keep the standards in terms of quality of service. The operation is executed as follows:

- Initially it is gathered all the activities that must be executed in that week.
- The creation of a calendar with all that activities with little or no special scheduling.
- Detection of the most important events and marking the values of the events to prepare the next step.
- Saving the initial calendar and with the rules and values of the GA create a new calendar.
- Randomly selects parents from current population and produces new chromosomes by performing crossover operation on pair of parents.
- Randomly selects the chromosomes from current population and replaces them with new ones. The algorithm not selects chromosomes for replacement if it is among the best chromosomes in population.
- Repeat until achieved a minimal index of satisfaction.

This operation on a computer with current specifications, is aimed to run in under a second, so speed is not a problem.

The connection with the iGenda is of a crucial form. The scheduled events are automatically relayed to the patient and physicist agenda. Having the capacity of real-time additions and modifications can be beneficial and of an optimal value to the way the route the physician has to do, thus increasing the performance.

5 CONCLUSIONS and FUTURE WORK

In this paper was presented the iGenda, an event scheduler based in a multi-agent architecture. Globally the project is a joined PMA and a CMS. The objective is to organize the user's day and an institution resources and human labour. This project makes the difference to other PMAs, once it introduces the component of free time occupation. Currently most of the project is already working and the focus goes to the remaining functionalities. There have been already some tests in a closed environment, the results are under the expected spectrum, it is intended to broad the tests to a real environment.

There are still problems and critical decisions to be made, likewise the choices of technologies and algorithms must be considered because a bad choice can set-back the project several months, mostly because the re-coding.

The Centralised Management System is currently under development and the finish should be done in a few months.

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In terms of future work we will consider some ideas that came up and surfaced during this work, namely:

- A Case Based Reasoning model is in study so that the iGenda will have the capacity to remember and learn from past decisions [15].
- A the weather detection mechanism will be also focus of a major overhaul in order to provide iGenda with the possibility to optimize the selection of events, considering the current and future weather (outside events).
- A Geographic Information System, a supportive GPS system that can accurately give the position of the user.
- The integration of the Centralised Management System in a real scenario, so conclusive tests can be made.

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