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MEMORY ASSISTANT IN EVERYDAY LIVING

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e-Health, Personal Memory Assistant, Ambient Assisted Living.

ABSTRACT

Memory is one's mental ability to store, to retain, and recall information, representing past and future, our dreams and/or expectations. However, as the human been ages, the capacity of remembering decreases as well the ability to pile up new memories, therefore affecting our quality-of-living and lowering our self- esteem. This configures a social and human dilemma. With the present work we intend to address some of these problems, in terms of a Personal Memory Assistant (PMA), in order to help the user to remember things and occurrences, making it in a proactive mode. It will also cater for some form of relaxation on the part of the user.

INTRODUCTION

An intrinsic characteristic of the human being is his/her memory. Our remembering capacity is of the utmost importance as it gives us the sense of being and the capacity to have a social life, to remember how things are done and to envision the future. This work is oriented to an older population, typically retired, with spare free time, helping them in schedule events with minimal interaction and suggesting activities to fill their unfilled time.
A PMA tool and a Social Enabler one are presented, as well as the simulation results of their impact on the user life.

Ageing Population

According to the United Nations Population Fund (UNPF), the life expectancy of the world population is increasing and the birth rate of children is decreasing rapidly. The UNPF estimates that the European Population decreased 13% in a fifty year period, increasing the age average to 48 years old (UNFPA 2002) at the age of 50 the human beings are severely affected by it, being the forgetfulness of events, namely the more recent ones, one of the most occurred symptoms. Memory is no more than the concept that refers to the process of remembering (Mohs 2007), aging, especially if associated with chronic diseases, affects our ability to remember. There is still no known way of reversing the human brain loss of information, so a possible solution may be the use of computational systems to store and retrieve all that data.

Thru the use of an agenda and/or calendar, we may reach the goals set to this work. However, the current technologies fail in this point, by misinterpretation of the actual needs of the users or the directions taken to approach the problem. On the other hand it has been shown that scheduling and storing intelligently the user's activities, making easier the communication with their peers and relatives, may greatly improve the elderly self-esteem on their daily activities (Aguilar, et al. 2004) (S. J. Brown 2003).

Memory Assistant

It is still unknown in detail how to store memories in the brain, how it works. At the present moment we can only foresee the way it works in terms of organization and memorization. This leads us to conclude that a human being with loss of memory can be helped by means of PMAs. An area that covers a broad spectrum, with many projects arising with different objectives, although they are scattered and have many different focus, like time-lapse recorders and event managers. In the agenda and organization arena, resulting from a thorough investigation, there are no projects being developed at the present time. There are, however, other projects in the memory assistant arena, which will be object of attention, serving also as a small benchmark of what is being done nowadays. None are directly related with our work, but some ideas can be correlated and some features may be considered.

HERMES
HERMES is aimed to provide cognitive care (Jiang, Geven e Zhang 2009). This project is supported by the EU under the Framework Programme 7. It is designed in order to provide an independent living and social participation, improving the quality of living of the user. The main objective is to develop a system, software and hardware, which will reduce the negative impact of declining cognitive capabilities, particularly the memory. An important feature of the this project is the implementation of a monitoring system which should be able to record every action and choice of the user in order to build an association "map", and based on that "map", creating a pattern that emulates the human memory mechanisms. Despite its ambitious goals, HERMES is still in a very early stage of development with an amount of problems that wave no known time of resolution.

M4L: Memories for Life
Developed by the Engineering and Physical Sciences Research Council, has as objective to use technological solutions to help the user's memory (P. J. Brown 2004). This

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project has focus on five different fields: health, private life, education, entertainment and science. Currently it is proposed a raw data archive centre that can store information of different users. The access to the data can be performed by hand-held devices and computers that have constant connection to the server. Basically it aims to save all the user information and put it available in one place. As a result, it intends to eliminate all the paper used and having, at the same time, all the people linked to the system connected. The project is still in a investigation and implementation phase, and any concrete results will be only be achieved in the years ahead.

VirtualECare Project

Initially developed under the VirtualECare project (Novais, Costa e Carneiro, et al. 2008) the iGenda has become more than a module, as it grew apart as independent project (Figure 1).
The main objective of the VirtualECare project is to build a multi-agent and multi-module system capable of monitoring and interact with its users providing health care services, thus, increasing their quality-of-living. Its distributed architecture is composed of several modules connected through a network, having each one a unique role. It has also become a great cradle of smaller projects that are now, waiting for their spotlight and independency.

AGENDA SCHEDULING AND ORGANIZATION

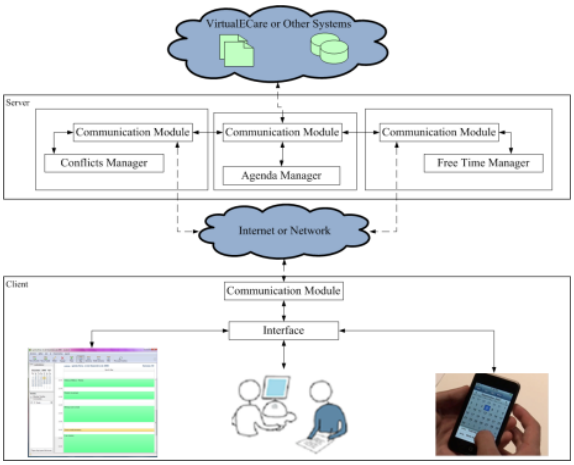

Figure 1: Modules Scheme of iGenda

Our main objective in this work is to produce an intelligent scheduler that interacts with the user through computational means, creating a product that will help the user to remember relevant information or events, i.e., a PMA, by emulating the way the brain processes new events and reorganises the already scheduled ones. For rescheduling an event we normally see in the agenda, which are the events able to be moved to other place(s), considering factors like their relevance and attached problems (e.g. other persons involved, a meeting).
It may help specially the ones with loss of memory, by sustaining all the daily events and making known to the user when it is time to put them into action. It will be able to receive information delivered by any platform and organise it in the most convenient way, according to predefined standards and protocols, so that the user will not need to be bothered about planning or scheduling specific events and tasks. The iGenda is a hierarchy of states and events (Figure 1), intended to deal with the users expectations. It is constituted by the Agenda Manager, the Free Time Manager, the Conflicts Manager and the Interface Manager. All the project modules were written in Java and Prolog, being dependant on the JADE to manage the agents.

Communication

The communication protocol complies with the FIPA-ACL XML (Caire 2006). All the modules will be compliant with this standard since they are all JADE implemented agents. Messages carry the information of updates and direct announcements. These messages are sent and received through the several modules and clients.
Also with the utilization of JADE it is possible the distribution of agents platforms across machines, which may have different operative systems with the possibility to migrate agents among machines at run-time. It also provides portability, which means that any module may run in different machines, being positioned on any part of the world.
Due to its small size the messages are lightweight, easy to be transmit between agents; due to tolerance to errors a message buffer was also created to support any miscommunication or loss of connection with the agents.
The new event messages will carry in their content XML formatted information (Listing 1).

Listing 1: An example of a new event message

```
(inform
      :sender     Admin@AdmM
      :receiver   AM0001@AmM
      :reply-with 1203302
      :language   XML
      :ontology   new_event
      :content    <new-event>
            <id>   0001</id>
            <prio> 3</prio>
            <sum>  "Visit dentist"</sum>
            <dateb>20090514</dateb>
            <timeb>110000  </timeb>
            <datee>20090514</datee>
            <timee>123000  </timee>
      </new-event>
)
```

Agenda Manager

The Agenda Manager (AM) sets the bridge between the remaining parts of the manager system and the scheduling one, using the communication infrastructure available to receive and to send requests. As a result, the AM stands for the starting point of all the work that has to be done. It configures a two stage module application. It manages the incoming events to be scheduled and programs the time that triggers the Free Time Manager.
It also supports the reception of multiple messages, thus increasing the overall performance of the system.
Indeed, the AM manages the entire project. Its assessment modifies the way the project works.

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Conflicts Manager

The Conflicts Manager (CM) module is intended to assure that there is no overlap of activities. This module schedules or reorganizes the events that are received from the AM, making sure that they are in accordance with the other events. When a collision of different hierarchical 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.
The CM will work whenever the Agenda Manager considers it is appropriate. This module has also the capacity to manage all the connections with the other users as well as with the user relatives.
The Conflicts Manager operation can be explained in the following way:

1. When an operation is done by an administrator, the AM receives the message and calls the CM.
2. The CM enters in action by reading all the calendar files, parsing the new event and using the CLP engine to compare the priority levels of eventually conflicting events.
3. It is created a new *ICS* calendar ready to be delivered to the user.
4. A new message is then sent to the user and to the administrator, notifying them that a new Calendar is available and that the new insertion was successful.

Free Time Manager

The Free Time Manager (FTM) will fit recreational activities in the free spaces on the user calendar, then trying to enforce the well being of the user. These activities configure an important milestone for an active ageing on the part of the user, once it promotes his/her cultural, educational and conviviality conducts, based on an individual plan. The FTM has a database that contains information of the user's favourite activities, previously checked by the decision support group.
As the project evolved, an idea emerged, that of inspiring the free time activities on the part of the user. One of them was the inclusion of community related projects. These projects were not developed here, but were imported and adjusted to the results expected to be achieved with this work. The two projects considered were the Time Bank (Castolo, Ferrada e Camarinha-Matos 2004) and ePal, which make up a type of community volunteerism.

$$v = -1\, x_{i=0}^{n}\, rand(|n|) \qquad (1)$$

The Free Time Manager uses a distribution function (1); it decides on the activity that is inserted into the user's free time. For instance, in a three activities packet, the rate for the activity of higher priority is of 70%, 25% for the second and 5% for the remaining one. The activities are merely suggestive, it comes to the user to decide to execute them or not. On the other hand the activities chosen are those that fit into the time space that is available.

1	2	3
-2	-2	-9
-3	-4	-6
-2	-4	-3
-3	-2	-6
-1	-6	-9
-3	-4	-9
-1	-2	-6
-1	-6	-9
-2	-4	-6
-2	-6	-6
-1	-6	-6
-3	-6	-6
-3	-2	-3
-2	-2	-3
-1	-2	-9
-3	-2	-6
-3	-6	-3
-2	-2	-3
-1	-4	-3
-2	-6	-6

Figure 2: An example of function (1) run

In Figure 2 it is depicted an example of the choices made, i.e., in green are posted the winning activities for each round, as well as the values returned by the function's (1) for each activity. As it may be seen the activity 1 presents a rate of choices of 65%, the activity 2 of 30% and the activity 3 of 5%, values that are proximal of the expected ones.

Interface Manager

The interface intends to be intuitive and easy to use. It is known that the elderly have some difficulties with the new technologies, so the interface must be intuitive and easy to use. Large buttons are used and only the necessary information is displayed. A variable warning system is also available. When an event is triggered or accomplished, the user is informed.

SIMULATION

A simulation platform was devised to test the overall system.

Free Time Manager

A typical result of a run of the FTM module is given in Figure 3. It presents not only a calendar where a set of activities were previously scheduled, but also the results obtained with the FTM module, i.e., a calendar filled with full of fun activities.

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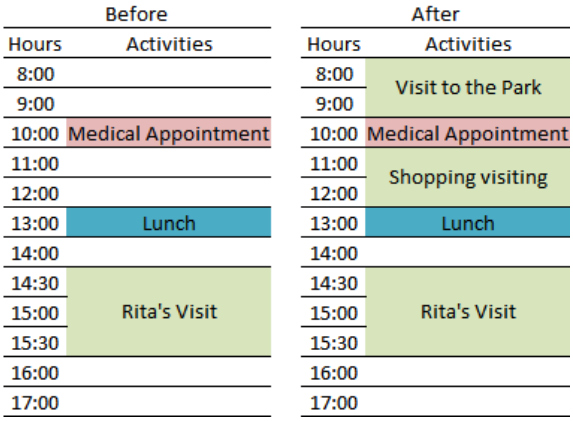
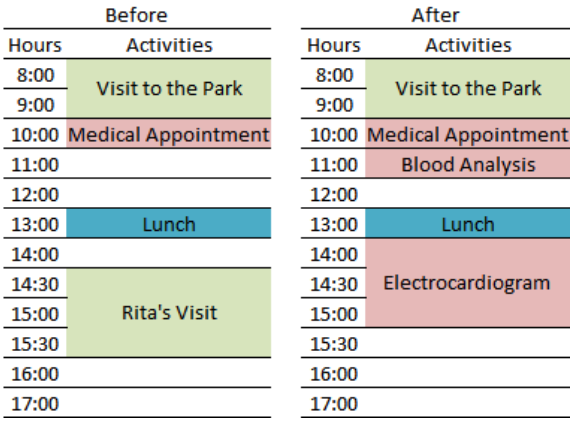


Before		After	
Hours	Activities	Hours	Activities
8:00		8:00	Visit to the Park
9:00		9:00	
10:00	Medical Appointment	10:00	Medical Appointment
11:00		11:00	Shopping visiting
12:00		12:00	
13:00	Lunch	13:00	Lunch
14:00		14:00	
14:30	Rita's Visit	14:30	Rita's Visit
15:00		15:00	
15:30		15:30	
16:00		16:00	
17:00		17:00	

Figure 3: A calendar's before and after picture of a FTM call

All the activities planned came from the database present in the system. On the other hand, the chosen activities have to fit into the time slot available. For example, and as it is shown on the calendar's picture before a FTM, let us consider three events only, i.e., a visit to the doctor, the lunch and the granddaughter visit (Figure 3). A lot of calendar's spaces remain available, and may be occupied by other activities. As it was explained before these activities were selected by the distribution function (1), having into consideration the priority values as also a randomization element that introduces variance to the final result.

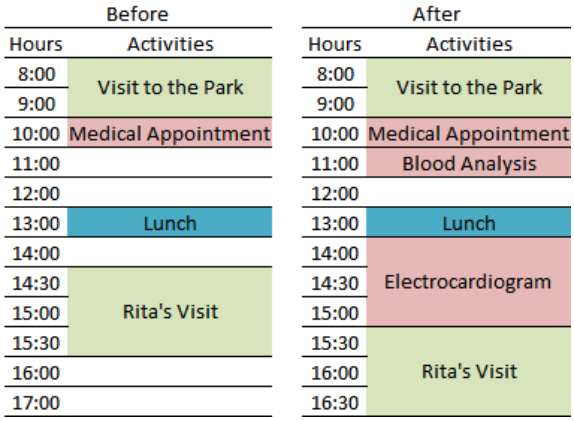
Conflicts Manager



Before		After	
Hours	Activities	Hours	Activities
8:00	Visit to the Park	8:00	Visit to the Park
9:00		9:00	
10:00	Medical Appointment	10:00	Medical Appointment
11:00		11:00	Blood Analysis
12:00		12:00	
13:00	Lunch	13:00	Lunch
14:00		14:00	Electrocardiogram
14:30	Rita's Visit	14:30	
15:00		15:00	
15:30		15:30	
16:00		16:00	
17:00		17:00	

Figure 4: The calendar's picture after a direct scheduling without rearrangement

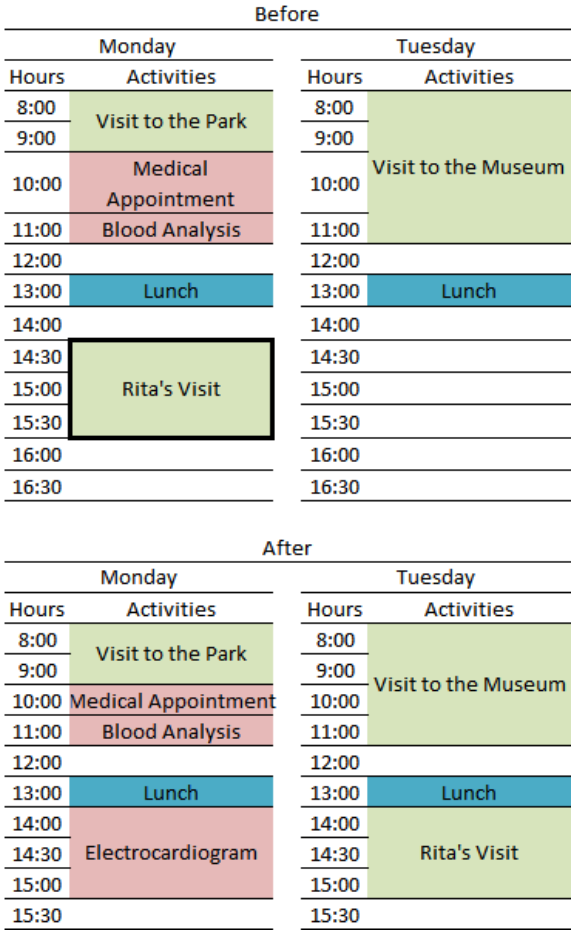
The Figure 4 denotes a direct scheduling. The result points to the elimination of an activity, Rita's Visit, replaced by one of higher priority, a healthiness one.
The CM avoids a direct scheduling with no regard for the previous scheduled events. It operates intelligently by triumph over all the problems, i.e., rescheduling the overlapping events. As it is seen in Figure 5, all the events that are healthiness have priority 1. If they overlap with any other activities, with minor priority, the formers are removed, and any person associated with this event is notified of that fact.



Before		After	
Hours	Activities	Hours	Activities
8:00	Visit to the Park	8:00	Visit to the Park
9:00		9:00	
10:00	Medical Appointment	10:00	Medical Appointment
11:00		11:00	Blood Analysis
12:00		12:00	
13:00	Lunch	13:00	Lunch
14:00		14:00	Electrocardiogram
14:30	Rita's Visit	14:30	
15:00		15:00	
15:30		15:30	Rita's Visit
16:00		16:00	
17:00		16:30	

Figure 5: The calendar's picture after a CM call

The "Visit to the Park" and "Rita's Visit" where immediately changed as they have a low priority factor. Rita was noticed of the rescheduled event.



Before

Monday		Tuesday	
Hours	Activities	Hours	Activities
8:00	Visit to the Park	8:00	Visit to the Museum
9:00		9:00	
10:00	Medical Appointment	10:00	
11:00	Blood Analysis	11:00	
12:00		12:00	
13:00	Lunch	13:00	Lunch
14:00		14:00	
14:30	Rita's Visit	14:30	
15:00		15:00	
15:30		15:30	
16:00		16:00	
16:30		16:30	

After

Monday		Tuesday	
Hours	Activities	Hours	Activities
8:00	Visit to the Park	8:00	Visit to the Museum
9:00		9:00	
10:00	Medical Appointment	10:00	
11:00	Blood Analysis	11:00	
12:00		12:00	
13:00	Lunch	13:00	Lunch
14:00	Electrocardiogram	14:00	Rita's Visit
14:30		14:30	
15:00		15:00	
15:30		15:30	

Figure 6: The calendar's picture after a CM call in two consecutive days

In Figure 6 it is shown:

- The result of a CM call on a previous event-filled calendar. As it can be seen the "Rita's Visit" is moved to Tuesday. This happened once Rita's visit was not programmed when the iGenda scheduled it. Rita's visit was moved to the day after, as she confirmed in the user calendar that she had that time slot available;

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- The result of shifting activities between two consecutive days. In Figure 6 it is shown a calendar's picture after a CM's call that happen in two consecutive days. As it can be seen the Rita's visit is on Tuesday. This happened because Rita could not be present when the iGenda scheduled it. She has moved the event to the next day as she confirmed on the user calendar that she had that time slot available.

FUTURE WORK

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

- A Case Based Reasoning model will be implemented, so that the iGenda will have the capacity to remember and learn from past decisions (Aamodt e Plaza 1994);
- A weather detection mechanism will be also fixed, in order to provide iGenda with the possibility to optimize the selection of events ; and
- A Geographic Information System.

CONCLUSIONS

Although this project has been conceived to set one of the functionalities of the VirtualECare project, it surpasses such endeavour. It turned into an independent and self-sufficient project, with potential to be used in other environments and situations.
Regardless of how it will evolve in the future, there are still problems and critical decisions to be made, namely the "density" problem, where by density we mean overcrowding the calendar of the user with too many activities, making it more stressful than relaxing.
It also makes the difference to other PMAs, once it introduces the component of free time occupation, a problem to be addressed in terms of socialization; i.e., in terms of a process by which the user learn acceptable and unacceptable behaviours for a give environment.

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