HOBS: Head Orientation-Based Selection in Physical Spaces

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TerraSwarm

CITRIS INVENTION LAB

Research at Google

image src: http://www.smartthings.com/

Smart Lock
Lockitron

Smart Thermostat
Nest

Smart Light
Philips Hue

Smart Outlet
Belkin WeMo

...

AT&T
11:56 AM
HOME
stacy's house
Let your guests in remotely with wireless locks.
22
Hub
All Hues
living room
kitchen
74
nest
porch
floor lamp
fan
front door

Iron
OFF
Fan
ON
Lamp
OFF
Coffee
ON
Switches
Sensors
Rules
More

naming

scaling

Lamp
Fan
TV
Fridge
Thermostat
Lock
Outlet 1
Outlet 2
…
…

visual divide

AT&T
11:56 AM
Lamp
Lamp Copy

Light Controls Explained

The cubicle area is divided into three lighting zones…

Lamp
Fan
TV
Fridge
Lamp Copy
XBox
Laptop
Thermostat
Lock
Outlet 1
Outlet 2
...
...

The visual divide of controllers and controlled objects.

Indirect Interaction

naming

scaling

visual divide

Head **O**rientation-**B**ased **S**election

"What You See Is What You Get" in **physical spaces**

laser

infrared

radio

Head orientation has limited precision

System Architecture

Prototype Architecture

Prototype - Augmented Glass

Prototype - Target Device

3:52
tap to connect

3:52
tap to connect

Area Cursors, The “Prince” Technique [Buxton CHI’95]
Enhanced Area Cursor [Findlater UIST’10]

Scanning
Refinement

3:41
01
02
03

Study Apparatus

HOBS vs. List

target acquisition time

- Head-worn
- Near-eye Display
- Glass touchpad
- IR for selection

- Head-worn
- Near-eye Display
- Glass touchpad
- List for selection

~25% time reduction $p < 0.001$

HOBS scales well

Scanning

Scanning
Refinement

But, refinement is bad…

refinement is 43% slower than “no refinement”, $p < 0.001$

image src: http://www.smartthings.com/

Naive IR

Iteration 2 - Intensity IR

IMAGINE
RADICAL

Intensity Based Ordering

3 4 5

4 3

~16% time reduction $p = 0.001$

Iteration 2 - still a list

“Spatial”

“Spatial”

Iteration 3 - Head Motion

Head Motion

Learning the Map

targe 4, pitch: 0, yaw: 0

Learning the Map

targe 4, pitch: 0, yaw: 0

targe 5, pitch: -3, yaw: 6

Adjacency Map For Selection

target	pitch	yaw
4	0	0
5	-3	6

prediction

head motion
pitch: 0
yaw: 10

Invariant on Relative Position

- Assumption: targets live on the periphery of spaces

Feedback

- “more natural way for demonstrating intentionality”
- “it leveraged the spatial sense that I already had just by using the system”
- “matching visual cues rather than numbers”

Limitation and Future work

- The adjacency map could be learned on the fly by correlating head motion and IR intensity reading.
- Our study design:
  - not yet systematically studied target density variation
  - performed in a lab environment
  - only measured first use.

Come to our DEMO

Conclusion and Contribution

- We proposed HOBS to interact directly with physical targets.
- We presented three iterations of design:
  - Naive IR, Intensity IR, Head Motion
- We contributed user studies on this novel interaction.
- We demonstrated our home control application.

People don't use
buttons, menus and sliders
to talk with each other

People don’t use
buttons, menus and sliders
to talk with devices

Thank you!
Questions?

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Head Orientation-Based Selection