Towards Attention Monitoring of Older Adults with Cognitive Impairment During Interaction with an Embodied Conversational Agent

P. Wargnier, A. Malaisé, J. Jacquemot, S. Benveniste,
P. Jouvelot, M. Pino and A.-S. Rigaud

3rd international workshop on virtual and augmented assistive technologies – March 23rd 2015

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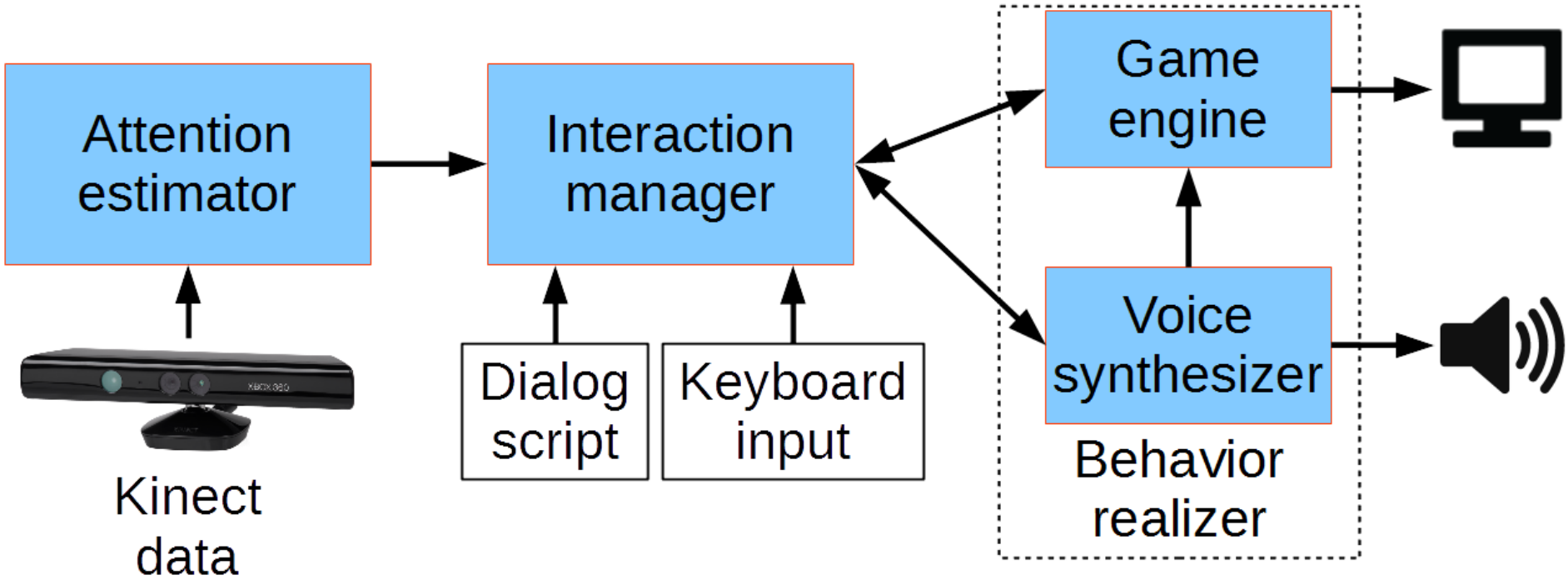
Project overview

- Challenge: Building an adapted user interface for older adults with cognitive impairment (and low computer literacy)
- Proposed solution: embodied conversational agents (ECAs)
- Design methodology: user-centered “living-lab” approach
- Place: Broca Hospital (Paris, France)

Why ECAs?

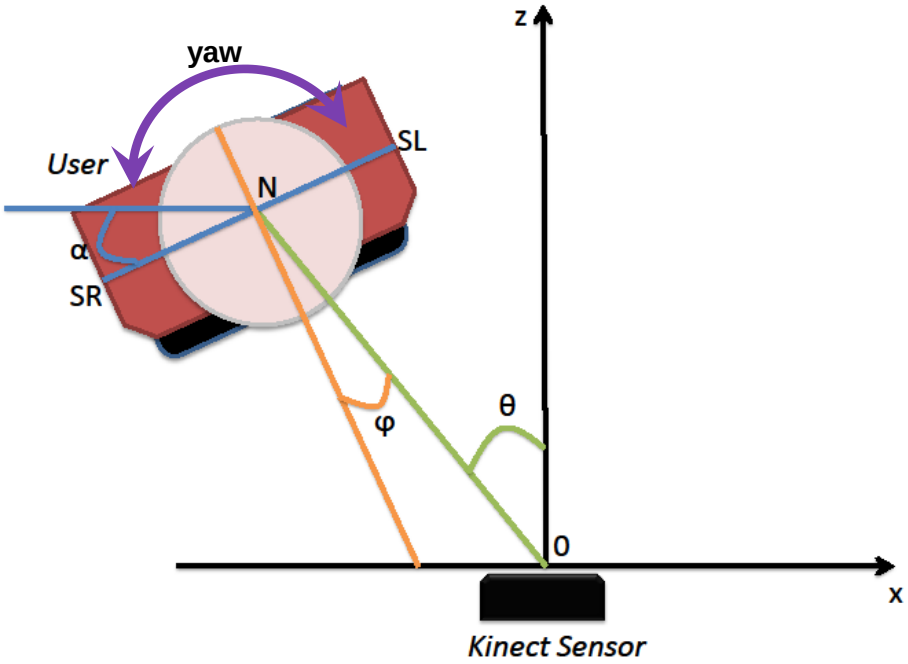
- Good task performance
- Attention and engagement
- Natural interaction
- Trust
- Lip-sync
- Non-verbal behaviors
- Personalization

System overview



Attention estimation method (1/2)

- A priori assumptions:
  - Attention = looking towards the display
  - Sensor placed on top of the display in the middle
- 3 features:
  - φ = divergence from direct orientation of the body towards the sensor
  - Yaw = the head's rotation around the vertical axis
  - Pitch = face up/face down rotation of the head

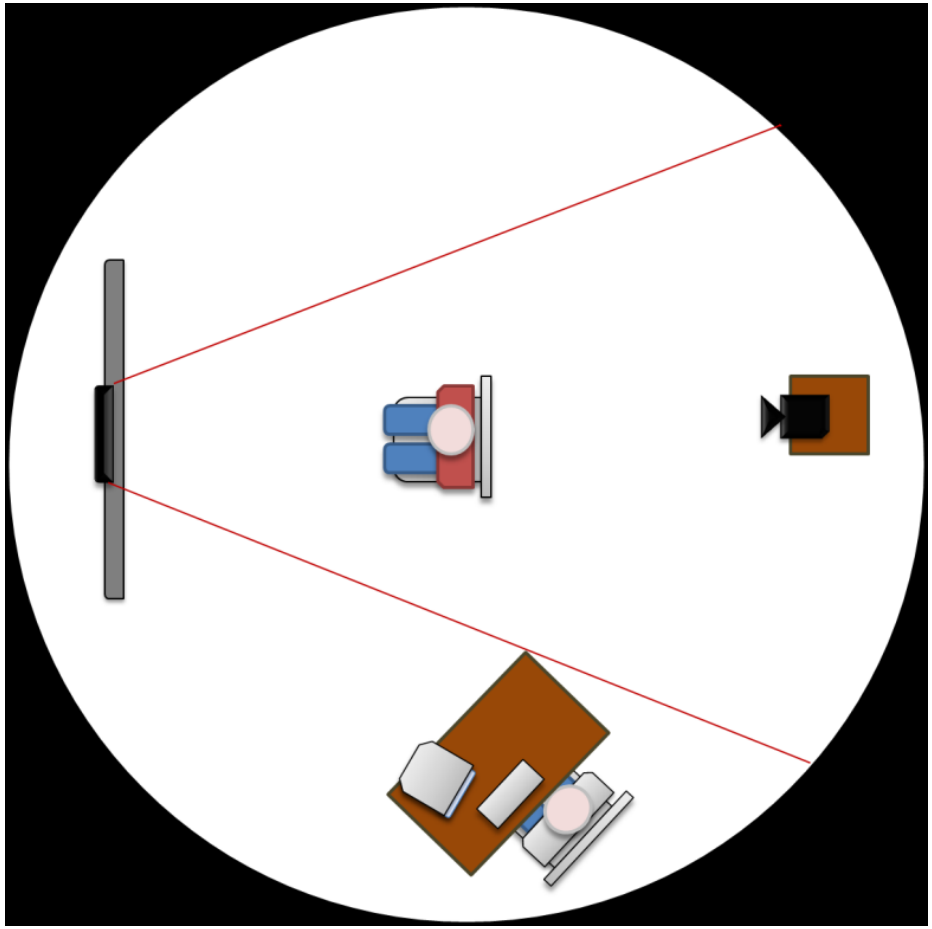


Attention estimation method (2/2)

- Features f_j averaged over 1-second sampling
- Features normalized as: $\overline{f_j} = \frac{\cos(f_j) - \cos(Max_j)}{1 - \cos(Max_j)}$
- Max_j = 60° for φ, 30° for yaw and 20° for pitch
- Attention value *A* computed as: $A = \sum_{j=1}^{n} \omega_j \overline{f_j}$
- Sum of the weights ω_j is 10, features in [0; 1]
- $\omega_\varphi = 3$; $\omega_{yaw} = 4$; $\omega_{pitch} = 3$; n = 3
- Decision: empirical hysteresis threshold

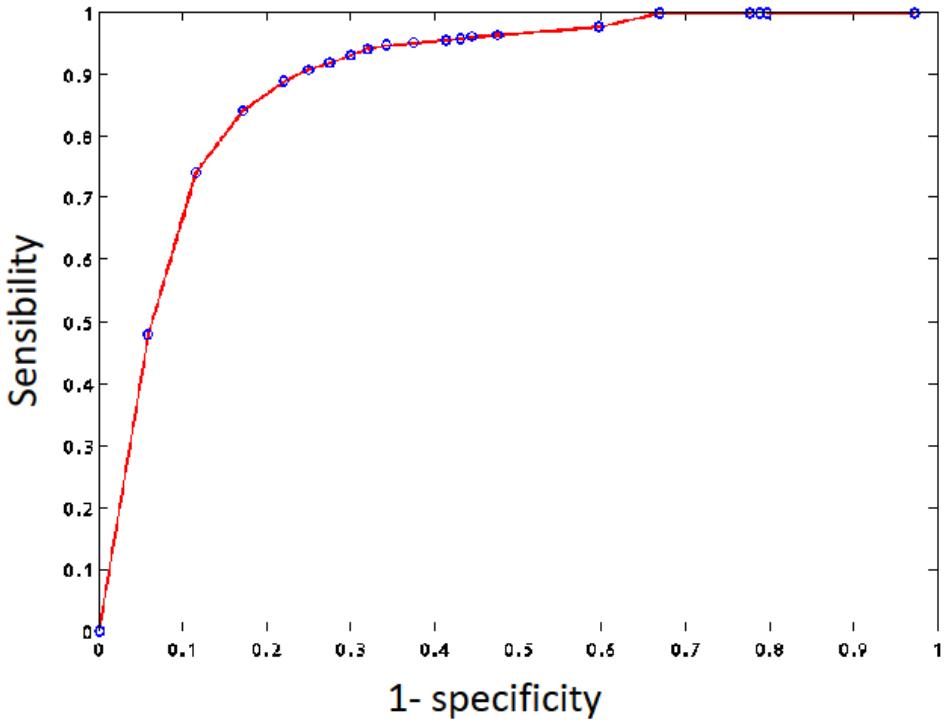
Evaluation

- 2 weeks of testing
- 14 participants: 4 males, 10 females
- Experts in assistive technologies
- *Wizard of Oz* with automatic reaction to attention monitoring
- 2 distractions introduced



Results

- 83% accuracy
- Optimal higher threshold = 8.5
- Expert's feedbacks:
  - Good adaptation of the character to their behavior
  - Easy understanding
  - Animation to improve



Conclusion

- Our attention estimation method is:
  - Simple
  - Accurate
  - Cheap
- The experts thought our system is:
  - Enjoyable
  - Easy to understand
- Improvement perspectives:
  - Upgrading to Kinect 2
  - Adding other sources of information (voice activity, sound source localization, speech recognition, eye tracking)

Future work

- First round of user trials: 6 participants with MCI or AD, age 75 to 90, completed
- Animation system changed
- Fully-automatic system
- Interaction management for 2 scenarios:
  - Choosing from a list of items
  - Guiding through the use of a device

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