Age Sensitive ICT Systems for Intelligible City For All

I’CityForAll

2012-2015

Coordinated by CEA

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CALL 4 ICT-based solutions for advancement of older persons’ mobility

Europe- National Agencies’ program to help older persons to sustain their optimal level of mobility for as long as possible, as well as enhance their individual sense of confidence, autonomy, competence, security and safety.

Swiss National Contact Point:
Secrétariat d’Etat à la Formation, la Recherche et l’Innovation (SEFRI/SBFI)

Aims at ICT-based solutions to identified user needs:
- Time-to-market perspective of 2 to 3 years after end of the project
- Realistic trial set-up at the end of the project
- Proactive end-user involvement throughout the life of the project
Starting point: **presbycusis**
Hearing impairment of older persons

Presbycusis impacting the **intelligibility perception** and the ability to localize sound source and therefore physical and social well being ...

3rd impairment of the elderly after arthritis & hypertension

- **14%** only wear hearing aids
- **2/3** do not think or refuse hearing-aids
Age Sensitive ICT Systems for Intelligible City For All

For advancement of older persons’ mobility

For better attractiveness/intelligibility/mobility in confined public spaces:
supermarket, railway stations, museum, theater, cinema, ....

Aim to reduce urban-related accidents of elderly in urban settings:
elderly are involved in 40% of fatal injuries (105,000 deaths/year), by walking/car 1500/day accidents requiring medical assistance - European Network for Safety among Elderly

1. l’City – Loudspeaker in public confined spaces
   For better intelligibility of vocal messages and jingles.

2. l’City – Car for vehicles
   For better localization of alarm sounds (e.g. ambulances, police cars) and an appropriate enhancement of in-car alarms (e.g. safety belt warning, lane change warning).

These systems will be “transparent” and embedded in mass products for the large public at reasonable cost for persons with pseudo-normal and presbyacousic hearing without impacting normal hearing people:

concept For All
**Motivation**
End-users
Psycho-sociology ORL

**Solutions**
ICT-solutions

**Age Sensitive Users – Products**

**ICity – Car**
Individual cars, professional vehicles, individual public transport

**ICity - Loudspeaker**
In railway station, airport, museum, supermarket

**Acoustic quality**

Audio expertise
Prototypes

*with ENEA subcontractor*
**i’CityForAll** study on **User requirements**

Cohort of users

<table>
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**I’CityForAll** study on **User requirements**

Cohort of users
I’CityForAll study on User requirements
Railway station

- To hear/understand vocal announcements during peak hours on a platform/main hall especially for users with hearing Aids
- To interact with teller/desk person especially for users with hearing Aids
- Loud sounds hurt users with Hearing Aid and normal users

But Jingles help all users to pay attention to the announcements

Bad quality of loudspeaker rendering
I’CityForAll study on User requirements
In the Car

• Most of users drive with window closed - In general, users can perceive outdoor alarms

• Normal users are able in general to estimate the distance of the coming alarm but Presby users suffer from not being able to estimate it especially with hearing Aids

• Recognizing if an alarm is coming from the front or the back, is more difficult for presby users with hearing Aids

• Most of users in general have problem in Recognizing if an alarm is coming from the left or the right, even normal users

Localization problem of outdoor alarms for all drivers
I’CityForAll study on User requirements

1- Lack of intelligibility of vocal announces
2- Confusion in localizing alarm sources

The design of 2 solutions in For All concept

[ICity – loudspeaker] for better Intelligibility of vocal announces and jingles

[ICity - car] for better localization of alarm sounds and enhancing in-car signals

1- Lack of intelligibility of vocal announces
2- Confusion in localizing alarm sources

affect differently
Normal
Presbycusis

Jeudi 15 mai 2014
Journée de printemps 2014 SSA
Objective

I’City – Loudspeaker in public confined spaces for better intelligibility of vocal messages and jingles
Age related hearing loss: ISO 7029
I’City – Loudspeaker for better intelligibility

In railway station, airport, museum, supermarket,...
Principle of modular pre-compensation (in station)

- Vocal message & jingle
  - Pre-compensation
  - Acoustic channel: revertation + noise
  - Quality measure
  - Active Audio loudspeakers

Profile ‘for all’
- High frequency loss
- Deficit on localization accuracy
- Enlargement of auditory filters
- Reduced unmasking ability

- Loudness perception
- Recruitment
- Cognitive decline

‘for all’ label
- Normal hearing person
- Hearing impaired person (with/without hearing aids)
- Hearing (aerial/bone conduction)

Acoustic comfort
Intelligibility
Localization
l’City – Loudspeaker for better intelligibility
in railway station, airport, museum, supermarket,…

Distortion conditions:
- Railway station noise, SNR=5dB
- Factory hall IR, TR=2 s

Original female voice

John: presbycusis person

Normal hearing
Demo 1

I’City – Loudspeaker for better intelligibility
in railway station, airport, museum, supermarket,…

Distortion conditions:
- Railway station noise, SNR=5dB
- Factory hall IR, TR=2 s
I’City – Loudspeaker for better intelligibility
in railway station, airport, museum, supermarket, ...

Distortion conditions:
- Babble noise, SNR=10dB
- Factory hall IR, TR=2s
Demo 1

I’City – Loudspeaker for better intelligibility in railway station, airport, museum, supermarket,…

Digital Audio Processor

- Speech conformer
- Presbycusis compensation

Distortion conditions:
- Babble noise, SNR=10dB
- Factory hall IR, TR=2 s

Signals used in this demo are derived from the database (WP2: deliverable D2.1, D2.1-bis)
The evaluation of quality/intelligibility is based on criteria from deliverable D2.2 (WP2)
**I’CityForAll** study on **User requirements**

1. Lack of intelligibility of vocal announces
2. Confusion in localizing alarm sources

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The design of 2 solutions in **For All concept**

- **[ICity – loudspeaker]** for better intelligibility of vocal announces and jingles
- **[ICity - car]** for better localization of alarm sounds and enhancing in-car signals

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Objective

I’City – Car in vehicles

for better localization of alarm sounds

(e.g. ambulances, police cars)

and appropriate enhancement of in-car alarms

(e.g. safety belt warning, lane change warning)
l’City – Car for enhancing alarm localization

3 solutions for enhancing the sense of safety and self confidence of drivers

In individual cars Professional vehicles: taxi bus, truck,…

for companies of individual public transport: autolib,…
Principle of modular pre-compensation (vehicle)

- High frequency loss
- Deficit on Localization accuracy
- Enlargement of auditory filters
- Reduced unmasking ability

Profile ‘for all’
- Normal hearing person
- Hearing impaired person (with/without hearing aids)
- Hearing (aerial/bone conduction)

- Loudness perception & Recruitment
- Cognitive decline

Fiat Loudspeakers or CEA Acoustic glass

acoustic channel:
- Urban noise
- Car noises
- Reverberation

‘for all’ label
- Acoustic comfort
- Detectability
- Localization

Quality measure
Listen to how John, a presbycusis driver, perceive the in-car alarm in

Spatial sounds with binaural recordings of HMI alarms emitted by the car stereo set. Sounds used for the simulation, are from the l’City For All Database.

Pre-compensation system ON

1. Seat Belt reminder
2. Parking aid
3. Turn signal
4. Closed window, parking exterior noise
5. Closed window, parking exterior noise
6. 110 km/h V gear, closed windows, traffic noise
Listen to how John, a presbycusic driver, perceive an outdoor alarm

Detectability distance

Brake distance + Distance travelled by the emergency vehicle during: driver reaction time + time to move the car away from the trajectory of the emergency vehicle. (Ballestegui, 2013)

Detectability distance for standard tow-tones:
- For 40 years old driver: 56 m
- For 60 years old driver: 20 m !!

Localization

In Lab localization test at CENTICH
17 % font/back plan confusion

Preliminary pre-compensation (may 2013)
13 % font/back plan confusion

Pre-compensation system ON

Car engine noise, closed windows, no traffic noise emergency vehicle at 30 km/h
Possible side considerations

« Implication probable de la presbyacousie dans les conséquences cliniques et psychosociales de la MA, voire dans l’accélération de son déclin cognitif »


Thank you for your attention

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