NRC·CNRC
Institute for Information Technology

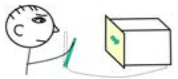
Working with a computer hands-free using Nouse® Perceptual Vision Interface

Main Principles:

1. Your nose tip is your Control Point (CP).
   1. CP detected by Nouse is shown as circle ◯
2. Motion Range (Rect) and Rest (Zero) position of CP must be learnt.
   - It's relative to Rect CP that is used to control
   - Rect is divided in blocks that are intuitive felt by the user as "furthest, non-zero, rest"
3. Hierarchical (head-then-nose) semi-automated Calibration: Computer guesses - user show
4. Other head motion is used for:
   1. Reset Motion (RM) command: when CP is bad.
   2. Binary Command (Bin): when CP doesn't move
5. When detected CP is not where you think it should be, help Nouse to regain it by using RM:
   1. 1st RM – reset search to zero position
   2. 2nd RM – reset nose data
   3. 3rd RM – reset head data (and Rect)
6. By default, Nouse is inactive. To activate, move to "furthest" (unless in cursor mode)
7. In active states, two main substates: moving and clicking (non-moving)
8. Multi-level cursor control:
   - from crude (joystick: click in zero position)
   - to precise (mouse nudging: click when stop)
9. Any action (click, start, end) requires confirmation:
   - Confirmation is done via synchronized motion in "Clicking" state – "Move out of the box"
10. Clicking is motion-based:
    - four types of click – four directions
11. Constant "Connection" with Nouse via Nousor
12. Motion codes (MC) are "writings in the air" that are used to change GUI setting and switch the modes.
13. NouseTyper and NouseChalk allow to interact & communicate in an non-keyboard style.
14. NouseBoard is a virtual keyboard that is mapped into motion range Rect.
15. Lock on screen or area can be used to map any other onsreen keyboard or application to Rect
16. All Nouse input tools are based on narrow range of head motion (on intuitive Motion Range blocks)

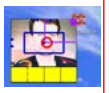
Feedback-providing Nouse Cursor (Nousor) as a key element of reliable hands-free control.

Just as a mouse user cannot move the cursor on the screen without first putting his/her hand on the mouse, so a Nouse user cannot work with a computer until s/he "connects" to it.



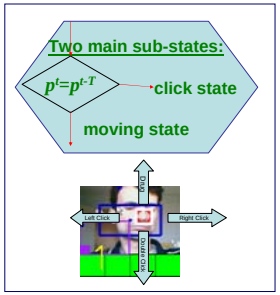
Nousor gives a user a "feel of touch" with the computer, which is missing in hand-free input devices and without which is reliable control is impossible.

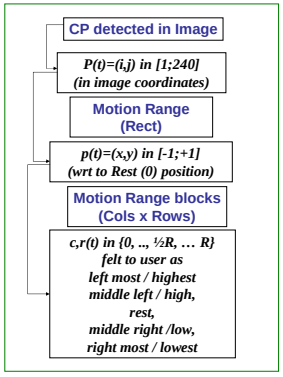
1. Used both for control (pointing/clicking) and showing the feedback (video detection results)
2. Does not replace cursor, but transfers control to cursor only when needed.



The better user feels it, the easier hands-free control is!

The computer and user must work as a team for the best control results to be achieved!





Head Calibration (Activation) State:

Tasks:
- •Activation by motion
- •User detection
- •Learn face (Head)
- •Zoom on the face
- •Estimate nose position
- •Estimate Motion Range Rect
- •(+Face recognition)

$s^t=s^{t-L}$

Head, Rect, GUI Settings

Head=0 Rect=0

RM?

Nose Calibration State:

Tasks:
- •Learn nose (Nose)
- •(+motion range)
- •(+motion commands)

Nose=0

RM?

Nose (+Rect)

Tracking-Control State:

Tasks:
- •Compute CP (nose): p
- •Compute other facial motions:
  - •Binary motions
  - •Reset motions

$p^t=0$

RM?

Facial Colour/Motion change

$p^t=(x,y) = f(p^{t-1}, Nose, Head, Rect)$

s^t=enter state

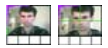
Command or data sent to computer

STATE MACHINE: $s^{t+1} = f(s^t, p^t)$

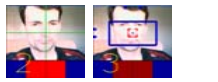
Nouse basic: cursor control & click	NouseCode	NouseChalk	
Nouse Modes/Tools:	NouseBoard (+NousePad)	NouseTyper	

Reference Guide:

Visual feedback provided by Nousor for different states

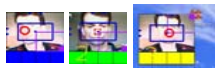


Head Calibration (Activation) State:
- "Noone is here. I'm inactive"
- "Face is detected. Wait – I'll zoom in!



Nose Calibration State:
- "Show your nose!" (Nose in center, please!)
- "Confirm your nose!" (Get out of the box!)

(opt) - "Show your motion range!"
(opt) - "Show your Reset Motion (RM)!
(opt) - "Show your Binary (Click) Motion!"



Tracking/Control state:
- "I'm in joystick mode"
- "I'm in clicking mode"
- "I'm in mouse (nudging) mode"

Extra: I'm in NouseTools

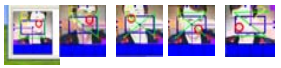
When Reset Motion detected:
- "I'm in reset mode. –

Put your nose center and then confirm !
Or show RM again to reset on higher level!

NouseBoard + NousePad

- •Touch corner for next letter selection
- •Go to block containing the letter
- • Confirm typing it by moving out of the block in countdown
- • Exit by motion command or "typing" Nouse. - Typed message will be saved in Clipboard and can be retrieved by right mouse click and "Paste".

NouseCodes - Motion Commands (MC)



- • Constantly checked upon visiting a corner
- • To confirm nod head, when letter appears

```
CODE_LENTH = 5

CODE_SETTINGS      41341
CODE_BOARD         12343
CODE_GLUE_CURSOR   24312
CODE_LOCKONAREA    24134
CODE_HALFSCREEN    21212
CODE_FREEZE        23412
CODE_DETECTFACE    21321
(defined in script)
```

NouseChalk:

- •Enter with MC
- •Click to start
- •Click to finish

→(erase)
←(go to next line), up (store and quit)

NouseTyper:

```
a = 1d4c3coa2b3
A = 2adc3coa
A = 2a1d4c3coa
(defined in script)
```

Nouse-PVI web-site: http:/vrs.iit.nrc.ca/Nouse

D. Gorodnichy. **On importance of nose for face tracking**. In Proc. IEEE Int. Conf. on Automatic Face and Gesture Recognition (FG 2002), pages 188–196, Washington DC, May 20-21 2002.

D. Gorodnichy and G. Roth. **Nouse 'Use your nose as a mouse' perceptual vision technology for hands-free games and interfaces**. In Image and Video Computing, Vol. 22, Issue 12 , pp 931-942, 2004.

D. O. Gorodnichy. **Perceptual cursor - a solution to the broken loop problem in vision-based hands-free computer control devices.** In NRC-CNRC Tech.Report. NRC/ERB-1133. Feb. 2006. NRC48472, 2006.

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