

Computer Vision and Digital Inclusion of Persons with Special Needs: Overview and State of Art

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Summary

- Digital and Social Inclusion
- Human-Machine Interaction and Special Needs
- Visual Sign Based HMI
- Computer Vision and Sign Language Translation
- Computer Vision and Wheelchair Control
- Computer Vision and Sensorial Substitution
- SIGUS Platform
- Conclusion and Future Work

Digital and Social Inclusion

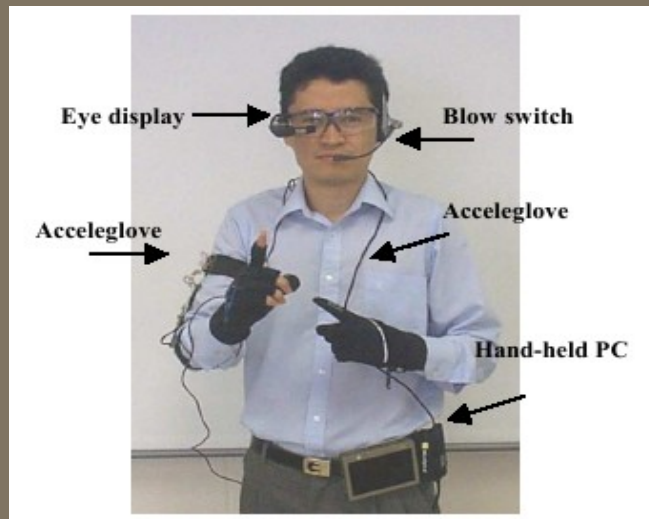
- 35% unemployed
- 26% live in poverty
- 21% no high school
- 11% severe disability
- 18% some disability
- +1 billion (world pop.)



HMI and Special Needs



Braille Display



Phraselator – J. H. Rebollar

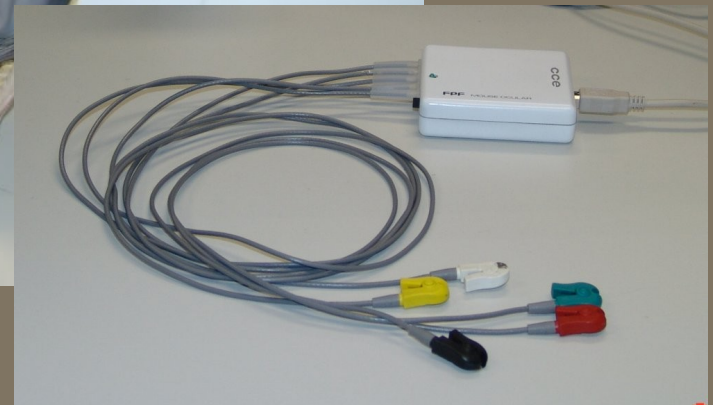


**EEG Brain Computer Interact.
Laura Kauhanen et alli.**

HMI and Special Needs



Mouse Ocular – Fund. Paulo Feitoza



Visual Sign Based HMI

- Low price – High performance – digital image capture device
- Few applications use webcams (Internet video communication)
- Non-intrusiveness and adaptability



CV and Sign Language Translation

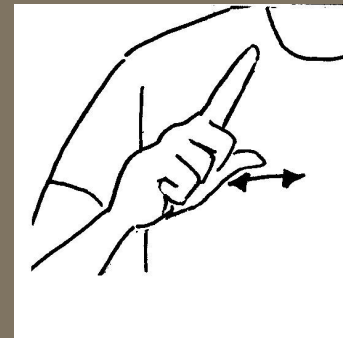
- 4000 to 20000 different sign languages and “dialects”
- Sophisticate and complex structure (not a simple map from letters or words from spoken language, not mimics)
- Multichannel information transmission: right hand (configuration, movement and relative position), left hand, eyes, cheeks, etc.



Late
Early



Work
Cousin

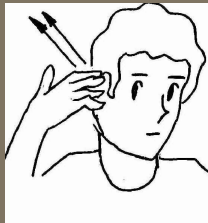


Have
Don't have

CV and Sign Language Translation

- Highly context dependent
- Example of syntactical structure:

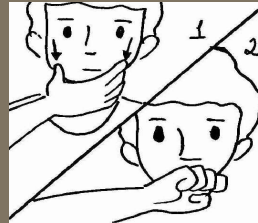
“My father and my son travelled to Portugal”



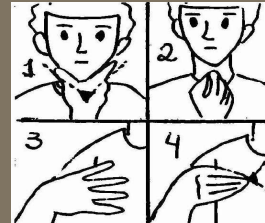
PAST
FUTURE



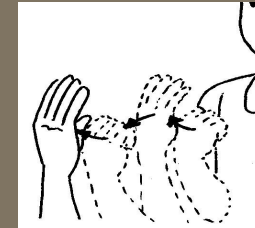
MY
YOUR



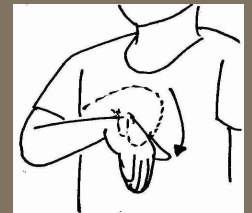
FATHER



SON
DAUGHTER



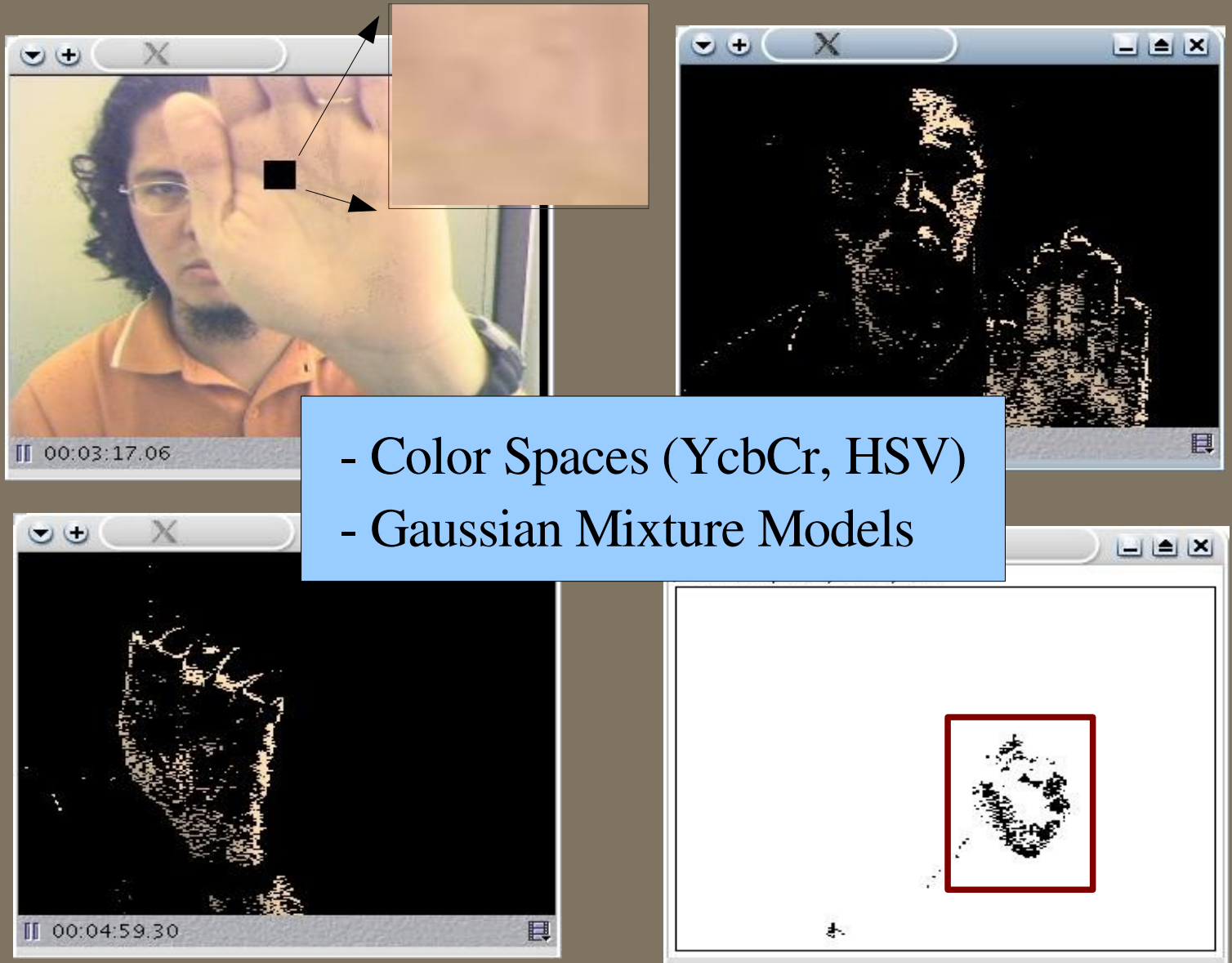
TRAVEL



PORTUGAL
BRAZIL

“spatial pronoun”

CV and SLT – Skin Color Based Segmentation



CV and SLT – Particle Filter Tracking



(a)



(b)



(c)



(f) E. Holden and R. Owens



B. Brandão; S. Goldenstein and J. Wainer (Subspace Hierarchical PF)

Deformable, Occluding,
Non-linear dynamics.
Complex backgrounds.
Real-time performance.

CV and SLT – Feature Extraction

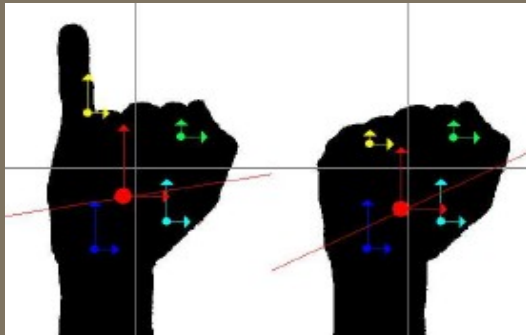
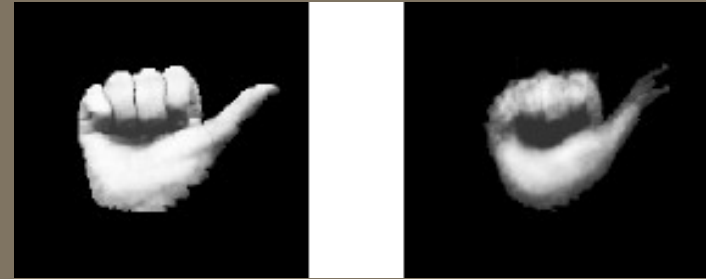
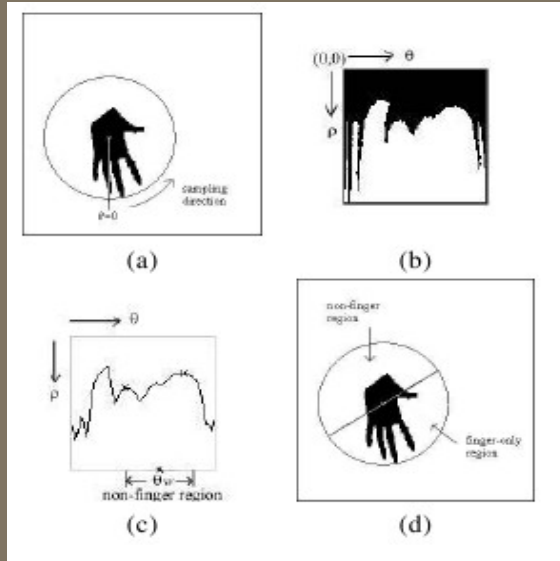


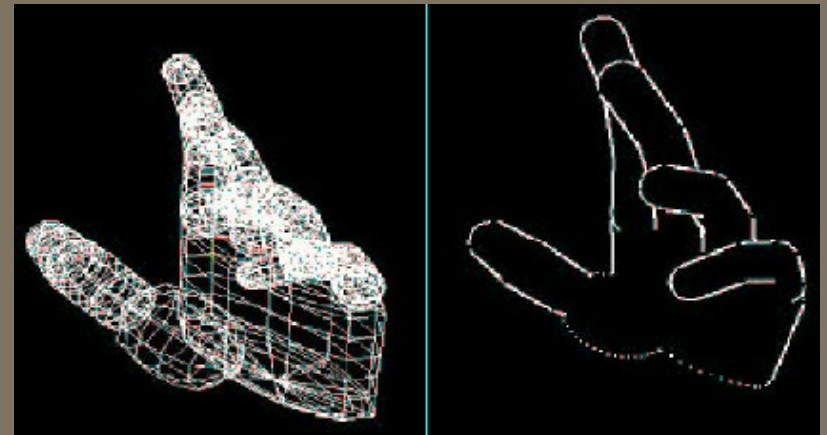
Image Moments



Eigen Hands / Fisher Hands

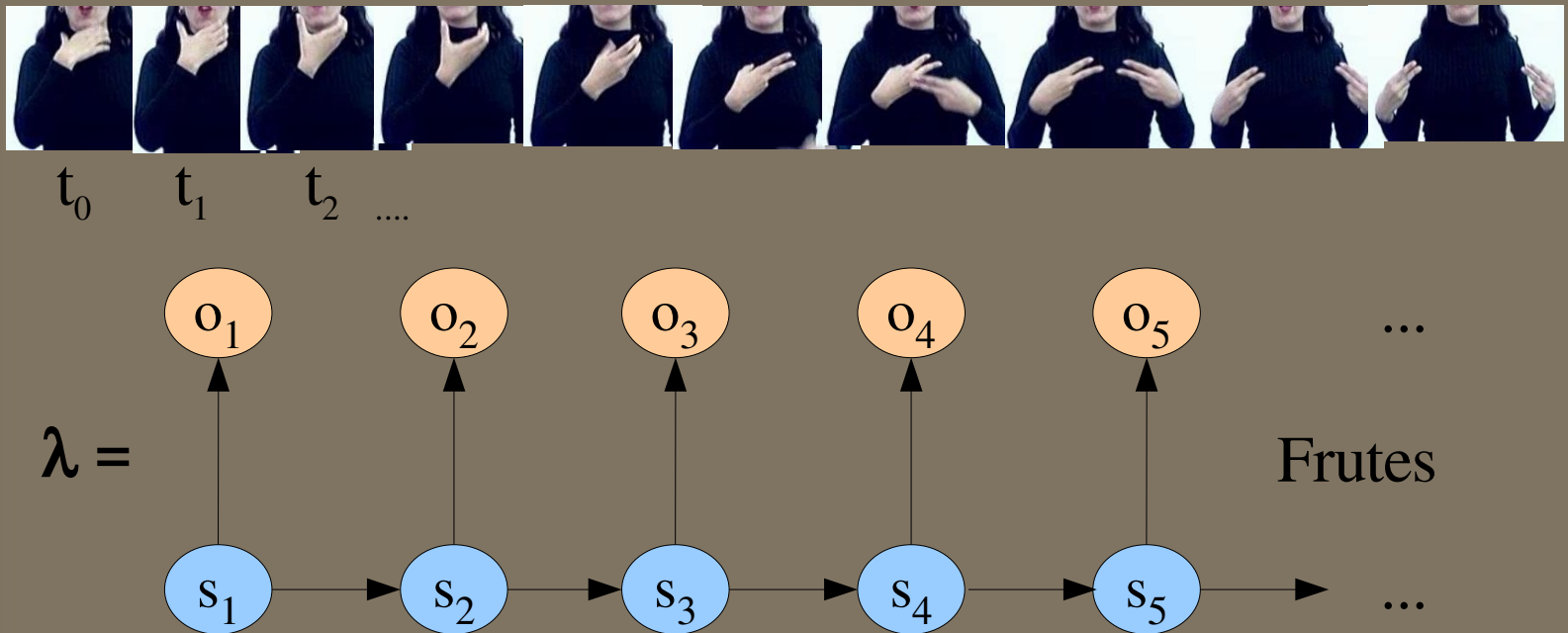


Polar Images



3 Models

CV and SLT - Classification



Poses/Gesture paradigm

Hidden state: Left hand in “C” configuration, near the queixo, right hand not present.

Observation: discretized or fuzzified versions of image features (alternatively Gaussian Hidden Markov Models may be used)

CV and Wheelchair Control

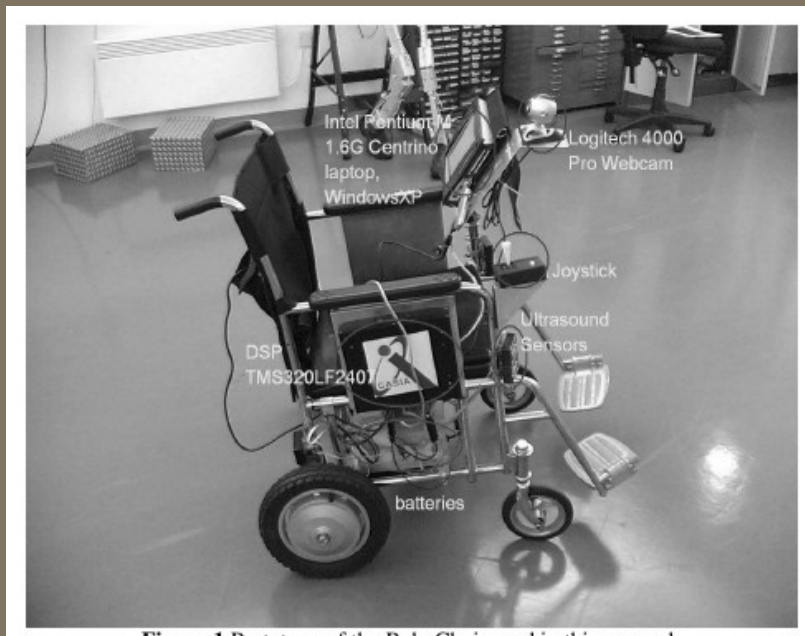
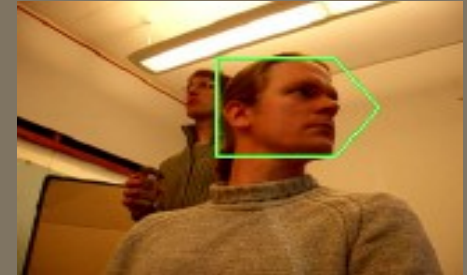
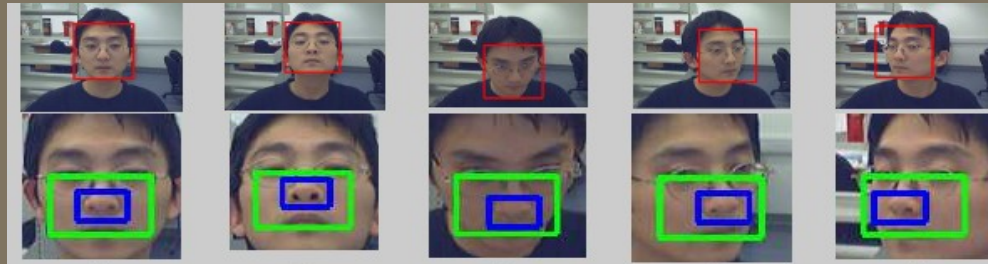
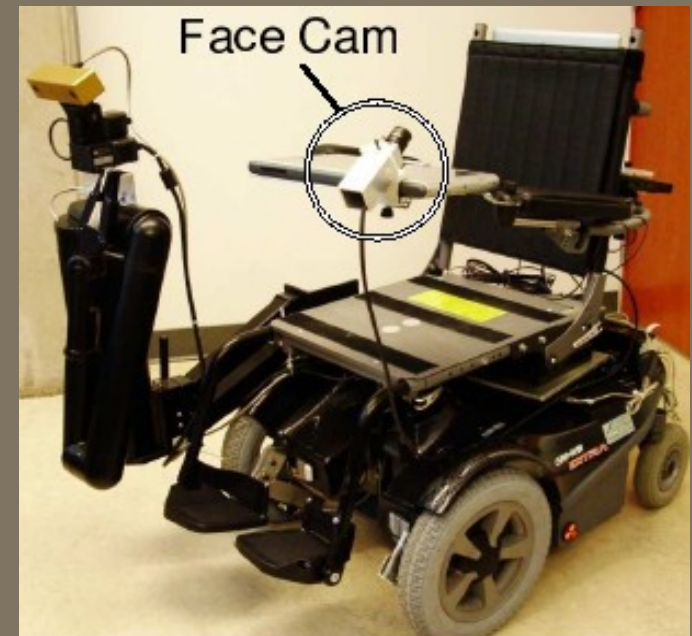


Figure 1 Prototype of the RoboChair used in this research

P.Jia, H. Hu, T.Lu and K. Yuan



Christian Bauckhage et. alli.

CV and Wheelchair Control

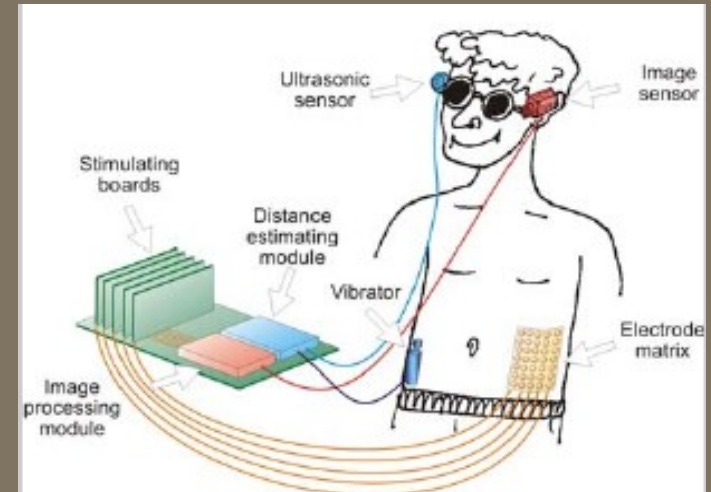


Illumination pattern using infra-red to cause controlled pupil specularities without disturbing the user (high contrast marks easy to locate).

CV and Sensorial Substitution



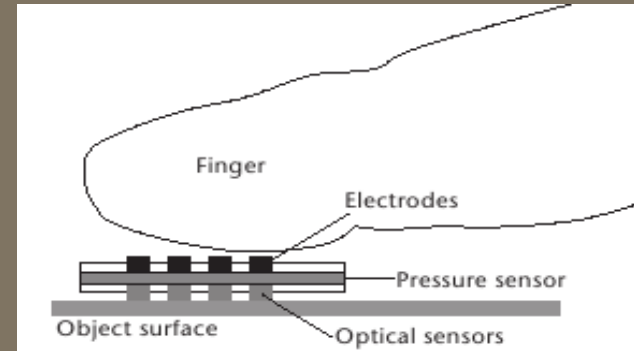
Forehead Retina System
(Univ. Of Tokyo and EyePlusPlus Inc.)



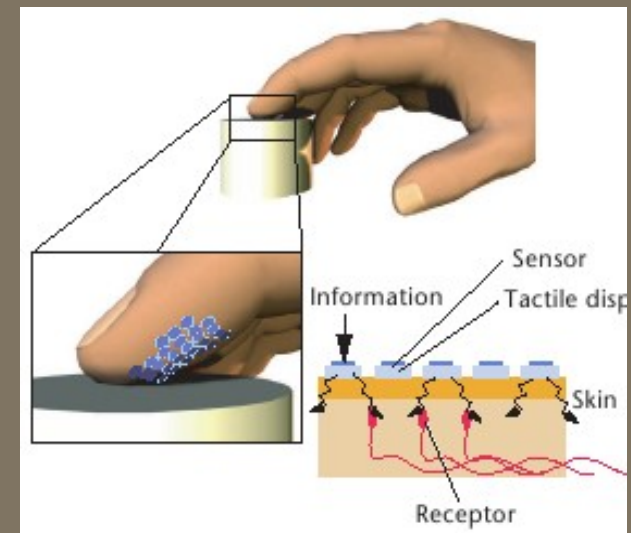
M. Conti et alli (GPEC)

- Visual stimulation -> Tactile stimulation
- Finger tips, belly, forefront, tongue
- Mechanical or electrical devices
- Electrical flow adjusted – no pain
- Very low resolution (20 x 20 matrix)

CV and Sensorial Substitution

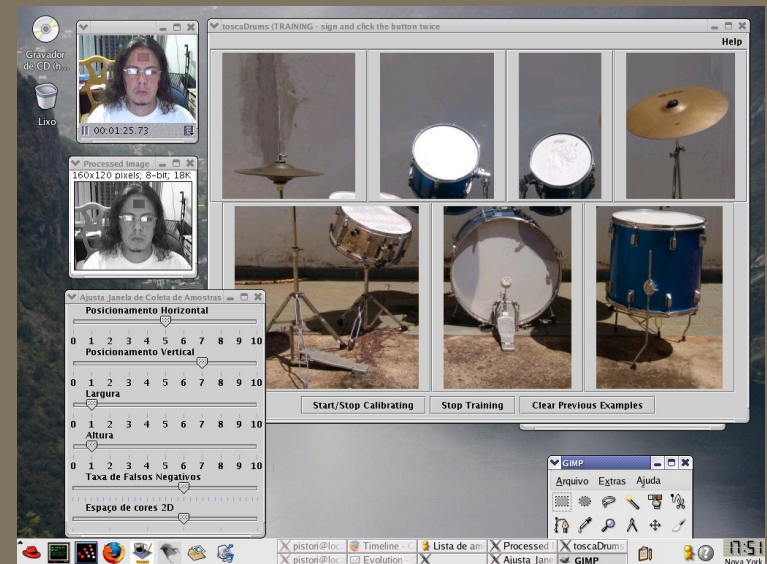
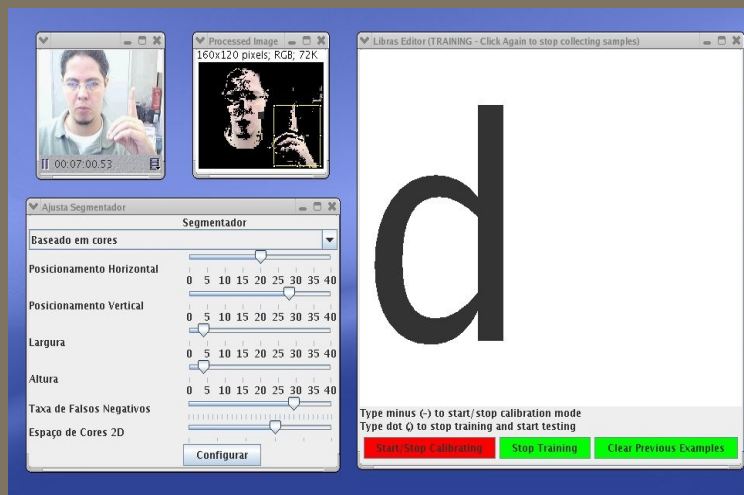


H. Kajimoto, N. Kawakami,
S. Tachi, M. Inami,



SIGUS Platform

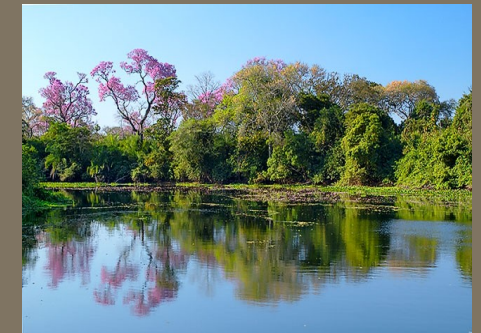
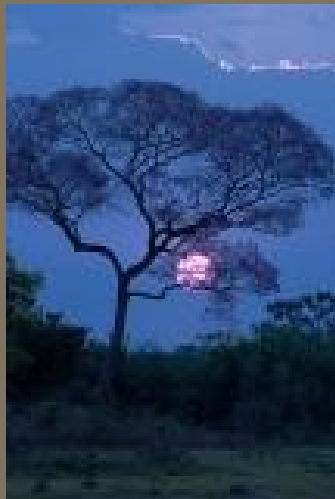
- Segmentation, feature extracting, tracking and classification algorithms tuned to visual sign based HMI
- Facilitate experimentation with different setups
- Prototypical systems: LIBRAS editor, drums for tetra., wheelchair control simul.



Conclusion and Future Work

- Techniques may be applied to other (“budget attractors”) problems (surveillance, general HMI, entertainment).
- Models and optimized version of particle filter
- Fisher hands
- Dimensionality reduction in temporal classification problems (Eigen/Fisher Gesture ?)
- Benchmarks

Visit Mato Grosso do Sul



Pantanal Wetlands, Bonito Caves, Fishing, Rafting, etc

Acknowledgments



SIBGRAPI – October 2008 - UCDB

