

#### The SWEET-HOME Project: Audio Technology in Smart Homes to improve Well-being and Reliance

M Vacher, Dan Istrate, François Portet, Thierry Joubert, Thierry Chevalier, Serge Smidtas, Brigitte Meillon, Benjamin Lecouteux, Mohamed Sehili, Pedro Chahuara, et al.

#### ► To cite this version:

M Vacher, Dan Istrate, François Portet, Thierry Joubert, Thierry Chevalier, et al.. The SWEET-HOME Project: Audio Technology in Smart Homes to improve Well-being and Reliance. EMBC, 2011, Boston, United States. hal-02088823

#### HAL Id: hal-02088823 https://hal.science/hal-02088823

Submitted on 3 Apr 2019  $\,$ 

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers. L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



# The SWEET-HOME Project: Audio Technology in Smart Homes to improve Well-being and Reliance





MULTICOM®



- <sup>1</sup>LIG UMR CNRS/UJF 5217 - GETALP Team http://getalp.imag.fr - MULTICOM Team http://multicom.imag.fr <sup>2</sup>ESIGETEL, ANASON Team
  - http://www.esigetel.fr
  - http://www.theoris.fr
  - http://www.technosens.fr
  - http://camera-contact.com









## The Sweet-Home Project Context and Goals

#### **Audio-based interaction technology :**

- to provide assistance by natural man machine interaction (voice and tactile command)
- ► to ease **social inclusion**
- to provide security reassurance by detecting situation of distress

Alarm Emission	Specialised Com- munication Devices
Intelligent Controller	

**Targeted users :** elderly people who are frail but still autonomous **Qualitative user evaluation for acceptance assessment :** 

<sup>3</sup>THEORIS

<sup>4</sup>TECHNOSENS

<sup>5</sup>CAMERA-CONTACT

- ► 8 healthy persons, 71≤age≤88
- 7 relatives and 3 professional carers
- Interviews and wizard of Oz tests in the DOMUS smart home
- 4 aspects considered : voice command, communication with the outside world, domotic system interrupting a person's activity and electronic agenda
- Conclusions : Great potential of audio technology to ease daily living for elderly and frail persons



Block diagram of the SWEET-HOME system architecture

#### **Smart Home Corpus Acquisition**

#### **Technical architecture of the flat**

- ▶ DOMUS smart home, 30 m<sup>2</sup>
- ▶ 150 sensors, 7 microphones
- virtual KNX layer seen as an OSGI (Open Service Gateway Initiative) service (KNX : ISO/IEC 14543-3)

## Experiment

▶ 21 persons (7 women, 14 men) - 38.5±13 years old (22-63, min-max) Activities of Daily Living in the flat

#### Layout of the DOMUS Smart Home and sensor position



Switch Contact sensor Serve Infrared Detector • Microphone

- Total corpus duration : 36 hours
- video data (for annotation purpose only)
- audio data (7 channels)
- KNX events
- Sound annotation : ADVENE software
- Activities annotation : Transcriber software

#### Images captured during the experiment



#### **Sound Classification**

- Direct information about the resident's status : cry, snoring
- Situation disambiguation : textile handling during a wearing activity inference
- Identification of the most useful sound classes according to the project objectives
- Generic classes : water, human, electrical engine, object falls, etc.
- ► 14 sound classes
- ► GMM classifier, 16 MFCC
- SVM, Gaussian RBF kernel

#### **Results**

GMM : 92% of correct classifications, SVM : 87%

#### **Speech Recognition**

#### **Distant Speech Corpus**

• extracted from the multimodal corpus (7 channels) - 21 speakers

## **ASR Techniques**

- 1. Speaker Adaptation
- Maximum Likelihood Linear
- Recognizer Output Voting Error Reduction (**ROVER**)
- Driven Decoding Algorithm (DDA)

#### **Results**

WER<sup>±SD</sup> Method

 $18.3^{\pm 12.1}$ Baseline

Phase 1 (training) : 862 sentences (total : 38 minutes 46s/channel) Phase 2 (test) : 917 sentences (total: 40 minutes 27s)

Regression (MLLR)

2. Multichannel Analysis Signal to Noise Ratio for each  $channel \implies$ BEAM-FORMING



 $16.8^{\pm 8.3}$ Beam Forming DDA +SNR  $11.4^{\pm 5.6}$  $20.6^{\pm 8.5}$ ROVER ROVER 2c+SNR 13.0 $\pm$ 6.6 ROVER + SNR  $12.2^{\pm 6.1}$ 

 TABLE: Mean WER (7 channels)

#### **Conclusion and Future Works**

## **New Smart Home System based on Audio Technology**

#### **Current developments :**

- Audio Algorithms
- Intelligent Controller

#### **Future Evaluation of the resulting system :**

Tests planned in different homes from **fully equipped** with domotic devices to poorly equipped

With elderly people



Contacts: <sup>1</sup> Michel .Vacher@imag.fr - <sup>2</sup> dan.istrate@esigetel.fr WEB SITE: http://sweet-home.imag.fr