Information and Language Technologies for Inclusion and Education

Oscar Saz
Fulbright scholar
Language Technologies Institute – Carnegie Mellon University
Personal presentation
Past work

- BSc (2004) in Telecommunications Eng. and PhD (2009) awarded by the University of Zaragoza (Spain)

- Specialized in language technologies, speech processing and speech recognition

- Joint work with Prof. Eduardo Lleida, W. Ricardo Rodriguez, Carlos Vaquero, Antonio Escartin and others
Present work

- Currently a Fulbright scholar at Carnegie Mellon University
  - Developing pronunciation tutors for ESL classes
  - Joint work with Prof. Maxine Eskenazi

- Working within the infrastructure of the Pittsburgh Science of Learning Center (Learnlab)
Interests

- Developing Natural Speech Technology
  - Usable by everybody, independent of their situation and condition
  - Technology adapts to the user

- With focus on domains of special impact and interest
Introduction
Information Technologies empower people

- access to information and education
- be closer to our relatives/friends
- exert our rights

But it has widen the gap between

- able and disabled people
- educated and uneducated
Technology developers have the mandate of
- facilitating the inclusion of everybody in technology
- provide inclusive uses of technology

This must be the joint work of
- Academic research
- Industrial partners
- Government agencies
This talk will address this issue from the point of view of Human Language Technologies (HLT)
- Technology exists (Dragon, Siri, Kinect...)
- Can we make it inclusive?
- The main premise is “Language is a natural interaction system for humans”
Overview for today

- HLT for inclusion
  - Voice-based computer interfaces
  - Voice-based web access

- HLT for education
  - Voice-based software for speech therapy
  - Voice-based software for ESL classes
HLT for Inclusion
CASE 1

- Framework: Collaboration with a centre for the assistance of cerebral palsy patients
- Date: 2008-2009
- Objective: Create voice-enabled access to computers
Inclusion Technologies

- This institution has computer-based activities which are greatly enjoyed by the patients
  - Despite major difficulties to access the computer
  - Existing systems for accessibility still require a physical control
Inclusion Technologies

- We developed a system to convert voice production into mouse and key strokes
- Embedded technology:
  - Voice Activity Detection
  - Noise Reduction
Inclusion Technologies

- An enhanced version uses vowels to completely emulate a mouse
- Embedded technology
  - Formant estimation
  - Formant normalization
Inclusion Technologies

- Show & Tell
Inclusion Technologies

CASE 1

- Outcomes: System was used by some patients with cerebral palsy, making interaction with computer faster and easier

- Future work: Robustness to several disorders, robust vowel estimation
Inclusion Technologies

CASE 2

- Framework: Collaboration with public radio corporation and other institutions
- Date: 2010
- Objective: Develop a voice-based system to design websites accessible to blind users
Inclusion Technologies

WEB READERS

- Read everything (including menus, banners and duplicate content)
- Information is not hierarchical
- No shortcuts for hot links

OUR PROPOSAL

- Developers decide what to read at the same time they design the site
- Create a 2-level hierarchy to ease access
- Use speech to access common features
Inclusion Technologies

- Remote speech recognition & synthesis
Inclusion Technologies

- HTML tags define:
  - Hierarchy
  - Elements to TTS
  - ASR commands
- Javascript:
  - Navigates the site
- Java Applet
  - Calls TTS & ASR
Inclusion Technologies

- Show & Tell
CASE 2

- Outcomes: System was scheduled to go live on 2010, but got indefinitely delayed for lack of personnel.

- Future work: Improvements require faster speech synthesis and solving browser issues.
HLT for Education
CASE 3

- Framework: Collaboration with public schools in Spain, especially with the Public School for Special Education “Alborada”

- Date: 2006-2010

- Objective: Develop a set of computer tools for speech therapy in special education
Education Technologies

- The result was Comunica (www.vocaliza.es)
PreLingua
- Training of several voice features: Intensity, fundamental frequency, breathing, vocalization
- Uses speech processing algorithms
Education Technologies

- Vocaliza
  - Practice of pronunciation of words and sentences
  - Uses speech recognition and speech evaluation to verify the pronunciation of the user
Cuentame

- Practice of semantics/syntax in spoken language
- Uses speech recognition to analyze the user’s fluency
Design features

- Easy installation and use: Teachers and students are not computer geeks
- Use symbols for Augmentative and Alternative Communication
- Feedback appropriate for the user’s age and never negative
- Full configuration for each unique user
Education Technologies

- Show & Tell
CASE 3

- Outcomes: Comunica has had a large impact
  - Hundreds of monthly visits to the website: Users from Spain to Mexico, from Puerto Rico to Argentina
  - Reports of cases of success from several users

- Future work: Web-based tools
CASE 4

- Framework: Work within the Learnlab structure
- Date: 2010-2012
- Objective: Develop new paradigms for pronunciation training in ESL classes
Education Technologies

- **Proposal:**
  - Create pronunciation tutors which can correct L2 speech in more natural situations (dialog)

- **Development:**
  - Create NLP tools to understand how errors in speech production affect perception
  - Develop software where the student can dialog with a virtual avatar
CASE 4

- Outcomes: Ongoing research, results to come
  - Looking for new and improved ways to teach pronunciation of English
  - ESL is very demanded nowadays
Conclusions
Conclusions

- Several examples have been shown here of applications of technology (i.e. language technology) to inclusion and education.

- Research in other IT fields is available too:
  - Eye and iris tracking
  - Brain-computer interfaces
  - ML-based Cognitive tutors
Conclusions

- Developing accessible technology is a necessary issue
  - Engineers, computer scientists and developers must have this in mind

- Never being afraid of becoming multidisciplinary and entering fields where technical expertise can make a difference
Conclusions

- Education and health-care/assistance are quickly growing fields in today’s economy.
- Requirements in technology for these fields will grow up.
- New opportunities arise.
  - For instance, technology for elderly assisted-living.
References
Our work

- Comunica
  - http://www.vocaliza.es
- Comunica 2.0 (beta)
  - http://web.vocaliza.es/
- VozClick y VocalClick
  - http://www.vocaliza.es/cadis.html
- Pittsburgh Science of Learning Center
  - http://www.learnlab.org
External work

- Vocal Joystick (J. Bilmes, UWash)
- VIVOCA (P. Green, U. Sheffield)
  - http://www.shef.ac.uk/cast/projects/vivoca
- TBALL (S. Narayanan-A. Alwan, USC-UCLA)
  - http://nautilus.icsl.ucla.edu/tball/
- Ortho-logo-paedea (EU project)
  - http://www.xanthi.ilsp.gr/olp/
- Carnegie Learning (CMU spin-off)
  - http://www.carnegielearning.com/
Information and Language Technologies for Inclusion and Education

Oscar Saz
Fulbright scholar
Language Technologies Institute – Carnegie Mellon University