VisualPen: A Physical Interface for natural human-computer interaction

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VisualPen

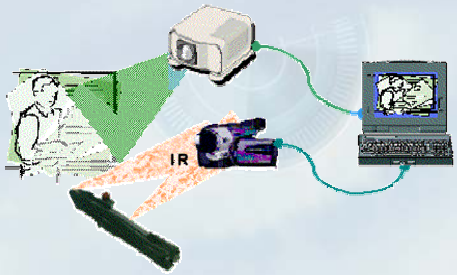
- It replaces keyboard and mouse:

- write

- draw

- and also to point, select (click), drag&drop and double click.

VisualPen



VisualPen

- The system can be operated from a wide range of distances

Desk

Board

- And, due to IR light, with all lightning conditions.

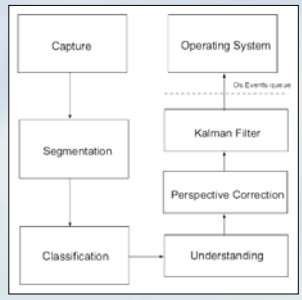
VirtualBoard*:Gesture Recognition

- Bare Hand HCI

- writing and drawing is not very natural

*C. Costanzo, G. Iannizzotto, and F. La Rosa - Virtualboard: Real-time visual gesture recognition for natural human-computer interaction. - In *Proc. of the IEEE IPDPS'03*, Nice, France, 2003.

VisualPen: The algorithm



VisualPen: The algorithm

Capture:

- Graylevel camera
- Resolution 320x240
- Two IR leds.

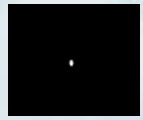
Pointing

Click event

VisualPen: The algorithm

Segmentation:

- Thresholding
- Connected components search



Pointing

Click Event

VisualPen: The algorithm

Classification and Understanding:

- Number of active leds in the same frame
- Shape analisys

VisualPen: The algorithm

Perspective Correction:

- Different resolution between camera and multimedia video projector
- Not orthogonal (Trapezoidal distortion)

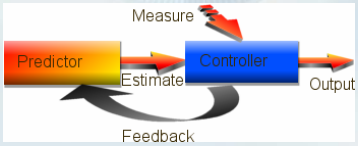
Desk

Board

VisualPen: The algorithm

Kalman Filtering:

- Filter noise
- Increase accuracy
- Smooth the motion



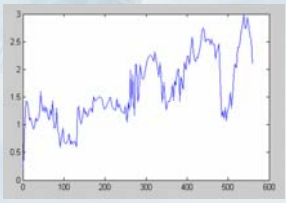
Performances

- Several environments
- Accuracy and repeatability
- Different lighting conditions
- Ground-truth reference
- Standard deviation of error

Performances

- Free hand
- Error less than 3 pixel

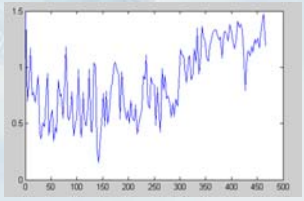
Horizontal straight line



Performances

- Free hand
- Error less than 1.5 pixel
- Uncertainty of the users in the second half of the abscissas

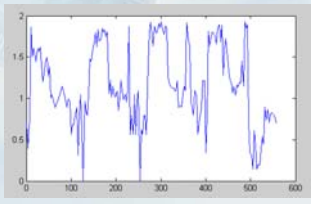
Arc of ellipse



Performances

- Free hand, pen constrained to slide on a fixed guide
- Intrinsic error oscillates around 1 pixel

Horizontal straight line



Performances

- Error due to the different resolution of acquired and projected images
- Sub-pixel accuracy – computationally intensive
- Negligible for normal use

Conclusions and future work

- Easy, natural input device
- Insensitive to lighting
- Low computational complexity
- Accurate

- Collaborative work sessions
- Interaction with Virtual and Augmented reality
- Porting to PDA devices