Time Orientation Training in AAL

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Abstract. A time display and time training device has been developed in collaboration between University and Special Education Schools, with which an empirical intervention is to begin shortly. Former trials in children provided evidences of time managing improvement, reduction of stress in changes of activity and usefulness in managing behavior contention.
This communication describes current version of the prototype which has been adapted to the experimental setup to be started this year which integrates feedback obtained in previous trials, in accordance with previewed experimental intervention.
Time passing is represented by turning off sequentially and gradually a row of luminous elements initially on, which provides for association with time perception. Besides luminous elements, tasks display provides for association of agenda-information. Tasks management support and anticipation to changes is supported by setting different colors to the luminous elements and by providing luminous or sound messages. Disruptive behavior control training is also supported by added flexibility in configuring different times and feedbacks.
Training tools are integrated in an AAL platform that includes home control and AAL specialized interface, keeping in mind its potential application to other cognitive impairments as Alzheimer disease.

Keywords: Time Orientation, AAL interface, human machine interface, training in AAL, special education schools.

1 Introduction

1.1 Aims and Scope

Temporal Orientation has been prioritized as a basic capacity to improve personal autonomy by education professionals of Alborada Special Education School in Zaragoza [1]. There has been a maintained collaboration between the University of Zaragoza and Alborada Special Education School in societal awareness of disability and in looking for solutions to children difficulties for more than 10 years. One of the collaboration areas is time orientation.

In such frame, we seek deeper understanding of training time-cognitive functions as well as a practical tool to improve this area in children with special needs. In order to assess and formalize intervention results, this action plans to perform a classical empirical research methodology with pre-intervention time-capacities assessment,

intervention and post-intervention assessment. Goal population is children in special education schools.

Goals of such training with children include (1) time perception capacity, time and agenda management; (2) make task-changes emotionally softer by supporting awareness of their vicinity; and (3) altered-behavior control support.

Additionally, since its integration in an AAL platform, the aims are boosted to a global Human Machine Interface (HMI) as far as time is concerned.

1.2 Previous Works and State of the Art

Time Orientation Concept. Classical human functions classification by the World Health Organization is a key document in cognitive functions [2]. It sets human time orientation as body functions and participation functions. As mental body functions it is included in items b1140 “awareness of day, date, month and year”; as part of superior cognitive functions it is included in item b1642 “time management by ordering events in a time sequence” and b1802 “subjective experience of duration and passing of time”. As participation functions it is considered in the item 2306 “adapting to time demands”. Another key document in time orientation concept is the PhD thesis of Gunnel Janeslätt [3-4] which further details those items by gradual cognitive evolution, from time perception to time orientation, to time management and to global time processing ability. In that work, the assessment tool KaTid is developed, which we have found very well suited for our intervention with children.

Time Orientation Intervention. The original idea from which our intervention originates comes from Arne Svensk’s report about the use of a quarter of an hour as an understandable time unit and about sequential turning off of luminous elements in a row as an comprehensible representation of time passing [5-7]. He reported the use of this approach for phone assistance to cognitive disabled adults for their time management, as shown in [6]. The quarter hour clock [8] was derived from his experience, which is a reference in assistance devices and is being extensively used in AAL field. Three cases studies about the use of "Quarter Hour Watch" have been written by two occupational therapists (Rose-Marie Remvall and Karin Mansson). One of the studies is based on his extensive experience in the introduction of this special watch in the early nineties, where it was used to perform the various daily tasks [7].

In our previous studies [9-10], tasks description images were also used for the various activities (in school, day center and at home) together with the row of luminous elements. The joint use of the foregoing caused the perception of time to show a substantial improvement.

Other few studies report good results by using time aids: in [11] authors showed that independence and autonomy should be considered as two separate concepts and report the importance of having frequent communication with the user to understand the usability of the aids. A recent study [12] concludes the effectiveness of time aids to improve time-processing ability and managing one’s time in children with intellectual and developmental disabilities.

2 Description of the Time Orientation Device

2.1 Forework and Specifications

From [7-10] some aspects have been considered to drive the time aid design:

- User's attention must be gained and advance notice must be given and use of sound and lighting/images information must be designed to improve understanding and the ability to gain user's attention. Prototype follows such suggestions from teachers.
- Provide enough flexibility by facilitating teaching professionals the programming of time indicators adapted to each user. Prototype considers this flexibility.
- Provide information about the environment through the programming of specific tasks. As part of a platform, software may use environmental information.

Following these premises, specific objectives were set to be included in the Time Orientation Device (DOT following Spanish initials). In particular, it is essential to try and obtain a tool that supports people with disabilities in:

- Perceiving the passage of time.
- Improving time orientation: awareness of time of day, week and time of year.
- Training for time management or task planning, so increasing independence.
- Anticipation of task changes to reduce associated stress.

Prototype described here is the fourth version of the DOT and part of a model developed in 2006 [9], 2011 [10], and later redesigned in 2015. Currently there is a prototype running at school for teacher's acquaintance and testing.

DOT is integrated into an AAL platform designed for schools, an extension included within the TICO-home-control system presented in [13]. TICO-home-control was installed during the last school year in the special education school to study adaptations and training strategies. Case studies and structured and semi-structured observations were applied with five children.

2.2 Description of the Time Panel

Hardware device consists of a translucent plastic panel of 81x19x6cm that integrates a series of 40 luminous elements (LEDs) which are configurable in color and brightness. Each element symbolizes a configurable time unit (quarter of an hour by default). Each LED either gets off or changes color with the passing of time. Next events are announced in a visual and acoustic way by a control device located in the upper part of the DOT. So stimuli to draw attention are given with sufficient time to avoid anxiety and to motivate the user. The device is ready to be hung on any surface.

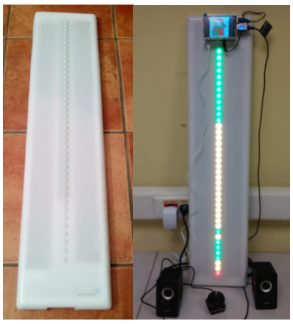
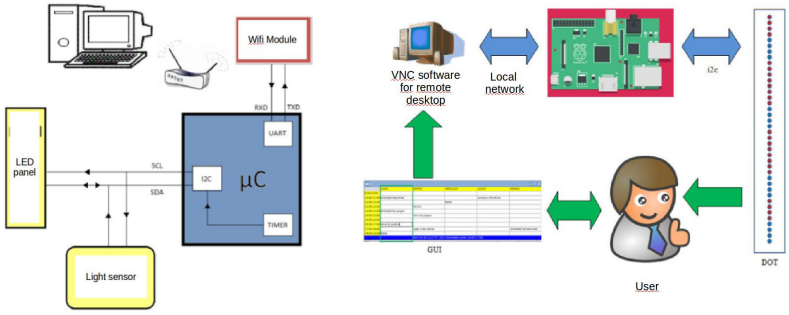


Fig. 1. (A) Initial aspect of the DOT, (B) Current aspect

2.3 Electronics

DOT electronics consists of two parts, the first one is formed by five LED boards, each one including eight high-brightness RGB LEDs together with its control chips (MAX7315). Every board has three control chips, one for each basic color, and is managed by an I2C interface. All LED boards are connected in series to be managed by a single I2C port. The second part is currently based on a Raspberry Pi (RPI) which is a low cost single board computer specifically developed for educational purposes. Previous versions used a Zigbee module to operate the LED boards from a remote computer, or an autonomous microcontroller board to operate the LEDs which provided autonomy from the classroom computer however limiting functionality about multimedia feedback and connectivity (Fig. 2A). Current version is equipped with a RPI boosting its connectivity, multimedia feedback and database management capacities (Fig. 2B).



(A) (B)

Fig. 2. (A) DOT version 2011, (B) DOT version 2015

Suggested by teachers, RPI has been equipped with a 3.5" 320x480 TFT screen to display the pictogram associated with each of the scheduled tasks, a set of speakers to reproduce the sound associated with the task, a Wi-Fi dongle for wireless communication and a webcam. LED boards are controlled with the GPIO connector of RPI.

2.4 Software

DOT uses Raspbian Jessie operating system, which is free and open source operating system optimized for the RPI hardware. It includes an open source HTTP web server (apache) as well as a general programming language of server-side code for dynamic web content development (php), a database data management system (MySQL) and a tool to manage MySQL databases (phpMyAdmin).

Multiple web applications have been developed to handle several databases (users and permissions, DOT configuration, logs…) besides some Python applications for the management of RF433 devices, webcam, mentioned I2C communication, video and audio playback applications.

2.5 Communications

Communication with the system can be done through the connection, as a client, through an SSH terminal, remote desktop, either locally (connecting directly to the RPI via Ethernet or Wi-Fi) or remotely since the system is provided with a DDNS service. This allows modifying the DOT tasks by programming them remotely. This communication can be established from any computer, smartphone, tablet, regardless of the operating system used (Windows, Linux, Android, Mac, etc.) in order to improve the usability and flexibility of the system.

3 User interface description

User interface integrates feedback obtained by workshops with teachers and previous trials, trying to maintain it simple for basic and standard configurations and providing enough flexibility for all intervention goals.

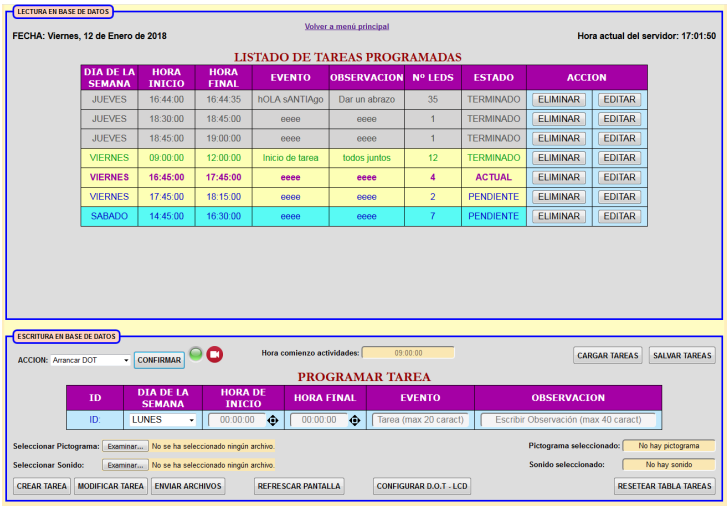


Fig. 3. Spanish DOT HMI main menu

When connecting to the RPI website, one can see the control environment shown in Fig. 3. Main menu screen is divided into two windows: scheduled task information and task introduction or editing.

First one shows current date and time, list of scheduled tasks for the whole day and the whole week, selection tool to delete or edit tasks one by one, task status in time (past, current and pending). Task status is shown with different color patterns: background color regards days: gray for days gone by, yellow for tasks for the current day and cyan/blue for tasks for future days. Font color displays task time regarding present moment: finished tasks have green font, current tasks purple and pending tasks blue.

The bottom window in Fig. 3 shows the editing window, where you can: (1) create new tasks; (2) edit any scheduled task to change the day of the week, start time, end time, name of the task, as well as the possibility to include some notes; (3) send pictograms and sounds to a folder for later use; (4) associate a pictogram and a sound to a task; (5) load/save tasks configured to an external file; (6) initialize the list of tasks; (7) display start time of daily activity; (8) turn on/off a webcam to assist user by visualization of the elapsed time or the environment.

A pop-up screen for each task shown in Fig. 4 allows for further editing: (9) enable and disable touch screen; (10) configure preferences in color codes and brightness of pending, current, finished, unscheduled tasks and set the tasks that turn on and off LEDs. It gives an option to perform LED color tests to directly check color outcome; (11) configure time base (hours, minutes, seconds) and multiplicative factor for each luminous dot (x1, x5, x10, and x15), having minutes and 15 as default (each dot means 15 minutes);

Fig. 4. DOT color and brightness - with test option - and time configuration window

Configuration is saved in a MySQL database. The way to access it is by username and password through the application phpMyAdmin or by saving the contents of the table in a file.

4 Future Work

Current prototype integrates collected needs for next intervention in training children. Intervention results will be assessed by evaluating time cognitive capacities of participants previous and after intervention with KaTid tool [3-4]. A period of 2 to 3 months is estimated for intervention, in which class agenda is to be introduced in described tool and multimedia feedback configured for participants. We are confident that good results in several areas of time orientation will be measured, from perception to daily time management.

Parameters to vary in intervention are currently in draft design and will be the focus of a future communication. Study of results will hopefully highlight which keys in training methodology are best adequate for each cognitive situation, from which training protocols and methods will be derived and written in user manuals. Special education teachers already have working communities to share education, ideas and materials, so they will take the baton to integrate and maintain a living AAL training tool.

Emotions recognition systems will be included in future set-ups to better know which time functions are being most stressful for participants to focus support and training on them. Works have started to include physiological parameters to measure anxiety level among others.

Future target population is expected to widen to elderly with dementia and cognitive impaired adults. New target groups considered are people with frequent memory failures, who periodically forget daily tasks and people in early stages of dementia, for whom support tool would show the task to be performed and also tutor the user through its realization with different configurable levels of detail.

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