MiDAS

ITEA 2
INFORMATION TECHNOLOGY FOR EUROPEAN ADVANCEMENT

MiDAS

Multimodal Interfaces for Disabled and Ageing Society

Project number: ITEA 2 - 07008

ITEA Roadmap application domains:
Major: Home_____
Minor: Nomadic_____

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Major: Human-Computer Interface_____
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TABLE OF CONTENTS

LIST OF FIGURES

1. Introduction

1.1. Purpose of this document

Within the main goal to convert the car as a system able to acquire information about car-driver behaviour by means of a non-intrusive sensor network and a multimodal interface designed to not disturb driving activity, according to the general architecture and the multimodal interface framework, this task will aim at defining and developing a very simple multimodal interface, evaluating the best modalities, and taking into account car environment constraints.

So, this document is collecting every design tasks related to it.

1.2. Document Overview

This document is divided by ten sections, some of them collecting information due to the parallel work carried out with WP2 and WP3 (sections 2 and 3), some others reporting the general architecture, both hardware and software, (section 4) in order to be the guide for the next sections 5 and 6.

So, according to general architecture shown within section 4, section 5 is reporting each of the hardware modules identified, and in the same way section 6 for software modules.

Finally, some general sections are reported too, section 7 for final conclusions, section 8 for references, section 9 to collect the list of acronyms and at the end an annexes section in order to group any other information like technical datasheets and so on.

1.3. Editors

Partner	Sections
ROBOTIKER	1.1, 1.2, 1.3, 1.4, 2, 3.1, 3.2,4, 5.x, 6.x, 7, 8, 9, 10
CNRS	1.3, 1.4, 3.1, 3.2, 4, 5.x, 6.x, 8, 9, 10
KATRON	1.3, 1.4, 3.1, 3.2, 4, 5.x, 6.x, 8, 9, 10
FICOTRIAD	1.3, 1.4, 3.1, 3.2, 4, 5.x, 6.x, 8, 9, 10
CREATIV IT	1.3, 1.4, 3.1, 3.2, 4, 5.x, 6.x, 8, 9, 10
GEOMOBILE	1.3, 1.4, 3.1, 3.2, 4, 5.x, 6.x, 8, 9, 10

Table 1. Editors

1.4. Change History

Date	Author	Update description	Doc. Version
11-05-2009	ROBOTIKER	Table of Content definition (first draft)	1.0
15-05-2009	ROBOTIKER	Table of Content definition (V1.2)	1.2

31-07-2009	CNRS	CNRS – Contributions to V1.2	1.3
29-09-2009	ROBOTIKER	Hardware architecture first draft	2.2
07-10-2009	FICOTRIAD	FICOTRIAD - Contributions to V2.2	2.2
04-12-2009	ROBOTIKER	Hardware architecture	3.0
22-12-2009	KATRON	KATRON - Contributions to V3.0	3.0
27-01-2010	CNRS	CNRS - Contributions to V3.0	3.0
18-02-2010	ROBOTIKER	Hardware + software architecture	4.1
22-03-2010	CNRS	Drowsiness system	4.2
23-03-2010	CITIC	CITIC (Call center) & HW-SW archit. update	4.3
16-04-2010	ROBOTIKER	Robotiker contributions (HW)	4.4
10-05-2010	ROBOTIKER	Robotiker contributions (SW)	4.5
03-06-2010	GEOMOBILE	Geomobile (HW & SW)	4.6
15-06-2010	ROBOTIKER	Second year review (V4.7)	4.7
18-06-2010	ROBOTIKER	Second year review (V4.8)	4.8
30-06-2010	ROBOTIKER	Last modifications	4.9
08-07-2010	ROBOTIKER	Final reviewed version	5.0
16-08-2010	KATRON	Minimal corrections	5.1

Table 2. Change history

2. Selected scenarios in "Drive" super-scenario

2.1. Overview

From the scenarios suggested by the MIDAS consortium, the main domains to be treated in the project are presented. Thus, the scenario selection may be achieved and this will offer the staring point to define the specific requirements for each scenario.

The different categories to be exposed are gathered into the following diagram:
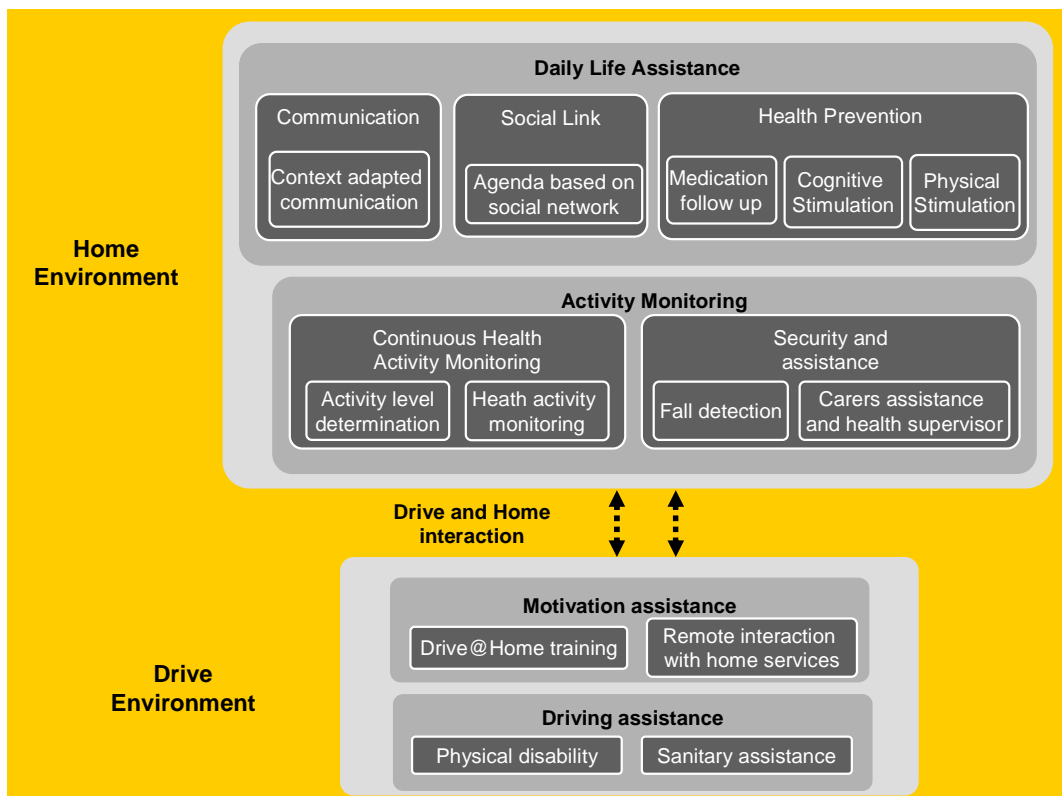
Figure 1 All scenarios overview

2.2. Drive Super Scenario Description

Driving super-scenario will consider two main types of users, people with a disability and the elderly. Some scenarios will be focused on the first one (disabilities) and some of them on the second one (elderly), both of them trying to simplify driving activity and car environment in order to maintain their autonomy.

Driving scenario will be simulated using car simulators, and the mentioned scenarios conditions are described on a more detailed way in the followings sub-sections. It means that the following two environments will be developed using the car simulator:

- Generation of urban driving environment with all of its characteristics (sounds, moving cars, weather and road conditions).
- Generation of highway driving environment with all of its characteristics (sounds, moving cars, weather and road conditions).

Besides, some home scenarios will be integrated together in order to re-use some services at home but from the car. It means that car will be an extension of home for some special features.

2.2.1 Motivation assistance: Drive@Home training

Marta is 40 years old. Two years before, was diagnosed of ALE (Amiotrofic Lateral Esclerosys). This illness generates a progressive loose of extremities strength. However, she needs her automobile to carry out all daily tasks. According to this needs, she have a similar driving command device installed at home, which allows her to carry out psicomotor exercises to improve deficiencies of her extremities and to consequently, store her current driving profile.
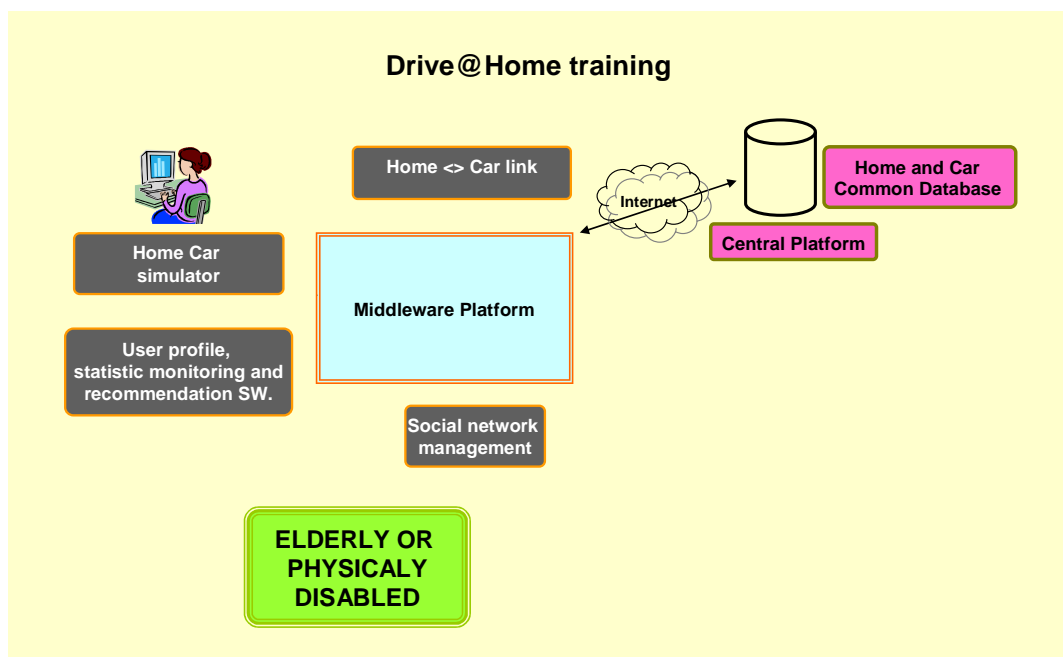
Figure 2 Drive@Home training

Through home-car communication, the guidance system controller installed in car is updated according to current physical capacities registered at home. This would allow her to have available her driving profile inside vehicle environment and also to possess a car control device adapted to her disabilities. When Marta has decided to drive her vehicle, steering system characteristics have been updated, and she, in spite of her disabilities, is able to carry out guidance function and can go shopping with total normality.

2.2.2 Motivation assistance: Remote interaction with home services

Returning to home, vehicle come inside residential network range and transmits all information concerning to drive activity during day to centralized computer placed at home. Marta has parked her vehicle, and when is accessing at home she goes to main computer display monitor. There, she is able to visualize all today driving statistics and consequently see what aspects of her driving have been improved thanks to psychomotor exercises and which not.
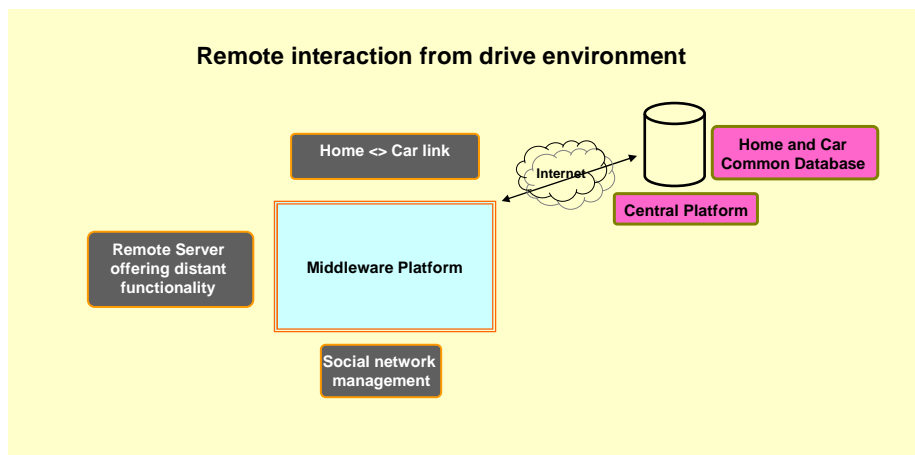
Figure 3 Remote interaction from drive environment

2.2.3 Driving assistance: Physical disability

Taking the following schema into account, "Driving assistance" will consider two main use cases, "physical disability" and "sanitary assistance".
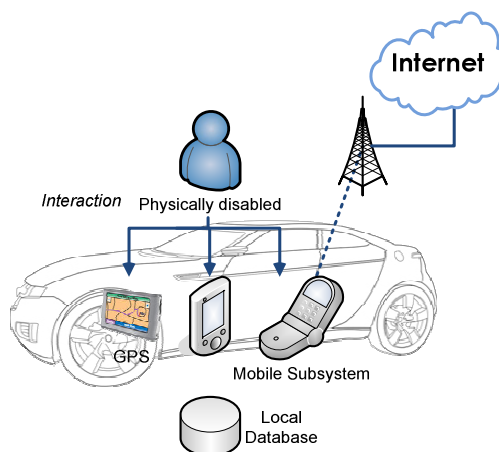
Figure 4 Driving assistance

So the named "physical disability" use case description is explained in the following paragraphs.

Three years ago, John had a car accident that caused him serious damages in his right leg. John is a veterinarian and he needs the car for the daily short journeys he does visiting the local farms.

Today John has to go to visit a farm so he takes his adapted car. As he cannot use the pedals, John's automobile is governed through a steering joystick instead of the habitual steering wheel. To facilitate the driving he carries out the execution of certain functionalities through voice commands. John can find the list of voice commands in the screen/head-up display when he is driving so he needs not to memorize anything.

In the way to the farm, it starts raining so John activates the voice recognition system and reads the text in the screen/head-up display attached to the function "windscreen wiper".

This enriched scenario has been obtained from several basic scenarios provided by partners involved mainly in WP5 in order to focus on some disabilities and apply technologies to simplify car guiding.

2.2.4 Driving assistance: Sanitary assistance

John and Carmen is a couple of pensioners that live comfortably in a suburb of a big city. John has health problems related with his heart. This is the reason why they have at home an assistance system able to connect with the sanitary services (see home scenarios). In the case that he has any problem he can have a quick assistance service at home.

Today the sun is shinning and it seems that is going to be a great day so the couple decides to take the car and visit new places. The car is an important element for them because it gives them autonomy and it raises their self-esteem.

The highway traffic is dense and there are many cars which are switching their lanes aggressively. After twenty minutes of journey in the car, John feels that he has a strong pain in the chest. He checks the system that controls the pulse and realises that his heart rhythm goes increasing. He stops the car in a service area and with the help of the touch screen (GUI) he activates his ECG (Electrocardiogram) acquisition system. The sensor network registers his heart activity and in a short time the system analyses the results and gives him a report by some messages. In this case the system tells him that his condition is worrying and that he needs medical assistance.

On the other hand, the car system allows them to connect to the house assistance system and control it. Through this system they can make use of the assistance services provided by their home system (home super-scenario). This way Carmen communicates their situation to the assistance services and sends their geographical position by GPS because they do not know exactly where they are. The assistance services can organize the right help on the right location knowing the position of the car. Besides, their sons' and friends' home scenario system receives notification of John's problems.

3. User Interface Specifications

3.1. Functional specifications

From the functional point of view driving scenario will take into account that systems developed will be physically versatile in functionality and also emotionally human friendly, mainly HMI and multimodal solution adopted. This means that besides facilitating the driving activity, it has to be performed without causing inconvenience (pain, noise, movement restriction, panic, etc). So, the devices or the technologies proposed will not be intrusive and cables and devices have to be hidden or in a discrete way.

Id (*)	Function Description (Only FU & FM)	Scenarios involved (**)
CAR_FU01	Provide remote control of the home control system.	MA-DH MA-RI
CAR_FU02	Let to car occupants to manage some services of the car control system through haptic, visual and voice channels.	MA-DH MA-RI DA-PD DA-SA
CAR_FU03	Let to car driver drives through the haptic device (joystick).	DA-PD
CAR_FU04	Show ECG and environment sensors information.	DA-SA
CAR_FU05	HSD must provide haptic feedback to users when steering.	DA-PD
CAR_FU06	HSD must provide haptic feedback to users when accelerating.	DA-PD
CAR_FU07	HSD must be handled either by disabled or by not disabled people.	DA-PD
CAR_FU08	HSD system must be quick and efficient, not giving important delays in response under user's handling.	DA-PD
CAR_FU09	Removed due to it was duplicated.	DA-PD
CAR_FU10	HSD's brake function must be activated using a single hand	DA-PD
CAR_FU11	HSD's acceleration function must be activated using a single hand.	DA-PD
CAR_FU12	HSD must be controlled by users with different levels of disabilities in arms and hands.	DA-PD
CAR_FU13	HSD must be controlled by left-handed and right-handled.	DA-PD
CAR_FU14	HSD's geometry must report instantly to users what the grip is and how the function to perform works.	DA-PD
CAR_FU15	HSD's brake function must be placed at a very near hand reach.	DA-PD

CAR_FU16	HSD's acceleration function must be carried out as in a motorbike's grip.	DA-PD
CAR_FU17	HSD's steering function must be performed by handling main level rightward and leftward to move vehicle to the right and to the left, respectively.	DA-PD
CAR_FU18	HSD's acceleration feeling must be enabled by an electronic engine placed near the grip, which must simulate different levels of force feedback to user's touch sense.	DA-PD
CAR_FU19	HSD's steering feeling must be enabled by an electronic engine placed near the base of the grip, which must simulate different levels of force feedback to user's touch sense.	DA-PD
CAR_FU20	HSD system must be handled correctly by an armrest which will support user's elbow weight.	DA-PD
CAR_FU21	HSD's software must be auto-configurable to adapt user's disabilities.	DA-PD
CAR_FU22	HSD's software must be auto-configurable to adapt user's disabilities.	DA-PD
CAR_FU23	HSD must be controlled by users with different levels of disabilities in arms and hands.	DA-PD
CAR_FU24	Web application: Provide a map with position, distance to home and address of the car	DA-SA
CAR_FM01	Test experimental car control (joystick, voice recognition, etc.), sensor (ECG, eye blink detector, etc.), and communication systems in a safe environment (simulator).	MA-DH MA-RI DA-PD DA-SA
CAR_FM02	Control the driving of the simulator also with an haptic device connected to the Car-PC (in addition to the standard controls like the steering wheel, pedals, etc.).	MA-DH DA-PD
CAR_FM03	Control the operation of the simulator also through commands received from the voice recognition system of the Car-PC (in addition to the standard controls).	DA-PD
CAR_FM04	Provide to the Car-PC the (simulated) GPS information corresponding to the location of the vehicle in the simulation environment.	DA-SA
CAR_FM05	Run exercise scenarios for driving the simulator using the haptic device and send the driving profile to the centralized home computer (over the Wi-Fi connection of the Car-PC of the simulator).	MA-DH
CAR_FM06	Receive from the centralized home computer (over the Wi-Fi connection of the Car-PC of the simulator) information regarding the driving activity done with the actual car and display the driving statistics.	MA-DH

(*) CAR_FX99 = Functional specifications in "Drive" super-scenario. Put X="U", "S" and/or "C" if it is related to User Interface (U), Sensors (S), Communications (C), or siMulator (M).

(**) MA-DH = Motivation Assistance-Drive@Home training,
MA-RI = Motivation Assistance-Remote interaction with home services,
DA-PD = Driving Assistance-Physical disability,
DA-SA = Driving Assistance-Sanitary assistance,

Table 3. Functional specifications

3.2. Technical specifications

From the technical point of view driving scenario will take into account the following general technologies:

- Multimodal GUI system (screen / head-up display).
- Sensor network for heart diagnostic.
- Out car communication system (between home and car scenarios).
- Driving simulation platform.
- Existing information from the car system (CAN network, and so on).
- Ergonomic joystick / haptic device.
- Voice-Command recognition system.
- Out door localisation system (GPS).

The following table collects all the necessary technologies focused on the multimodal user interface to carry out every functionalities described in the previous section.

Id (*)	Technology to be used (Only TU & TM)	Scenarios involved (**)
CAR_TU01	Touch screen technology for User Interface in order to have graphical and haptic inputs modes.	MA-DH MA-RI DA-PD DA-SA
CAR_TU02	Simulator in order to simulate use cases for car scenario.	MA-DH MA-RI DA-PD DA-SA
CAR_TU03	Control system based on a Car-PC system with Linux, Java and OSGI middleware.	MA-DH MA-RI DA-PD DA-SA
CAR_TU04	PCI dSpace card installed in a PC and connected to Haptic	DA-PD

	Device	
CAR_TU05	Desktop PC with a monitor display to set up Haptic Device.	DA-PD
CAR_TU06	AC/DC Power Supply for Haptic Device.	DA-PD
CAR_TU07	dSpace external signal box for Haptic Device.	DA-PD
CAR_TU08	GPS (position).	DA-PD
CAR_TU09	GSM (phone calls).	DA-PD
CAR_TU10	1 USB connector.	DA-PD
CAR_TM01	Generic, fixed-base (no motion platform) car cabin mock-up to be built by KaTron.	MA-DH MA-RI DA-PD DA-SA
CAR_TM02	Three 26-inch LCD monitors arranged side by side to display the field of view of the driver of the simulator through the front and side windows, including the views in the rear mirrors.	MA-DH MA-RI DA-PD DA-SA
CAR_TM03	Surround sound system to simulate the sounds of the vehicle and the environment.	MA-DH MA-RI DA-PD DA-SA
CAR_TM04	Simulator-PC to control all real-time aspects of the simulator (such as the generation of the images and sounds, acting upon the inputs received from the control devices in the cabin of the simulator, and driving the diplays on the dashboard of the simulator), prepare the simulation scenarios (weather and traffic conditions etc.), and view the simulation results.	MA-DH MA-RI DA-PD DA-SA
CAR_TM05	Simulator-PC shall be connected to the Car-PC through Ethernet.	MA-DH MA-RI DA-PD DA-SA

 (*) CAR_TX99 = Technical specifications in "Drive" super-scenario. Put X="U", "S" and/or "C" if it is related to User Interface (U), Sensors (S), Communications (C), or siMulator (M).

(**) MA-DH = Motivation Assistance-Drive@Home training,
MA-RI = Motivation Assistance-Remote interaction with home services,
DA-PD = Driving Assistance-Physical disability,
DA-SA = Driving Assistance-Sanitary assistance,

Table 4. Technical specifications

4. General architecture

4.1. Hardware

The general hardware architecture will be according to the following figure:
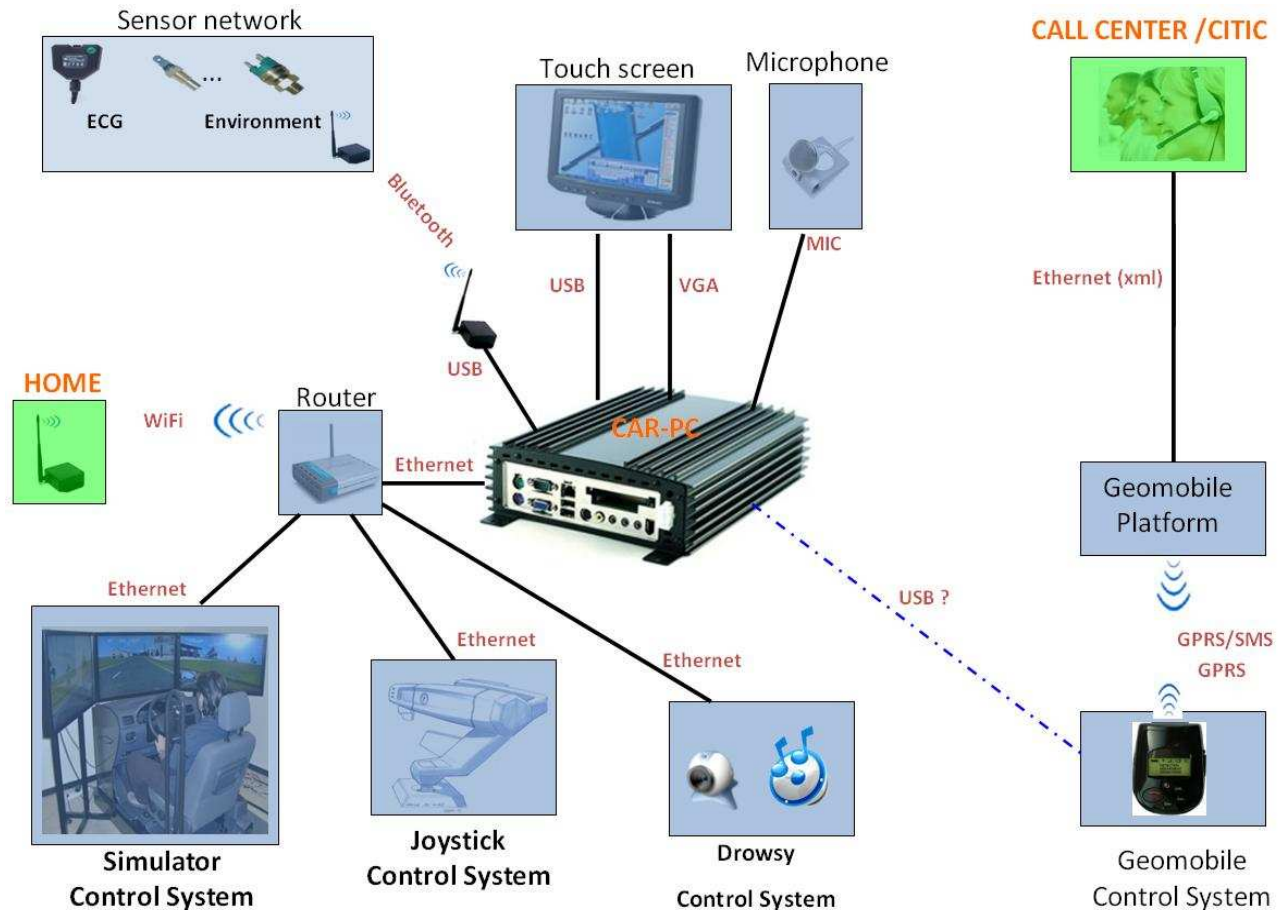
Figure 5 Hardware General Architecture

According to the above architecture, mainly eight sub-systems have been identified:

- Multimodal HMI: It includes Car-PC and one touch screen, microphone and speakers.
- Sensor network: network of sensors for environment and driver ECG evaluation.
- Simulator Control System: Katron simulator system.
- Joystick Control System: Ficotriad control system for specific joystick.
- Drowsy Control System: CNRS "drowsy" control system for drowsiness evaluation.
- Geomobile Control System: Geo-localization system.
- Call center: CITIC call center.
- Home Control System: Subsystem based on a PC able to connect with Car-PC.

Regarding the called "Home Control System" the following figure shows more detail about the hardware to consider:
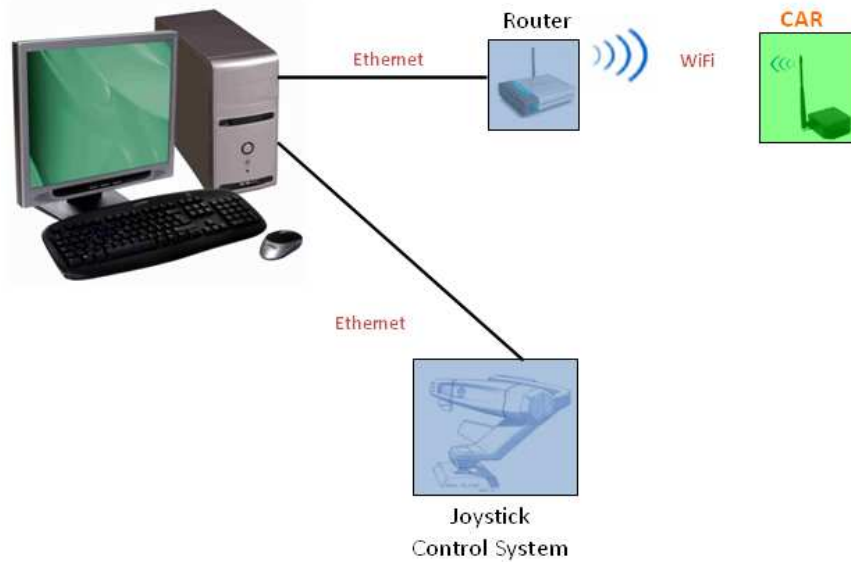
Figure 6 "Home Control System" Hardware Architecture

So, based on this hardware overview of sub-systems to be integrated within the called "Drive" super-scenario, each of these sub-systems are explained in section 5 (User Interface: Hardware) from the user interface point of view. To have more details from the "Sensors" or "Communications" point of view see the corresponding deliverables D5.2 and D5.3.

4.2. Software

The following figure shows every software module identified during design task and they are described in more detail on section 6 focussing on HMI and multimodality:
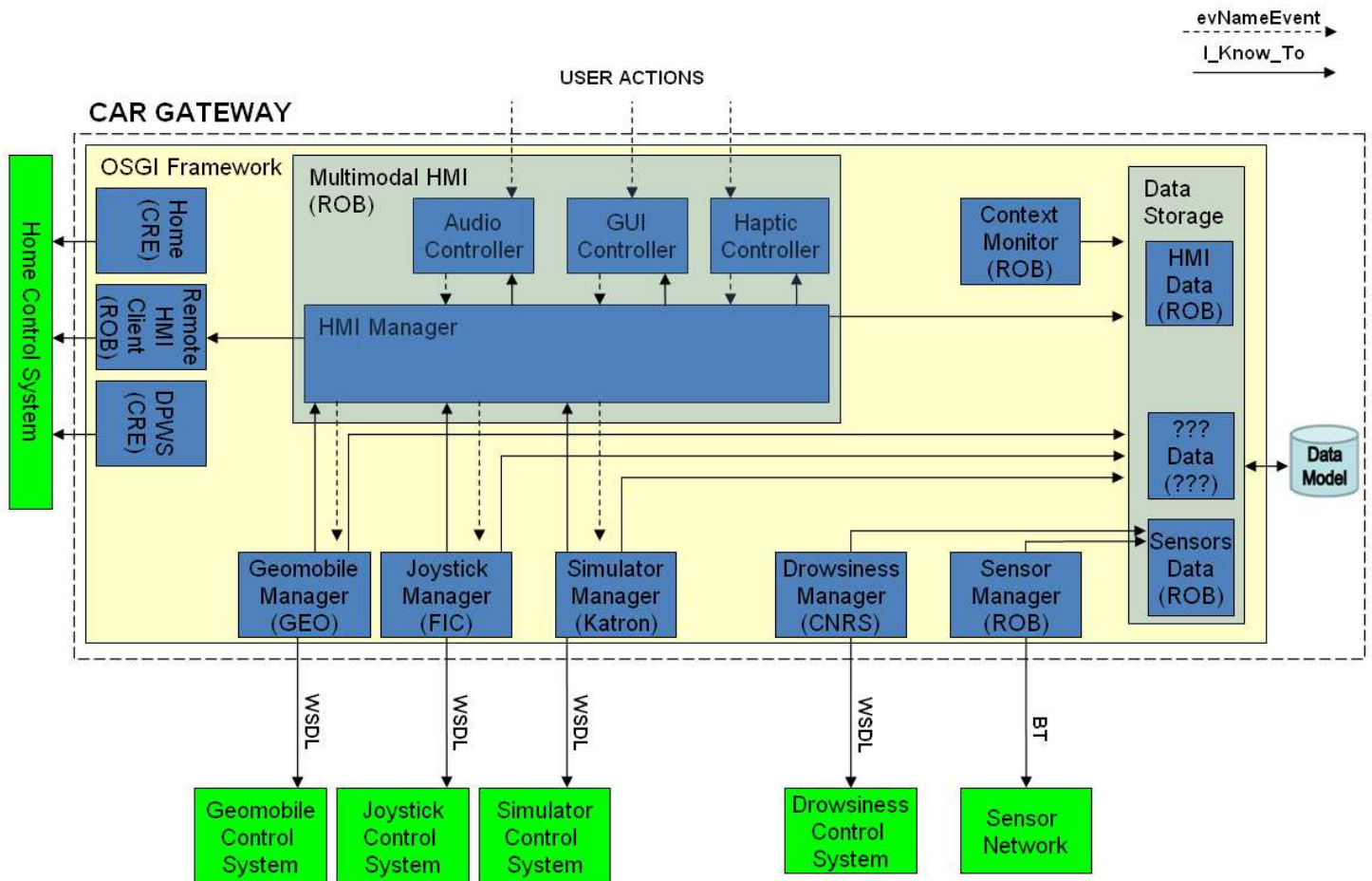
Figure 7 Software General Architecture

CAR Gateway Software Environment

The called "CAR GATEWAY" shown in the previous figure will be based on the following software environment:

- **Operative system**: Ubuntu 8.04.2 Hardy Heron Release i386 (Kernel -> 2.6.22.19).
- **Middleware**: Osgi Eclipse 3.6.0
- **DBMS**: MySql 5.1.33

5. User Interface: Hardware

The following sub-sections detail every hardware module considered in the previously defined overview hardware architecture from the "user interface" point of view (if nothing to report put "No applicable").

5.1. Multimodal HMI

5.1.1 Description

The called "Multimodal HMI" subsystem is formed by a Car-PC able to connect by one USB and one VGA connections a touch screen. Besides, two more connectors for one microphone and speakers should be considered too.

5.1.1.1. Functional description

The following table describes the main functionalities related to each hardware element considered within this sub-system:

Hardware element	Function
Car-PC	Receive every events coming from "tactile", and "voice" channels.
	Send information through the "visual" and "audio" (voice or sounds) channels.
Touch-screen	Detect every selection on the screen using tactile channel.
	Show Graphical User Interface panels using the visual channel.
Microphone	Receive voice commands coming from the car-driver.
Speakers	Generate alarms or suggestions by audio channel.

Table 5. Functions in subsystem 1

5.1.1.2. Technical description

Car-PC:

The Car-PC equipment will be based on VIA EPIA CN Mini-ITX mainboard. The VIA EPIA CN Mini-ITX mainboard is available with either the 1.3GHz or 1.0GHz VIA C7® processor and boasts the ultra efficient VIA V4 bus interface and VIA CN700 digital media chipset to inspire a new generation of powerful and flexible digital media appliances.

Figure 8 VIA EPIA CN Mini-ITX mainboard

Offering a rich digital media platform, the VIA EPIA CN Mini-ITX mainboard integrates the VIA UniChrome™ Pro IGP graphics processor with MPEG-2 hardware acceleration and the Chromotion™ CE engine to ensure smooth, crystal clear digital media streaming and playback. The platform also supports DuoView+ and has S-Video and RCA outputs to facilitate the design of dual display devices, as well as rich multi-channel audio for surround sound.

Setting new standards for flexibility and feature completeness, the VIA EPIA CN Mini-ITX mainboard supports up to 1GB of 400/533MHz DDR2 memory, native SATA II 0 and 1, and 10/100 Mbps broadband Ethernet. The platform also includes a PCI port, serial, parallel and USB ports for unparalleled connectivity options.

The VIA EPIA CN Mini-ITX mainboard is compatible with Microsoft® Windows® 2000/XP, XPe and CE, as well as Linux, and offers developers a rich suite of security and media applications to accelerate time to market. Fully compatible with all Mini-ITX, FlexATX and MicroATX chassis and associated accessories including the new 120W DC-DC converter for VIA EPIA Mini-ITX mainboards, the VIA EPIA CN Mini-ITX gives developers and system integrators the essential tools to create innovative digital media appliances.

Key Features:

- Integrated VIA UniChrome™ Pro AGP graphics with MPEG-2 decoding acceleration
- Supports DDR2 400/533 SDRAM
- Supports TV-out
- Supports two SATA
- Supports eight USB 2.0 (four as pin headers)

See "Annexes" section for more technical details (datasheet).

Touch screen:

The touch screen will be based on Xenarc technology:

Figure 9 XENARC 700TSV (7") TFT LCD)

See "Annexes" section for more technical details (datasheet).

Microphone:

Taking into account only specific commands will be managed by voice channel, no special requirements will be necessary for microphone devices. It would be more important if "natural language" capabilities were required. Then, typical microphones connected to "Line In" connection in VIA mother board will be enough.

Speakers:

Similar to microphones, no special requirements will be necessary for speakers and the integrated "Line Out" for speakers will be enough too.

5.1.2   Interfaces

Only one USB and one VGA will be required by touch screen. Besides, one "Line In" for microphone and one "Line out" for speakers will be necessary. Further details in D5.3.

5.2.   Sensor network

5.2.1   Description

The called "Sensor network" subsystem is formed by some transducers in order to provide data about the environment and driver status. This subsystem don't have any user interface, so more information can be obtained in D5.2.

5.2.1.1. Functional description

The following table describes the main functionalities related to every hardware element considered within this sub-system:

Hardware element	Function
Temperature sensor	Provide data about in-car temperature.
Humidity sensor	Provide data about in-car humidity conditions.
Atmospheric pressure sensor	Provide data about in-car atmospheric. pressure.
Light sensor	Provide data about in-car light (day/night).
Air quality sensor	Provide data about in-car air quality.
ECG sensor	Provide data about the driver state.

Table 6. Functions in subsystem 2

More details in D5.2.

5.2.1.2. Technical description

Not applicable (see D5.2).

5.2.2 Interfaces

Not applicable (see D5.2).

5.3. Simulator Control system

5.3.1 Description

The simulator system consists of a car cabin mock-up, which includes a seat, dashboard, steering wheel, gearstick, pedals (acceleration, brake, and clutch), and a handbrake, three LCD monitors placed in front of the cabin mock-up, speakers, and a set of Simulator PCs.
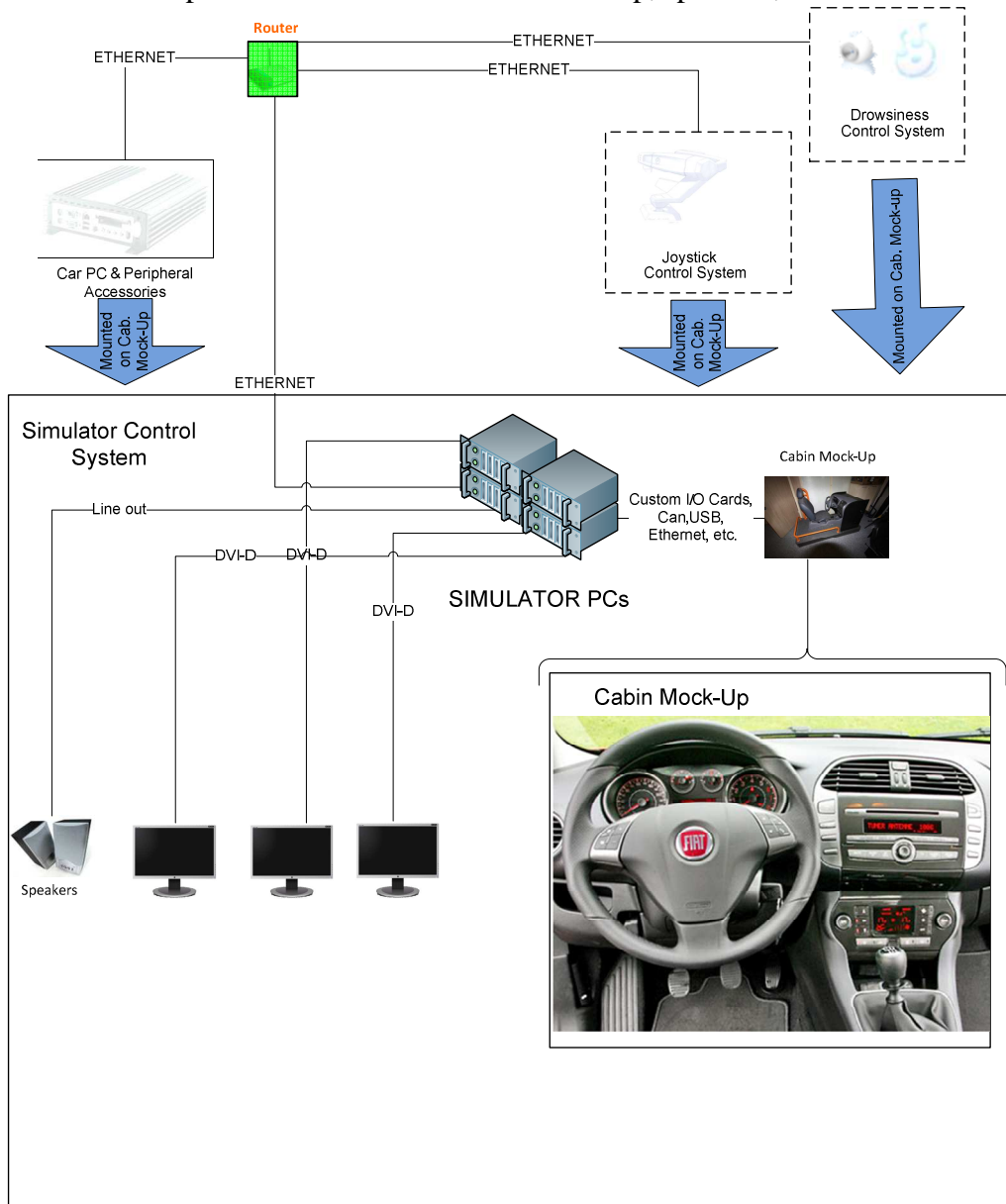
Figure 10 Simulator Control System Hardware Architecture

5.3.1.1. Functional description

The following table describes the main functionalities related to every hardware element considered within this sub-system:

Hardware element	Function
Simulator PCs	Receive control inputs from the steering wheel, gearstick, pedals, and other switches and knobs on the dashboard of the cabin mock-up.
	Generate road and environment images in real time according to control inputs and feed them to the LCD monitors.
	Generate car and environment sounds in real time and feed them to the speakers.
	Provide a graphical user interface to start and stop the simulation.
Cabin mock-up	Allow the driver to control the driving simulator using the steering wheel, gearstick, and pedals housed in the cabin mock-up.
LCD monitors	Display the images that simulate the driver's field of vision.
	Display a graphical user interface for the control of the simulator.
Speakers	Play car sounds and environment sounds.

Table 7. Functions in subsystem 3

5.3.1.2. Technical description

Simulator PCs:
Top of the line computer equipments will be used in order to be able to generate realistic 3-D images in real time. With this purpose in mind, Intel Core i7 family processors, high performance Nvidia graphics cards, and Gigabyte or Asus brand motherboards will be used in the Simulator PCs.

Cabin mock-up:
Real car parts will be used in the cabin mockup to create an immersive environment for the driver. All of these hardware parts will be driven by powerful computers to create a realistic driving experience, including all environmental sounds, road conditions, etc.

The cabin mock-up will be based on FIAT Bravo cars. The driver's seat, dashboard, steering wheel, pedals, handbrake, instruments, lights, switches, etc. will be original FIAT Bravo parts. The cabin mock-up will also include an outer frame to help create a feeling of being inside a car cabin.

The weight of the mock-up will be around 250 to 300 kg. Lockable wheels will be used for ease of transportation.

A custom electronic system behind the original steering wheel will sense its movements and provide information regarding the direction of the car to the Simulator PCs.

Sensors placed on the pedals will be used to read the pedal positions in real time. Custom electronic cards will be installed in the Simulator PCs to receive this information.

A 5-speed manual transmission gearstick will be designed and built by KaTron. The gear positions will be read digitally. The mechanical and electronic design will make it necessary to press the clutch to shift gear as in a real car. Similarly, the simulator will have to come to a full stop in order to engage reverse gear.

The displays and switches on the dashboard of the cabin mock-up will be driven using a custom CAN Bus card installed in the Simulator PCs.

LCD monitors:

The driver's field of vision will be simulated with three 26-inch LCD TVs placed side by side in front of the cabin mock-up. These TVs will be HD-ready and have a response time less than 8 ms.

Speakers:

A high quality 2.1 sound system will be used in the driving simulator to play all sounds coming from the simulated car and the environment.

5.3.2 Interfaces

The car controls on the cabin mock-up will be connected to the Simulator PCs via CAN Bus and custom electronic connections. A custom CAN Bus card and a custom PCI I/O card will be used in the Simulator PCs for this purpose.

The connection of the Simulator PCs to the Joystick Control System, Drowsiness Control System, and the Car PC will be realized via an Ethernet connection.

LCD monitors will be connected to the Simulator PCs via DVI-D cables.
Speakers will be connected to the Simulator PCs via line-out audio cables.

5.4. Drowsiness Control System

5.4.1 Description

The system is composed of a high performance PC connected to the CAR-PC through the router and a web cam that is used to capture driver's face as seen in Figure 11. The system uses its own speakers via lineout and/or in-car audio hardware.
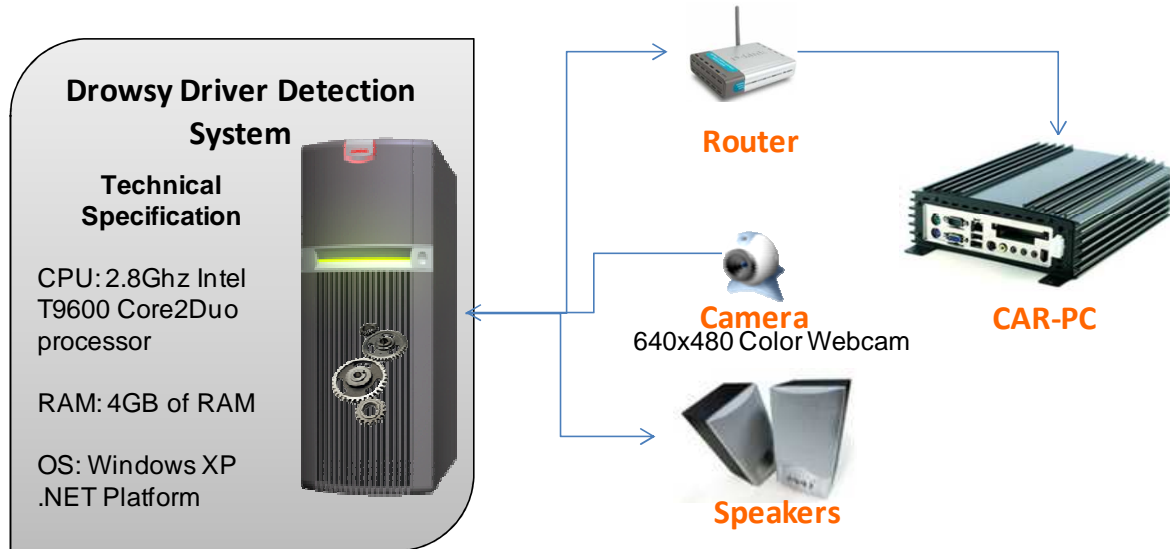
Figure 11. Hardware general architecture

Drowsiness sensor is formed by a standard webcam and PC that detects the pattern of long duration eye-lid closures. Eye blink duration is the time spent while upper and lower eye-lids connected. The pattern indicates a potential drowsiness prior to the driver falling asleep and then alerts the driver by using voice messages.

5.4.1.1. Functional description

Table 8 describes the main functionalities related to each hardware element of drowsiness sensor.

Hardware element	Function
PC	PC is the main processing power of the drowsiness detection sensor. It collects and process video frames grabbed from the camera and create voice messages if necessary.
Camera	It is located in front of the driver and it captures driver's face at 30fps and delivers the output to the PC for processing.
Speakers	Generate alarms sent by PC and warns the driver.

Table 8. Functions in subsystem 5 (drowsiness sensor).

5.4.1.2. Technical description

PC: Intel T9600 Core2Duo 2.8GHz CPU, 4Gb RAM, 100GB HDD.

Processor Number	Intel T9600
# of Cores	2
# of Threads	2
Processor Base Frequency	2.8 GHz
L2 Cache	6 MB
Bus/Core Ratio	10.5
FSB Speed	1066 MHz
FSB Parity	No
Instruction Set	64-bit
Processing Die Lithography	45 nm
Max TDP	35 W
VID Voltage Range	1.05V-1.2125V
Package Specifications	
T_{CASE}	105°C
$T_{JUNCTION}$	105°C
Package Size	35mm x 35mm
Processing Die Lithography	45 nm
Processing Die Size	107 mm^2
# of Processing Die Transistors	410 million
Sockets Supported	BGA479, PGA478
Intel® Turbo Boost Technology	No
Intel® Hyper-Threading Technology	No
Intel® Virtualization Technology (VT-x)	Yes
Intel® Trusted Execution Technology	Yes
Intel® 64	Yes
Idle States	No
Enhanced Intel® Speedstep Technology	Yes
Intel® Demand Based Switching	No
Execute Disable Bit	Yes

Table 9. CPU Specification for PC (Drowsy control system)

Camera: 640×480 color webcam.

Model	A4 Tech PK-835-1
Image Sensor	1/4" color progressive CMOS 640×480pixels
Product Dimension	Fuselage+Clip: 1.8(L)x0.5(W)x2.4(H) in. Product Weight: 0.12 Ib. Package Weight: 0.31 Ib.
Lens Specification	F=2.4,f=4.9mm,View Angle 54°
Focus Range	Automatic focus,30cm to infinity
Operating System	Microsoft Windows® 98/ME/2000/XP/2003/2004

Table 10. Camera Specification

Speakers: 5W stereo speakers.

5.4.2 Interfaces

No visual user interface will be provided. Output of the system will be a voice message that alerts the driver via speakers.

5.5.   Geomobile Control system

5.5.1   Description

Geomobile GOS device is a simple GSM handset dedicated for elderly people. Device includes GPS module. It's suitable in car and in home scenario.
The section describes the Geomobile Control System as illustrated here:
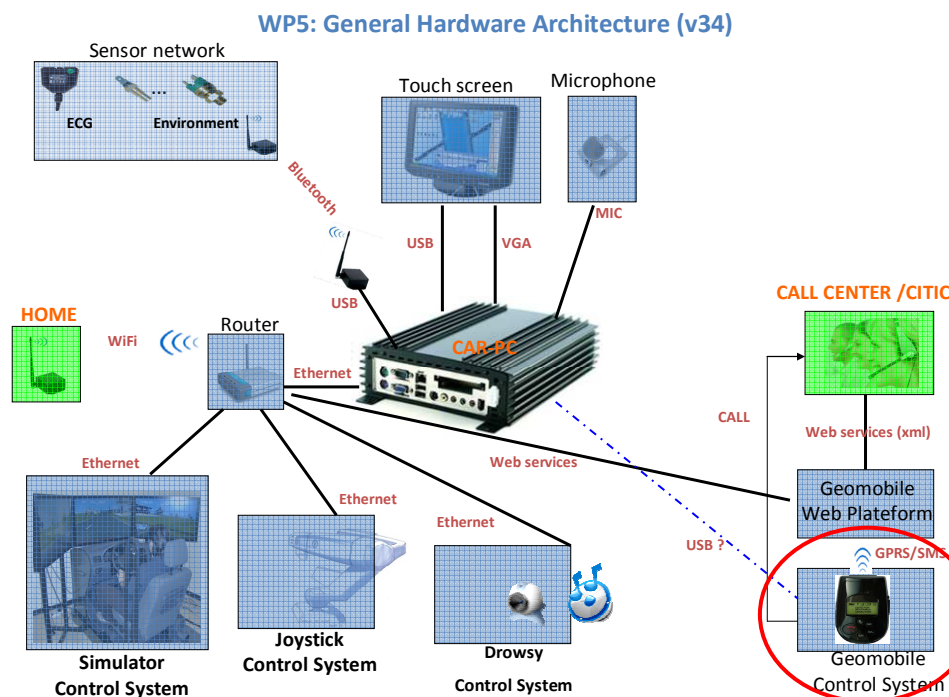
Figure 12. Geomobile system within Hardware general architecture.

Each GPS device is associated to an account on Geomobile location platform described in Software Chapter.

5.5.1.1.   Functional description

Geomobile GPS device is a simple GSM and GPS device dedicated for elderly people. It can be carry out from car and used at home to ensure assistance in case of emergency.

The following table describes the main fun ctionalities related to every hardware element considered within this sub-system:
.

Figure 13. Geomobile device.

Hardware element	Function
SOS button	Press for 3 seconds the SOS button to be in communication with CITIC assistance.
ON/OFF button	Press for 5 seconds to switch on/off the device.
P button	Dials a number from the phone book.
1 button	Calls predefined number 1
2 button	Calls predefined number 2 / Navigation between phone contacts
3 button	Calls predefined number 3 / Navigation between phone contacts
LEFT button	Enters to the phone book.
Base station	It charges the device.
Cigar lighter	It charges the device.
LCD display	Shows all the information of the system (Battery level, GSM signal, …)
3G accelerometer	Detects when the car is moving or when the car is stopped for a long time.

Table 11. Functions in subsystem 6.

Further information about the functions of every hardware element can be found on the Geomobile annex at the end of the document.

5.5.1.2. Technical description

Geomobile GPS device is a small and powerful GPS, GSM/GPRS tracking device that is designed for personal remote positioning and emergency reporting.

Geomobile GPS device is suitable for applications such as human body or vehicle security etc. Instantly locate and report your position by using GPS, SMS/ GPRS solution, three quick dial keys for emergency calls, and one panic button for emergency alarm.

These are some of the product features :
- Get current location
- Tracking (by time interval, distance interval or smart mode)
- Journey logging up to 100,000+ locations
- Emergency alarm
- Emergency calls
- Geo-fencing control
- Motion Alarm
- GSM/GPRS simultaneously
- Battery power low alarm
- Power Management
- Voice communication
- User report alarm
- Firmware upgrading remotely
- Unit password settings
- SIM pin code setting

Hardware Specifications :

- GSM 850/900/1800/1900
- GPRS class 10, TCP/UDP
- GPS 20 channels "All-In-View" tracking
- Cold/Warm/Hot start time: 42/38/1 sec.
- Superior sensitivity: -159dBm tracking
- Built-in rechargeable 1100mA/h Li-ion battery
- Built-in 4MB Flash Memory for data logger
- Built-in speaker and microphone
- Built-in 3D G-sensor for power management
- 128 x 64 LCD display (with back-light function)
- Ultra low power consumption: GPS/GSM stand by time up to 60 hours
- Mini USB port for charging and data exchanging

5.5.2 Interfaces

See the related annex.

5.6. Call Centre

5.6.1 Description

MIDAS Supervision Centre module is responsible for attending any type of incoming communication (telephone call, videoconference, home alarm, car alarm, periodical information sending, etc.). It also allows outgoing communications, depending of user privileges (user role). Finally information is accessed through the Supervision Centre.

5.6.1.1. Functional description

Main functionalities implemented by Supervision Centre are the following:

- User authentication. Only allowed users can access the system.
- Information access control. Not every user can access every functionality and data. A concrete user can access a functionality in two ways:
  o The access is completely forbidden or granted
  o The access is granted but only for certain data (e.g. a non specialized user can access to medical data, but only for its relatives)
- Attend every incoming call. This call can be treated by the system automatically or has to be attended by an operator, depending of its type and importance
- Make possible to establish outgoing calls. It will be possible depending of user privileges
- Manage every incoming message from hardware devices
- Alert managing
- Huge data storage

The following table describes the main functionalities related to every hardware element considered within this sub-system:

Hardware element	Function
Primary phone line (E1)	It is an usual telephone line, but using a Communication Server, a large number of extensions can be defined, and 30 concurrent communications can be established (incoming as well as outgoing). This primary line gives the hardware support for concurrent communications, although an additional element (Communication Server) is needed to manage them

Table 12. Functions in subsystem 7

5.6.1.2. Technical description

Next figure shows Supervision Centre general architecture. Every module characteristics, functionalities and used technologies can be seen below.
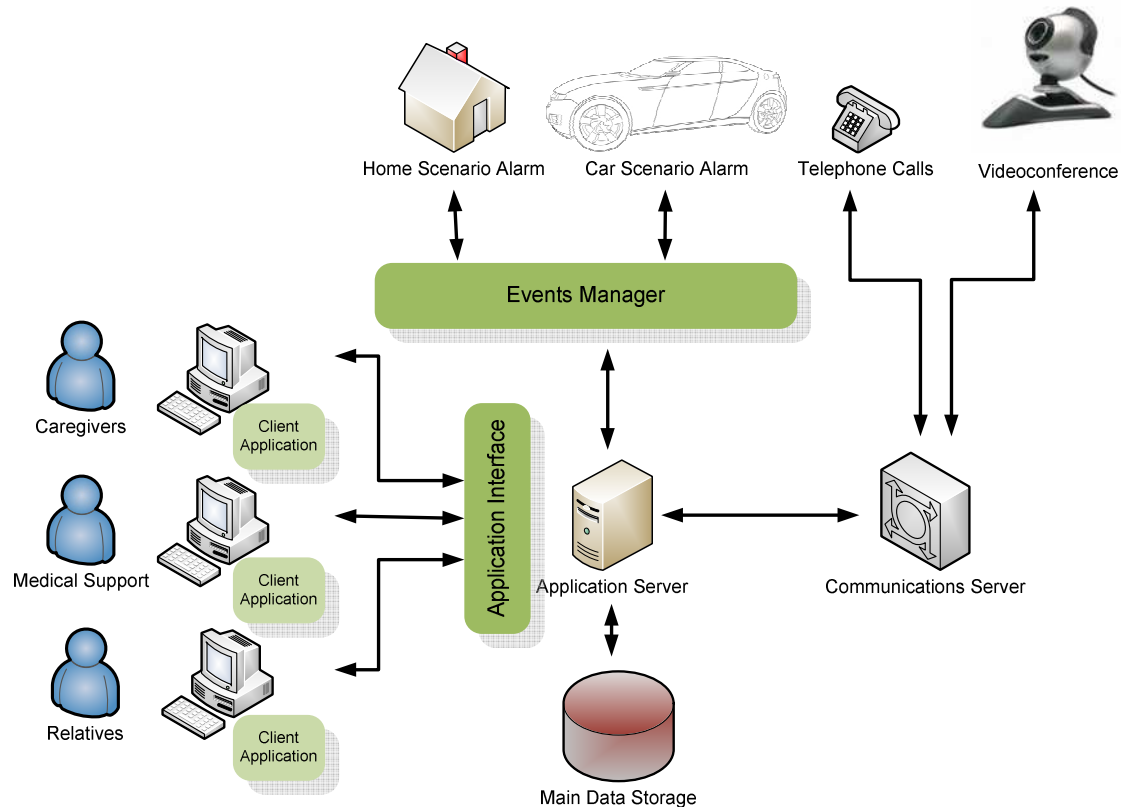
Figure 14. Supervision centre.

Modules Description

Functionalities and technical characteristics of every module

- Application Server
  - o Functionalities
    - ▪ Business Rules Implementation (Drools?)
    - ▪ Data Storage Interface
    - ▪ Actuations Protocols Definition (Drools?)
    - ▪ Users Profiles (Access Rights)
    - ▪ Centralized Whole System Control (System Log)
  - o Technical Characteristics
    - ▪ Multithread Service
    - ▪ High Availability
    - ▪ Three Layers (data independence)
    - ▪ Programming Language (Java?)
    - ▪ Persistence Layer (Hibernate?)

- Client Application
    - o Functionalities
        - ■ Application Server Front-End
        - ■ Communications Management
        - ■ Users Authentication (LDAP?)
        - ■ Alerts Management
    - o Technical Characteristics
        - ■ Stand Alone (Audio + Videoconference)
        - ■ Multiplatform Application (GUI based on QT?)
        - ■ Programming Language (Java?)

- Application Interface
    - o Functionalities
        - ■ Client Applications Requests Management
        - ■ Routing
        - ■ Messages Parsing
    - o Technical Characteristics
        - ■ Remote Access
        - ■ Programming Language (Java?)

- Main Data Storage
    - o Functionalities
        - ■ Huge Data Storage
        - ■ Concurrent Access
        - ■ Users Authentication
        - ■ Sensible Information Treatment
        - ■ Data Integrity
    - o Technical Characteristics
        - ■ Implemented with a DBMS (MySQL ?)
        - ■ Fault Tolerant Mechanisms (Clustering?, DB Replication?)
        - ■ DB Optimization (Indexes, Normal Forms)

- Events Manager
    - o Functionalities
        - ■ Application Server Front-End
        - ■ Incoming/Outgoing Messages Treatment and Parsing
        - ■ Data Exchange Security Implementation
        - ■ Events/Alerts Filtering
        - ■ Messages Treatment
    - o Technical Characteristics
        - ■ Remote Access
        - ■ Multichannel
        - ■ Programming Language (Java?)
        - ■

- Communication Server
  - Functionalities
    - Communications Hardware Management
    - Incoming/Outgoing Communications Management
    - Notifications to/from Application Server
    - Fault Tolerant
  - Technical Characteristics
    - Implemented with Asterisk?
    - QoS
    - Dialplan Implementation
    - Multichannel (DTMF, VoIP, Videoconference, Fax)
    - Programming Language (Java?)

Modules Interfaces

- Events Manager / Scenarios (car & home)

Events Manager is in charge of incoming/outgoing messages from/to car and home devices. When a device installed at home or in the car has to send information to Supervision Centre, it will be received and managed in the Events Manager module. On the other hand if a configuration message (for example) has to be sent to a device, Events Manager will compose and send it. A common communication protocol is needed between Events Manager and these devices, and DPWS will be used for this purpose. Additionally, a home/car gateway is needed to route messages to a concrete device.

For incoming messages there is no problem, but outgoing messages implies to send a message to a device that is behind an ADSL router with no previous request. In such a case, the router default behaviour is to drop the incoming message. To solve this problem a STUN server is used. With STUN can be simulated a previous request by introducing a dynamic NAT rule, to allow the message to be sent by the Events Manager.

- Communication Server / telephone

Incoming and outgoing calls are made through the primary line (E1), but Asterisk uses internally TDMoE (**T**ime **D**ivision **M**ultiplexing **o**ver **E**thernet). To convert from E1 protocol (Q.931) and TDMoE a hardware device called foneBridge is used.

- Client Application / Application Interface

This communication is supported by Thales Application Service.

- Client Application / Communication Server
- Communication Server / (Home-Car) Gateway

In both of these cases to establish a videoconference multimedia elements has to be transmitted. These multimedia elements are transmitted in these two channels. The used protocol to open/close connections these connections is SIP.

- Application Server / Communication Server

Every communication is obviously managed by the Communication Server (Asterisk). Nevertheless, Communication Server needs to notify certain situations to the Application Server, and when an outgoing communication is going to be established a message on the opposite sense is needed.

In the Asterisk case, there is a Java API to allow this bidirectional communication: AMI (Asterisk Management Interface).

- Application Server / Main Data Storage

Application Server cannot access to information directly, because Application Server should be dependant of the DBMS. Using a persistence layer, this problem is avoided. Hibernate makes the Application Server code independent of the DBMS used; it could be possible to change the DBMS (using the same data model) with no change in Application Server code.

5.6.2 Interfaces

Not applicable.

6. User interface: Software

Mainly, the "car gateway" software system will be a Java-based system that uses OSGi technology. Java is considered one of the most influential programming languages. These are some of its most important features:

- Platform independent: *write-once-run-anywhere*
- Simple
- Object oriented
- Portable
- Dynamic

On the other hand, the OSGi framework is a module system and service platform for the Java programming language that implements a complete and dynamic component model. OSGi bundles (a group of Java classes and additional resources) can be remotely installed, started, stopped, updated and uninstalled without requiring any reboot.

Considering their features, the Java + OSGi duo gives this module the independence, simplicity and portability needed to configure and run it on any car.

6.1. Multimodal HMI

6.1.1 Description

The Multimodal Human Machine Interface (HMI) implements the interface between the user and the system. It provides the logical and physical infrastructure needed to monitor and manage the system's status, in real time. This software module controls the logical structure of the mentioned HMI. The physical devices used for the physical structure has been shown on previous sections.

6.1.1.1. Functional description

Multimodal HMI general architecture is shown in the following figure:
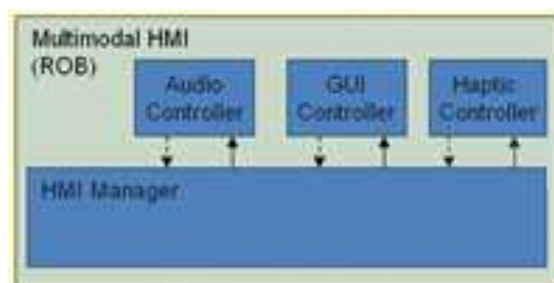

Figure 15. Multimodal HMI overview

As seen on the figure, the module is formed by four components: Audio Controller, GUI Controller, Haptic Controller and HMI Manager.

GUI Controller gives the graphic view of the interface. The GUIs are composed of a set of panels that show the visual output of the Multimodal HMI.

Audio Controller manages the Audio input and output. Its speech recognition technology allows control of the interface by voice commands, such as "radio", "back", or "volume up", for example. Furthermore, the speakers give system's status info by audio output.

Haptic Controller manages the touchscreen technology in order to let the driver control the interface by a simple finger touch.

HMI Manager does the entire administration job in this module. It connects the haptic, audio and GUI controllers, in order to make a unified source of information. The HMI Manager is connected to the context monitor module, so the Manager knows the conditions of the driver and the driving experience every time.

Thanks to this information, the HMI Manager is able to send orders to the controllers (Audio, GUI, Haptic) it administrates, so that the driver's attention on the road doesn't decrease, avoiding possible accidents.

For example, when the HMI Manager receives that the car is going 160 km/h, tells the Haptic Controller not to allow further control of the HMI by touch, as well as telling the GUI Controller to disable some of the control buttons on its panels.

Because the security settings should not be always the same (each driver's age, vision, reflexes… are not the same), the Multimodal HMI asks for a user authentication at the start of the drive, so that it recognizes the driver and customizes the security parameters.

For example, if a 75-year-old driver is going 110 km/h, the Multimodal HMI would disable some of the options that it wouldn't disable if the driver was 25 years old.

6.1.1.2. Technical description

The figure below shows the Multimodal HMI's data schema:
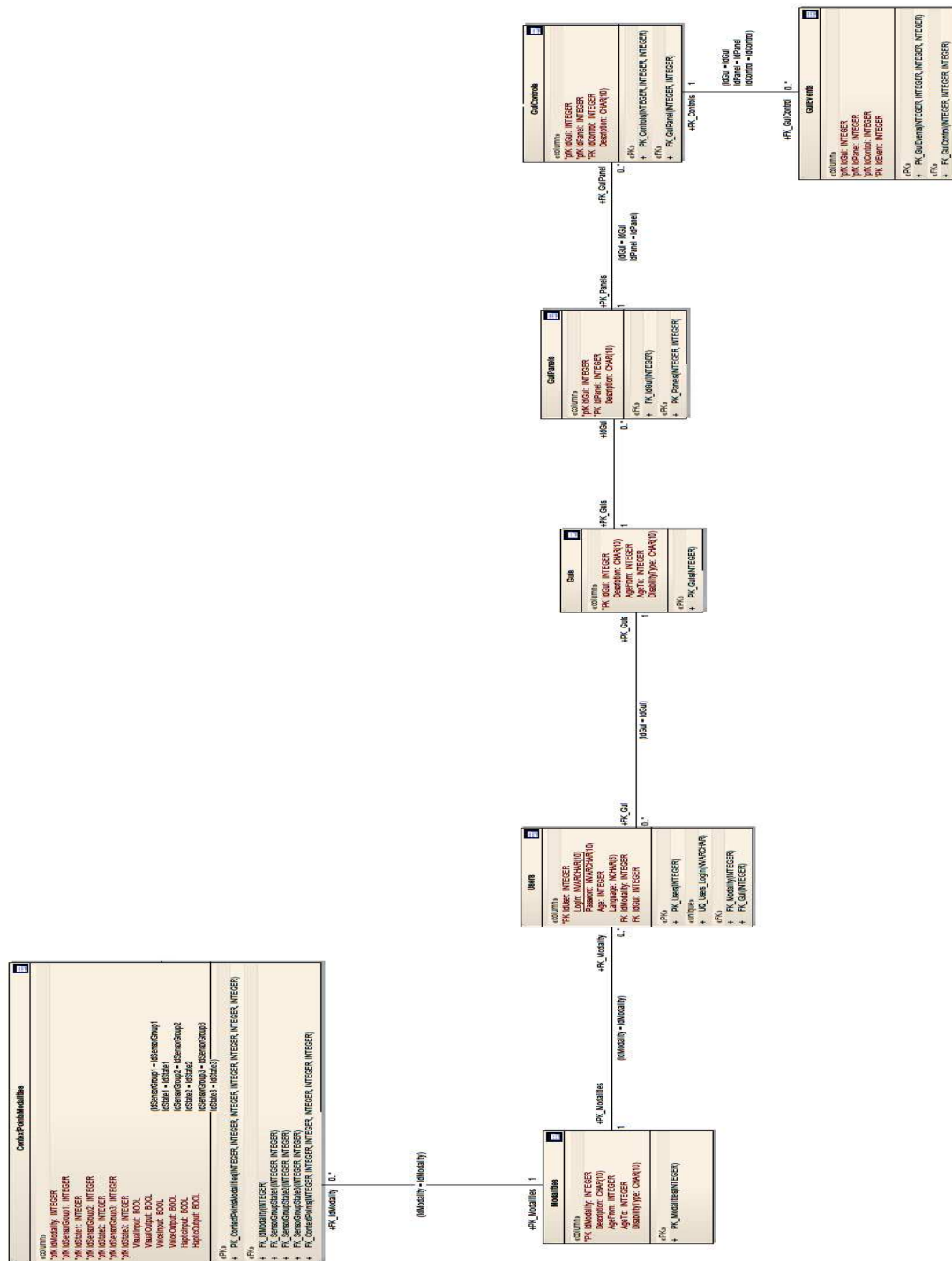

Figure 16. Multimodal HMI data model

As shown in the figure above, when the user authenticates, the Multimodal HMI knows the type of GUI (IdGUI) and Modality (IdModality) the driver is related to, and customizes the settings according to his/her properties.

On the other hand, the GUI is composed by a set of panels, and in the same time, are composed by a set of controls that lead to different events in the system, such as turn down the volume, go back to the previous panel, etc. The mentioned schema is shown on the following figure:
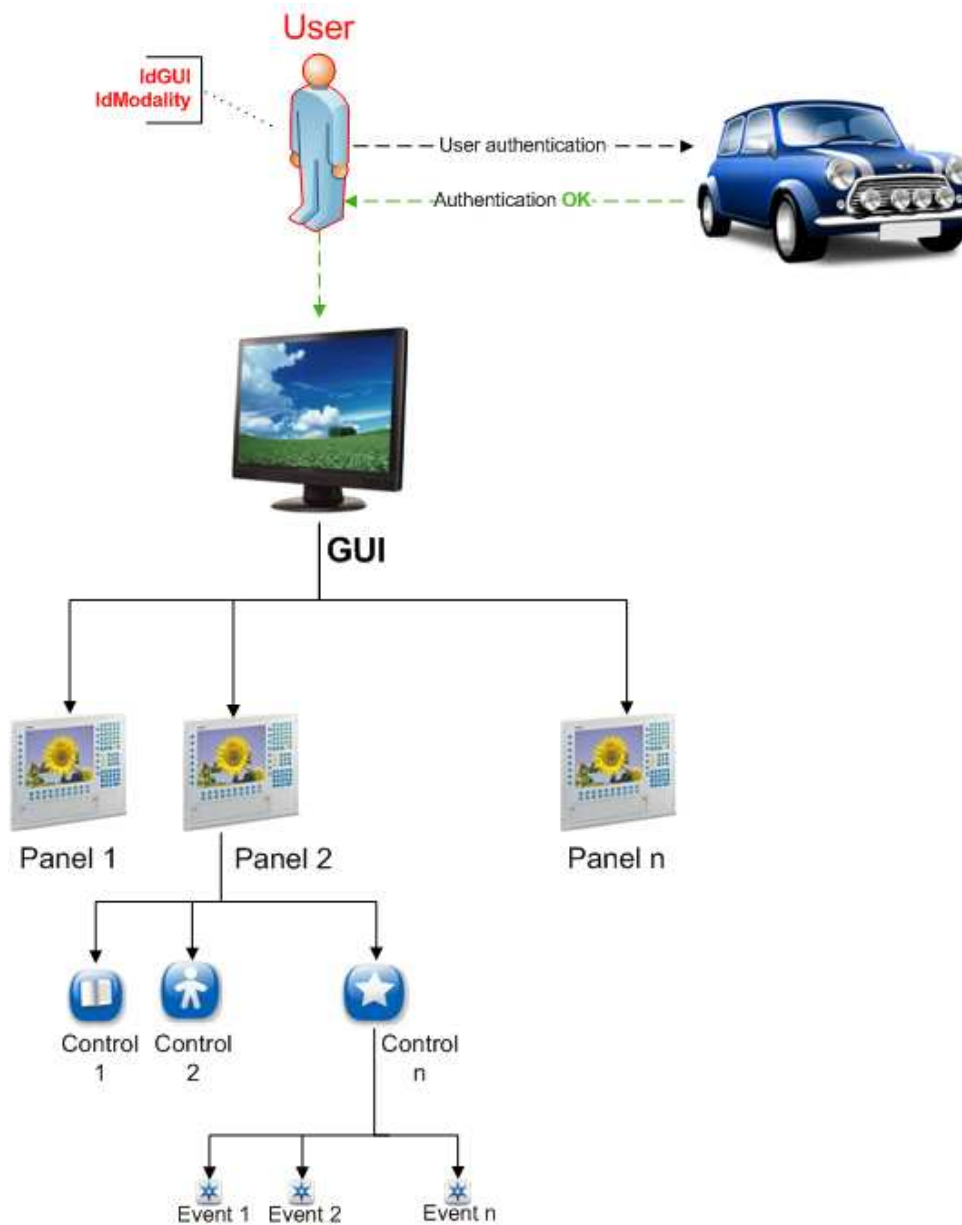

Figure 17. GUI overview

6.1.2   Interfaces

To be defined.

6.2.   Geomobile Manager

6.2.1   Description

See "Geomobile Control System" section and the related annex.

6.2.1.1.   Functional description

See "Geomobile Control System" section and the related annex.

6.2.1.2.   Technical description

See "Geomobile Control System" section and the related annex.

6.2.2   Interfaces

See "Geomobile Control System" section and the related annex.

6.3.   Simulator Manager

6.3.1   Description

The Simulator Manager will handle the communication between the Simulator Control System and the HMI Manager of the Multimodal HMI. The Simulator Manager will pass commands from the HMI Manager to the Simulator Control System and status information from the Simulator Control System to the HMI Manager.

The Simulator Manager will at the same time pass data generated by the Simulator Control System to the Data Storage.

6.3.1.1.   Functional description

The Driving Assistance – Physical Disability scenario requires that the driver be able to control certain devices in the car (such as the windscreen wipers) using voice commands. These voice commands will be passed from the Audio Controller to the HMI Manager, which in turn will send it to the Simulator Manager. Finally, the Simulator Control System will receive the command from the Simulator Manager and execute the command (activate the windscreen wipers in the simulator). The Simulator Control System will then report back to the HMI Manager that the wipers have been activated by way of the Simulator Manager.

The Simulator Control System will also send the geographical location of the car in the simulation environment to the Simulator Manager. This information can be supplied to both the HMI Manager and the Data Storage.

6.3.1.2. Technical description

The list of data that the Simulator Control System will supply to the Simulator Manager is given in Section 5.2.7 *Connection with simulator: Ethernet (KATRON)* of Deliverable D5.3: *Communications design*.

This list of data includes the vehicle location, speed and acceleration; road inclination; positions of car controls (steering wheel, pedals and gear); environmental conditions (rain, wind, light).

6.3.2 Interfaces

Not applicable.

6.4. Drowsiness Manager

The service is implemented using Visual Studio .NET 2008 platform with C++ language on Windows XP operating system. The application grabs the video frames and performs computer vision methods to detect drowsiness of the driver. The whole system based on .NET Framework. In addition to the base classes, OpenCV and STASM (Milborrow and Nicolls, 2008) libraries used for computer vision functionality.

6.4.1 Description

Camera with a minimum resolution of 640×480 pixels must be placed in a way that the drivers face is in frontal upright position. In addition, presence of the video device must not create uncomfortable situation for the driver. When the system detects drowsiness, a voice message alert is triggered by the system.

6.4.1.1. Functional description

CAR_FS08 Drowsy Driver Detection service includes several sub-methods that provide additional functionality:

- Face Detection
  o Base requirement for the service is the availability of the face detector. Rest of the tasks depends on the output of this functionality.
  o Input is the grabbed video frame.

- Output is the 2D location and size information of detected faces (Face.x, Face.y, Face.width, Face.height) relative to the frame size. In addition, segmented face is provided.

- Eye Detection
  - Input is the output of face detection
  - Output is the location of the two eye (eye{L,R}.x, eye{L,R}.y) relative to the frame size and the approximate rotation angle of the head position in the range of 70-120 degrees where 90 degree represents the frontal upright position.

- Eye Blink Detection
  - Input is the output of face & eye detection and predetermined threshold values.
  - Output is the statistical values on detected eye blink (frequency, duration)

- Artificial Neural Network Learning
  - Input is the normalized output of all detection methods
  - Input layer has 40 neurons, two hidden layers with 50 neurons in each and two neurons in output layer representing driver's drowsiness state.
  - Output is a trained artificial neural network for drowsy driver recognition stored in OpenCV XML format.

- Drowsy Classification
  - Input is the normalized output of all detection methods and the trained ANN model.
  - Output is a voice message in case of drowsiness.

In addition to the 2D location and size information of facial features, these methods also stores date and time information for further analysis. For example, location of face and facial features are stored with associated date and time information in a database in addition to the high-level classification results. We define three states for the driver drowsiness as seen in the next table. Typical eye blink duration is less than 400ms on average and 75ms for minimum. For this reason, we used T_{Drowsy}=400ms and $T_{Sleeping}$=800ms.

Drowsiness level	Description
Awake	Blink durations $< T_{Drowsy}$.
Drowsy	Blink durations $> T_{Drowsy}$ and Blink durations $< T_{Sleeping}$
Sleeping	Blink durations $> T_{Sleeping}$

Table 13. **Three level for drowsiness**

Drowsiness detection directly connects to the eye-blink detection component. Timing of eye-closed events is compared with the threshold values. Considering a car at 90km/h, TDrowsy and TSleeping values corresponds to 10m and 20m of distances, which gives enough time for the system to give an alarm signal to the driver.

6.4.1.2. Technical description

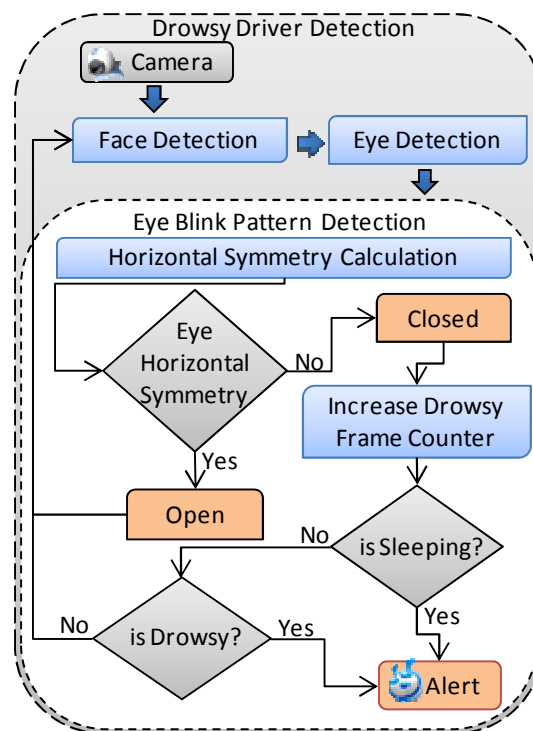Operation flow diagram of the system is shown in the figure:

Figure 18. Drowsy driver detection system operation flow diagram

6.4.2 Interfaces

No applicable.

6.5. Sensor Manager

From the "Multimodal User Interface" the sensor manager will only provide data from some sensors in order to be evaluated by the "context monitor" software module. So, the Context Monitor module will take decisions related to the available options on the HMI. Not any other involvements are related to "Sensor Manager" module.

6.5.1 Description

Not applicable (see D5.2).

6.5.1.1. Functional description

Not applicable (see D5.2).

6.5.1.2. Technical description

Not applicable (see D5.2).

6.5.2 Interfaces

Not applicable (see D5.2).

6.6. Data Storage

6.6.1 Description

Data Storage will be based on "MySQL" (version 5.1.33), one of the most popular relational databases. These are some of the features of MySQL:

- Full relational database
- Cross-Platform portability
- High performance, scalability and reliability
- Small footprint
- Easy to use

In this module Hibernate framework will be used to access to the relational database. Hibernate is a powerful, high performance object/relational persistence and query service for the Java language. Hibernate lets you develop persistent classes following object-oriented idiom, including association, inheritance, polymorphism, composition, and collections. Hibernate also allows you to express queries in its own portable SQL extension (HQL), native SQL, or with an object-oriented Criteria and Example API.

The Data Storage module will be fully accessible by an independent OSGi bundle. The main properties of the OSGi framework can be seen in the module 6.1, "Multimodal HMI".

6.6.1.1. Functional description

This module is responsible of maintaining all the data accessible thanks to a single bundle, which must be called in order to query the information we want to get. Hibernate framework will be used, so we will only need Java language to access to the data, since the SQL calls are made automatically by Hibernate itself.

Main functionalities implemented by Data Storage are the following:

- Keep the data administration in an independent Osgi bundle which can be started, reloaded, updated and stopped in real time.
- Access to the data withdrawing the use of SQL language.
- Automatically transform Java functions (faster and easier to remember) into SQL calls.
- Create an easy to use, Java based, and portable data storage system.
- Provide a common interface to manage data stored in database, based in the following schema:
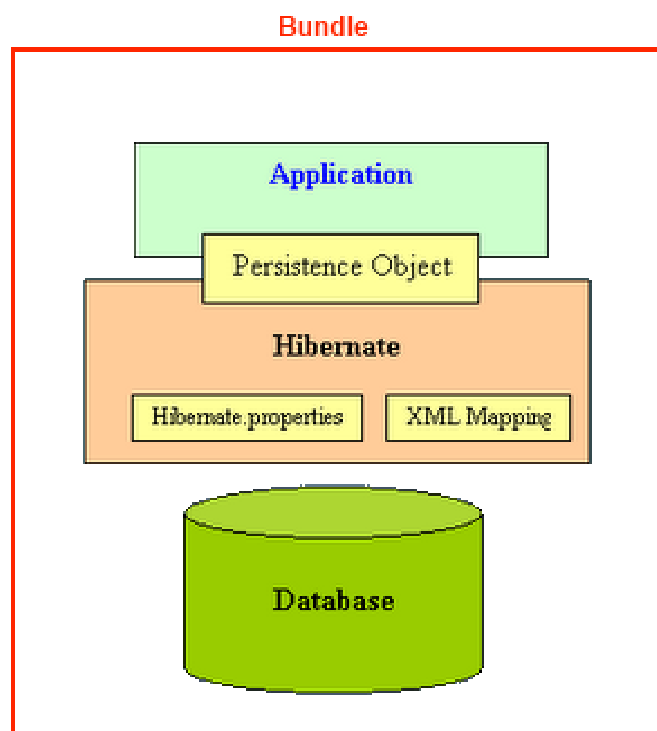

Figure 19. Database system overview

6.6.1.2. Technical description

According to the schema shown in previous figure, the general database structure will be formed by tables and relations shown in the following figure:
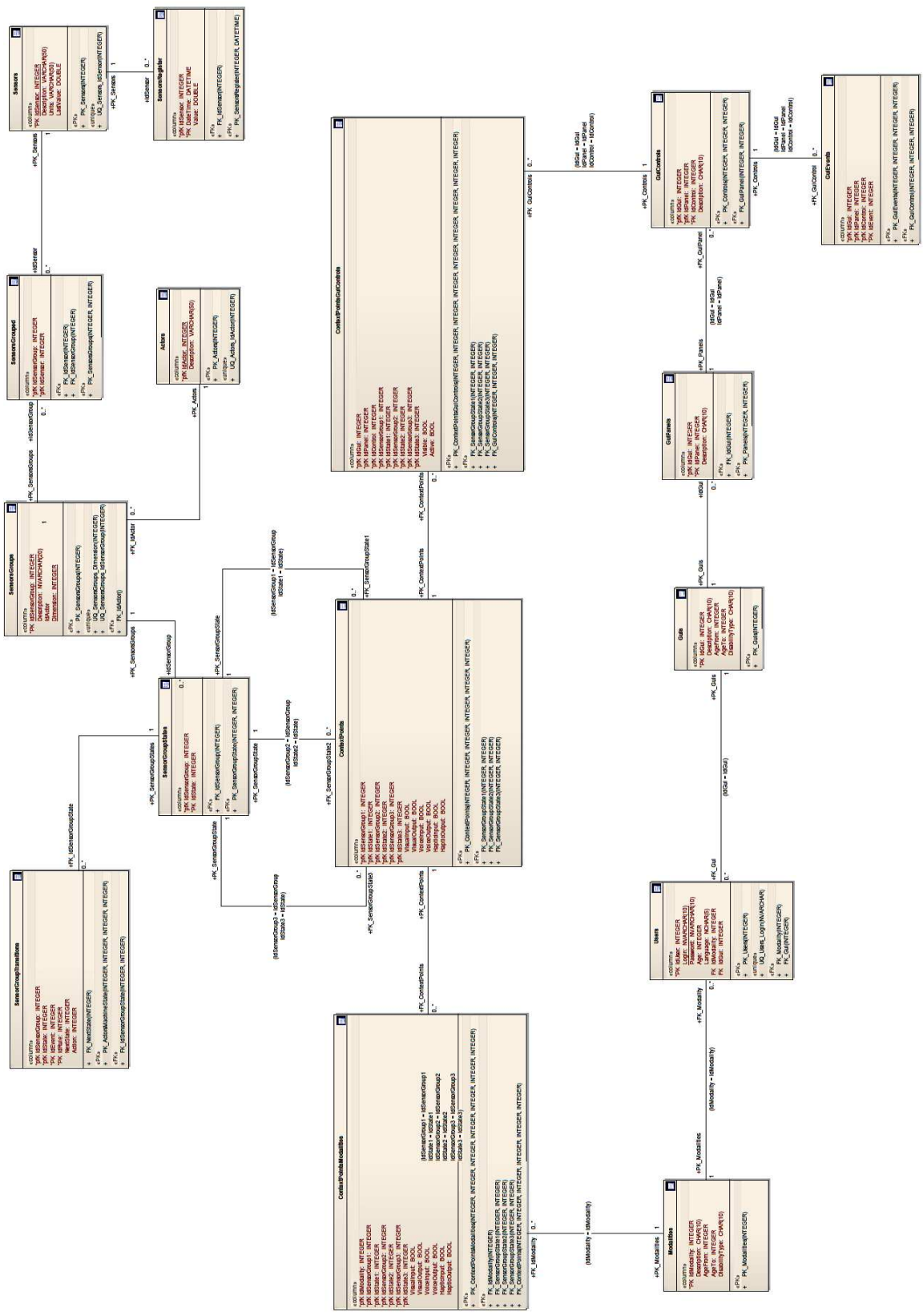
Figure 20. General data model

6.6.2 Interfaces

These are the general functions to carry out with each table:

- **AddRegister_*Tablename* ( )**: Add a new register to an existing "*Tablename*" table.

- **RemoveRegister_*Tablename* ( )**: Delete the specified register of the "*Tablename*" table. The identified register must exist in the table.

- **ModifyRegister_*Tablename* ( )**: Modify an existing register of the "*Tablename*" table. The identified register must exist in the table.

- **SelectRegisters_*Tablename* ( ): S**elect the specified registers(and their fields) we want to see from the "*Tablename*" table.

- **RemoveAll_*Tablename* ( )**: Delete every single register of the "*Tablename*" table.

6.7.   Geomobile Control System

6.7.1   Description

Geomobile platform provides location service over a web platform displaying positions of GPS devices. It provides tools to setup GPS devices (SOS phone number, quick dial phone number, phone book, geofence area, and tune parameters for fall and motion detection…). It contains an SMS gateway to notify end-user in case of alarms or to read SMS from GPS devices as GPS SmartPhone and GPS Geomobile devices.

This section describes the Geomobile web location platform linked to GPS devices as illustrated here:
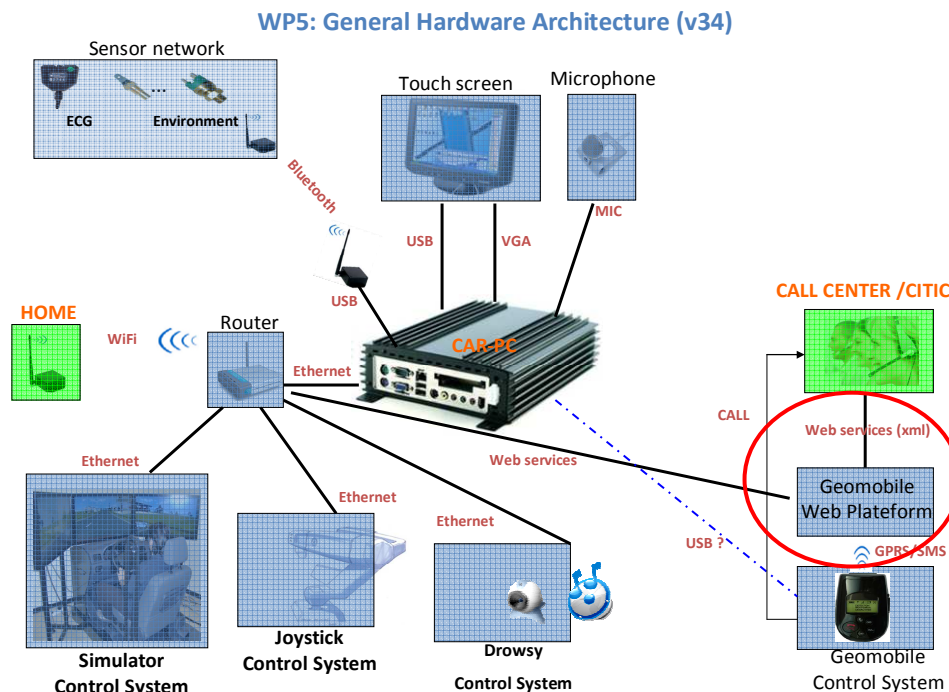
Figure 21. Geomobile Manager overview

Each GPS device is associated to an account identified by a login and a password.
Each account:
- ⇨   Provides positions of GPS devices
- ⇨   Displays current alarms
- ⇨   Provides a configuration manager to update configuration of GPS device
- ⇨   Provides notifications in case of alarms
- ⇨   Reports alarms to call centre from web services

6.7.1.1. Functional description

Geomobile Web Platform provides a set of functions and services for a call centre providing assistance to a person carrying a GPS device. These functions provide relevant information to operators from a call centre to assist a person in his car.

When an incoming call happens, the phone number identifies the caller. The identification file of caller is shown to assistant operator with the associated alarms. This file gives the name and address of the subscriber and the list of persons to be contacted in case of emergency. From this identification file, a button can be added to access the associated account of Geomobile Web Platform.

These are some of the key features of the Geomobile Software platform:
- Account access and administration
- Localization
- GPS device configuration
- SOS alerts
- Outgoing call administration
- Input call filter
- Phone book
- Numerical keyboard
- Zone alert
- Motion alert

Further and deeper information about these features can be found on the Geomobile annex at the end of the document.

6.7.1.2. Technical description

The web location platform is a java web application running on J2E Jonas server. The platform can receive positions from 3G/GPRS network and from SMS as it is composed of SMS gateway. This gateway is able to receive location from SMS. Database is managed by MySQL tool, while web server is managed by Apache. Tomcat is used for java tool aplications.
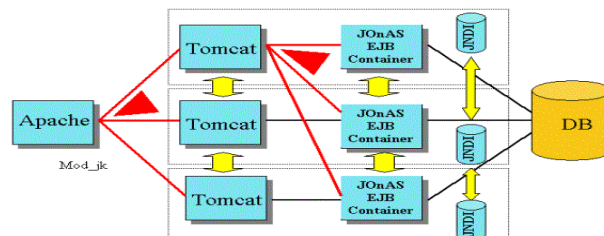

Figure 22. Geomobile web platform infrastructure.

6.7.2 Interfaces

No applicable.

6.8. Simulator Control System

6.8.1 Description

The Simulator Control System will provide an immersive environment and a realistic car driving experience, and will be used to simulate the driving scenarios. It will function as a safe test bed for the sensors, communication devices, HMI device, steering device and the drowsiness control system to be developed within the scope of the MIDAS project.

6.8.1.1. Functional description

The Simulator Control System will be used to simulate the driving scenarios. The driving cabin of the simulator will be built using original car parts as much as possible in order to provide an immersive environment and a realistic car driving experience.

The simulator will be controlled using the steering wheel, gearstick, and acceleration, brake, and clutch pedals located in the car cabin mock-up. The dashboard will include functional instrumentation and controls such as speedometer, tachometer, signal switches, light controls, signal and light indicators, etc.

The driver's field of vision will be simulated using three large LCD monitors placed in front of the cabin mock-up. The driver will interact with the simulated world using the car controls and receive visual and audio feedback through the monitors and speakers.

City and highway driving environments will be generated. Weather and road conditions, traffic, sounds, etc. will be simulated.

6.8.1.2. Technical description

The Simulator Control System will be developed on the Microsoft Windows XP Operating System using Microsoft Visual C++ Integrated Development Environment and the Qt Development Framework.

It will be built on top of KaTron's generic DRIVEtron software architecture shown in the following figure:
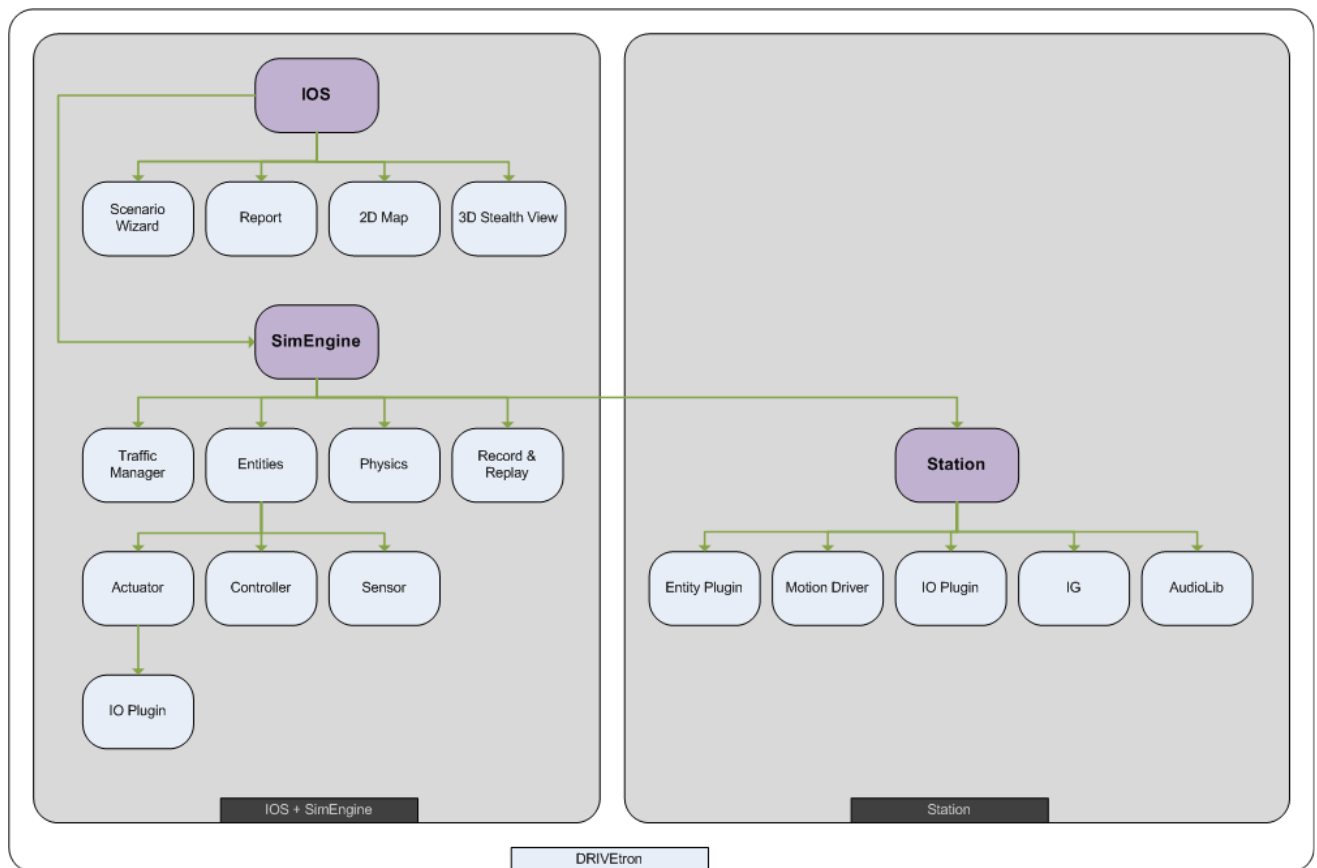
Figure 23. Simulator Control System Software Architecture

The driver's field of view willl be 120 × 40°. Three 26-inch LCD monitors will be used to display the six visual channels: front, left, right windows, and the rear-, left side-, right side-view mirrors. The frames per second will be greater than 30 Hz.

The sky (sun, clouds, moon, and stars) will be simulated in real time in accordance with the date, time, and geographical coordinates. Weather conditions (snow, rain, and fog) will also be simulated in real time.

Movement of vehicles in traffic will be simulated in real time. Headlights of vehicles, traffic lights, building and street lights will be simulated in real time. Vehicle sounds (engine, horn, wheel) and environmental sounds (traffic sound, sounds of other vehicles) will be simulated.

Autonomous vehicles will move and behave as specified in the scenario definition. They will obey the speed limits and traffic lights unless specified otherwise. These autonomous vehicles will change lanes if specified in the scenario definition.

In addition to long monotonous parts the highway will also have intersections, mountainous parts, curved sections, tunnels, rest areas. The number of lanes on the highway will be 1-3 in each direction.

Control Station

The simulator will also include a separate Control Station which will be used for the preparation and control of simulation scenarios, and debriefing. The start date and time and the duration of the scenario and the starting point of the car will be entered at the Control Station.

It will be possible to add different vehicle types such as sedan, hatchback, minibus, bus, truck, police car, ambulance, fire truck, etc. to the scenario via the Control Station. There will be an interface to specify the directions and behaviors (slow, fast, aggressive) of the vehicles to be added to the scenario. It will also be possible to create traffic directly by specifying its direction, intensity, and behavior.

The Control Station will allow the addition of events to the scenario at a specified time and a place. Some event examples are suddenly appearing vehicle at an intersection, traffic accident, animals on the road.

It will be possible to save a prepared scenario to a scenario definition file. A saved scenario file can then later be loaded, modified, and resaved if desired.

The Control Station will be able to record a simulation while it is being played. Saved simulations can later be replayed. During replay, one can pause, stop, rewind and fast-forward. It will also possible to alter the camera position during the replay.

6.8.2 Interfaces

No applicable.

6.9.   Drowsiness Control System

Drowsy Driver detection service receives input from a color video camera attached in front of the driver and processes the grabbed frames for the drowsiness. The detector is a video camera and software that regularly checks the eye of the driver to detect eye blink frequency, eyelid movements and eye blink duration. The system detects a pattern of long duration eye-lid closures indicating a potential drowsiness prior to the driver falling asleep and then alerts the driver by using voice messages.

Figure 24. Typical view of the drowsy driver detection system

Whole system is designed to work with Windows Operating system with the latest .NET Framework V3.5. The next figure describes the software architecture for the drowsy driver detection service.
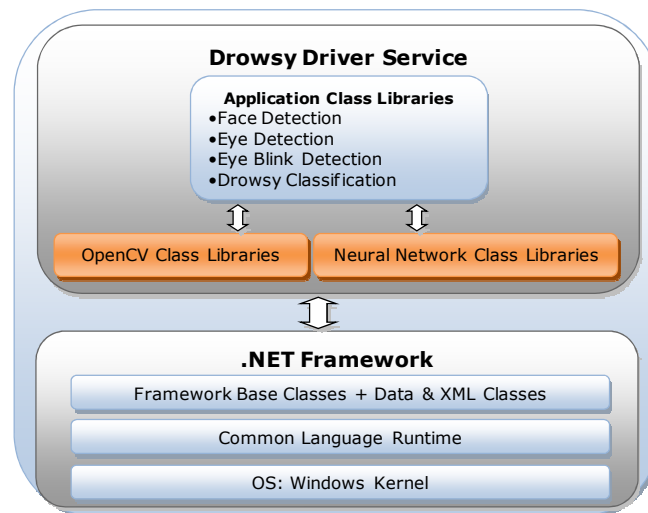

Figure 25. Software Architecture for Drowsy driver detection

The service is implemented using Visual Studio .NET 2008 platform with C++ language on Windows XP operating system. The application grabs the video frames and performs computer vision methods to detect drowsiness of the driver. The whole system based on .NET Framework. In addition to the base classes, OpenCV and STASM (Milborrow and Nicolls, 2008) libraries used for computer vision functionality.

6.9.1 Description

Camera with a minimum resolution of 640×480 pixels must be placed in a way that the drivers face is in frontal upright position. In addition, presence of the video device must not create uncomfortable situation for the driver. When the system detects drowsiness, a voice message alert is triggered by the system.

6.9.1.1. Functional description

Drowsy Driver Detection service includes several sub-methods that provide additional functionality:

- Face Detection
  - o Base requirement for the service is the availability of the face detector. Rest of the tasks depends on the output of this functionality.
  - o Input is the grabbed video frame.
  - o Output is the 2D location and size information of detected faces (Face.x, Face.y, Face.width, Face.height) relative to the frame size. In addition, segmented face is provided.
- Eye Detection
  - o Input is the output of face detection
  - o Output is the location of the two eye (eye{L,R}.x, eye{L,R}.y) relative to the frame size and the approximate rotation angle of the head position in the range of 70-120 degrees where 90 degree represents the frontal upright position.
- Eye Blink Detection
  - o Input is the output of face & eye detection and predetermined threshold values.
  - o Output is the statistical values on detected eye blink (frequency, duration)
- Artificial Neural Network Learning
  - o Input is the normalized output of all detection methods
  - o Input layer has 40 neurons, two hidden layers with 50 neurons in each and two neurons in output layer representing driver's drowsiness state.
  - o Output is a trained artificial neural network for drowsy driver recognition stored in OpenCV XML format.
- Drowsy Classification
  - o Input is the normalized output of all detection methods and the trained ANN model.
  - o Output is a voice message in case of drowsiness.

In addition to the 2D location and size information of facial features, these methods also stores date and time information for further analysis. For example, location of face and facial features are stored with associated date and time information in a database in addition to the high-level classification results. We define three states for the driver drowsiness as seen in the next table. Typical eye blink duration is less than 400ms on average and 75ms for minimum. For this reason, we used T_{Drowsy}=400ms and $T_{Sleeping}$=800ms.

Drowsiness level	Description
Awake	Blink durations $< T_{Drowsy}$.
Drowsy	Blink durations $> T_{Drowsy}$ and Blink durations $< T_{Sleeping}$
Sleeping	Blink durations $> T_{Sleeping}$

Table 14. Three level for drowsiness

Drowsiness detection directly connects to the eye-blink detection component. Timing of eye-closed events is compared with the threshold values. Considering a car at 90km/h, TDrowsy and TSleeping values corresponds to 10m and 20m of distances, which gives enough time for the system to give an alarm signal to the driver.

6.9.1.2. Technical description

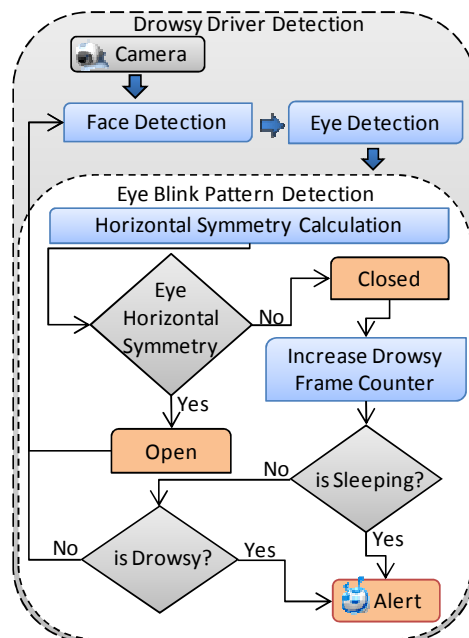Operation flow diagram of the system is shown in the following figure:

Figure 26. Drowsy driver detection system operation flow diagram

6.9.2 Interfaces

Not applicable

6.10. Sensor Network

Not applicable (see D5.2).

7. Conclusions

Main general modules have been defined and the corresponding interfaces too.

DPWS and Joystick control system interfaces definition are pending to be better defined.

Due to time constraints and funding problems in Spain some modules, mainly software modules will be probably reduced according to the next integration phase results.

8. References

1. http://www.who.int/research/en/

2. http://www.who.int/classifications/icf/en/

3. Opencv Website, http://sourceforge.net/projects/opencvlibrary

4. S. Milborrow and F. Nicolls, Locating facial features with an extended active shape model, in Proc. Eur. Conf. Computer Vision, Marseille, France, 2008.

9. Acronyms List

CAN: Control Area Network
ECG: Electro-Cardio-Gram
GUI: Graphical User Interface
GPS: Global Positioning System
HMI: Human Machine Interface

10. Annexes

10.1. VIA EPIA CN Mini-ITX datasheet

Mini-ITX Series

VIA EPIA CN

Mini-ITX C7® Board with MPEG-2 & TV Support

Features

- Integrated VIA UniChrome™ Pro AGP graphics with MPEG-2 decoding acceleration
- Supports DDR2 400/533 SDRAM
- Supports TV-out
- Supports two SATA
- Supports eight USB 2.0 (four as pin headers)

Specifications

Model Name	EPIA CN13000G	EPIA CN10000EG
Processor	1.3GHz VIA C7®	1.0GHz VIA fanless C7®
Chipset	VIA CN700 North Bridge VIA VT8237R Plus South Bridge	
System Memory	1 DDR2 400/533 DIMM slot Up to 1GB memory size	
VGA	Integrated VIA UniChrome™ Pro AGP graphics with MPEG-2 decoding acceleration	
Expansion Slot	1 x PCI slot	
Onboard IDE	2 x UltraDMA 133/100/66 connectors	
Onboard LAN	1 x VIA VT6103 10/100 Mbps Ethernet PHY	
Onboard Audio	VIA VT1618 Muliti-channel AC'97 Codec	
Onboard TV Out	VIA VT1625M Encoder	
Onboard I/O Connectors	1 x USB connector for four additional USB 2.0 ports 2 x SATA connectors 1 x LPT connector 1 x CD-in connector 1 x CIR connector (switchable for KB/MS) 1 x Front panel connector 1 x Front panel audio connector for Line-out and Mic-in 2 x Fan connectors for CPU and system fans 1 x ATX power connector	
Back Panel I/O	1 x PS2 mouse port 1 x PS2 keyboard port 1 x VGA port 1 x Serial port 1 x RJ-45 LAN port 4 x USB 2.0 ports 1 x RCA port (S/PDIF or TV out) 1 x S-Video port 3 x Audio jacks: Line-out, Line-in and Mic-in (Horizontal, Smart 5.1 support)	
BIOS	Award BIOS 4/8Mbit flash memory	
Operating System	Windows 2000/XP, Linux, Win CE, XPe	
System Monitoring & Management	CPU voltage monitoring Wake-on LAN, Keyboard Power-on, Timer Power-on System power management AC power failure recovery	
Operating Temperature	0° C - 50° C	
Operating Humidity	0% ~ 95% (relative humidity; non-condensing)	
Form Factor	Mini-ITX (4-layer) 17 cm x 17 cm	
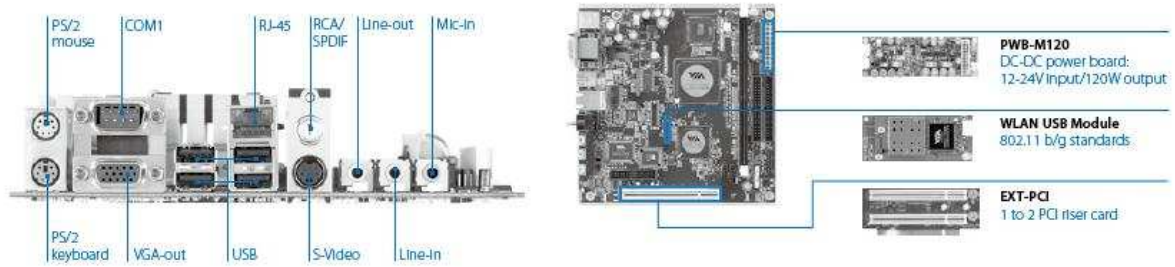
Ordering Information

Model Name	CPU Frequency	Description
CN13000G	1.3GHz C7®	Mini-ITX Board with 1.3GHz C7®, VGA, TV-out, USB, LAN, COM, IDE & SATA
CN10000EG	1.0GHz C7®	Mini-ITX Fanless Board with 1.0GHz C7®, VGA, TV-out, USB, LAN, COM, IDE & SATA

Block Diagram
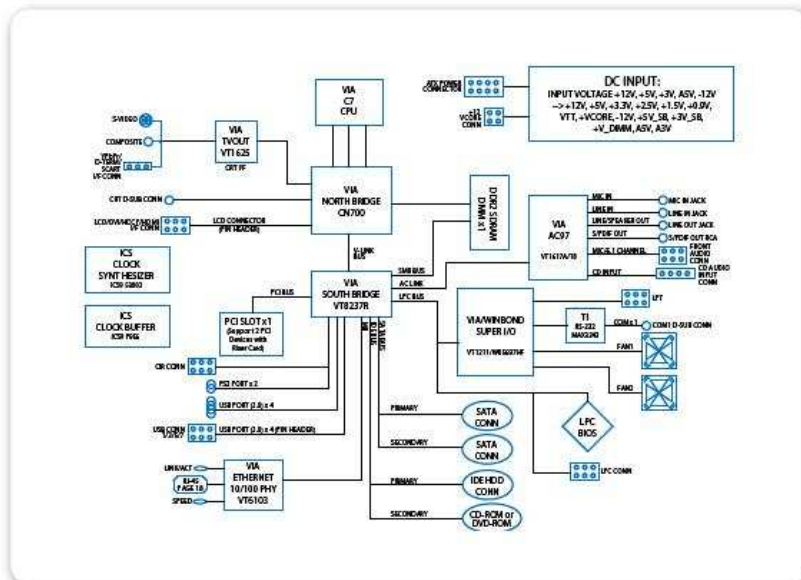
Packing List

Items

1 x ATA-66/100/133 IDE ribbon cable
1 x General installation guide
1 x Driver Utility CD
1 x I/O bracket

10.2. Xenarc touch-screen datasheet

XENARC 700TSV™
7" TFT LCD Touchscreen Monitor w/ VGA & AV inputs

Now with 5-Wire Resistive Touchscreen!

Xenarc Technologies Corp. is one of the first LCD manufacturers to introduce a 7" LCD screen with VGA input and Touchscreen. In-Car computing is the next step in computing technology, and we are committed to serving this up and coming technology sector.

This popular product incorporates the innovation of our VGA 7" models along with a 5-wire resistive Touch-Screen panel. Use the convenient touch-screen as your input device, control your mouse cursor or the mini on screen keyboard that comes with your operating system. The touch screen utilizes the USB port as the interface. You can connect several 700TSV monitors to your computer and the touchscreens would work simultaneously through the multi-monitor support.

These monitors come included with an instruction manual, a copper monitor stand, an AC adaptor, a connection cable, cigarette lighter car adaptor, and touchscreen drivers for DOS, Windows, Windows Vista, Linux, and Mac OS.

To install this monitor in a vehicle, check out our Windshield Mount, Model # WSM-1. Please also take a look at the non-touch version 700YV if you don't need a touchscreen.

Features

- For In-Car Computing, PC, Server, GPS, and various VGA Use
- High Brightness, High Contrast LCD Panel *New*
- 5-wire resistive Touch Screen (USB) *New*
- Multi-Monitor Touchscreen Support
- VGA Input (15 pin D-SUB) x 1 & Video Input x 2
- Audio Input / Built-in Speaker
- NTSC / PAL Multi-System
- 16x9 Aspect Ratio
- High Resolution Display
- Auto detects 800x480 resolution
- Upgraded High-Brightness CCFL Backlight
- Adjustable backlight level for night-time use
- Pixelworks High Performance Image and Video Signal Processor
- **AISS** - Advanced Image-Scaling and Shaping
- 16:9 / 4:3 Scaler settings
- Last Input memory
- Last Power setting memory
- IR Remote Control
- Auto power-on upon signal detection
- Automatic display adjustment
- On Screen Display Control
- Mirror Image Flip (VGA and Video Modes) *New*
- Vertical Image Flip (VGA and Video Modes) *New*
- Copper Stand: 360° / Height Adjustment
- 20-Pin heavy-duty connector
- Anti Glare Coating
- Supports 11V DC ~ 24V DC
- "E" Mark Certified for Automotive use

Specifications

- Model #: 700TSV
- Screen Size: Diagonal 7" (16:9)
- Physical Resolution: 800 (H) x 480 (V) WVGA
- Supported Resolution: 640 x 480 ~ 1024 x 768
- Dot Resolution: 2400 x 480 = 1,152,000 (dots)
- LCD Brightness: 500 cd/m²
- Contrast Ratio: 400:1
- Viewing Angle: 140° Horizontal, 100° Vertical
- Touch Screen Interface: USB port
- Operating Voltage Range: DC 11V ~ 24V
- Power Supply: DC 12V
- Power Consumption: <8W
- Operating Temperature: 23°F ~ 158°F
- Storage Temperature: -22°F ~ 185°F
- Dimension (in): 7.75W x 4.75H x 1.38D
- Weight (lb): 1.28
- FCC, CE, E13 Certification
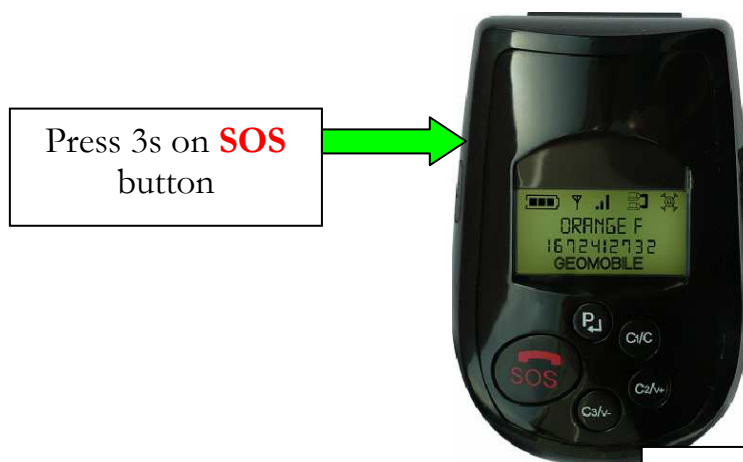- ROHS Compliant
- 18 Month Warranty

10.3. Geomobile

10.3.1 Hardware

- *Switch ON or Switch OFF GPS Device*

Press 5s on the right button →

- *SOS call*
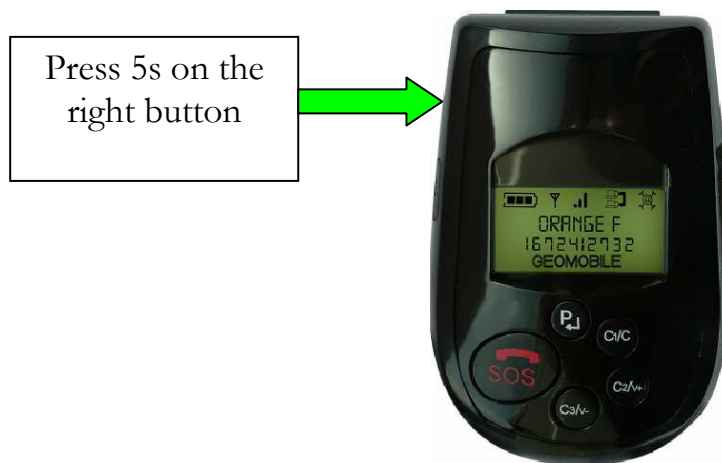
Press 3s on **SOS** button →

To be localised first time, device has to be Outside for 2-3 minutes and symbol on LCD is fixed. When symbol is blinking, Geomobile device could not be localized.

Press 3 seconds on SOS button until a beep, then you will be in communication with CITIC assistance. All calls can be localized in real time from Geomobile platform.

From touch screen device, SOS call can be triggered as :
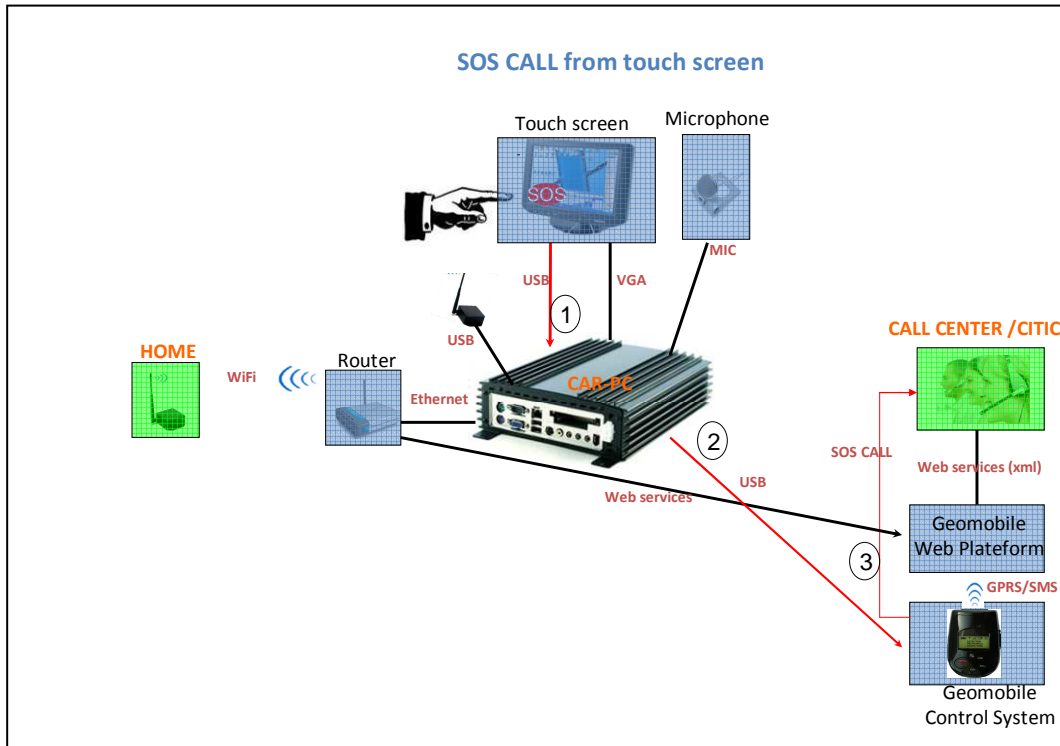
- *Make a call*

To make a call to three predefined number, press 3 seconds on C1 or C2 or C3 buttons until a beep happens. Number is dialed automatically. Micro and loudspeaker are on the back side of the device. During a call, you can press on SOS button to hang up.

Call can induced from touch table to Geomobile GPS device through web service (c/f SOS call).

- *Pick up a call*

Press briefly on whatever button except SOS button

- *Call from phone book*

Press briefly on this button To access phone book
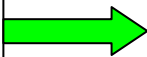
Button P

Button +

Button -

Press briefly on the button located on left side to access phone book. The button + and button – allow to parse phone book of 15 contacts.

When a contact is found, press 3 seconds on button P to dial the corresponding phone number.

- *Charge device*

GPS device needs to be charged every day. Device is fully charged after 5 hours. Autonomy is around 17-20h for a standard use. LCD display can be switched off when device does not move but it can make

Plug in to charge device.
White point on upper position.
Beep happens when it is correctly plug in

Device can also be charged from the base station and from the car cigar lighter charger connector.

- *Motion*   *detection*
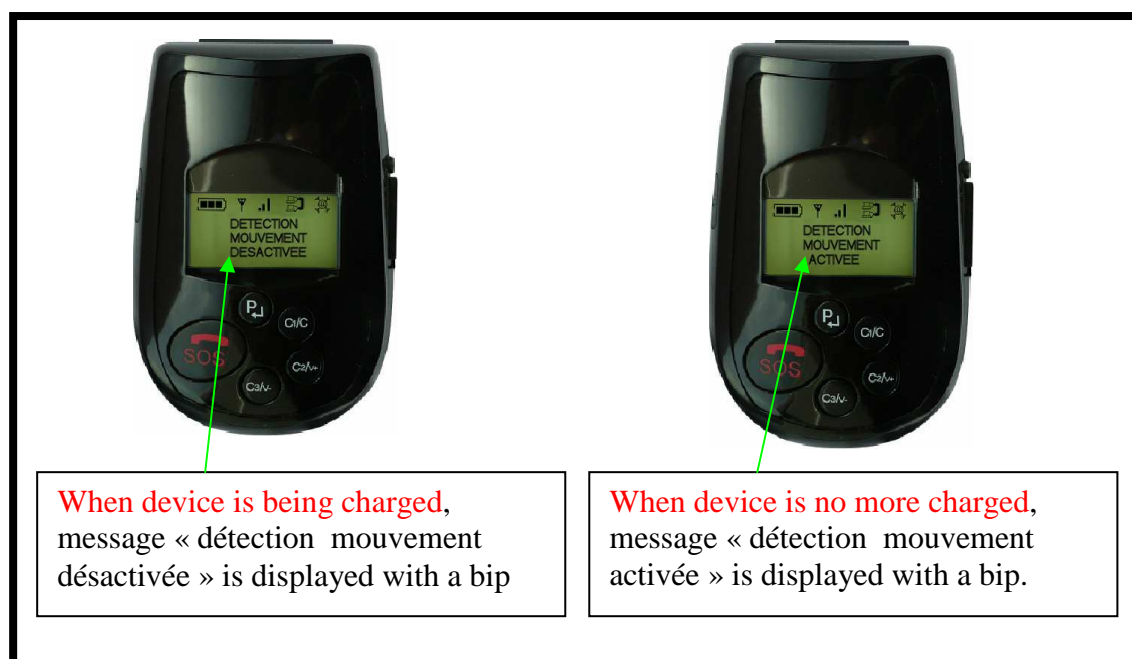
  Device contains 3G accelerometer to detect when car is just moving or when car is stopped for a long time.

  In case of no motion for a certain time t1, GPS device does beeps for a certain time t2. If no button is pressed during beeps, man down alert is triggered and GPS device call automatically CITIC Call Centre.
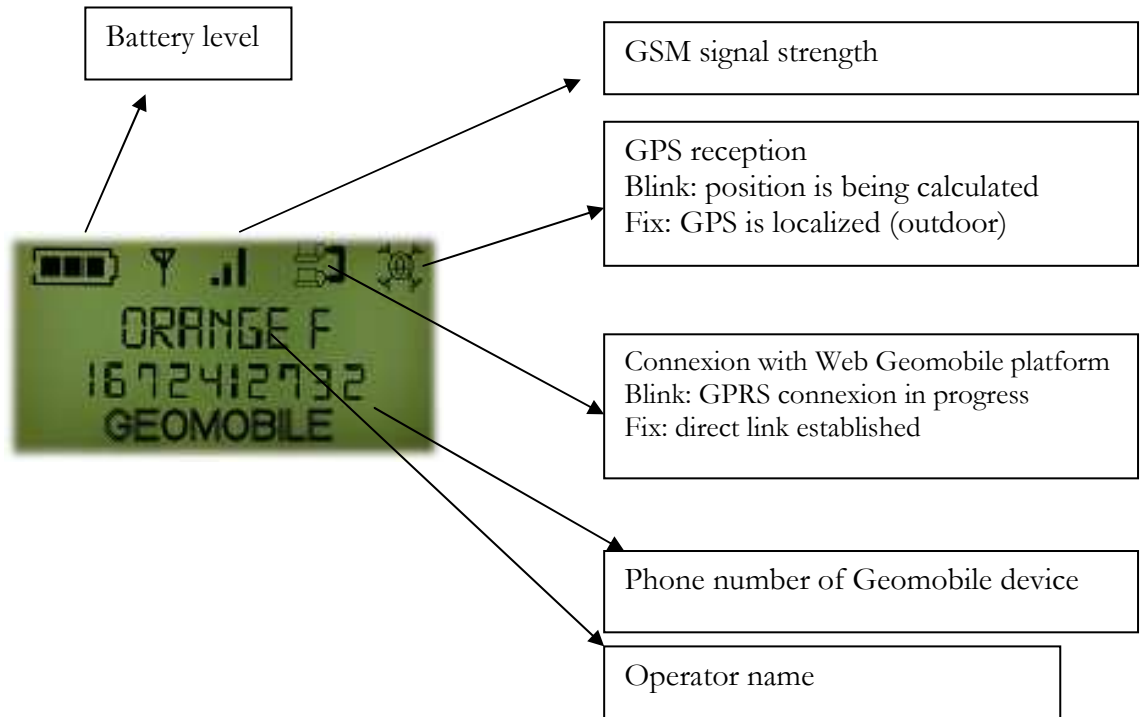
  Web localization platform displays the current location of GPS device and the corresponding alarms.

  Time t1 and t2 can be setup from Geomobile Web platform and device is updated in OTA mode.

  When device is being charged, Man down alert function can be disabled.

When device is being charged, message « détection mouvement désactivée » is displayed with a bip

When device is no more charged, message « détection mouvement activée » is displayed with a bip.

- *DIAGNOSTIC on LCD display*

Battery level

GSM signal strength

GPS reception
Blink: position is being calculated
Fix: GPS is localized (outdoor)

ORANGE F
1672412732
GEOMOBILE

Connexion with Web Geomobile platform
Blink: GPRS connexion in progress
Fix: direct link established

Phone number of Geomobile device

Operator name

10.3.2 Software

- *Account Access*

Web location platform of MIDAS is accessible from :
midas.whereru.eu
On the left side, login and password fields have to be filled to access to an account.
When an alert happens (SOS, Zone, Fall alarm, …) , account can be accessed automatically from the identification file of the subscriber from a url address.

Test account : tel=0601020304 password=geomobile

- *Account*

Account is composed of :

- *Localization*

Clicking on button "*Lancez la localisation*" in the previous panel, location of GPS device is provided, as shown in the next picture:

Alice's location is center on the map when you click here

History of positions

Position information on SOS call

Street number

Force the location in SMS mode

Change the location of the house symbol to give distance between person and his/her house

Battery in charge	OK	Status OK
Battery level 6		SOS Call
Battery level 5		Fall detection/Motion detection
Battery level 4		Zone Alert
Battery level 3		Standby Mode
Battery level 2		Last information not updated (more than 4 minutes)
Battery level 1	OFF	Switch off
Battery level 0		
Unknown Battery level		

GPS position accuracy is about 10 meters when GPS reception is very good. Each position is associated to a confidence index that indicates the level of GPS reception for CITIC teleassistance.

Confidence index	GPS position accuraty
weak	around 100 meters
good	around 20 meters
excellent	around 10 meters

When clicking on following buttons: 5 minutes, 15 minutes et 240 minutes, you will get respectively positions on « 5mn », « 15mn » et « 240mn » (historic positions) time window.
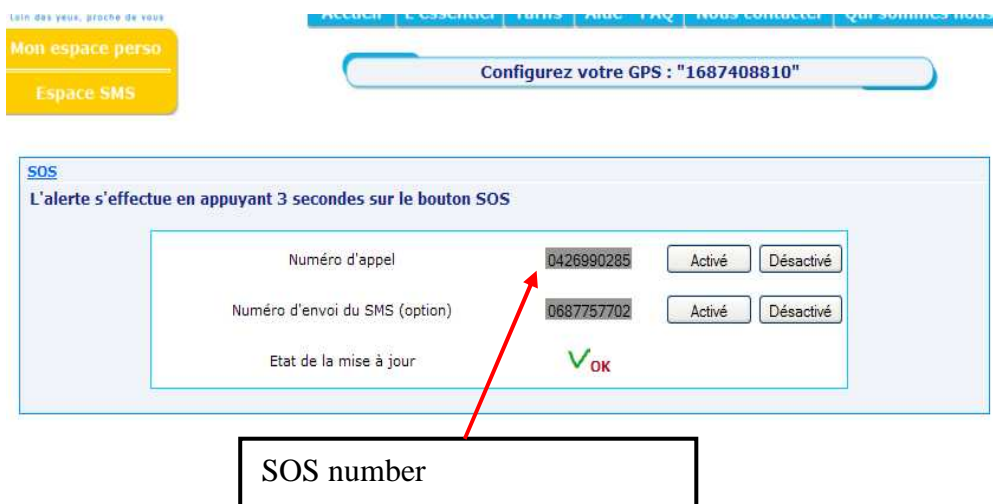Positions are refreshed automatically from web AJAX requests to Geomobile database every 30 seconds.

- *GPS device configuration*

All configuration options allow changing the configuration of GPS device in OTA mode (Over The Air) and in real time.

GPS device are setup with a pre-defined configuration but can be change afterwards for SOS, zone, motion alerts, predefined numbers and the phone book.

- *SOS*

From this window, you can change :

- SOS Call : type your SOS number for the SOS call and click on "activate".
- SOS SMS : type your SOS number for the SOS SMS and click on "activate".

- *Outgoing calls*

From this window, you can setup three predefined numbers.
Type number and click on "activate" to enable the number.

- *Input call filter*

Filter can be enabled to receive only authorised calls.
From this window, 3 phone numbers can be defined.
For example:
- If fields are empty : no filter is applied
- If you type 1, 2 or 3 numbers, only these numbers are authorized to call GPS device.
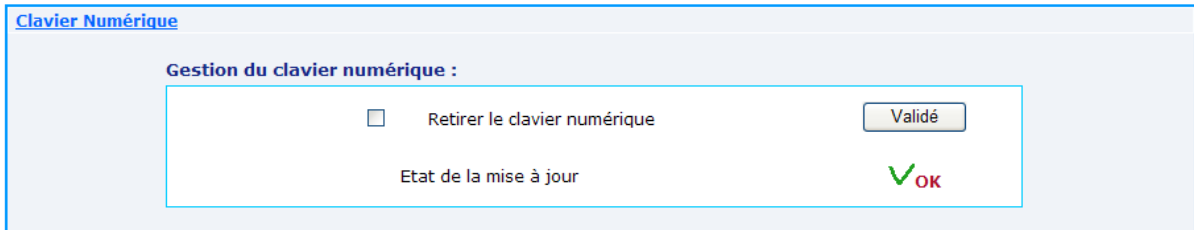
- *Phone Book*

Phone book can be accessed from button located on the left side of GPS device.

- *Numerical Keyboard*

Numerical keyboard can be activated to dial a free number.
When activated, press on the button located on the left side of GPS device.

- *Zone Alert*

Zone alert can be defined as live zone or dangerous zone.
When you leave from live zone, alert is triggered.
When you enter in dangerous zone, alert is triggered.
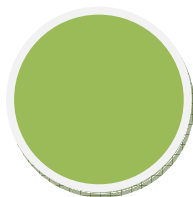The Zone is a circle. The radius goes from 80 meters to 64kms.
This alert corresponds to :

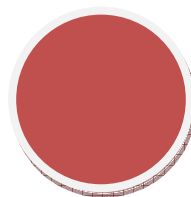⇨ an automatic call from GPS device to Call centre
⇨ a SMS notification
⇨ an email notification

Live zone is associated to a green circle on the map.
Dangerous zone is associated to a red zone on the map.

live zone   *dangerous zone*

- *Motion Alert*

When a car or person does not move from a defined timing motion alert is reported to assistance. GPS device contains 3G accelerometer sensor to analyse motion.

When GPS device does not move after a defined timing ,"t1", a series of beeps are sent for a defined timing interval, "t2". If no motion is detected or no button is pressed during this timing interval, motion alert is triggered. *t1* and *t2* can be tuned from this configuration window.

Logo ⚠ is displayed on the map where alert is triggered.

10.3.3 Interaction

Geomobile Web Platform provides a set of web services to interact with tools from Call center.

This set of web services is an exchange protocol between Geomobile platform and call center as CITIC. This protocol was reviewed and approved by CITIC.

The purpose of this document is to describe:
- Interface to access an account associated to a GPS device
- Interface to change user information from an account
- Protocol reporting alarm as SOS alarm, Zone Alarm, Fall detection alarm to a third party application.
- Interface to trigger SOS from GPS define

10.3.3.1.1 Account

Each GPS device is associated to a single account which can be accessed from login and password. Login is the SIM phone number of GPS device.

10.3.3.1.2 Account access

Account access can be processed from an encrypted http request over SSL protocol. This allows an automatic account access from a supervisor center.

Here an example for a valid account:

https://secure.whereru.eu/GeoGPS/identification?client_tel=0601020304&client_password=geomobile&process=session&webwap=web

Parameters	Definition
Client_tel	SIM phone number
Client_password	Password Super password can be implemented for a group of device
Process	Action
webwap	Web for web platform Wap for mobile platform

This command can be applied from a button inserted into the client identification file.

Client identification file is a file opened when the caller is identified. Tis file contains user information as name, address, list of persons to contact and all relevant information to an assistance center.

When this command is applied, account is accessed and result is to display GPS positions of persons and alarms on map as illustrated here.

10.3.3.1.3 *Device name*

Each GPS device has a name displayed on LCD screen and on its back side. This name is the phone number of its SIM except that first number is replaced by 1. For instance, the phone number is 0601020304, the corresponding name is 1601020304. The associated Geomobile account can be accessed through the following url :

GPS Device name : 1601020304
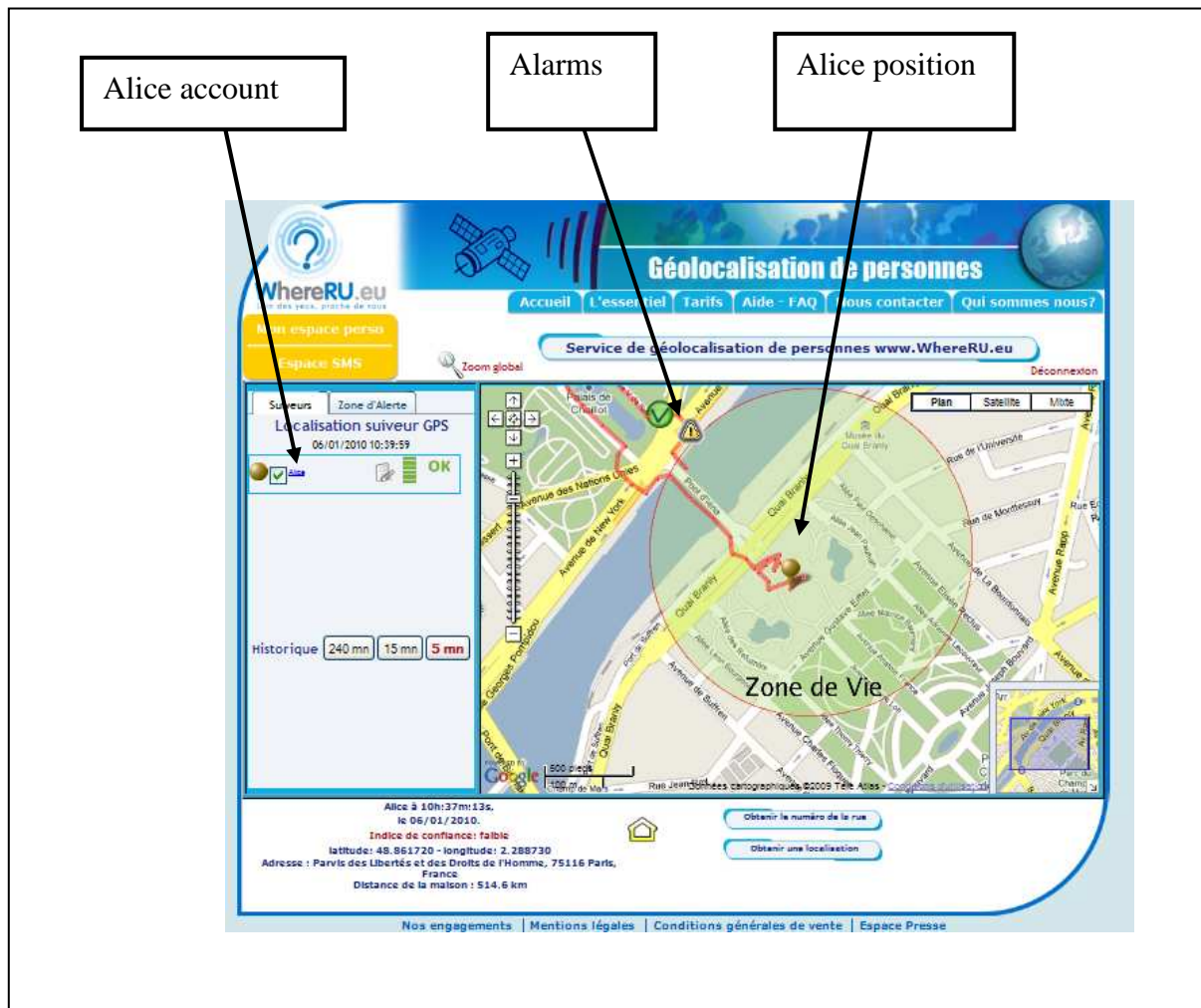
https://secure.whereru.eu/GeoGPS/identification?client_tel=0601020304&client_password=geomobile&process=session&webwap=web

10.3.3.2   Profile Account

Most of supervisor center application uses their own database to register client information as name, address, zip, city and list of persons to contact in case of troubles. Geomobile platform provides a simple interface to change client profile information. This is an automatic way to pass client information form assistance center database to Geomobile platform database.

Client is in charge of GPS devices belonging to the web account.
Child is the person who wears GPS device. The account contains only one GPS device

First Name and name of "child" person is displayed on map.
Address, Zip, city of "client" person are used to place his/her house symbol on map. In case of emergency, distance between his/her current GPS position and his/her home can be calculated and displayed.
Email is used to notify events (SOS, Fall, zone).

Client and Child can be identical if needed.
If a field is missing, it is left unchanged.

client_civility	Can be : man, woman, lady
client_name	Client name, max length=30
client_fname	Client first name, max length=30
client_address	Client address, max_length=3 lines of 20 characters
client_zip	Client zip code, french format as 07120
client_city	Client city, max length=30
client_country	Client country, can be only france
client_birthday	Client birthday as 02
client_birdmonth	Client birthmonth as 12
client_birthyear	Client birthyear as 1973
client_email	Client email use to notify alerts. In case of call center, use email from Call center company as alert@domain.com max length=35
child_name	Name of GPS device displayed on map max length=35 = length(child_name+ child_fname)
child_fname	First name of GPS device displayed on map

	max length=35 = length(child_name+ child_fname)
child_alert_sms	Mobile phone number used to notify alerts as Zone and Fall alerts

https://secure.whereru.eu/GeoGPS/identification?client_tel=06xxxxxxxx&client_pass word=xxxx&process=accountupd&client_fname=olivia&child_name=doise&child_fn ame=david&child_alert_sms=0601020304

The url length has to be less than 2083 characters
Character encoding is UTF-8

Geomobile platform returns http response 200 for OK or http response 403 for a forbidden request.

10.3.3.3 Alarms

Geomobile platform can provide 4 types of alarms:
- ⇨ SOS alert
- ⇨ Zone alert
- ⇨ Fall detection
- ⇨ Alarm for future use

Each alarm is reported though voice communication channel. This is the common and easy way to identify the caller from his/her SIM phone number and open his/her identification file from a supervisor center.

However voice call can fail sometimes due to trouble on GSM network (as GSM network congestion, lack of GSM coverage, low battery level of GPS device). Alarm has to be transmitted on other communication channels as GPRS and SMS channel.

Geomobile platform supports following communication channels according of alarm type:

	Voice	GPRS	SMS
SOS	**Supported**	**Supported**	**Supported**
Zone	**Supported**	**Supported**	**Supported**
Fall	**Supported**	**Supported**	**Supported**
Alarm (TBD)	**Supported**	**Supported**	**Supported**

➔ SOS alarm triggers SOS voice call to a phone number 1 and then SMS SOS and GPRS SOS data are sent
➔ Alert zone alarm triggers voice call to a phone number 2 and then GPRS Zone data is sent

➔ Fall detection alarm triggers voice call to a phone number 3 and GPRS Fall data is sent

Geomobile platform contains SMS and GPRS gateway.

SMS and GPRS data are sent from GPS device to Geomobile platform after voice communication as illustrated here:

Alarm Triggered	Voice Communication		Voice Hang up	SMS sent	GPRS sent
↓	↓		↓	↓	↓
t0	t0+1		t0+2	t0+3	t0+4
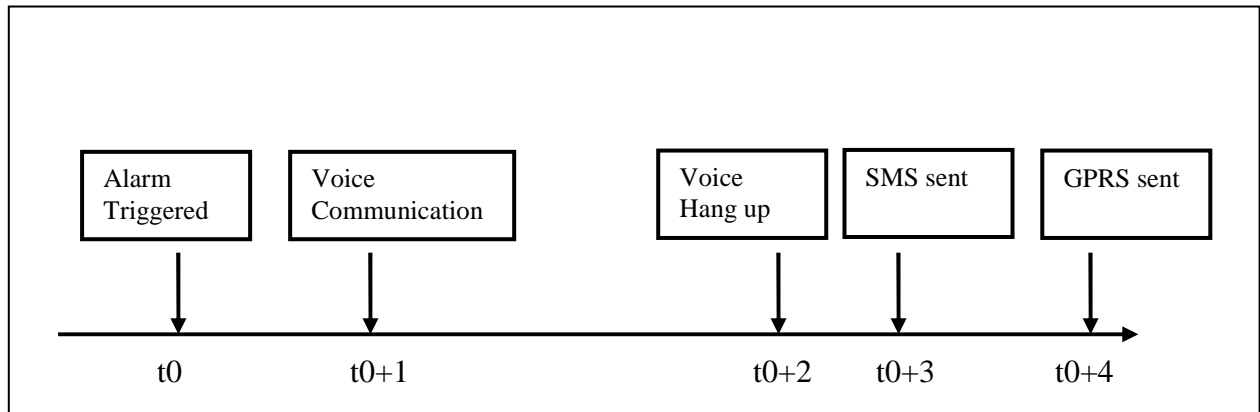
Even if voice communication succeeds, SMS and GPRS data are sent from GPS device to Geomobile platform. Alarms are backup on these communication channels. Platform can be enabled to inform a third party application that these alarms (SMS, GPRS alarm data) were triggered.
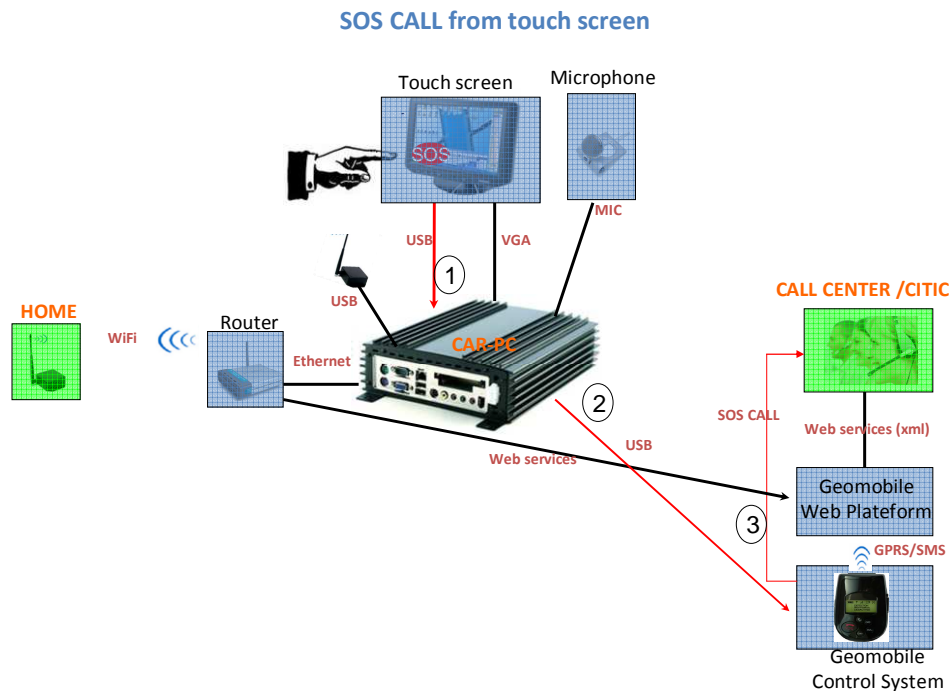
A simple datagram based on XML structure is used to forward these alarms.

10.3.3.3.1 *SOS*

SOS alarms can be triggered from :
⇨   GPS device by typing on SOS button
⇨ Touch screen by typing on SOS logo (step 1).
Afterwards, USB command (step 2) is sent to GPS device to trigger SOS call (step3) .

SOS CALL from touch screen

However the current driver of Geomobile GPS device does not support Linux platform. So it has been decided to trigger SOS call through Geomobile web location platform.

Web service has to be defined to trigger SOS call between touch screen and web location platform.

10.3.3.4 Communication layer

Geomobile platform uses TCP/IP as this protocol is widely used and broadband links largely available

10.3.3.4.1 TCP/IP protocol layer

10.3.3.4.1.1 Event transmission

The dialog uses the BSD socket interface using TCP/IP protocol.
- **The third party application is the server and Geomobile platform is the client.**
- Geomobile platform connects to a given TCP port and the communication is established. If the link fails, Geomobile platform tries to reconnect three times. For the server side, a permanent connection has to be used. For client, tcp port is opened and closed after transmission.

10.3.3.4.2 Datagram format

10.3.3.4.2.1 Event

An event is encapsulated in a XML documents as :
<event></event>
Example of an event: here an example for SOS alarm

XML request :
00cc<event><id>5313</id><trid>70563568</trid><date>20091215085241</date><callerid>0670563568</callerid><alarm><state>1</state><text>ALARME SOS GPRS 15/12/2009 08h:52m:41s</text><code>02</code></alarm></event>
(**without carry return**)

4 bytes	Number of bytes transmitted. Server reads these four bytes to know how many bytes it has to read.
<id>	Unique number of event. Is a simple incremental counter. This allows checking the sequence of events from server side.
<trid>	Id of GPS device which is its phone number with out prefix "06"
<date>	Date of event, ISO format YYYYMMDDHHMMSS
<callerid>	Caller phone number as 0601020304
<alarm>	Alarm event
<state>	Always 1 meaning alarm opened
<text>	Type of alarm can be : ALARME SOS SMS 15/12/2009 08h:52m:41s ALARME SOS GPRS 15/12/2009 08h:52m:41s ALARME ZONE SMS 15/12/2009 08h:52m:41s ALARME ZONE GPRS 15/12/2009 08h:52m:41s ALARME ABSENCE DE MOUVEMENT SMS 15/12/2009 08h:52m:41s ALARME ABSENCE DE MOUVEMENT GPRS 15/12/2009 08h:52m:41s With : 15/12/2009 day/month/year 08h:52m:41s hour/minute/second **The content of code can be display on the client identification file to inform operator about alarm type received and date/time when events occurs**

<code>	02 : for SOS alert
	ZV : for Live Zone alert
	ZG : for Dangerous Zone alert
	FALL : for fall detection
	OTH : other alert to be defined

10.3.3.4.2.2   Acknowledge

The event is acknowledged by the <ack> XML tag.
- In case of positive acknowledge, the <ack> tag should be 1.
- In case of negative acknowledge, the <ack> tag should be 0.

Example :

Server response = 000C<ack>1</ack>   (without carry return)

000C is the number of bytes transmitted

10.3.3.5   Code implementation and test

10.3.3.5.1 XML request

Java code example can be requested on demand.

XML request can be tested on the following server "193.253.178.250" and port 9912.
This server returns acknowledge 0 when input request fails or 1 when input request is valid.

XML request are sent from Geomobile platform to your server and acknowledge is sent back by your server.

Data format of an XML request can be tested on the following server :

```
telnet 193.253.178.250 9912
Trying 193.253.178.250...
00cc<event><id>5313</id><trid>70563568</trid><date>20091215085241</date
><callerid>0670563568</callerid><alarm><state>1</state><text>ALARME  SOS
GPRS 15/12/2
009 08h:52m:41s</text><code>02</code></alarm></event>
000C<ack>1</ack>
```

When acknowledge is 1, the request is valid.

XML request is generated by the Geomobile platform when it received an Alert SMS or an Alert GPRS data. This request can be emulated from Geomobile platform. IHM is under construction to sent these SMS and GPRS requests to Geomobile platform.

Please contact Geomobile to have requests on demand.

10.3.3.6   Alarm format

Geomobile platform can receive SMS sent from GPS mobile device if it is previously registered to the platform.

A mobile device is registered by giving IMEI and its phone number to Geomobile support. Press *#06 # to get IMEI number from GPS mobile phone.

SOS SMS format is:
Emergency Report
SOS active
Date/Time:20090228 180020
Lon:4.138418
Lat:44.753971
Speed:0Km/h
Satellites:0

With :
Emergency report : SOS alarms
Date/Time format : yymmdd hhmmss
Lon : WGS-84 coordinate system
Lat: WGS-84 coordinate system

Geomobile platform receives SMS on the phone number: +33687757702.

Others alarms can reported by SMS with the report string including a series parameters indicating as following:

IMEI,Unit ID, DateTime, Longitude, Latitude, Speed, Heading, Altitude, Satellite, ReportID,Mileage

Format for each returning parameters:
IMEI : IMEI number of device
Unit ID: The ID of the device. (Maximum length is 10 digits)
DateTime: YYYYMMDDhhmmss (GMT)
Longitude: WGS-84 coordinate system
Latitude: WGS-84 coordinate system
Speed: 0~65535 km/h
Heading: 0~360 degrees
Altitude: Altitude of GPS postion.
Satellite: 0~12 (reception number of Satellite)
Report ID: xxx. Different report ID indicates different meaning of each returning

Mileage : number of mile (not used; default 0)

Report ID	Description
0	GPS location to be displayed (single location)
2	GPS location to be displayed (tracking mode)
4	SOS emergency
29	movement detection
30	Fall detection
37	sleeping
40	Battery is low
41	Device is switched off
42	Device is switched on
47	Remove external power source
48	Connect external power source
From 50 to 99	Geo-fence detection

Note : SOS can be sent using these two data formats

Example for SOS :
IMEI,Unit ID,DateTime, Longitude, Latitude, Speed, Heading, Altitude, Satellite, ReportID,Mileage
359589992749623,1000010000,20100209174448,4.345073,44.431696,0,264,110,6,4, 0.0

This data format **can be sent by SMS** channel to the phone number: +33687757702.
or **by GPRS** channel on port : 84.246.226.29:**2222**

here an example :
telnet 84.246.226.29 2222
$WP+GETLOCATION=1849 (sent by platform to get location of device)
359589992749623,1000010000,20100209174448,4.345073,44.431696,0,264,110,6,4, 0.0 (sent by GPS device)
$WP+TEST=1849 (sent by platform to get battery level of GPS device, can be ignored)
$OK:TEST=0,4.227V (sent by GPS device, can be ignored)

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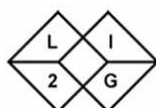
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