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PROJECT Nº: AAL-2012-5- 232

D3.1 SALIG++ COMPONENTS TEST

Start Date of Project : 01/06/2013

Duration :

36 months

PROJECT FUNDED BY THE AAL JOINT PROGRAMME						
Due date of deliverable	M10, M21, M33					
Actual submission date	2014-11-30					
Organization name of lead contractor for this deliverable	ΡΙΑ					
Author(s)	PIA					
Participant(s)						
Work package	WP3. System Integration, testing and evaluation					
Comments						
Classification						
Version	Version 1					
Total number of pages	21					

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1. Introduction

The present document describes results of the tests from initial integration work done within scope of activity of WP3. The objective of this deliverable is to present results of so far tested components of SALIG++ system, especially functionalities of:

- "Safety at home" subsystem,
- Videoconferencing subsystem,
- Pose recognition subsystem,

Subsystems mentioned above were installed and configured in PIAP facility especially dedicated for preparation of system integration. The facility was equipped with required IT infrastructure (1 Gbps local network, 20 Mbps uplink/downlink Internet connection) and PC computers. For "Safety at home" scenario testing, provided by PIA set of safety sensors (main control unit, movement detectors, fire detector, leaking gas detector, temperature detectors, "open-door" detectors together with remotely controlled water valve) were set up. Preconfigured by DIV equipment (Raspberry Pie units, HD USB cameras, others) was installed and served as video conferencing subsystem. Provided by TUD equipment for pose recognition (MS Kinect sensor) was also installed. All subsystems were appropriately tested.

2. Objectives and methods

The components test aims to verify the basic functionalities of SALIG++ subsystems for their compliance with the requirements described in D1.2 "Technical specification and interaction design". Properly working and interacting between themselves subsystems will allow for realization of End User scenarios fully defined in D1.1 "Scenarios, Use Cases, and Requirements". Tests done during Year 1 of the Project were conducted to:

- Obtain basic functionality of subsystem for "Safety at home" scenario realization, for ensuring personal safety related to external risks (i.e. detected fire) within senior apartment,
- Set up working locally video conferencing subsystem, enabling audio/video communication in both directions: from caregiver web portal to senior TV set as well as in the opposite direction,
- Acquire working pose recognition subsystem, providing to the system information about actual pose of senior and his/her both potentially dangerous activity (i.e. fall detection) and routine activity (i.e. taking medicines on time, eating)

Performed tests have put stress on the basic functionality of each separate component. More comprehensive tests including subsystems performance, comprising also interaction functionality between different subsystems, will be performed in the next year of the project.

2.1 "Safety at home" subsystem test

Subsystem was installed in PIA premises laboratory consisting two rooms. PIA provided all elements of the subsystem, including:

- PC server (with preinstalled VMware environment) and laptop with Windows 7 64bit
- Set of sensors:
 - Wireless Fire detector
 - Wireless Leaking gas detector

- Wireless Flood detector
- 3 pcs. of wireless movement detectors
- o 2 pcs. of wire movement detectors
- o "Open-door" detector
- o Wireless movement detector with embedded camera
- Wrist emergency button
- Wall programmable button
- Two-channel temperature sensor
- Wireless water valve serving as an example of subsystem actuator
- Main Control Unit equipped with wireless modem, GSM/UMTS modem, Ethernet card, USB 2.0 connector
- Moxa Nport server (4xRS-232/485, 1x Ethernet)

Subsystem elements were mounted on the laboratory walls, ceiling and on water installation. Then, after pre-configuration done in dedicated software, they have become part of fully operated safety subsystem.

For appropriate maintenance of information coming from separate sensors, a Java application has been developed by PIA and tested locally. The most important functionalities of the application were presented below:

- Querying Main Control Unit about list of active sensors and actuators
- · Processing information with status of each sensor
- Providing messages to Main Control Unit for controlling connected to the system actuators
- Ensuring protocol translation between local Distributed Sensors platform and MediaSense platform common for each elements of SALIG++ systems (JSON format)

Pictures of PIA Integration laboratory were presented below. Red arrows present some elements of the subsystem:



Fig. 1. PIA Integration Site – Room 1 – main entrance to the laboratory, wireless flood detector, wireless movement sensor, wire movement sensor, open-door detector.



Fig. 2. PIA Integration Site – Room 1 – video server, caregiver laptop, Raspberry Pie unit, Logitech HD camera.



Fig. 3. PIA Integration Site – sink equipped with flood detector working with wireless transmitter.



Fig 4. PIA Integration Site – Room 2 – Pose recognition server, Main Control Unit, Moxa Nport server, wireless & wire movement detectors, MS Kinect, Raspberry Pie unit, Logitech HD camera, wrist emergency button, wall programmable button.

Some elements of "Safety at home" subsystem communicate with the Main Control Unit with the use of wired bus, however majority of sensors utilize wireless communication. Both of them require pre-configuration process, available in dedicated software.

Pictures below presents some print screens done during pre-configuration procedure:

👌 F-Lin	🕒 F-Link 1.1.3 [Online] - SALIG+ Distributed Sensing - 2014.07.15_18_17.fdb Logged in: Service technician Instalator in SERVICE mode, guarding completely disable								
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SALIG	SALIG+ Distributed Sensing - 2014_07_15_18_17 Logged in: Service technician Instalator in SERVICE mode, guarding completely disabled								
Initial s	Initial setup Devices Section Users Users reports Parameters Diagnostics PG outputs Calendars Communication								
A P	Name	Туре	Section	Reaction	Internal	PG activation	Internal settings	Supervision	Alarm I 📤
0	Main Control Unit	JA-106K	1: Room 1				Enter		
1	Radio Module	JA-110R	1: Room 1				Enter		
2	Communication Interface	?	1: Room 1	•		No			
^(ep) 3	Keyboard	JA-154E	1: Room 1	None		No	Enter		
^{((p)} 4	Wireless Water Detector	JA-181M	1: Room 1	Flooding		1: Water Detector			
5	MCU Inside thermometer	JA-111TH	2: Room 2	None		No	Enter		=
⁽⁽⁹⁾ 6	Wall Button	JA-188J	1: Room 1	None		5: Wall Button	Enter		
⁽⁶⁹⁾ 7	Wrist Button	JA-187J	2: Room 2	None		6: Wrist Button	Enter		
⁽⁽⁰⁾ 8	Front Door Movement Detector with Camera	JA-160PC	6: Break-i	None		9: Front Door Movement	Enter		
^(ep) 9	Front Door Opening Detector	JA-181M	1: Room 1	None		10: Front Door Opened			
((0)) 10	Fire/Smoke Detector	JA-150ST	2: Room 2	Fire alarm		2: Fire Detector			
((0)) 11	Room 1 Movement	JA-185P	1: Room 1	None		7: Room 1 Movement			
((0)) 12	Room 2 Movement	JA-185P	2: Room 2	None		8: Room 2 Movement			
⁽⁽⁰⁾⁾ 13	Gas Detector	JA-180G	1: Room 1	Fire alarm		3: Gas Detector			
14	BUS Room 1	JA-110P	1: Room 1	Delayed zone A a		7: Room 1 Movement	Enter		
15	BUS Room 2	JA-110P	2: Room 2	Delayed zone A a		8: Room 2 Movement	Enter		

Fig. 5 List of available sensors and actuators in the laboratory.

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	📭 🙆 🍐 🖤 🏠	5	S 🔀 🗌	۵ 楶					
Keypad	eypad Login Events Settings RF signal Building map SBRVICE Upload Online Exit								
SALIG+	SALIG+ Distributed Sensing - 2014_07_15_18_17 Logged in: Service technician Instalator in SERVICE mode, guarding completely deabled								
Initial se	Initial setup Devices Section Users Users reports Parameters Diagnostics PG outputs Calendars Communication								
	Name	Туре	Section	Activation me	Status	Battery/volt	Voltage	Signal	Note
0	Main Control Unit	JA-106K	1: Room 1		ОК	13.7 V	13.7 V/0 mA; 13.7 V/2	54 % GSM	
1	Radio Module	JA-110R	1: Room 1		ОК		0.0 V		
2	Communication Interface	?	1: Room 1		ОК		-0.1 V		
^{((p))} 3	Keyboard	JA-154E	1: Room 1		ОК	70 %		100 %	
^{((p)} 4	Wireless Water Detector	JA-181M	1: Room 1		TMP			100 %	
5	MCU Inside thermometer	JA-111TH	2: Room 2		ОК		0.0 V		
^{((p))} 6	Wall Button	JA-188J	1: Room 1		ОК			100 %	
⁽⁶⁹⁾ 7	Wrist Button	JA-187J	2: Room 2						
(⁽⁰⁾ 8	Front Door Movement Detector with Camera	JA-160PC	6: Break-in Lab		Disabled	60 %		100 %	
⁽⁶⁹⁾ 9	Front Door Opening Detector	JA-181M	1: Room 1		ОК			100 %	
((0)) 10	Fire/Smoke Detector	JA-150ST	2: Room 2		ОК	100 %		100 %	
(69) 11	Room 1 Movement	JA-185P	1: Room 1	ACT	ОК			100 %	
((0)) 12	Room 2 Movement	JA-185P	2: Room 2	ACT	OK			100 %	
⁽⁶⁾ 13	Gas Detector	JA-180G	1: Room 1						
14	BUS Room 1	JA-110P	1: Room 1	ACT	ОК		-0.2 V		
15	BUS Room 2	JA-110P	2: Room 2	ACT	ОК		-0.3 V		
⁽⁶⁹⁾ 30	Break-in Sensor	JA-185P	6: Break-in Lab	ACT	ОК			100 %	
((0)) 31	Wireless Siren	JA-150A	1: Room 1		Disabled				

Fig. 6 Diagnostic window - with operational status of each element.

👌 F-Link) F-Link 1.1.3 [Online] - SALIG+ Distributed Sensing - 2014_07_15_18_17.fdb Logged in: Service technician Instalator in SERVICE mode, guarding completely disable									
🖕 <u>F</u> ile J	Eile Edit Control panel Window F-Link									
Eeypad	Keypad Login Events Settings RF signal Building map SSRVICE Upload Online Internet Egit									
SALIG+	Distributed Se	nsing - 2014_07_15_18_	17 Logged in: Serv	ice technician Insta	lator in SERVICE mode, guarding	completely disabled			Curre	nt History Import
Initial se	tup Devices	Section Users Users	reports Paramete	rs Diagnostics	PG outputs Calendars (Communication				
Position	Section name	Common section	Dartial cotting	Circa alarm	Report when we at	and the second second	0.00	81 J	N	
		Common Section	Fai uai securiy	Siren alarm	Report when unset	Limited access time	Section disab	Status	Note	
1	Room 1	No				No	Section disab	Service mode	Note	
1 2	Room 1 Room 2	No No				No No	Section disab	Service mode Service mode	Note	
1 2 3	Room 1 Room 2 Entrance Door	No No No				No No No No	Section disab	Service mode Service mode Service mode	Note	
1 2 3 4	Room 1 Room 2 Entrance Door Emergency	No No No No No				No No No No No No	Section disab	Status Service mode Service mode Service mode Service mode Service mode	Note	
1 2 3 4 5	Room 1 Room 2 Entrance Door Emergency Total	No No No No No No No				No No No No No No No	Section disab	Status Service mode Service mode Service mode Service mode Service mode	Note	

Fig. 7 List of section in laboratory – alarms from each section provide different information to the system.

🕑 F-Link 1.1.3 [Online] - SALIG+ Distributed Sensing - 2014_07_15_18_17.4db Logged in: Service technician Instalator in SERVICE mode, guarding completely disable								o x				
🔶 File Edit Control panel Window F-Link									- 8 ×			
Login Login Events Settings RF signal Building map SETVICE Logical On												
SALIG+ Distributed Sensing - 2014_07_15_18_17 Logged in: Service technician Instalator in SERVICE mode, guarding completely disabled												
Initial se	tup Devices Section	Users	Users reports Par	ameters	Diagnostics F	PG outputs Calendars	Commun	nication				
Posit	Name	Logic	Function	Time	Activation	Blocking of PG outputs	Reports	Record PG into event memory/transmi	PG disab	Current status	Test PG output	Note
1	Water Detector	NC	ON/OFF		Activation	None	Enter			Enabled	Test PG output]
2	Fire Detector	NO	Impulse	00:00:05	Activation	None	Enter			Disabled	Test PG output]
3	Gas Detector	NO	Impulse	00:00:05	Activation	None	Enter			Disabled	Test PG output]
4	CO Detector	NO	Impulse	00:00:05	Activation	None	Enter			Disabled	Test PG output]
5	Wall Button	NO	Impulse	00:00:05	Activation	None	Enter			Disabled	Test PG output]
6	Wrist Button	NO	Impulse	00:00:05	Activation	None	Enter			Disabled	Test PG output]
7	Room 1 Movement	NO	Impulse	00:00:05	Activation	None	Enter			Disabled	Test PG output]
8	Room 2 Movement	NO	Impulse	00:00:05	Activation	None	Enter			Disabled	Test PG output]
9	Front Door Movement	NO	Impulse	00:00:05	Activation	None	Enter			Disabled	Test PG output	
10	Front Door Opened	NO	Impulse	00:00:05	Activation	None	Enter			Disabled	Test PG output]

Fig. 8 List of pre-programmed actions for threats detected by each sensor.

According to predefined actions separately prepared for particular scenario, functionalities of subsystem were investigated. Some actions connected with sensors/actuators specific functionality were tested and confirmed. Due to predefined actions, gathered information is provided to MediaSense platform, where DB Reasoner processes it and make appropriate decisions for caregivers (like presentation of pop-up on caregiver portal). Independently from taken by Reasoner decisions, the "Safety at home" subsystem offers instantaneous both: notification of caregiver by i.e. SMS text messages or e-mails and actions for installed actuator (like switching off valve water). This functionalities were also tested during Year 1 of project.

As an example, actions for several algorithms were presented below:



Fig. 9 Actions dedicated for detected flood in senior apartment.



Fig. 10 Action dedicated for activity statistics preparation.



Fig. 11 Action dedicated in case of Carbon Monoxide/propan-butan detected.

Algorithm elements marked green color were taken into account during test of SALIG++ components.

2.2 Video conferencing subsystem test

Specific elements of the subsystem were provided by DIV. The list of elements is presented below:

- Entone STB box + dedicated remote control
- 2 pcs. of Raspberry Pie units
- 2 pcs. of HD Logitech cameras
- Pre-configured images of DIV software ready to deploy under VMware environment
- Pre-configured software provided on SD cards (one for each Raspberry Pie unit)
- RTSS hub protection dongle

After DIV video subsystem deployment on provided by PIA VMware server, the initial configuration were conducted by DIV with the use of remote desktop, to obtain presented below scheme of architecture:



Fig. 12 Video subsystem architecture built in PIA SALIG++ Integration site.

Entone STB box suits as a dedicated equipment connected at senior apartment:

- via HDMI cable to senior TV set,
- via Ethernet cable to IT infrastructure.

With the use of STB remote control, senior can operate the system, particularly:

- switch TV screen from live program to SALIG++ portal,
- initiate video call,
- · accept incoming from caregiver video call,
- reject incoming from caregiver video call.

All presented above operations are easy and intuitively available by pressing buttons on remote control, respectively:

- STB button,
- OK button,
- Green button,

• Red button.

After video subsystem tests of separate elements, the overall performance was tested, according to provided specification:

a. STB to PC communication

What	Register
Setup	 Two smart-cameras (Logitech HD Pro Webcam 920 connected to Raspberry PI (Model B) running Salig++ software) connected to a LAN. One STB (Entone Kamai) connected to the LAN (all equipment is connected to the same LAN). One computer connected to the LAN. TV channels are made available by connecting the LAN to a live broadcasting infrastructure running "Fokuson" middleware by Nordija.
	Note: if the procedure below doesn't work as described, first exit the Salig++ video on the TV if it is still showing by pressing the red button on the remote control. Close the Salig++ menu interface if it is open by pressing the "exit" button on the remote control. Then restart the STB client portal (press the "menu" button on the remote control, navigate to and select the following options using the arrow buttons and the "OK" button on the remote control: "Settings" > "System Info"> "Restart" > "Reload portal"). Continue the procedure from step two.
Reproduction Steps	 Turn on the TV, STB and computer Wait until the TV shows a TV channel. Open a browser window on the computer and navigate to the following address: "http://10.6.3.103:9000" (or refresh the browser window if the webpage is already open). Log in using the following credentials: user "web1" and password "salig314". Press the blue button on the remote control to open the Salig++ interface on the TV. The TV shows the Salig++ interface including a contact list with registered subscribers. Subscribers that are logged in are listed with a green light indicator preceding their name. Subscribers that are not logged in are listed with a green light indicator preceding their name. Subscribers that are not logged in are listed with a red light indicator preceding their name. Subscribers that are not logged in are listed with a red light indicator preceding their name. Subscribers that are not logged in are listed with a green light indicator preceding their name. Wait until a green indicator appears preceding the user "Web Client 1". Navigate to "Web Client 1" (using the arrow keys on the remote control) and press "OK" on the remote control. A message appears on the TV ("Calling Web Client 1 Hang Up"). A message appears in the browser window to establish a connection. After a few seconds the computer displays two video windows (a small window within a big one). The big window shows the smart-cam connected to the STB, the small window shows the smart-cam connected to the computer. The TV shows the video feed from the computer. Check if the lag, volume and image quality are of good quality by talking to another user. Stop the call from the STB, by pressing the red button on the remote control. Both the TV and the computer return to the Salig++ menu interface. Press "exi
Expected Result	A two way video communication should have been established, with good image and audio quality, and with a latency of less than 0.5 seconds.

b. PC to STB communication

What	Register
Setup	 Two smart-cameras (Logitech HD Pro Webcam 920 connected to Raspberry PI (Model B) running Salig++ software) connected to a LAN. One STB (Entone Kamai) connected to the LAN (all equipment is connected to the same LAN). One computer connected to the LAN. TV channels are made available by connecting the LAN to a live broadcasting infrastructure running "Fokuson" middleware by Nordija.

Reproduction Steps	 Note: if the procedure below doesn't work as described, first exit the Salig++ video on the IV if it is still showing by pressing the "exit" button on the remote control. Close the Salig++ menu interface if it is open by pressing the "exit" button on the remote control. Then restart the STB client portal (press the "menu" button on the remote control: "Settings" > "System Info"> "Restart" > "Reload portal"). Continue the procedure from step two. 1. Turn on the TV, STB and computer. 2. Wait until the TV shows a TV channel. 3. Open a browser window on the computer and navigate to the following address: "http://10.6.3.103.9000" (or refresh the browser window if the webpage is already open). 4. Log in using the following credentials: user "web1" and password "salig314". 5. The browser window shows a contact list with registered subscribers. Subscribers that are logged in are listed with a green light indicator preceding their name. Wait until a green indicator appears preceding the user "STB Client 1". 6. Click on "STB Client 1" in the browser window. The "Call" button to establish a connection. 7. The browser window shows a new message indicating that a call is being set up ("Calling STB Client 1 Hang Up"). A pop up appears on the TV screen ("Incoming Call Web Client 1 Accept call Reject Call"), press the green button (Accept Call) on the remote control to establish a connection. 8. After a few seconds the computer The TV shows the video fed form the computer. 9. Check if the lag, volume and image quality are of good quality by talking to another user. 9. Check if the lag, volume and image quality are of good quality by talking to another user. 9. Check if the lag, volume and image quality are of good quality by talking to another user. 9. Check if the lag, volume and image quality are of good quality by talking to another user. 9. Check if the lag, volume and image quality are of
Result	and with a latency of less than 0.5 seconds

Conducted tests confirmed video subsystem basic functionality. Pictures below presents results gathered from the test procedures:

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👯 Apps 🗋 Salig Web portal				
		0		
		CALL CAL		
		JALLG++		
	0	Jsername		
	D	locauord		
	F	assword		
			Submit	

Fig. 13 Caregiver Web portal - initial screen with logon fields

🗅 Salig Web portal 🛛 🗙 🔛 🔤	_	-	
← → C □ 10.6.3.103:9000			☆ =
🔛 Apps 🕒 Salig Web portal			
SALIC++			
Contacts Web Client 2			
Call			

Fig. 14 Caregiver Web portal – screen visible after successful logon. Green indicator next to user name indicates that user is available for calling.

C 10.6.3.103:9000		
💾 Salig Web portal		
0		
ALIG++		
ontacts		
Web Client 2		
STB Client 1	Establishing call	
	Lotablioning ball	
	CTD Client 1	
	STB Client T	
🛃 Call		

Fig. 15 Caregiver Web portal – screen visible during estabilishing call to caretaker STB box.



Fig. 16 Caregiver Web portal – screen visible during call attempt to caretaker STB box.



Fig. 17 Caregiver Web portal – screen visible during incoming call from caretaker STB box.



Fig. 18 Caregiver Web portal – screen visible during call with caretaker STB box. On the right bottom corner, caregiver has Picture-in-Picture view from their own camera.



Fig. 19 Caretaker TV set – picture of screen done when video call with cargiver is estabilished. On the bottom of the picture, the wall programmable button and wrist emergency button are presented.

Initial tests of video subsystem confirmed that their baisic functionalities work well with good performance. Quality of video and latancy time are on acceptable level ensuring good communication channel between caregiver and caretaker.

2.3 Pose recognition subsystem test

The subsystem for pose recognition was prepared by TUD together with ALM. Software, including:

- The executable file of eating and fall-down detection implementation by C++,
- MongoDB,
- Python,
- PyMongo Python distribution tool for MongoDB
- Sleepy.Mongoose MongoDB REST Server
- cURL tool

Listed above software were installed on provided by PIA server with Windows 7 64-bit system.

Sent by TUD hardware (MS Kinect sensor) were then attached to the server giving functional system for pose recognition.

Figure below presents working application:



Fig. 20 Working applications ensuring pose recognition functionality.

The table below with logs is an example of output from the applications. Recognized predicitions of senior postures (like eating, falling down, etc.) are stored in local MongoDB for further processing.

C:\MongoDB\salig_project\exe_file\exe>LocalHON4D_eat_falldown_kinect http://localhost:27080 5000
rest port: <u>http://localhost:27080</u>
output time slot: 5000
Start to set up:
size of training_min_max: 228000
load training_min_max success!
Loading training model
load training model success!
{"ok" : 1}
set up finish!
start to monitor
sequ.get_sliding_window_size() > _read_kinectcache_size! Waiting more depth image!
_cache_size: 10
_cache_size: 20
sequ.get_sliding_window_size() > _read_kinectcache_size! Waiting more depth image!
_cache_size: 30
sequ.get_sliding_window_size() > _read_kinectcache_size! Waiting more depth image!
_cache_size: 40
_cache_size: 50
_cache_size: 60
eating predicted label: -1 decision value: -1.15065

_cache_size: 70

eating predicted label: -1 decision value: -1.17443

eating predicted label: -1 decision value: -1.13979

sequ.get_sliding_window_size() > _read_kinect._cache_size! Waiting more depth image!

_cache_size: 80

_cache_size: 90

eating predicted label: -1 decision value: -1.06912

_cache_size: 100

{"oids": {"\$oid": "53c66d79e53a28105051912e"}}

non-eating!

{"oids": {"\$oid": "53c66d79e53a28105051912f"}}

Normal (no fall down)!

_cache_size: 110

eating predicted label: -1 decision value: -1.10275

eating predicted label: -1 decision value: -1.05773

_cache_size: 120

eating predicted label: -1 decision value: -1.04831

eating predicted label: -1 decision value: -1.05656

sequ.get_sliding_window_size() > _read_kinect._cache_size! Waiting more depth image!

5. Results and conclusions

The results from the initial test of SALIG++ components show that expected basic functionalities of each tested subsystem have been fully achieved. They confirmed that crucial for SALIG++ subsystems work with satisfactory performance.

As further steps of testing foreseen during the next stage of the project, listed below aspects have to be taken into account:

- interactions between all SALIG++ subsystems working together on common platform,
- overall performance of the system working under real conditions at the selected Pilot Site,
- results, suggestions and comments gathered during evaluation by End Users.