



COGKNOW

D2.6.1

Prototype Release of Home
Based Visualisation Service

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Context

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WPL	Veiko Raime (MOBI)
Task T2.6	Home Based Visual Interface This task addresses the development of a suitably large display to relay the reminder messages to the person within the home environment. Once the mobile device is 'docked' with this interface, all further messages will be relayed through a video interface. In the first instance it is envisaged this component will take the form of a Tablet PC which will evolve into a customised device throughout the duration of the project.
TL	Richard Davies (University of Ulster)
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1. Summary

This deliverable presents the prototype system which has been developed within the Project to offer persons suffering from mild dementia with a fixed resource within their home environment through which delivery of services can be offered.

Specifically, the work has involved the development of a suitably large display interface which has been used to relay the reminder messages to the person within the home environment along with the delivery of other required services. The visualisation service is integrated with the home hub that controls the synchronisation of services with the mobile based cognitive prosthetic. The visualisation service has been created using off-the-shelf technology integrated by a suite of customised software.

A demonstration of the visualisation service can be accessed by viewing the DVD which complements this document. Additionally the video has been made available in two different sizes and can be accessed using the following links.

[https://cdh.project.ltu.se/main.php/Cogknow%20Field%20Trial%202%20\(Medium\).wmv?fileitem=27852809](https://cdh.project.ltu.se/main.php/Cogknow%20Field%20Trial%202%20(Medium).wmv?fileitem=27852809)

[https://cdh.project.ltu.se/main.php/Cogknow%20Field%20Trial%202%20\(Small\).wmv?fileitem=27852808](https://cdh.project.ltu.se/main.php/Cogknow%20Field%20Trial%202%20(Small).wmv?fileitem=27852808)

2. Introduction

2.1. Impact of Dementia and Assistive Technologies

Dementia is a mental deterioration that exhibits typical symptoms including impairment of memory, thought, perception, speech and reasoning. It is a chronic disease whose effects are progressive and irreversible. According to recent studies, dementia can affect over 5% of people over the age of 65 and more than 40% of people over the age of 90.

Recent advances in assistive technologies to support independent living have provided many tangible solutions for those who require assistance within their home environment. Although a plethora of assistive technologies exist, there has been a relatively lesser focus on development of cognitive prosthetics for persons with mild dementia.

It is becoming a recognised fact that persons suffering from mild dementia can benefit from a form of cognitive prosthetic which can be used to assist them with their day to day activities both within and outside of their home environment. The goal of our current work is to develop a successful user-validated cognitive prosthetic for persons with mild dementia. The target solution will comprise a fixed stationary component, a mobile based component and an environment equipped with sensor technology.

2.2. The COGKNOW Approach

Our current work has been driven based on an assessment of unmet needs of both persons with dementia and their carers [1]. Following these studies key areas within which support should be offered have been identified:

- issues surrounding remembering.
- communicating with others.
- engaging in everyday activities of pleasure.
- perceived feelings of safety.

Within our technical development work we therefore hope, to assist dementia suffers to:

- remember.
- maintain social contact.
- perform daily life activities.
- enhance feelings of safety.

The development approach which has been adopted is based upon a three phased waterfall methodology. The first of these phases involved user requirements gathering, prototype development, field testing and evaluation from user, technology and business perspectives [D5.4.1]. The first evaluation has guided the second phase of our work.

2.3. Purpose of Report

It is the intention of the current document to describe the prototype home based visualisation interface, especially with regards to personalisation functionality. This report should be read in conjunction with the DVD where the functionality of the system can be viewed.

In the following Sections we will describe the framework of our home based visualisation service which complements its prototype delivery.

3. Architecture

3.1. COGKNOW Hardware Components

The main hardware components that make up the CogKnow system are shown in Figure 1 and are described as follows:

Stationary Device: the purpose of this device is to act as a hub within the home environment and hold the personal details along with reminder based information for the person with dementia (PwD). The device has a touch screen interface hence providing the opportunity to deliver messages to the user and also to collect their interaction with the system. This technical component of the system is the core of this Deliverable in terms of the provision of the visualisation service.

Mobile Device: the PwD is equipped with a mobile device. This offers a tailored suite of functions and has the potential to provide support both around the home and also when the person leaves the home.

Sensorised environment: a limited number of sensors are to be placed within the home to detect doors etc. being left open. In addition X10 technology is utilised to support the deployment of actuators to control devices like radios and lamps.

Central Server: this is used to store all personal information related to users of the system and to capture the details of the services offered, such as reminders. All information stored on the server is regularly synchronised with the stationary and mobile device.

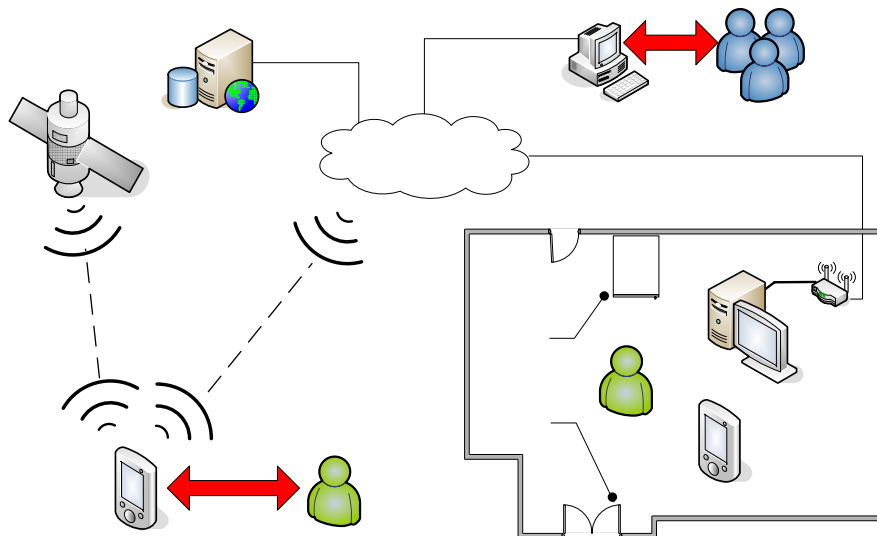


Figure 1: CogKnow system infrastructure.

A summary of all the hardware used within the CogKnow system in chapter 1 of the DVD.

3.2. COGKNOW Software Components

In addition to these physical hardware components there are a number of software layers which are utilised to interface between the aforementioned four main components of the CogKnow system. The provision of these software layers allows the creation of visual services which aim to address the unmet needs of the PwDs. Figure 2 shows the software architecture used within the stationary component to provide the services that will require communication support on a PSTN link, parsing XML data from a server and reading sensor data from the sensorised environment.

In addition there are drivers adapting the hardware components (sensor system, X10 actuator system, voice modem, touch screen).

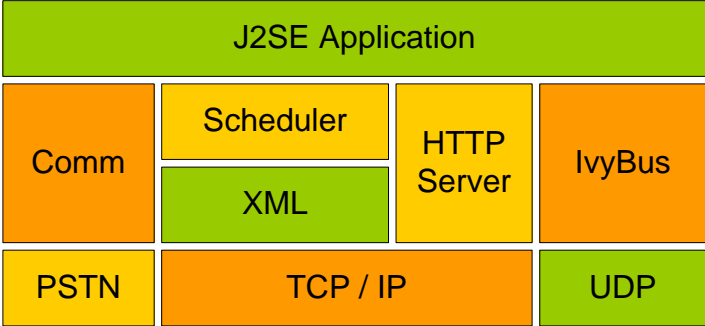


Figure 2: Software layers on Stationary Component.

3.3. Screen Layout Design

To assist with the usability of the system the layout of the screen on the stationary device was developed to support placeholders for time related information on the left hand side and key communication/safety features along the top (Figure 3). This layout remains consistent regardless of how the user interacts with the system and which service is being offered. The remaining space on the interface has been dedicated to facilitate dynamic services. Figure 4 shows the software interface with an example instance of the services being deployed.

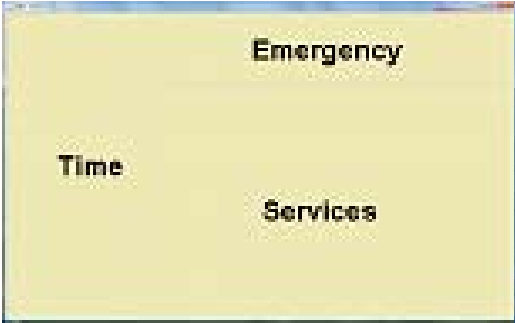


Figure 3: Stationary screen design layout.



Figure 4: The stationary device home screen.

As part of the user requirements process, four key areas were identified and a number of functional requirements were assigned within each of these areas. As highlighted in Section 2.2 the four areas of cognitive reinforcement under consideration within the Project are remembering, communication, daily activities and safety.

The following Sections will address each of the areas describing each functional requirement through a small technical description. These descriptions are complemented by the presentation of the prototype on the accompanying DVD.

4. Functionality

4.1. Remembering and Reminding

Zanetti et al. (2000) [2] asked five patients with Alzheimer's Disease to conduct seven prospective memory tasks on set times with the help of an electronic agenda and compared the effort with a control condition in which the same tasks had to be performed without the electronic agenda. All participants performed significantly better on the memory tasks when using the electronic agenda

Reminding has previously been identified as the main area of unmet user needs. The reminding service requires the establishment of three main functionalities:

1. Reminding a PwD to carry out a task via a multimedia message.
2. The provision of an agenda calendar.
3. Time indication using a clock.

4.1.1. Time Indication

A time indication component is located in the top left corner of the screen. The date and time are visualised with date formats being country specific for the United Kingdom, the Netherlands and Sweden. The time aspect can be configured to be either an analogue or digital clock as shown in Figure 5. Additional personalisation can be made selecting twenty-four hour format, the presence of a seconds hand and the text size used to convey the date. The following XML excerpt shows what can be personalised.

```
<Time id="0" name="Time" type="analogue" twentyFourHour="false" secondsHand="false" textSize="20"></Time>
```

Figure 5 shows the time component in both analogue and digital formats.

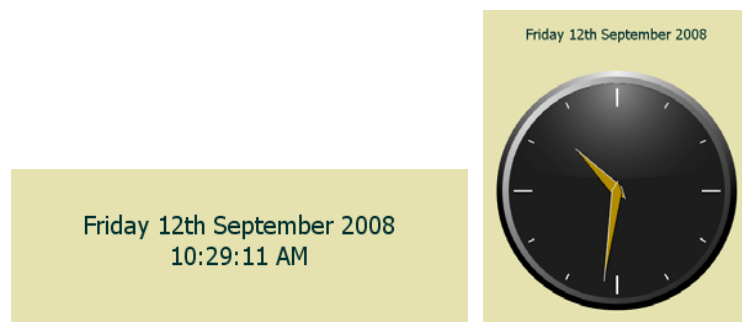


Figure 5: Digital and analogue time component.

See chapter 10 on the DVD for a demonstration of the time indication in operation.

4.1.2. Reminders

The reminding service is a core part of the system and is distributed across all four hardware components. The COGKNOW server stores and configures all reminders for all PwDs. This is achieved via a web based interface allowing quick and efficient control of each reminder through the personalisation of text, image (see Figure 6) or video messages. The stationary

device delivers various types of multimedia content on a touch screen display and can obtain direct confirmation or acknowledgement of any reminders delivered to a PwD following their interaction with the touch screen.

Reminders can also be delivered to the mobile device, however, more limitations are placed on the multimedia content due to limited screen size.

When a reminder fires on the stationary device it signals its arrival via an audible alert which repeats itself typically every 20 seconds for the duration of the reminder. If a reminder is configured as text or an image then these items are presented immediately to the person with dementia. In instances when a video reminder is issued, it is only started when the person with dementia presses the screen.

The rationale behind this approach is to ensure that the person with dementia is in front of the screen when the video starts. (If the video were just to start playing on an endless loop there is a high probability that the person with dementia will commence viewing in the middle of the video hence causing confusion.)

At a system level the following XML excerpt shows how the reminding service can be configured.

```
<Reminders id="9" name="Reminders" contactInterval="1"></Reminders>
```

The contact interval can be adjusted in minutes to configure how often the schedule is checked on the server. Additionally, by omitting the <Reminders> tag in its entirety this service can be disabled.

To view a reminder firing on the touch screen see chapter 10 on the DVD.

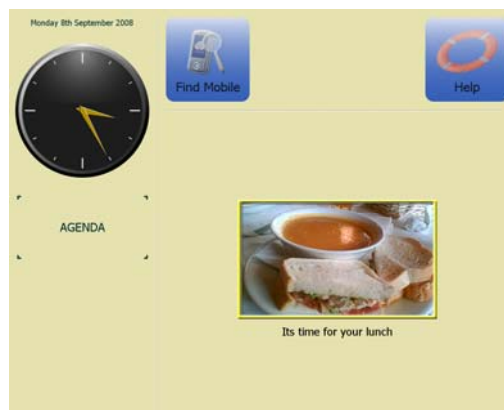


Figure 6: An example reminder with text and image parts.

4.1.3. Agenda

To assist in reminding, an 'agenda' component is provided in the form of a quarter hour clock¹. The purpose of the agenda is to hold a summary or short textual description of the future reminder alongside the time it is due to be activated and a visual depiction of the

¹ Even though this concept is named "quarter-hour clock", it is actually a count-down timer.

remaining time until the reminder is due. The visual aid used to help depict the amount of time remaining on each agenda item can be personalised to either a circle with four quadrants or a battery like indicator with four levels (Figure 7). The agenda item serves as a constant reminder that a particular prospective task is due within a certain timeframe. The total maximum number of items in the agenda is set to 3 with the additional constraint that only reminders due on the same day will be shown, or within the next 6 hours. It is possible to filter only those reminders that are related to appointment events. Appointments tend to require more preparation time and for some users it is envisaged that the agenda component will only be used for appointments.

See chapter 10 on the DVD for a brief summary of the agenda item in operation.

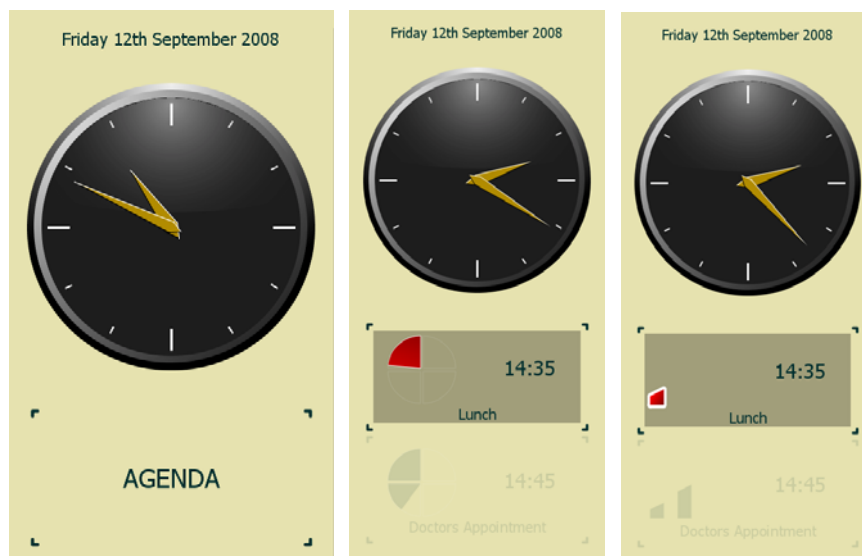


Figure 7: Quarter hour clock component.

4.1.4. Item Locator

The project aims to address innovation by advancing the state of the art in the provision of cognitive reinforcement via ICT solutions. One such service is an item locator service that operates within the home environment using three dimensional RFID technology. The following section describes the item locator service and its components in more detail.

At a hardware level the item locator service consists of at least two RFID readers² (Figure 8) which can read active RFID tags. There are two types of active RFID tags, the first is a reference tag and is static in nature and in general is attached to a fixed reference object in space. The second is an item tag and is attached to a particular item such as a wallet or some keys and is free to move throughout the home environment.

² Using a third reader is recommended, as it simplifies installation and can better tolerate tagged items being shielded off by metallic surfaces or being too far from a reader.



Figure 8: RFID reader and two 3D active tags.

To help facilitate the person with dementia in retrieving a misplaced item the system offers an item location service through a single button on the main menu of the stationary touch screen. Once activated a sub menu is offered to the person with dementia where they can select an item that they are trying to locate. The system will then take a short period of time to locate the item and provide the answer in terms of a location (room name in house³) to the PwD. Figure 9 shows screen shots of the item locator service at various parts in the sequence of activating it to finding the item. An example excerpt of XML showing configuration of the item locator service:

```
<ItemLocator id="4" name="Item Locator" text="Find" icon="search.png">
  <Item name="Keys"></Item>
  <Item name="Wallet"></Item>
</ItemLocator>
```

To view a video clip of the item locator service running in a simulated living environment please refer to chapter 4 on the DVD.

³ Although these indications can seem not accurate enough, the scientific analysis determined that showing the room number is more useful for the PwD than any other complex solution like a map.

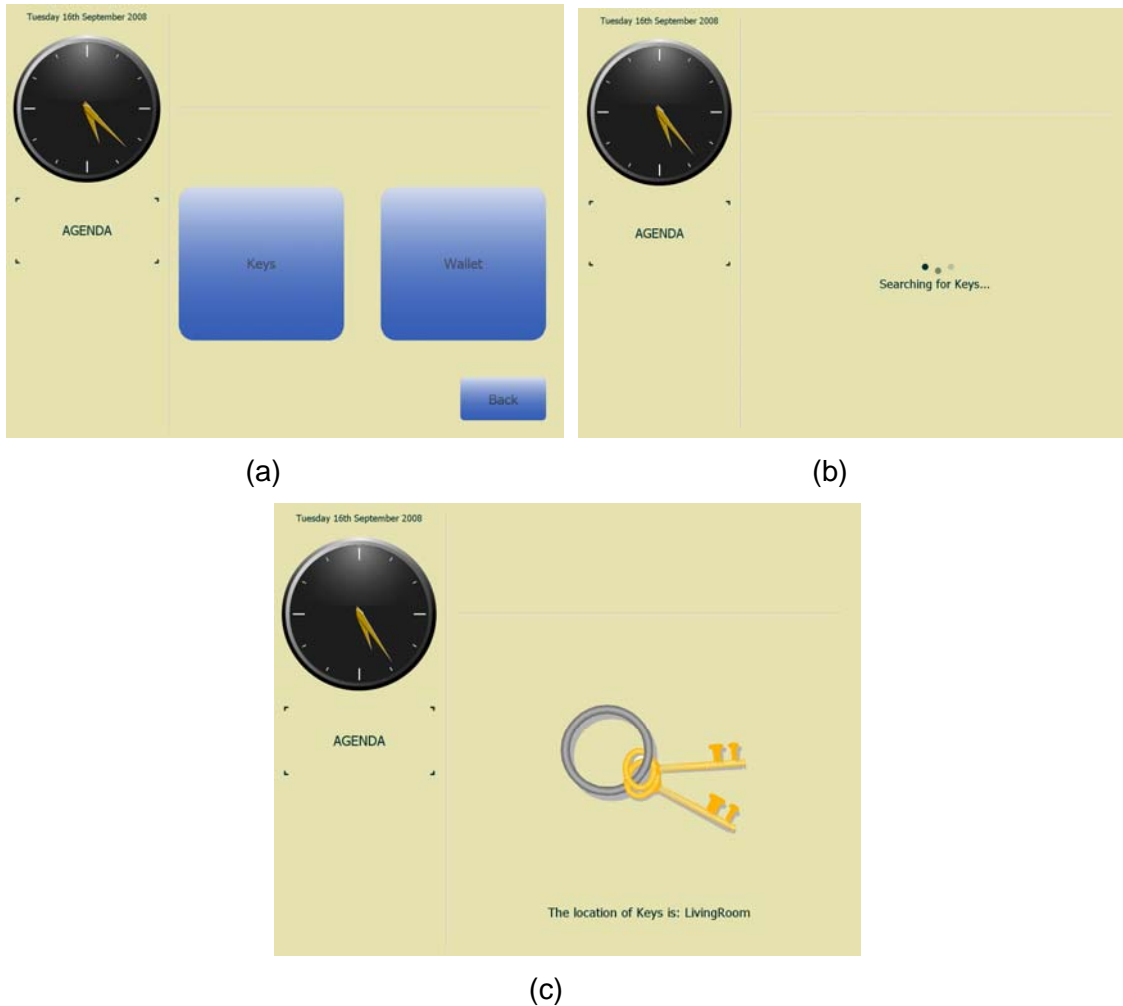
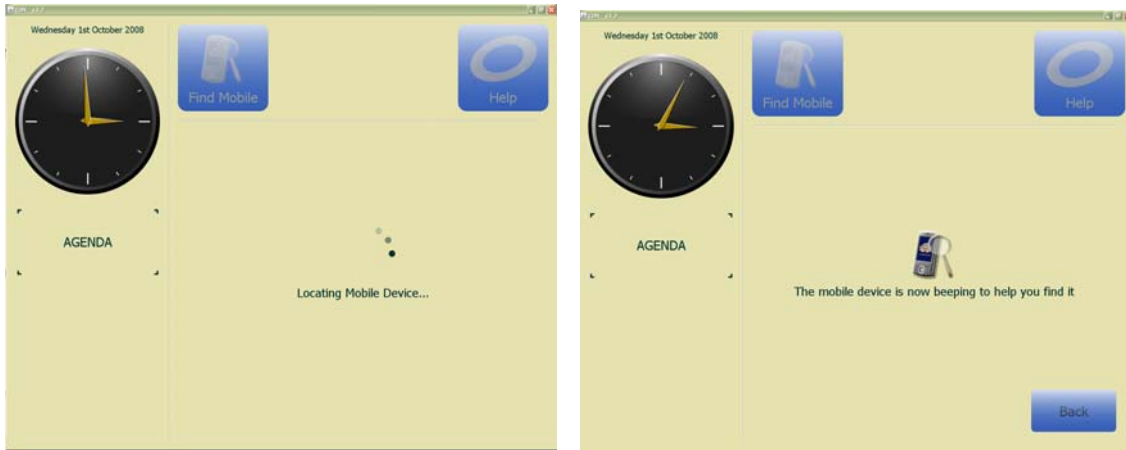


Figure 9 Item Locator service views.

- a) Item locator main menu.
- b) Message displayed to user when the system is searching for an item.
- c) Message and icon displayed to user whenever keys have been found.

4.1.5. Find Mobile Device

To help facilitate the retrieval of the mobile device when misplaced the stationary device offers a service that when activated causes the mobile device to emit an audible sound. The availability of such a service relies on a communication channel between the mobile and stationary components being active. Once the activation message has been received by the mobile device it will sound an audible alarm for a predefined length of time which can be customised according to a PwDs requirement (see **¡Error! No se encuentra el origen de la referencia.**). The mobile device will then acknowledge receipt of the activation command to facilitate feedback via the stationary device. This communication process between the mobile and stationary device can take a few seconds until it has completed successfully during which the screen shown in **¡Error! No se encuentra el origen de la referencia.a** is presented to the PwD.



(a)

(b)



(c)

Figure 10: Find Mobile Device Screenshots

- a) Message presented during search for mobile device.
- b) Message presented when mobile device is beeping.
- c) Message presented when the mobile device is out of range.

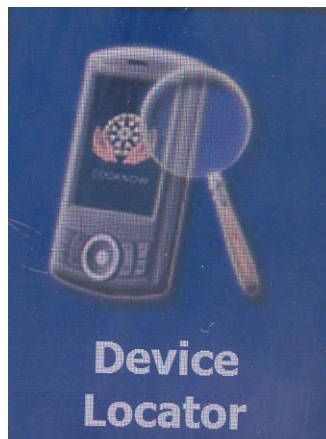


Figure 11: Screen shot of device locator service on mobile device

4.2. Communication

White & Dorman (2000) [3] analyzed the contents of messages posted on an Alzheimer mail group and concluded that the opportunity to share, unburden or vent, is perceived as empowering and helpful to carers. Almost every Alzheimer association offers a website where people with dementia and their carers can join forums, post messages or chat with fellow sufferers. Many Alzheimer associations also have a 24-hour telephone support service for emotional support and information on regional support services like Alzheimer café's and meeting centres.

Social communication is an important part of daily life for PwD in order for them to remain in close contact with relatives and friends, as diminished social contacts may induce a steep cognitive decline.

4.2.1. Picture Dialling

A picture dialling service is provided to help the PwD whilst placing a phone call. The process is simplified into two steps. The first step involves lifting the phone handset which has been adapted with a hook sensor to detect when it is lifted. This activates the phonebook menu which contains a list of contacts which are visualised using people's pictures and their names. The second step involves the PwD selecting a contact by pressing the screen which automatically dials and connects the call. Figure 12 shows the handset used and how it is mounted onto the touch screen. It should be noted that the handset has no keys for entering numbers and that all control is by using the touch screen display. Up to 8 contacts can be configured for this service (Figure 12).

Chapter 5 on the DVD shows a demonstration of the picture dialling service for both outgoing and incoming calls.

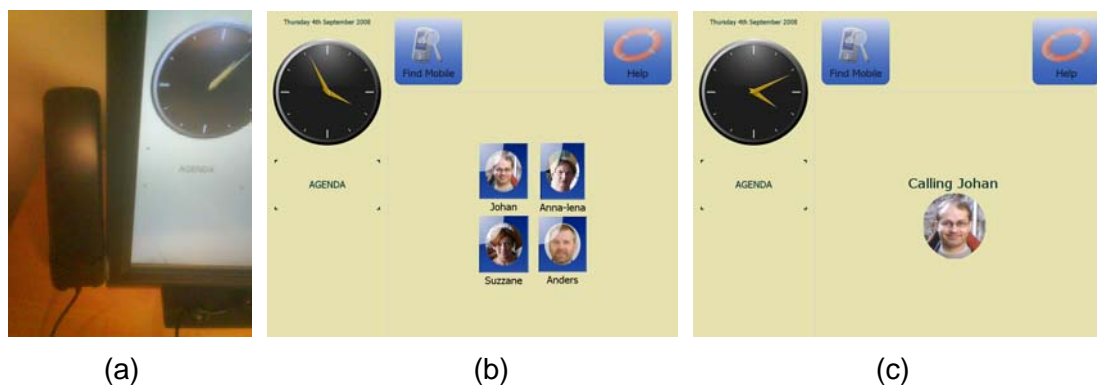


Figure 12: Picture dialling views

- a) Phone handset attached to the side of the touch screen.
- b) Phonebook menu showing four contacts.
- c) Calling screen shown during the initialisation of a call.

Additionally, picture dialling is available on the mobile device to facilitate social communication when the person with dementia is outside of the home environment. This

works in much the same way as the stationary device with the only difference being that the phonebook menu is activated by pressing a phone icon on the mobile device screen.



Figure 13: Mobile device showing the picture dialling service.

The following XML excerpt shows an example configuration of the picture dialling service, which consists of a phonebook containing ranked contacts.

```
<PictureDialling id="1" name="Picture Dialling" invertedHookSwitch="false">
  <PhoneBook>
    <Contact>
      <Name>Johan</Name>
      <Number>02890 123456</Number>
      <SmallPictureFile>johan_small.png</SmallPictureFile>
      <LargePictureFile>johan_large.png</LargePictureFile>
      <Priority>1</Priority>
      <SIPUsername>101</SIPUsername>
    </Contact>
    <Contact>
      <Name>Anna-lena</Name>
      <Number>02890 654321</Number>
      <SmallPictureFile>Anna-lena_small.png</SmallPictureFile>
      <LargePictureFile>Anna-lena_large.png</LargePictureFile>
      <Priority>1</Priority>
      <SIPUsername>101</SIPUsername>
    </Contact>
    <Contact>
      <Name>Susanne</Name>
      <Number>02890 123654</Number>
      <SmallPictureFile>Susanne_small.png</SmallPictureFile>
      <LargePictureFile>Susanne_large.png</LargePictureFile>
      <Priority>1</Priority>
      <SIPUsername>101</SIPUsername>
    </Contact>
    <Contact>
      <Name>Anders</Name>
      <Number>02890 654123</Number>
      <SmallPictureFile>Anders_small.png</SmallPictureFile>
      <LargePictureFile>Anders_large.png</LargePictureFile>
      <Priority>1</Priority>
      <SIPUsername>101</SIPUsername>
    </Contact>
  </PhoneBook>
</PictureDialling>
```

4.3. Daily Activities

Systematic observations indicate that the Visual Memory Lanes have a favourable impact on engagement, stimulate positive affect and activity-related talking, while also reducing fidgeting [4].

Guiding the behaviour (e.g., to go to a day-care centre, eat more meals) of people with dementia by music and sung messages output by an IC recorder was found to be highly effective [5]. The researchers suggest that music can have a strong effect on mental stability and the method can easily be applied to other activities of daily life.

It is difficult to identify common activities across person with dementia, and cultural differences are apparent across the three test sites in differing locations throughout Europe. Therefore, activity assistance services must be personalised. Two fixed activities (examples) are provided:

1. trying to keep the person with dementia motivated during the eating process.
2. leisure activity of listening to music.

The following sections describe each of these services in more detail.

4.3.1. Activity Assistance

The aim of the activity assistance component is to help a person with dementia through an activity that they would otherwise find difficult to complete. This is achieved via a series of instructional video prompts for each step in a particular task. The video prompts must be recorded in the PwD's home and the steps be carried out by the person with dementia. In addition, each step must be simple to understand and complete after viewing the video clip, so video clips should be kept short. The rationale for this is to reinforce familiarity and focus the attention onto one task, avoiding confusion. Once the task has begun the person with dementia can either replay the current task or go to the next/previous task. Figure 14 shows an example of a user pressing the next button on the touch screen.

An example video showing activity assistance in operation is in chapter 11 on the DVD.

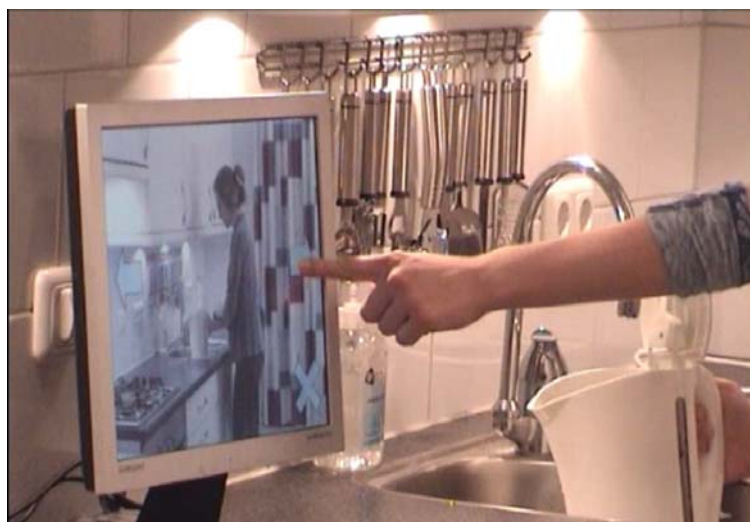


Figure 14: Activity assistance screenshot.

4.3.2. Motivate to eat

A common problem among persons with dementia is making sure that they eat properly. It has been identified that playing music during the eating process encourages persons with dementia to eat more than they otherwise would [4]. In order to provide this service effectively the system should be able to detect when the person with dementia is eating and respond by playing some music. The system achieves this by analysing sensor data in the home environment. A *context-rule* determines when the eating process has started; when the person with dementia is in the kitchen and it is lunch time and the fridge is opened and then the oven is used, and then and the person with dementia sits down at the kitchen table. Only this series of events will trigger music playing. The sensors involved in detecting these steps are:

- an infrared movement sensor in the kitchen.
- a software schedule sensor to detect lunch time.
- an open/close magnet sensor on the fridge and oven doors.
- a pressure sensor on the chair at the kitchen table.

This service plays music when eating, after the user has completed the following steps in turn and during lunch time: entering the kitchen (movement sensor), opening the fridge (door sensor) opening the oven (door sensor) and sitting down a few seconds (chair sensor). All these sensors can be operated wireless from batteries to avoid cabling issues.

Due to the non-visible nature of this service pictures or screen shots are not provided.

A short video clip of the operation of motivate to eat can be found in Chapter 8 of the accompanying DVD.

4.3.3. Media Playing

A common activity in the home is for PwDs to listen to some music or watch some television. The aim of this service is to make easy operating complicated devices such as music players and television sets. The feature provided is music playback, involving the ability to turn on/off music via a single icon on the touch screen. Once pressed the icon or button grows in size to indicate that a press has been acknowledged by the system. With the music activated the system simply plays through a list of music files in random order (see Figure 15). By pressing the icon again the music stops and the button shrinks back to its original size.

A short video clip of the media control is available in Chapter 6 of the DVD.



Figure 15: Media playback service showing both active and inactive states.

4.3.4. Device Control

This service allows PwDs the ability to control the state of appliances such as radio, lamps and other home appliances. A single button is presented to the PwD which can be personalised in terms of the text and associated image. Once the service is activated a message is sent using X10 technology from a main controller (**¡Error! No se encuentra el origen de la referencia.** left side) to an appliance module (**¡Error! No se encuentra el origen de la referencia.** right side) which activates or deactivates the appliance accordingly. One example of the device control service configured to turn on/off a radio can be seen as the right topmost service in Figure 15.



Figure 16: X10 controller and appliance module.

4.4. Safety

Implementing monitoring technologies and detection devices or alarm systems inside and outside the home of elderly persons is potentially useful to enhance (perceived) safety and security of the person suffering from dementia as well as carers. Over the last few decades, detection devices and alarm systems for health problems and safety have been developed for different diagnostic groups.

High-priority needs are knowing that doors are closed and locked, and preventing wandering inside and outside of the home.

4.4.1. Door Warnings

Sensors on the front or back doors protect against unintentionally leaving doors open or unlocked. It is obvious that having the front door open in any home poses a risk to home security and becomes more significant for persons with mild dementia as the frequency of occurrences tend to be more. If the door is left open for a period of time then a warning message is issued to the touch screen where the person with dementia can either act on the message and close the door or disable the message by pressing the screen. The same functionality that is used for the front and back doors can be transferred to other items in the house that may be left ajar such as the fridge or oven doors. The time interval before a warning triggers can be set differently for day time and night time.

Chapter 3 on the DVD highlights two possible uses for warning sensors, using an office door and a fridge as examples.



Figure 17: Front door warning message.

4.4.2. Emergency Contact

To enhance feelings of safety for the PwD an emergency contact function is located in the top right most section of the screen. An important feature of this service is that it is always visible and prominent to allow speedy access in moments of stress or panic (see Figure 17). There are only two steps required to activate this service and both steps can be sequenced in any order, these are pressing the emergency contact button and lifting the phone handset. Once this service is activated it automatically places a call to the primary carer.

4.4.3. Night Time Wandering

To help address safety issues during the night that mainly relate to wandering, a service is available that will automatically activate a standing night light. During night hours a bed sensor can detect the PwD has vacated the bed upon which a light is activated through the x10 technology. When the PwD returns to bed the light is automatically turned off.

Chapter 9 on the DVD demonstrates the operation of the night time wandering service.

4.5. Personalisation

To manage the process of personalisation the system was specifically developed to facilitate ease of configuration and offer high levels of user personalisation.

Prior to the deployment of the technology within the home environment a 'pre-trial' interview is required with the person with dementia and their carer. During this interview the person with dementia (along with their carer) can be assessed in terms of their perceived unmet needs.

This information can then be used to help personalise which of the services should be selected for the user along with details of the necessary personalisation within the services themselves (for example number of contacts in picture dialling phone book and preferred timeout values for the warning messages).

It is anticipated that the carer for the PwD will be the person mainly responsible to make the service selections. The process will also be supported by a healthcare professional, who will manage and monitor the system once it is actually deployed.

4.5.1. Language

In order to support the system at three locations throughout Europe, namely Northern Ireland, the Netherlands and Sweden it must conform to the local languages there. Any words or phrases that appear on the interface are translated from English to both Dutch and Swedish and are held in a flat file where they can be looked up and presented to the PwD accordingly.

5. Conclusions

This report has provided details of the home based visualisation service with the CogKnow Project. The report should be read in conjunction with the accompanying DVD.

The report has provided an overview of the functionality of the system within the main areas of cognitive reinforcement which are being addressed by work within the Project.

Following development of these technical services, as presented within the report, evaluation of their perceived utility will be assessed during a series of three planned Field Trials in Northern Ireland, Lulea and Amsterdam. Based on the feedback from these evaluations the system will be adapted accordingly

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