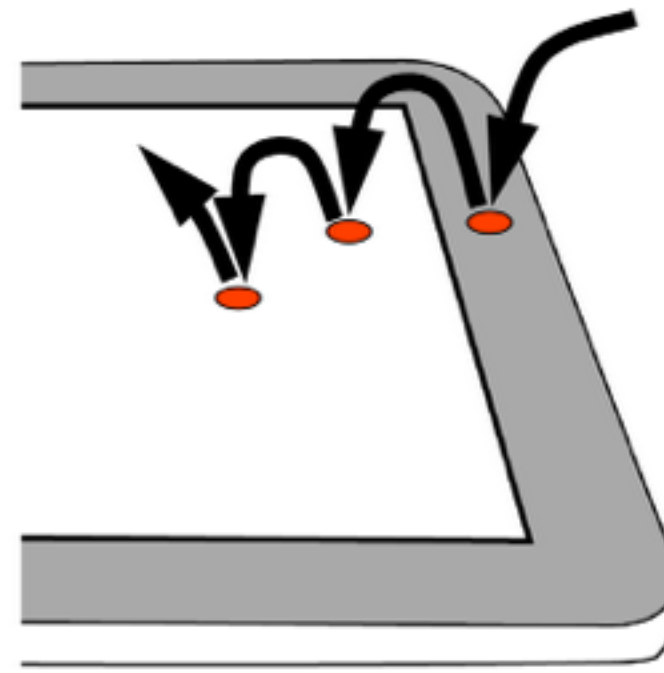
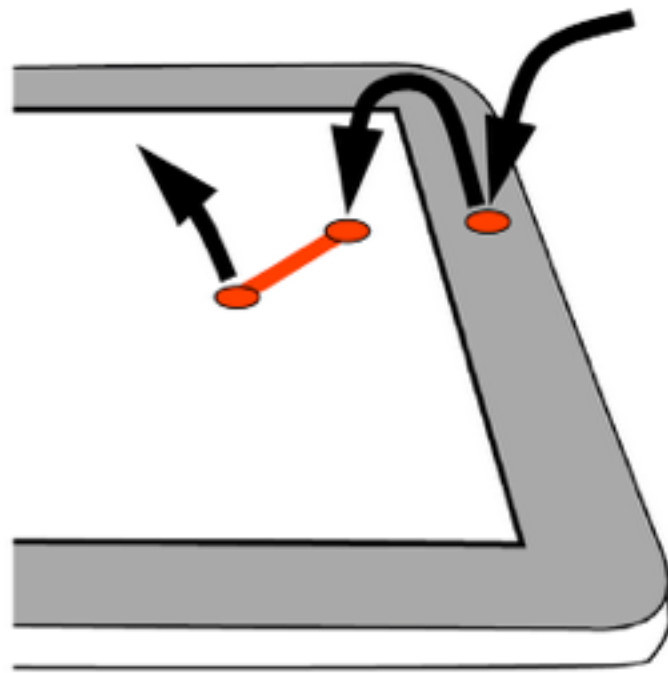


Bezel-Tap Gestures: Quick Activation of Commands from Sleep Mode on Tablets

Marcos Serrano, Eric Lecolinet, Yves Guiard

VIA Project -Telecom ParisTech

Paris, FRANCE



Growing number of mobile applications

177 applications

73 occasionally

32 very often

[Shin 12]

Growing number of mobile applications

177 applications

73 occasionally

32 very often

[Shin 12]



iPhone 10
The tallest iPhone yet.

source: <http://mashable.com/2012/09/13/iphone-10/>

Growing number of mobile applications

177 applications
73 occasionally
32 very often

[Shin 12]



iPhone 10
The tallest iPhone yet.

EASY ACCESS
STRUCTURE

source: <http://mashable.com/2012/09/13/iphone-10/>

New usages of tablets



TouchSquid
source: <http://touchsquid.org>

New usages of tablets



TouchSquid

source: <http://touchsquid.org>



New usages of tablets

ALWAYS AVAILABLE
RAPID ACCESS



TouchSquid

source: <http://touchsquid.org>



Mobile device energy saving

Capacitive sensor
turned OFF



Mobile device energy saving

Capacitive sensor
turned OFF

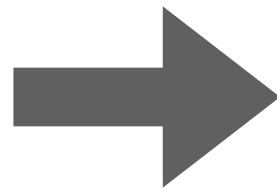
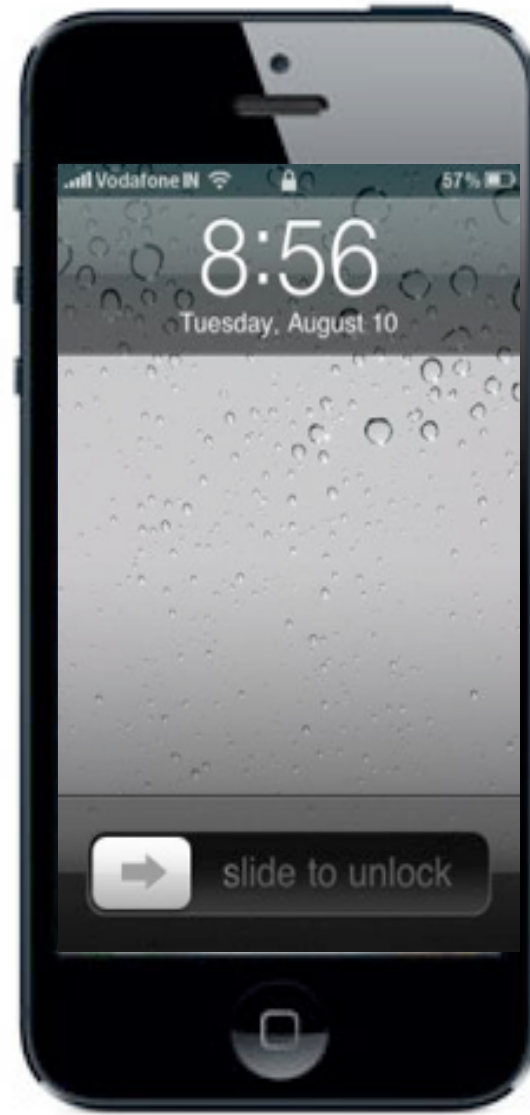


Mobile device energy saving

Capacitive sensor
turned OFF

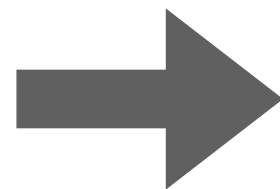


Capacitive sensor
turned ON

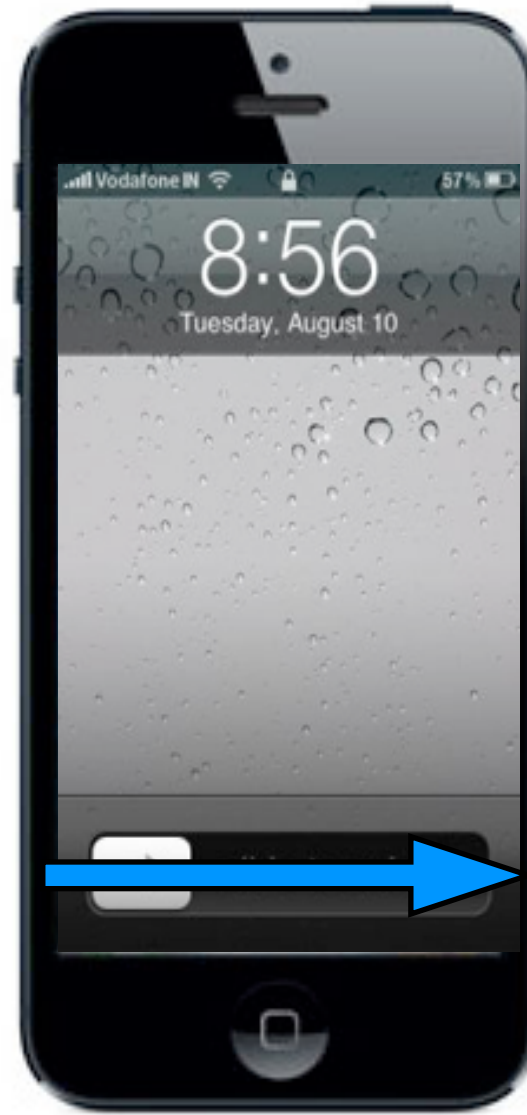


Mobile device energy saving

Capacitive sensor
turned OFF

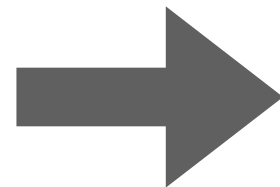


Capacitive sensor
turned ON

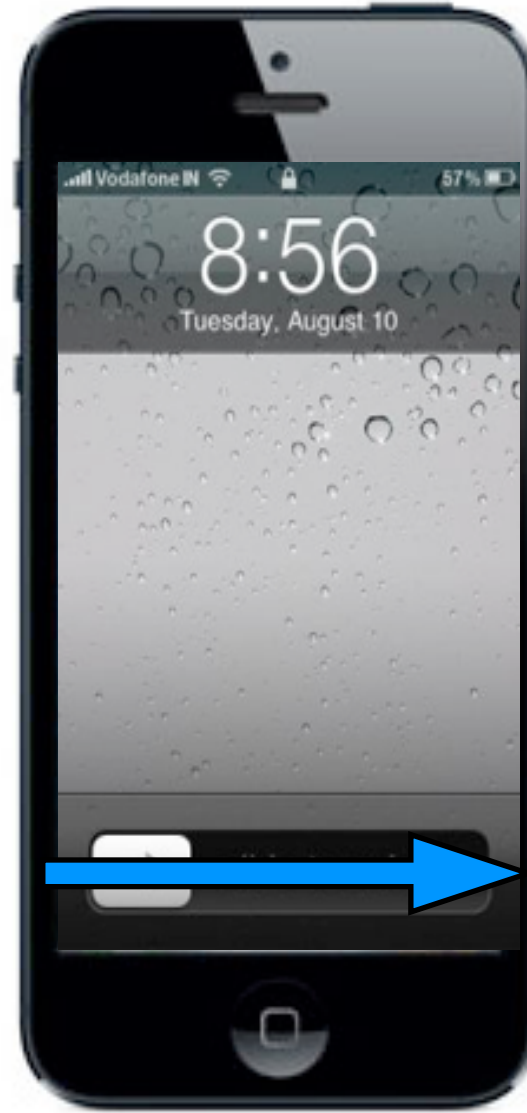


Mobile device energy saving

Capacitive sensor
turned OFF



Capacitive sensor
turned ON



**LOW POWER
CONSUMPTION**

ROBUST

Need for **always-available**

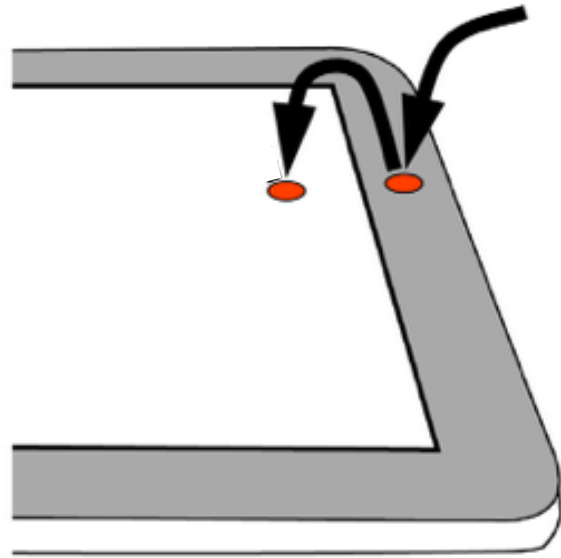
low-consuming

robust

rapid access to mobile commands

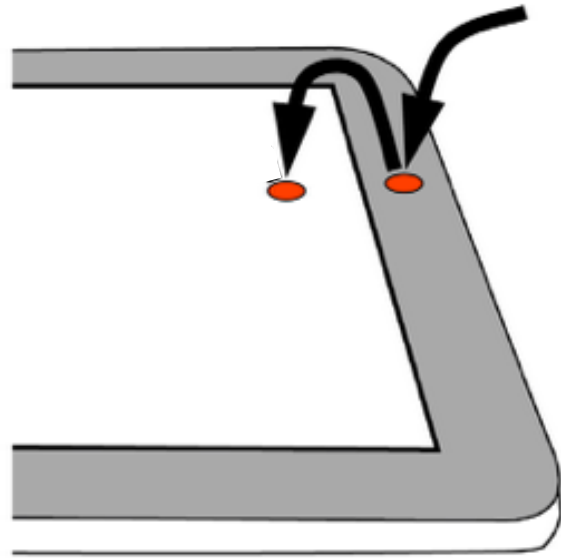
Our contributions

1. Bezel-Tap



Our contributions

1. Bezel-Tap

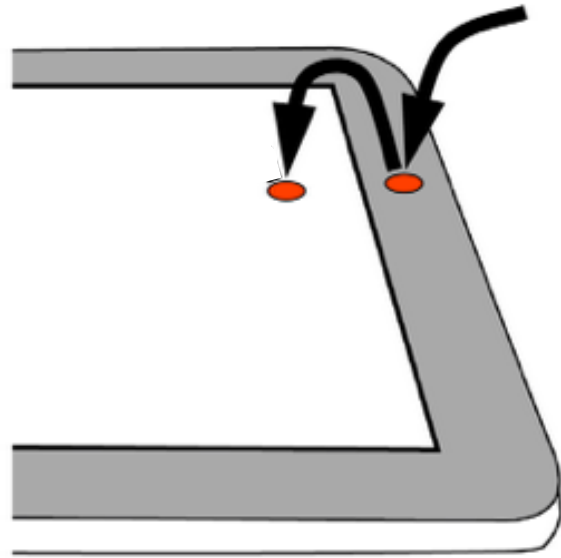


2. Evaluation



Our contributions

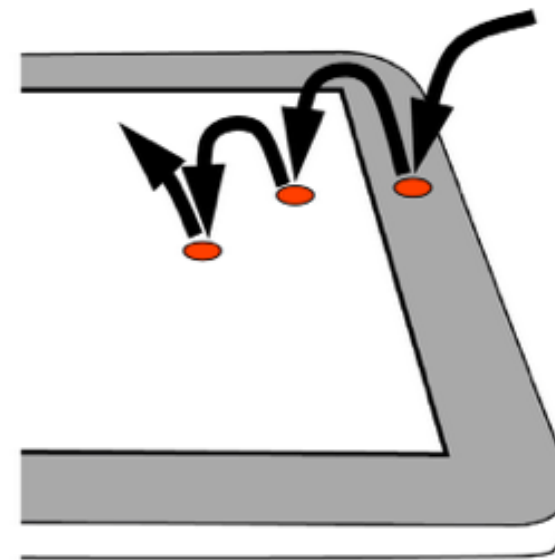
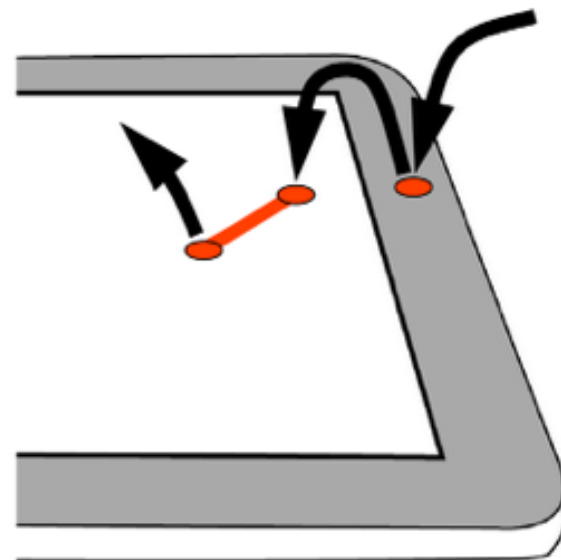
1. Bezel-Tap



2. Evaluation



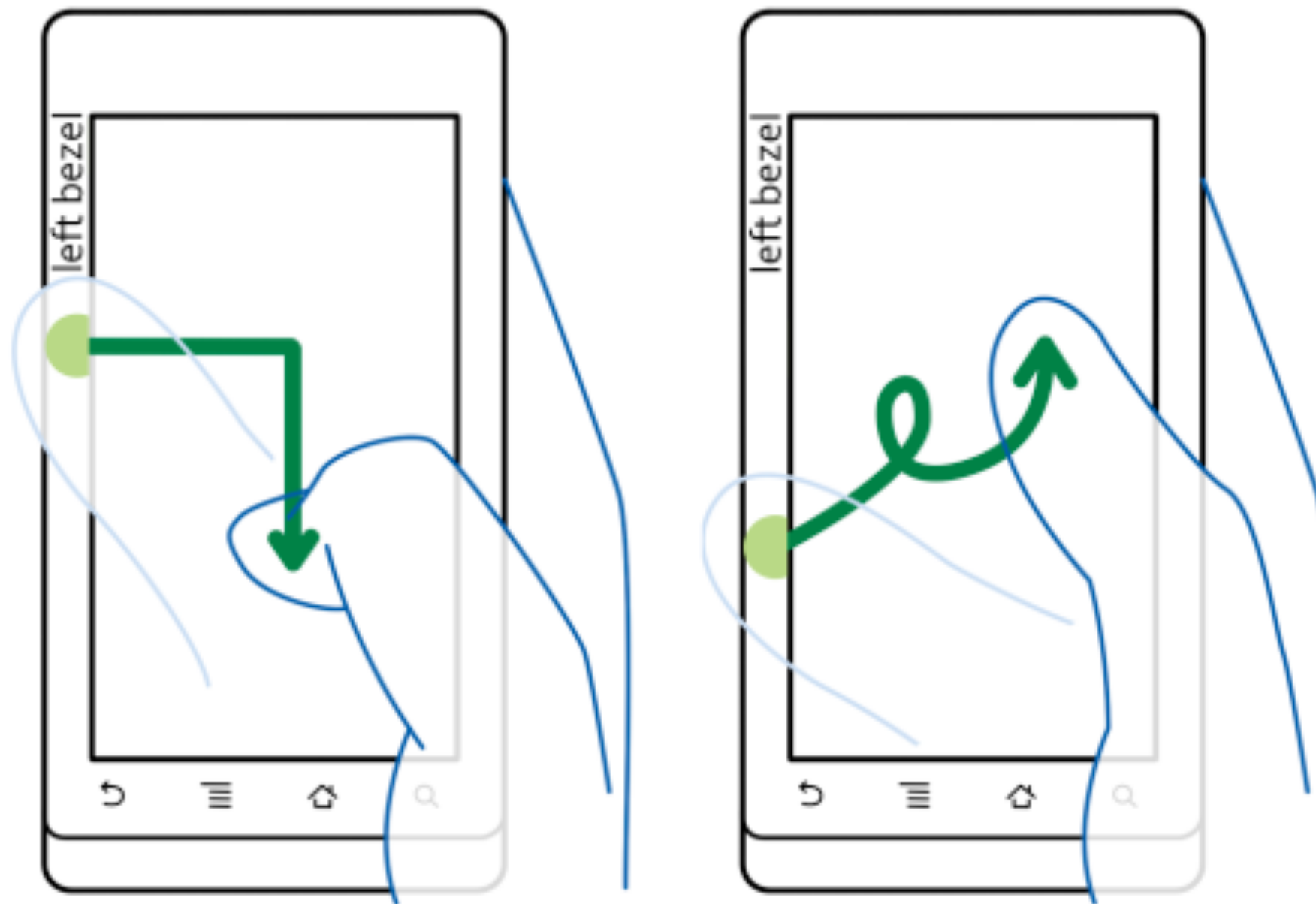
3. Hierarchical menus



Related work

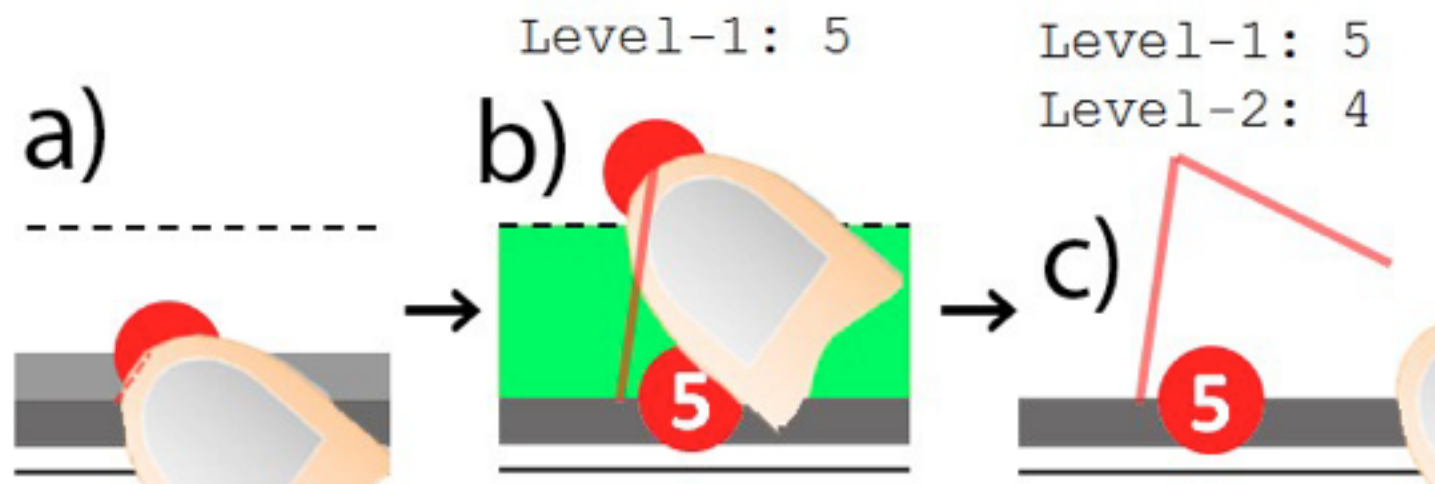
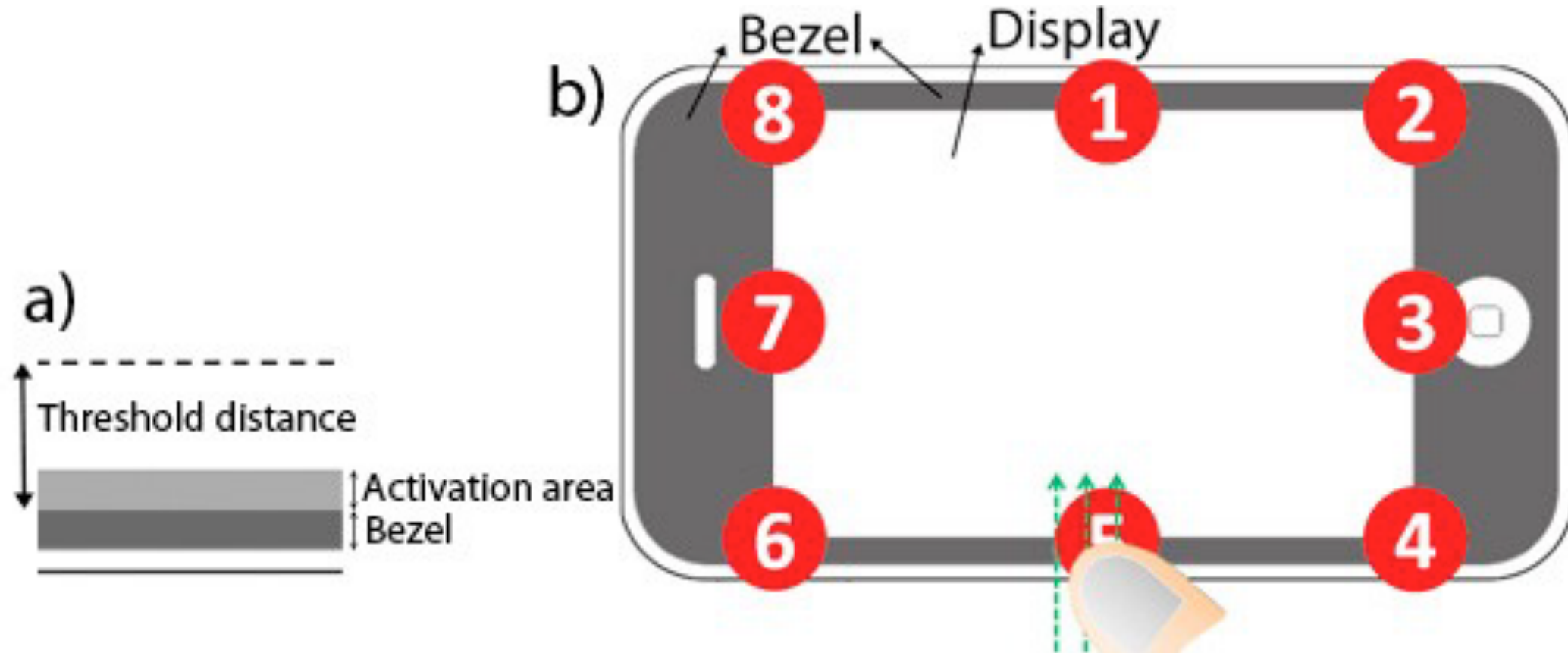
Bezel Gestures

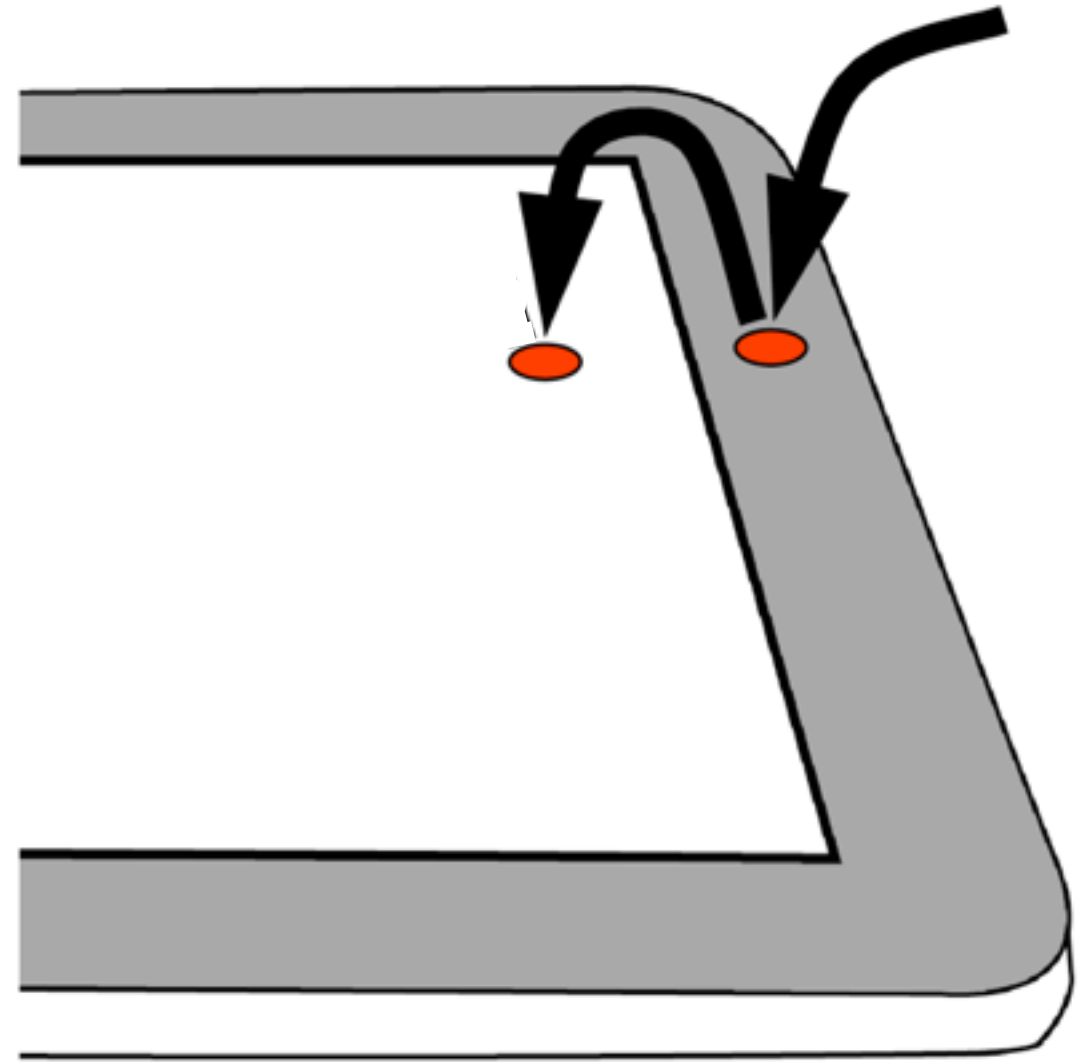
[Bragdon 10]



Bezel Menu

[Jain 12]





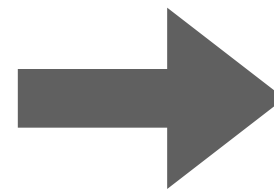
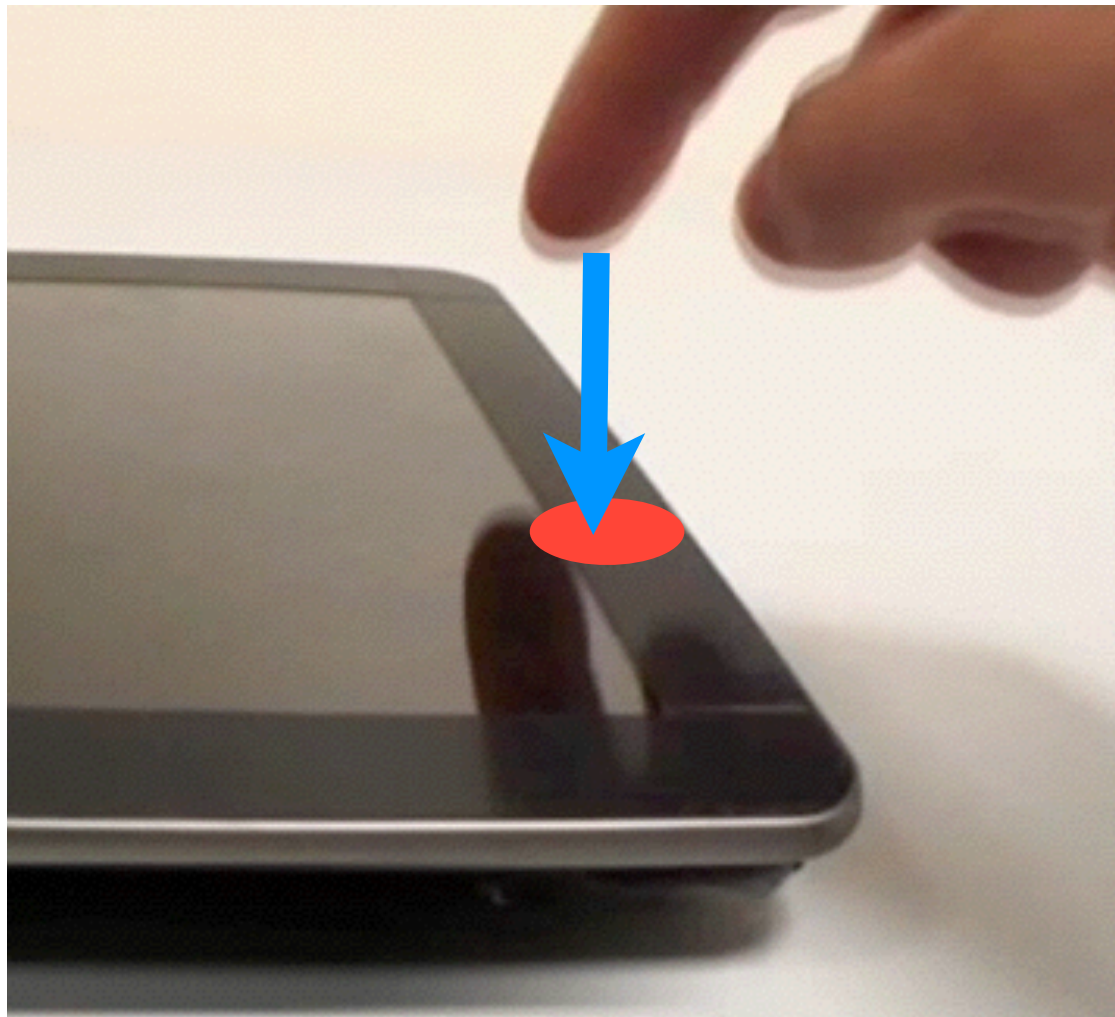
1. Bezel-Tap

Two-steps gesture

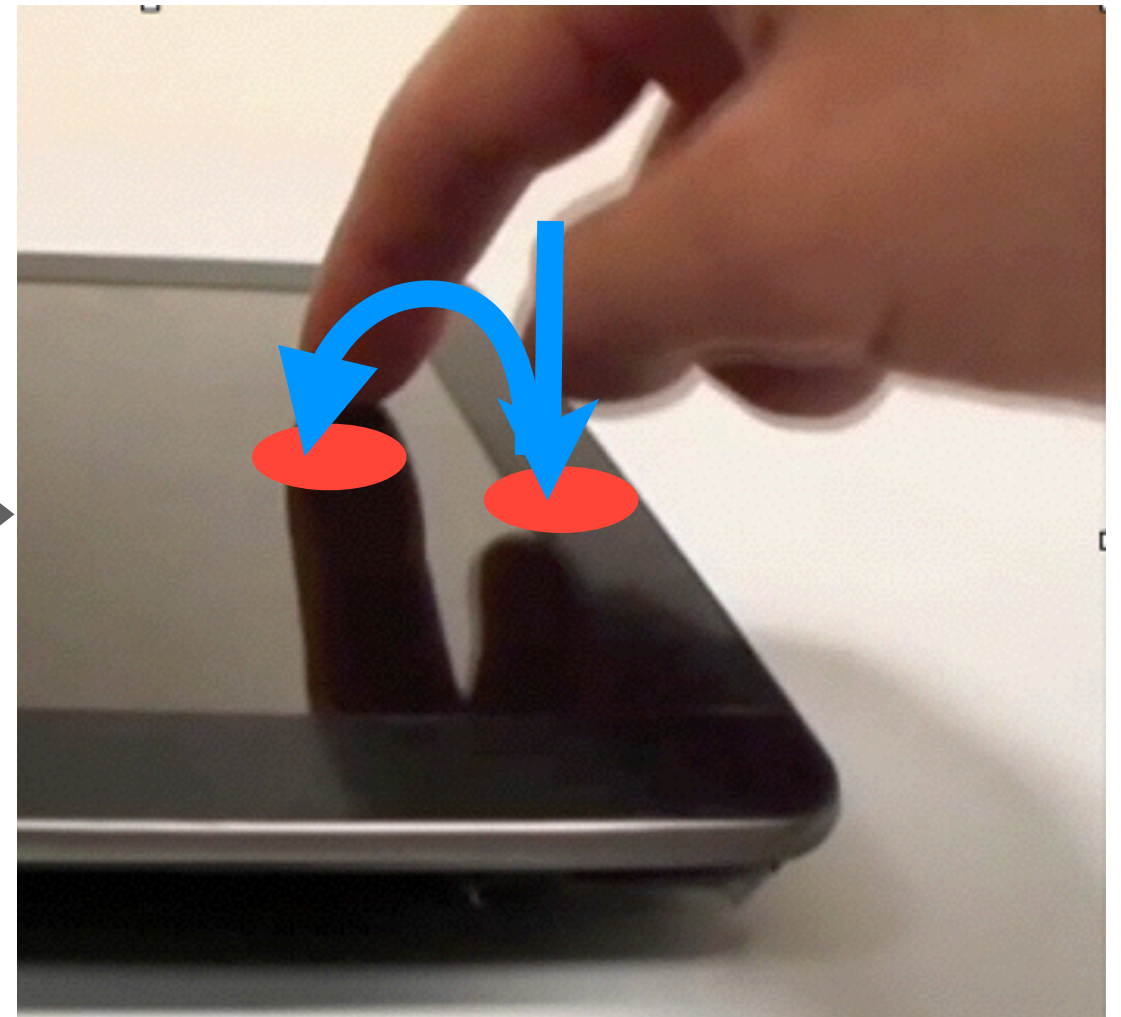


Two-steps gesture

1. Bezel tap

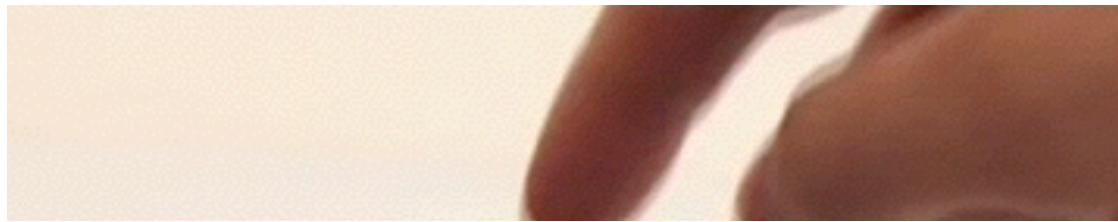


2. Screen contact



Two-steps gesture

1. Bezel tap



2. Screen contact



Low power consumption

Rapid

Robust

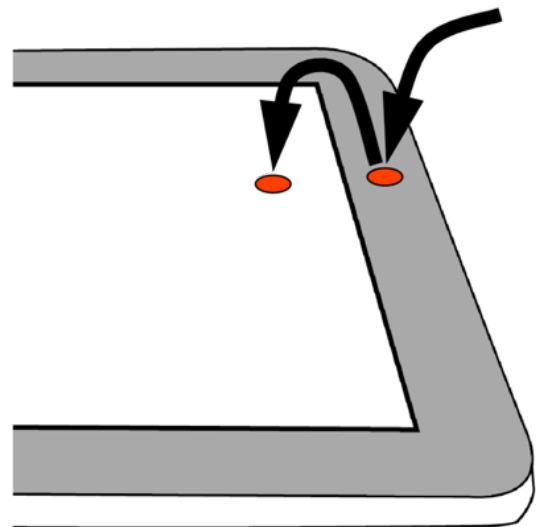


Detection

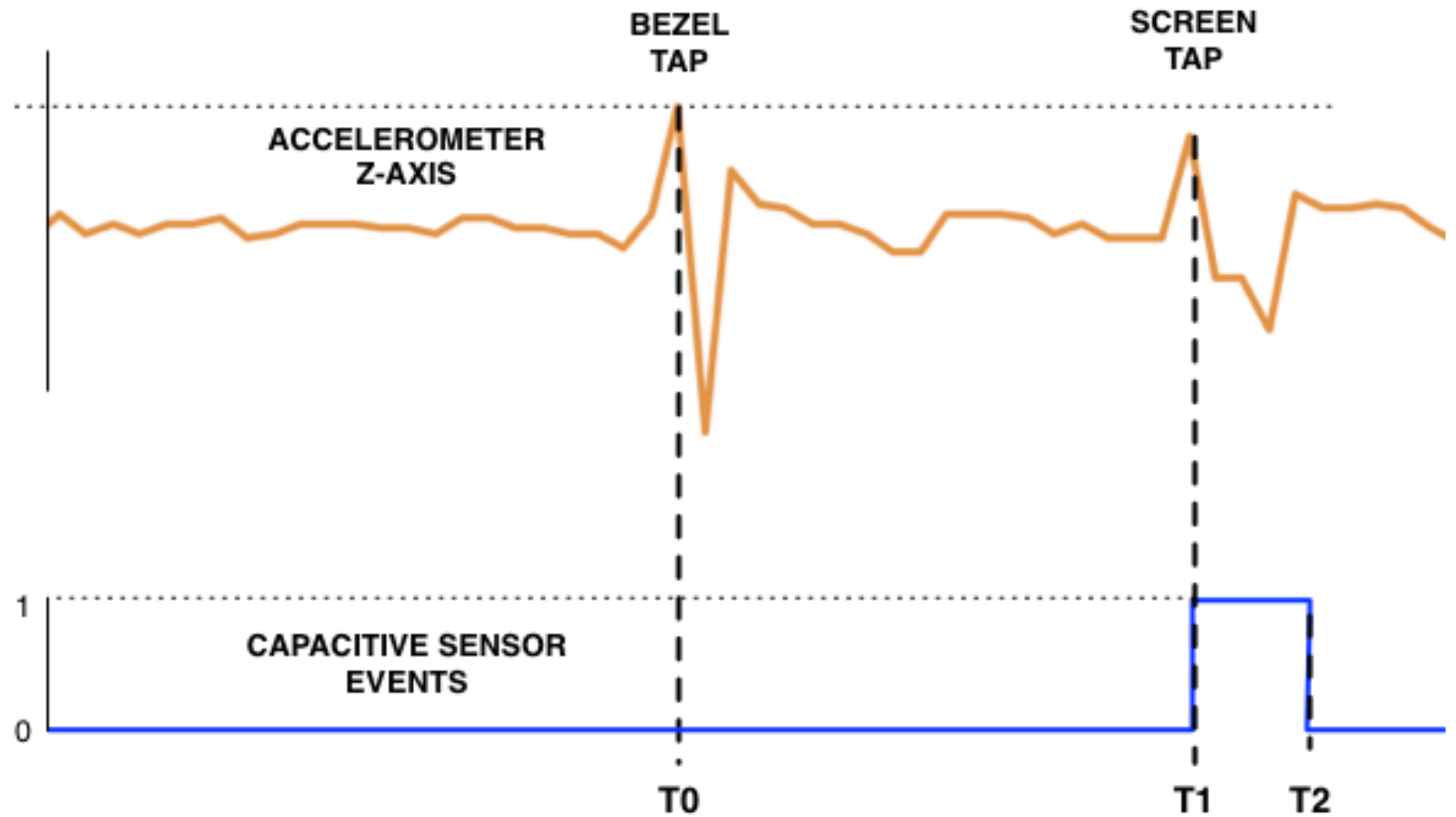
Low power consumption

Rapid

Robust



Bezel-Tap



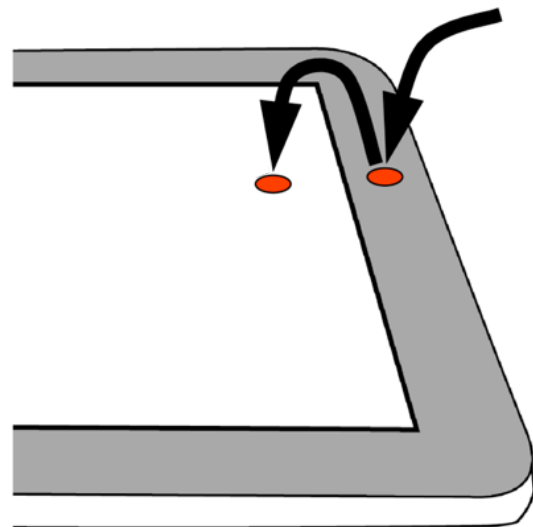
Detection

Low power consumption

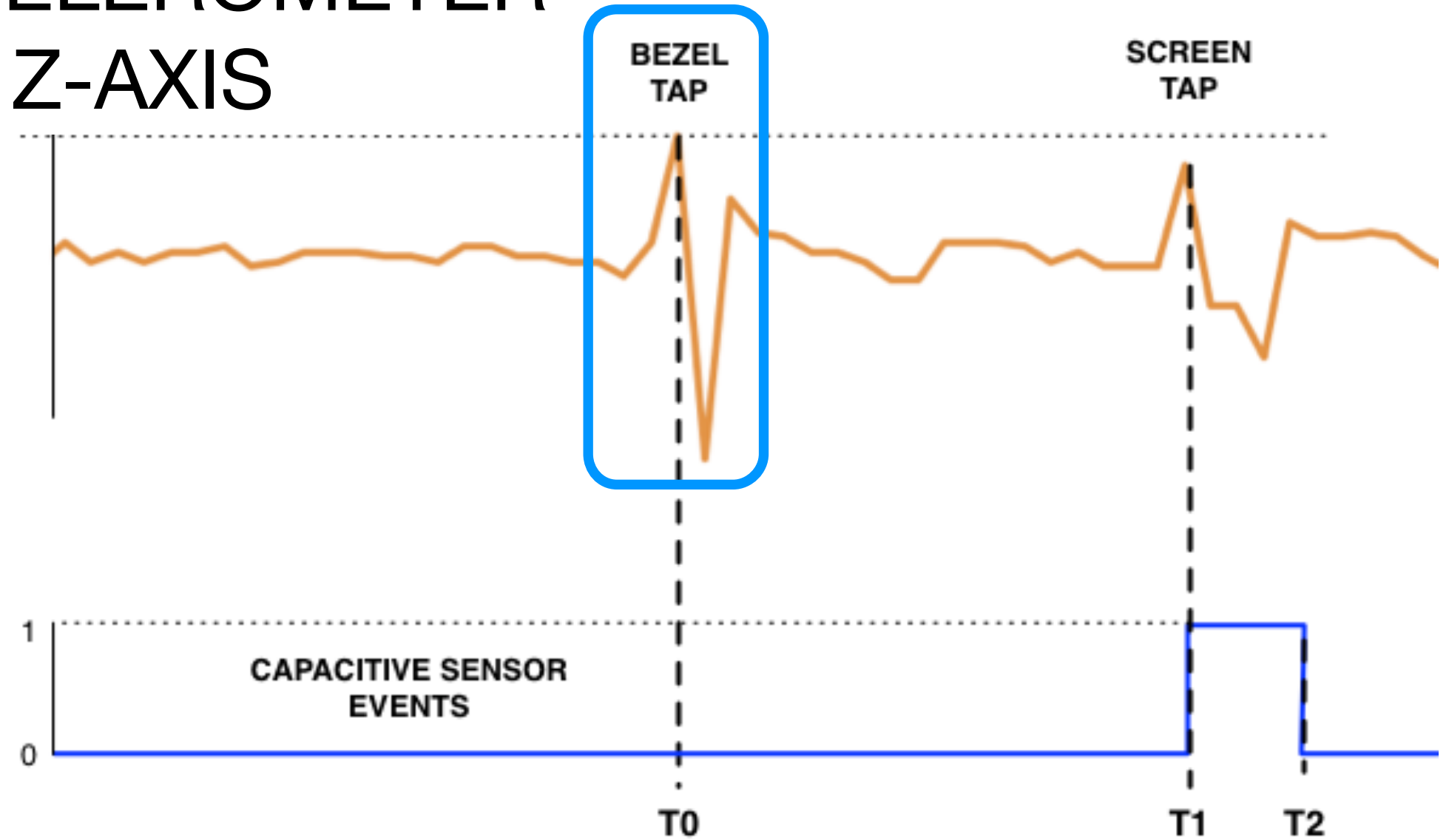
Rapid

Robust

1. ACCELEROMETER Z-AXIS



Bezel-Tap



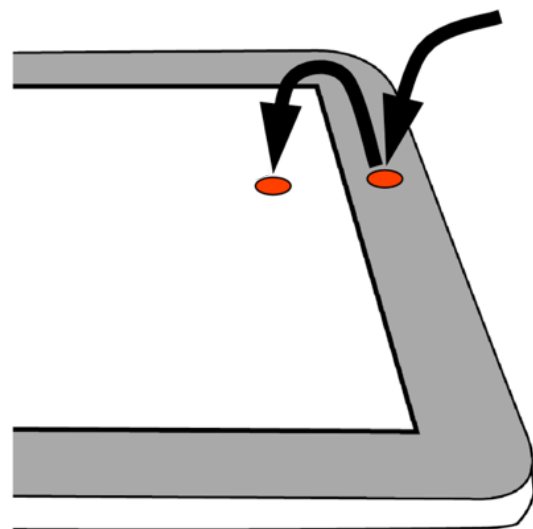
Detection

Low power consumption

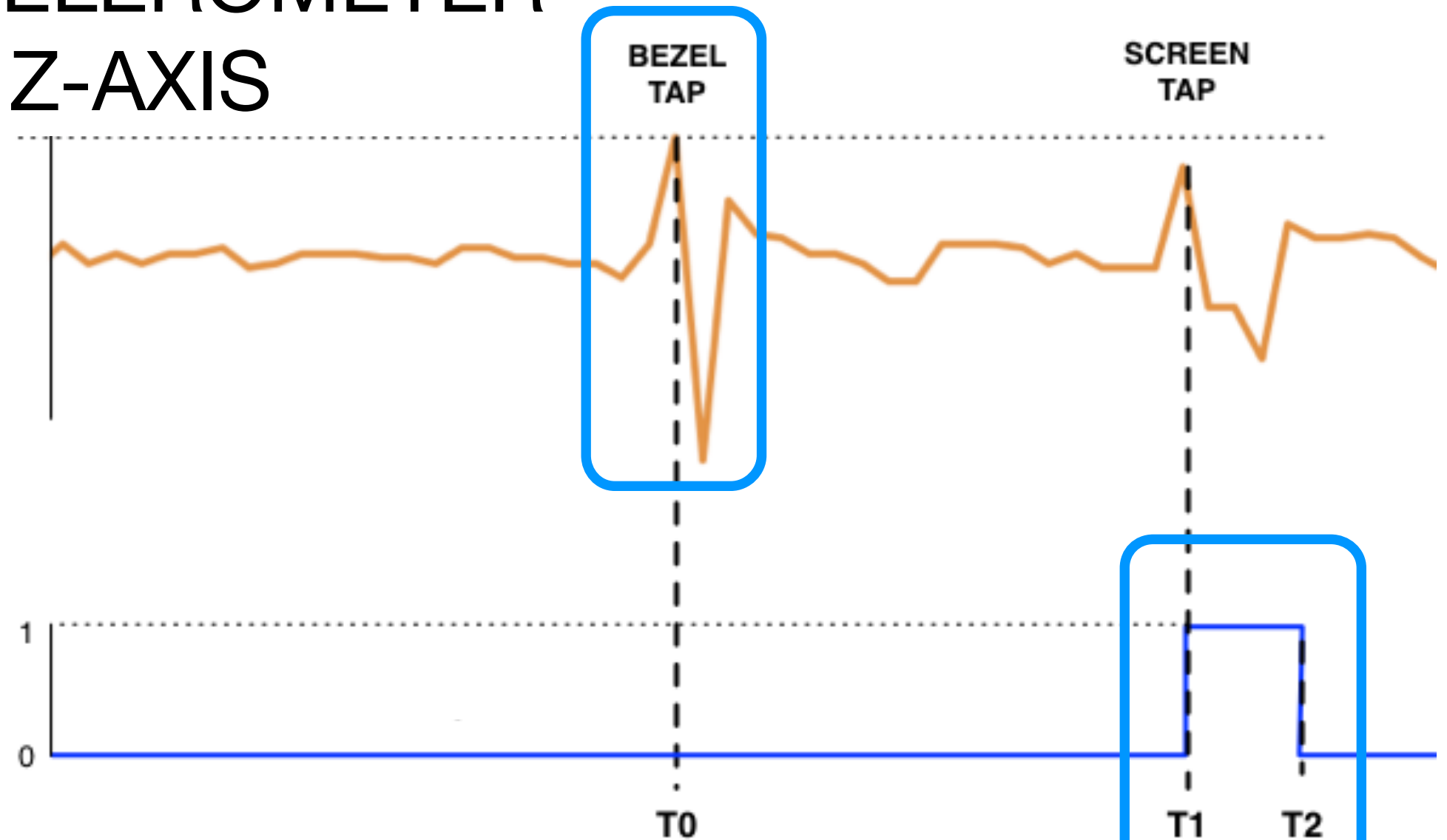
Rapid

Robust

1. ACCELEROMETER Z-AXIS



Bezel-Tap



2. CAPACITIVE SENSOR

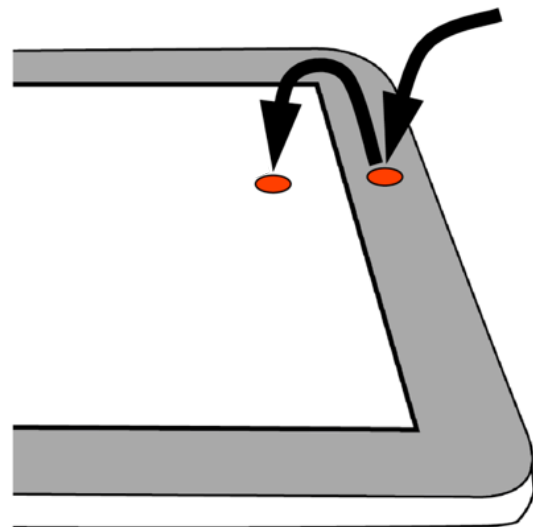
Detection

Low power consumption

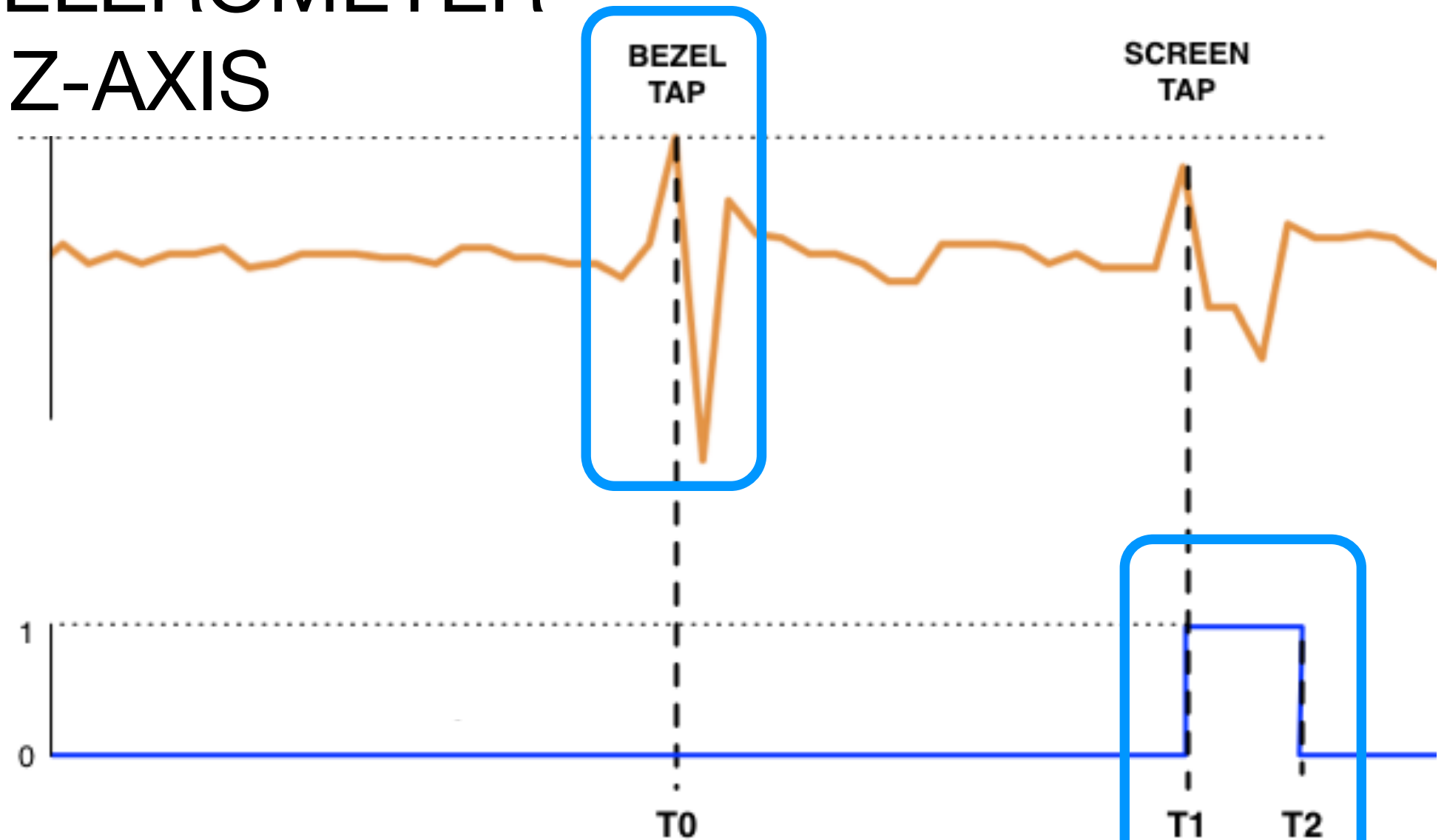
Rapid

Robust

1. ACCELEROMETER Z-AXIS



Bezel-Tap



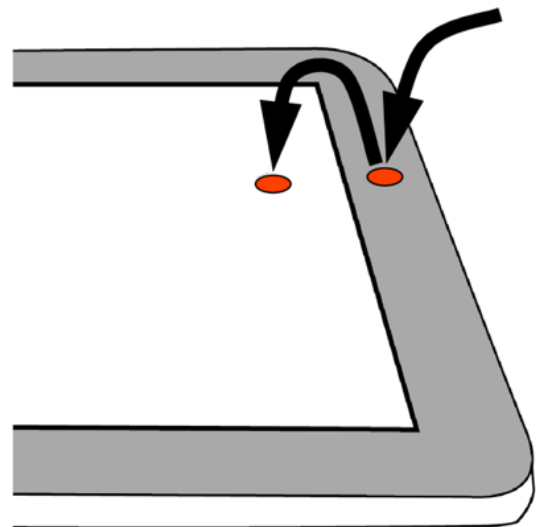
2. CAPACITIVE SENSOR

Inter-tap time

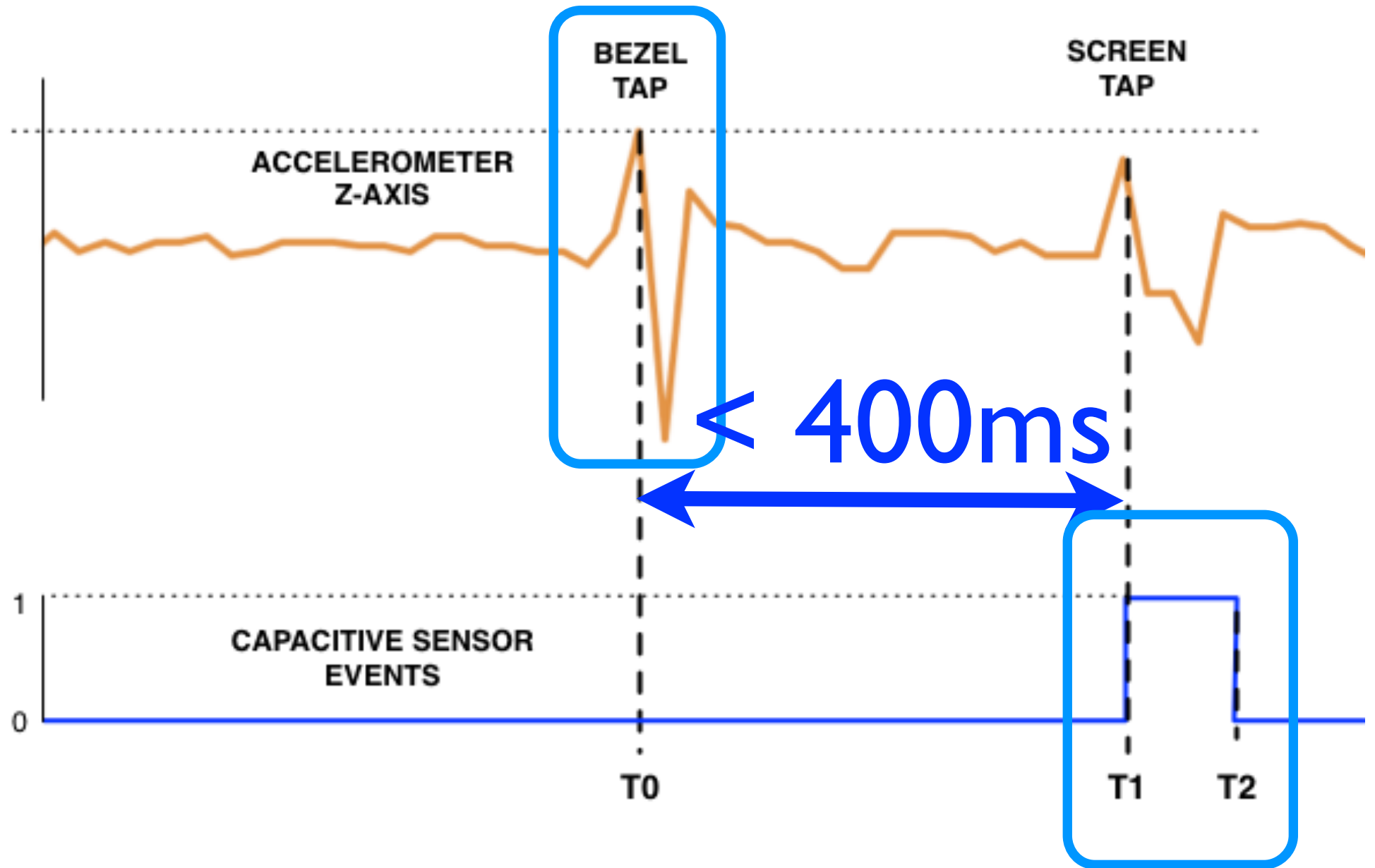
Low power consumption

Rapid

Robust



Bezel-Tap

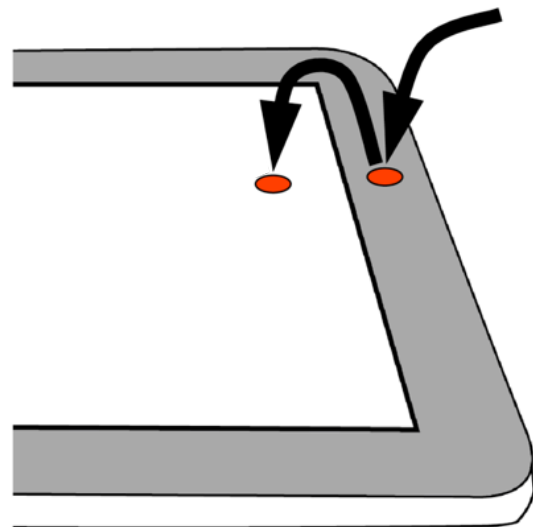


Succession of events

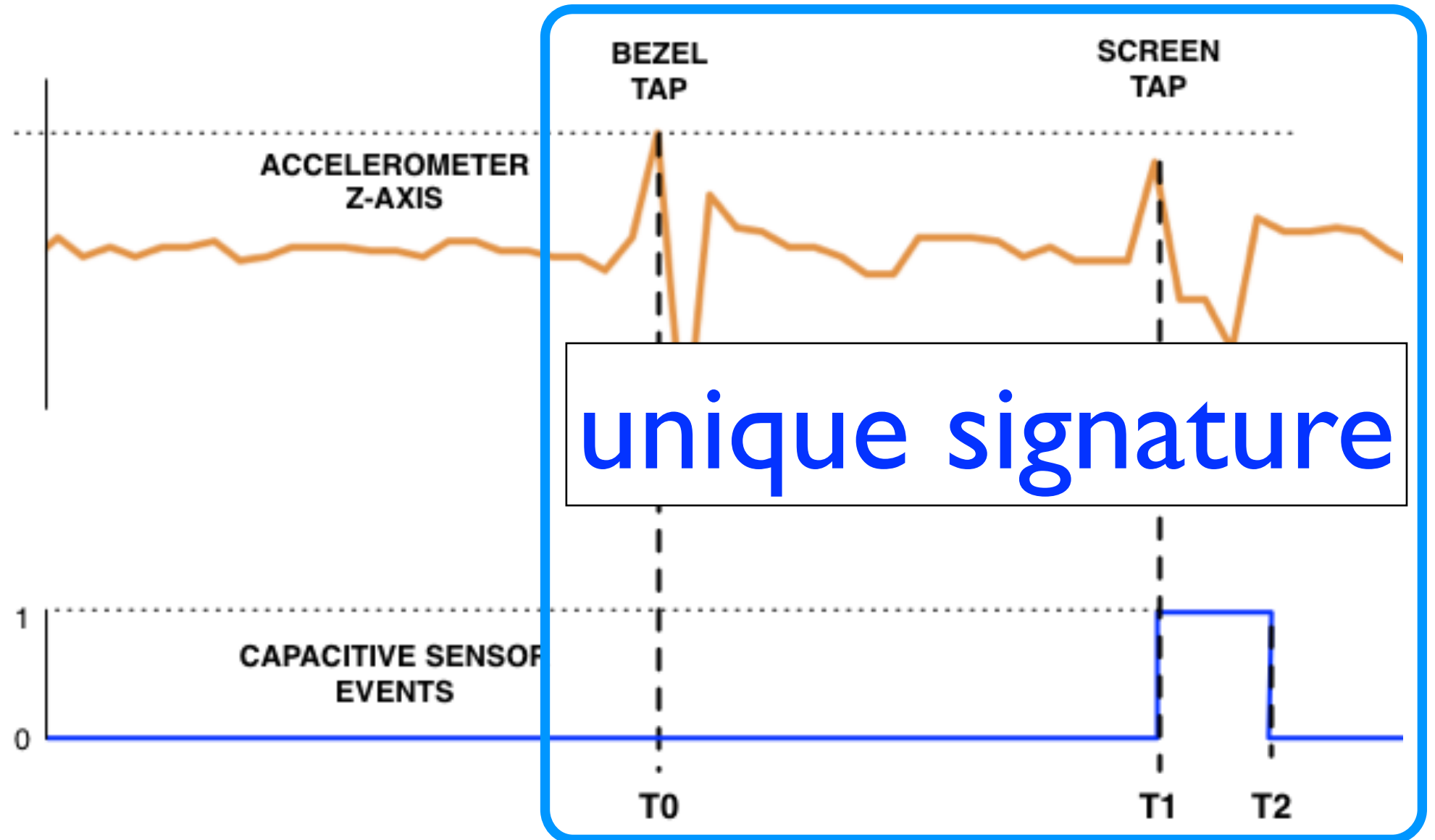
Low power consumption

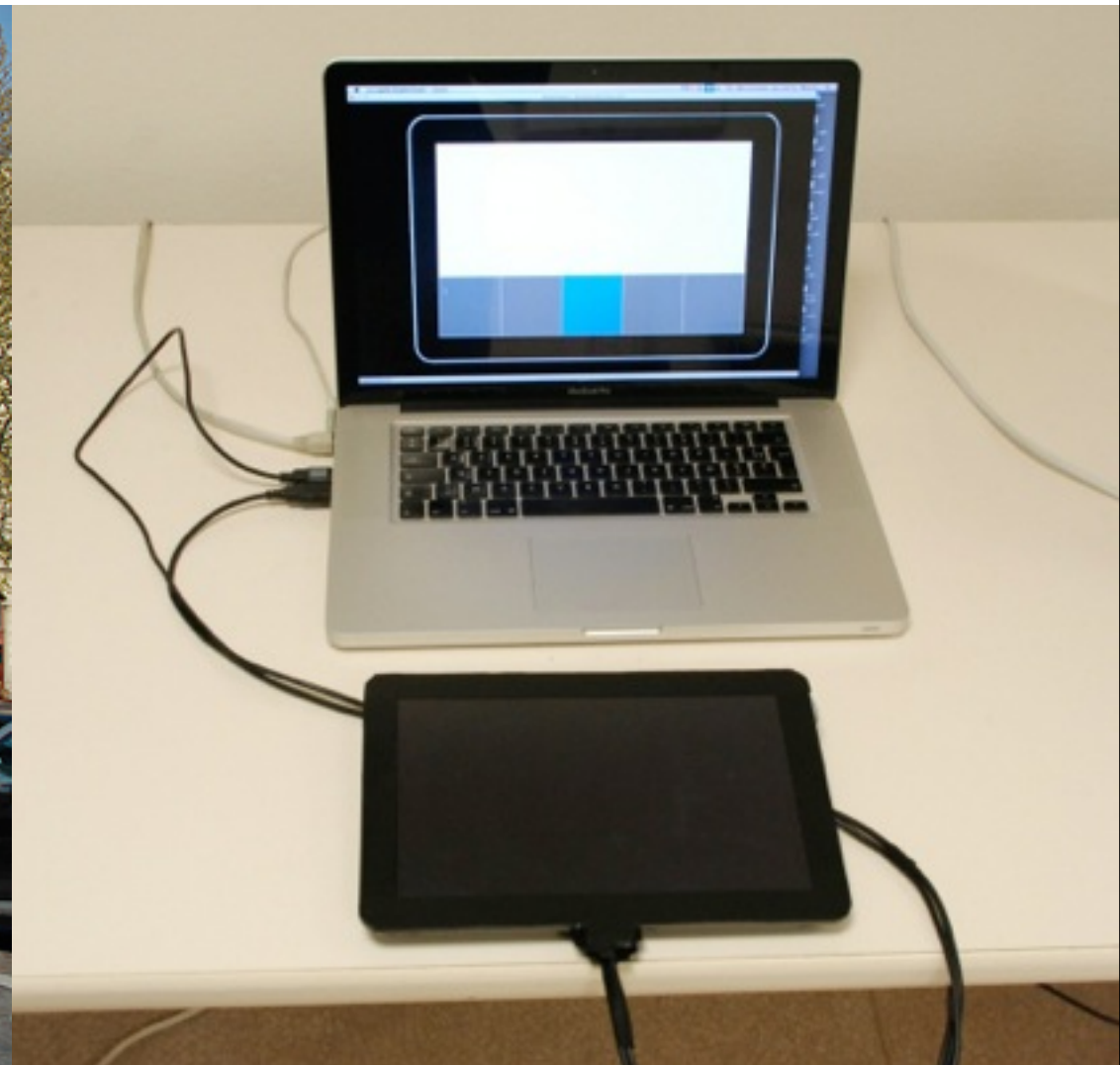
Rapid

Robust

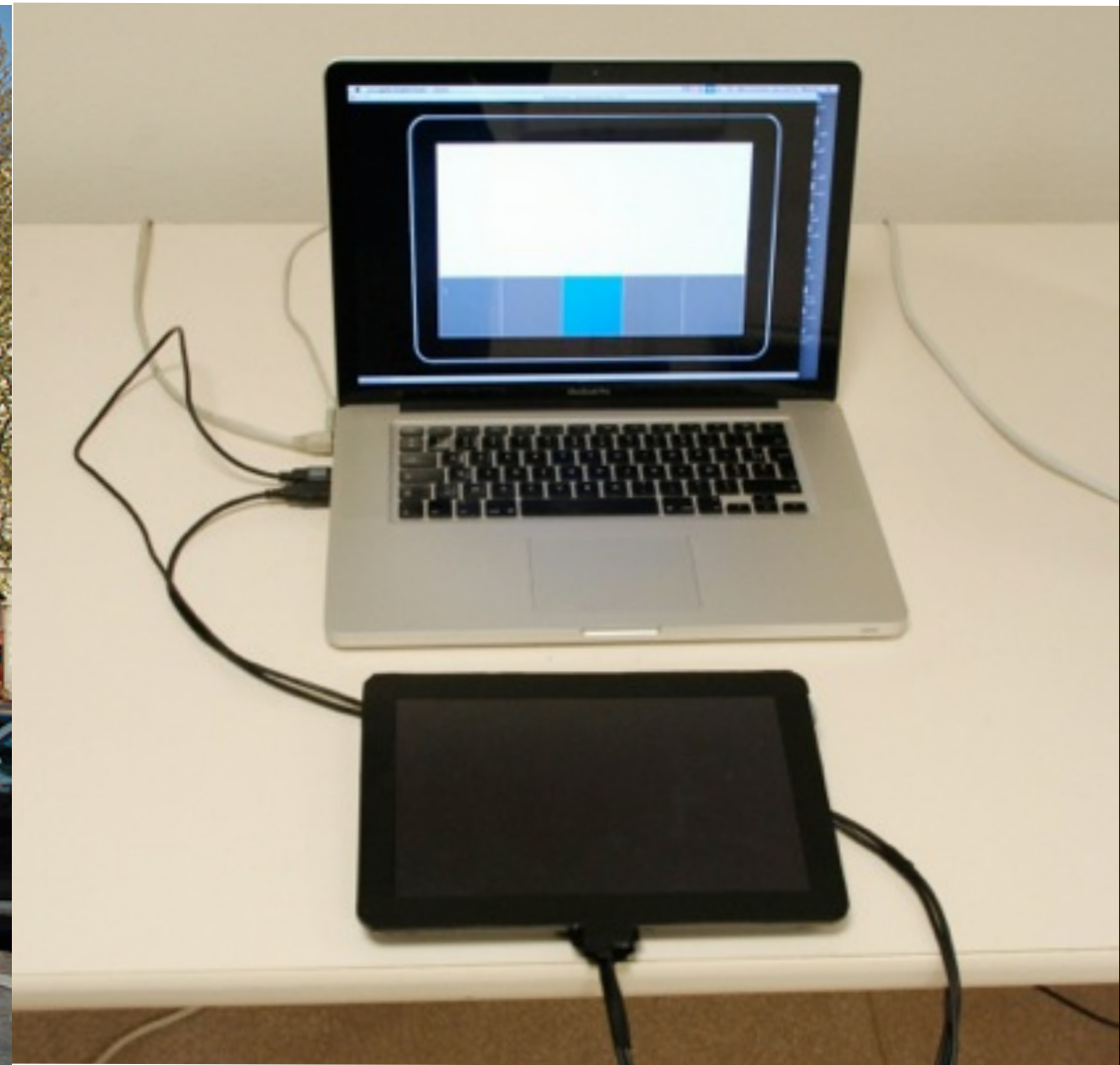


Bezel-Tap





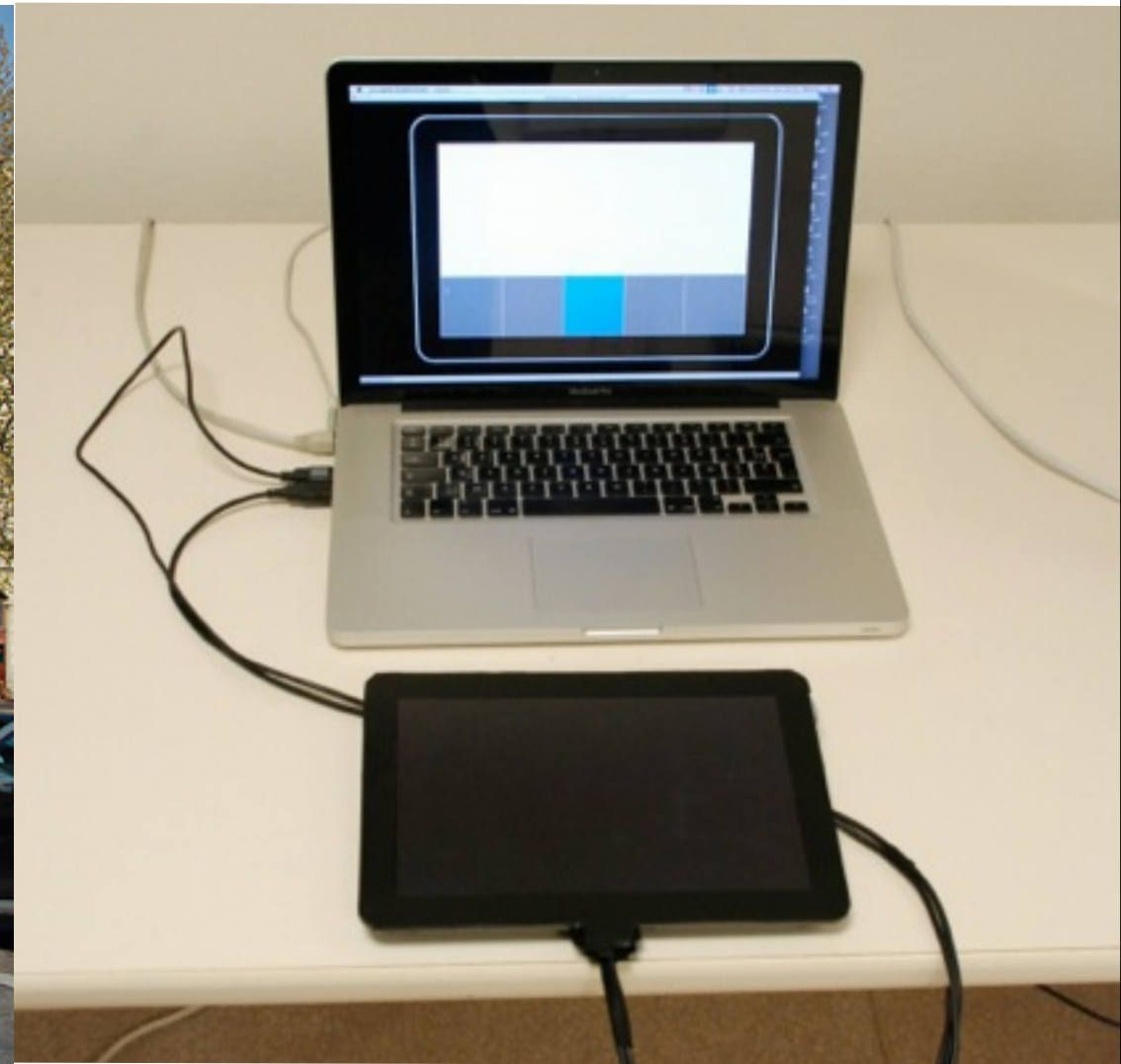
2. Evaluations



False positives
Robustness
Energy consumption



False positives
Robustness
Energy consumption



Size of command set
Dormant tablet

Field study 1: robustness

12 participants
24h each participant
Used it at least 1h



Field study 1: robustness

12 participants
24h each participant
Used it at least 1h

+ 25h of use



Field study 1: robustness

12 participants
24h each participant
Used it at least 1h

+ 25h of use



Number of false positives = 0

Field study 2: Power consumption



Field study 2: Power consumption



+ 8h
accelerometer
log



Field study 2: Power consumption



6.15 taps/hour



Tablet in sleep mode

12 participants

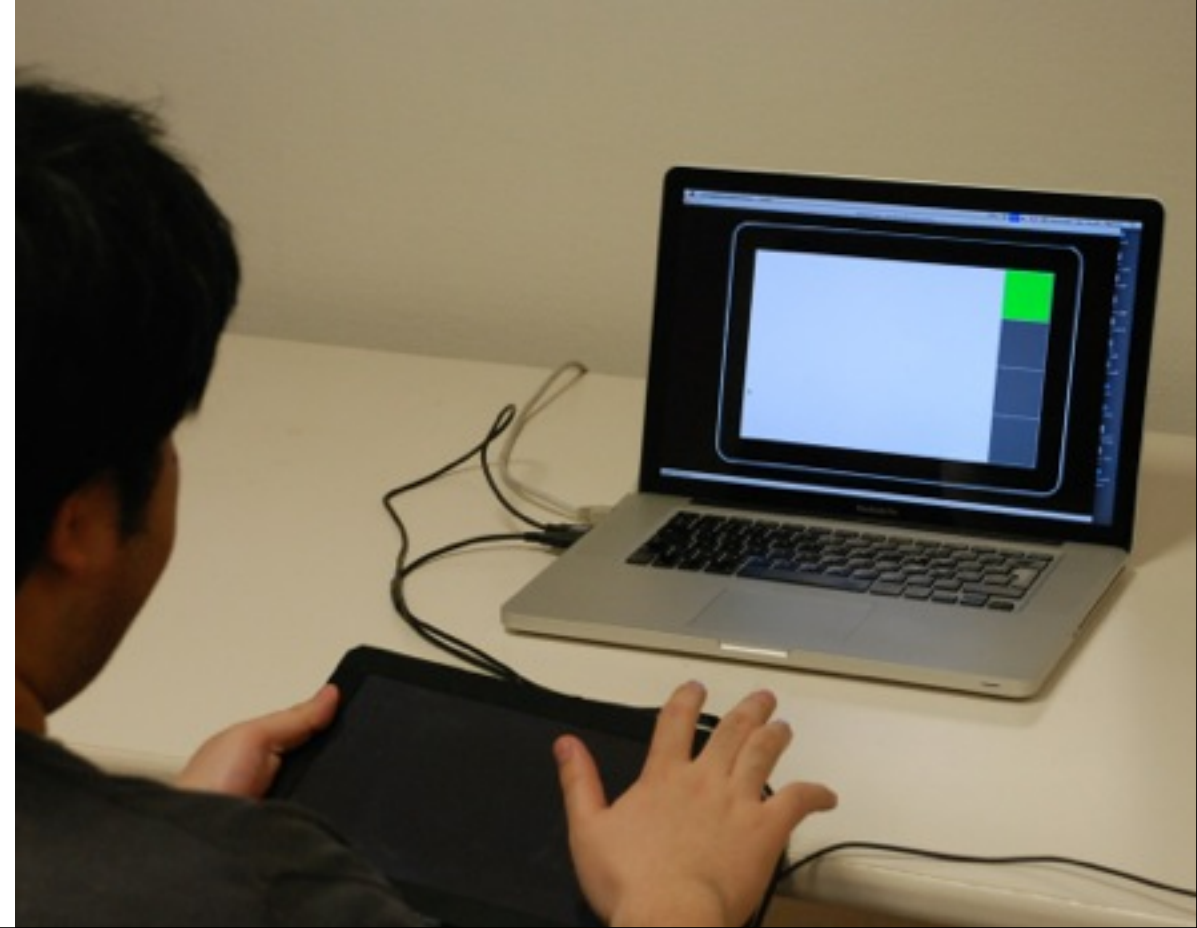
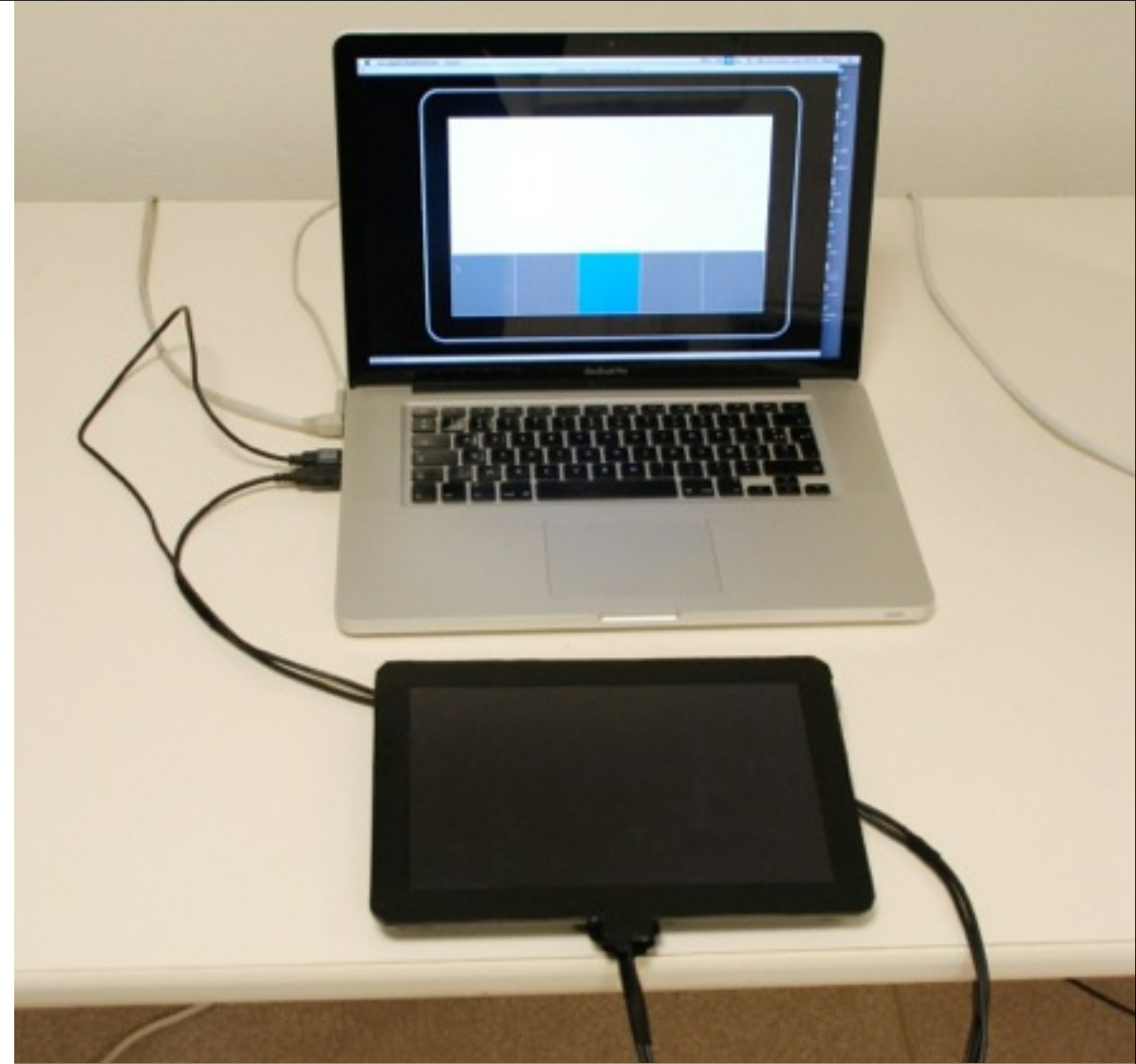
352 trials/participant

4224 trials

Two Factors:

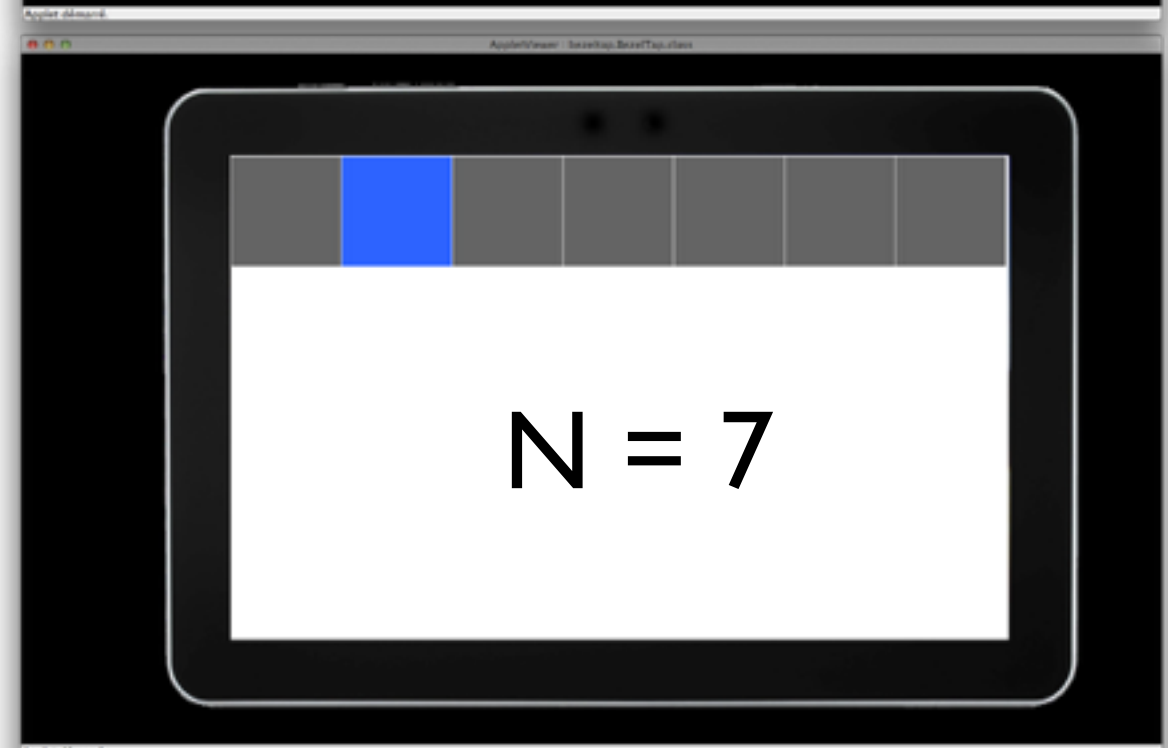
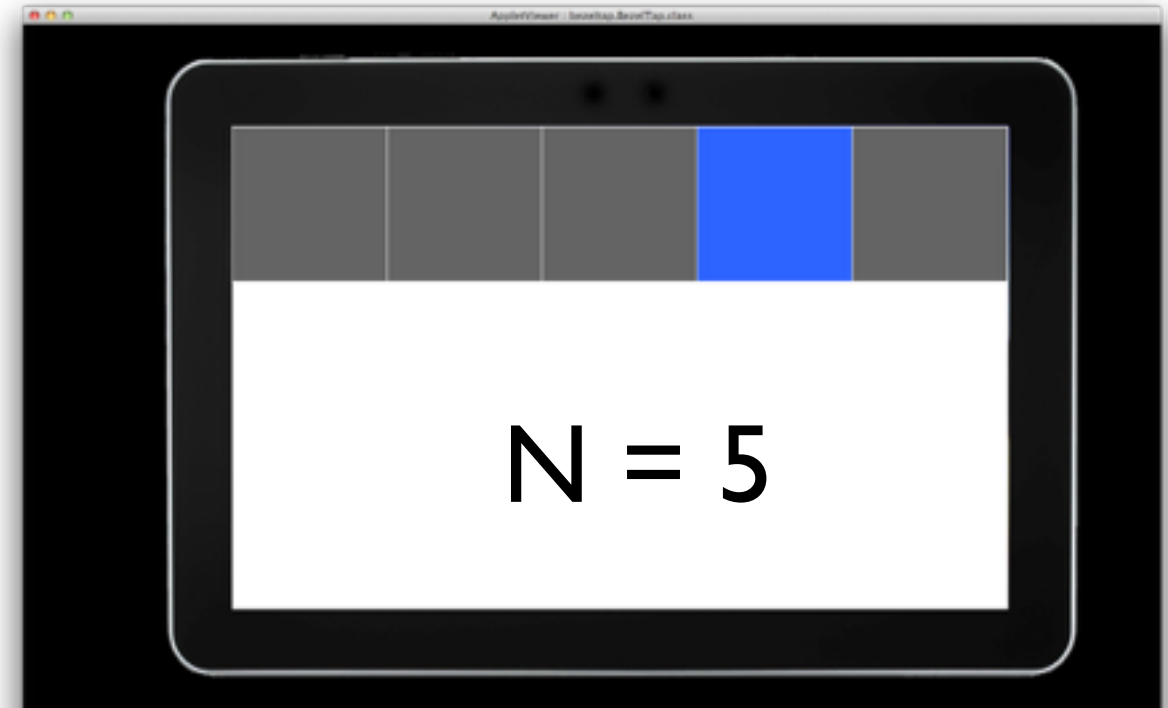
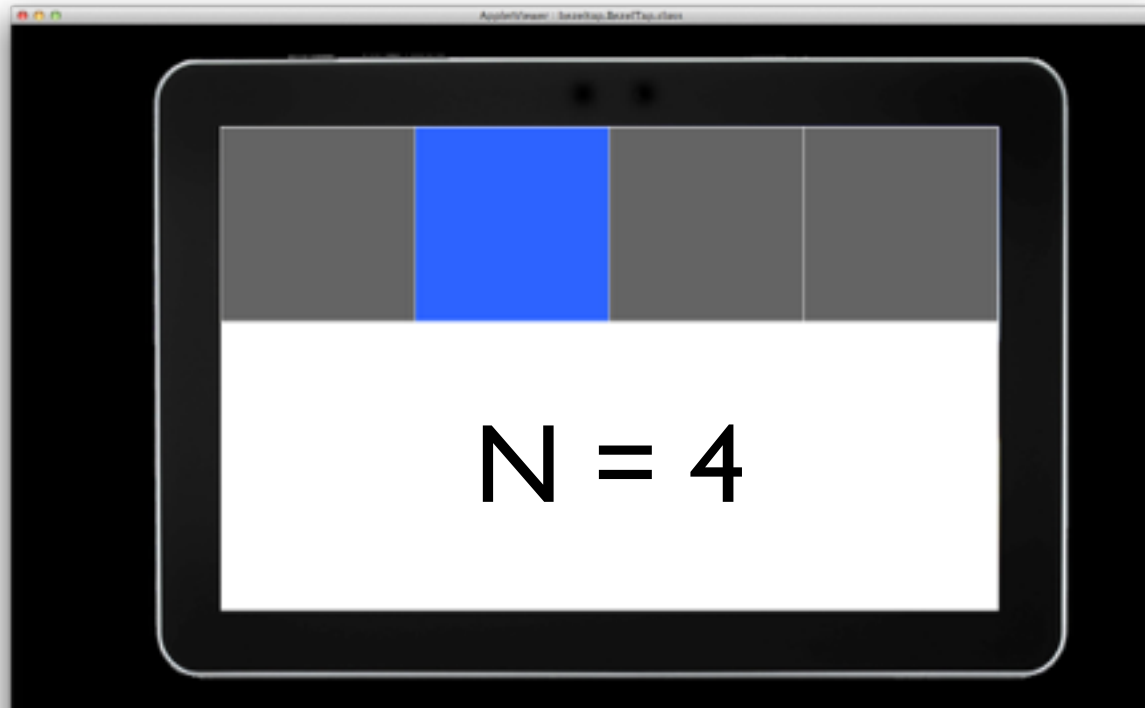
Position (top, bottom, left, right)

Number of items (4, 5, 6, 7)

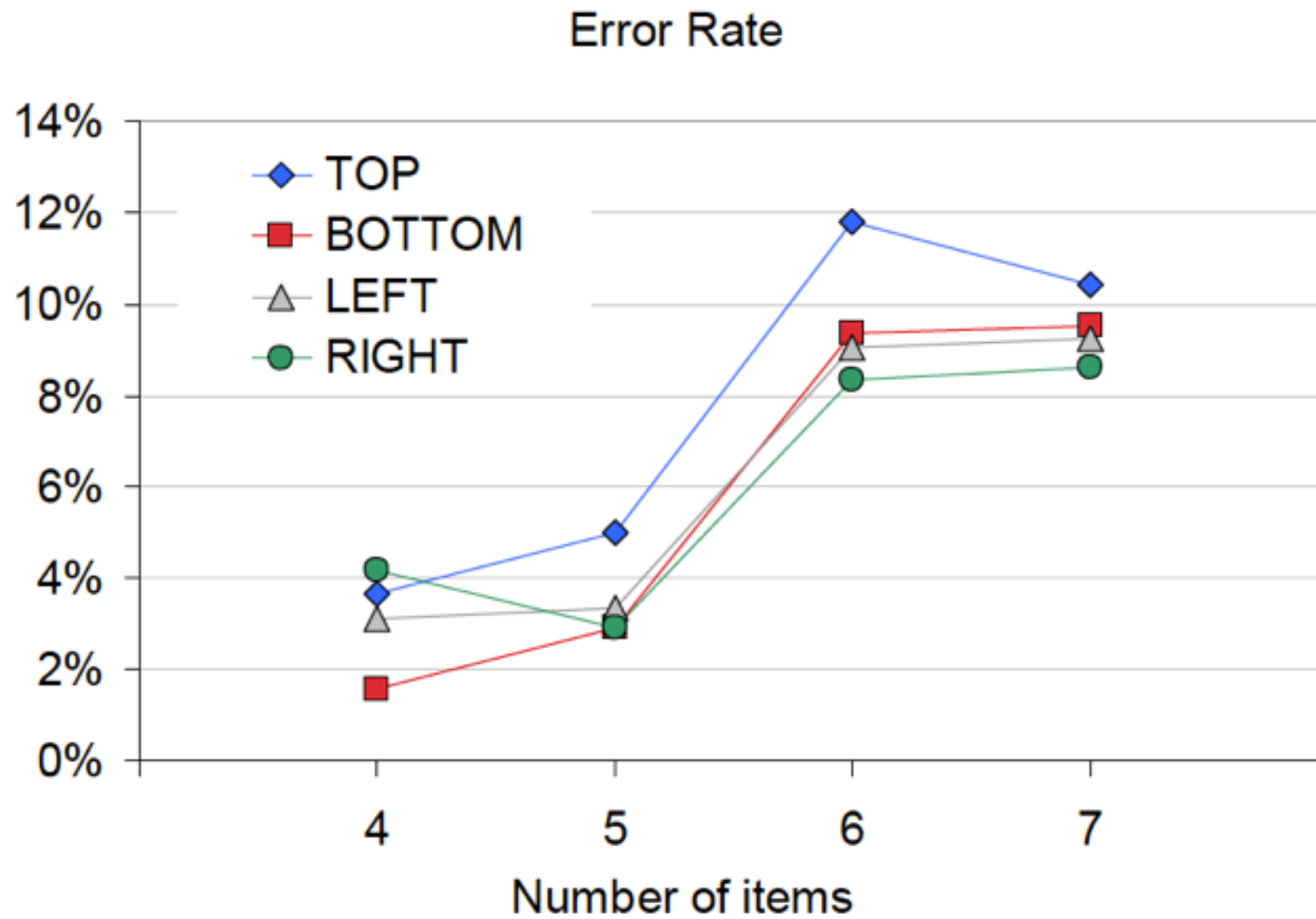


Tablet in sleep mode

Position = top



Results



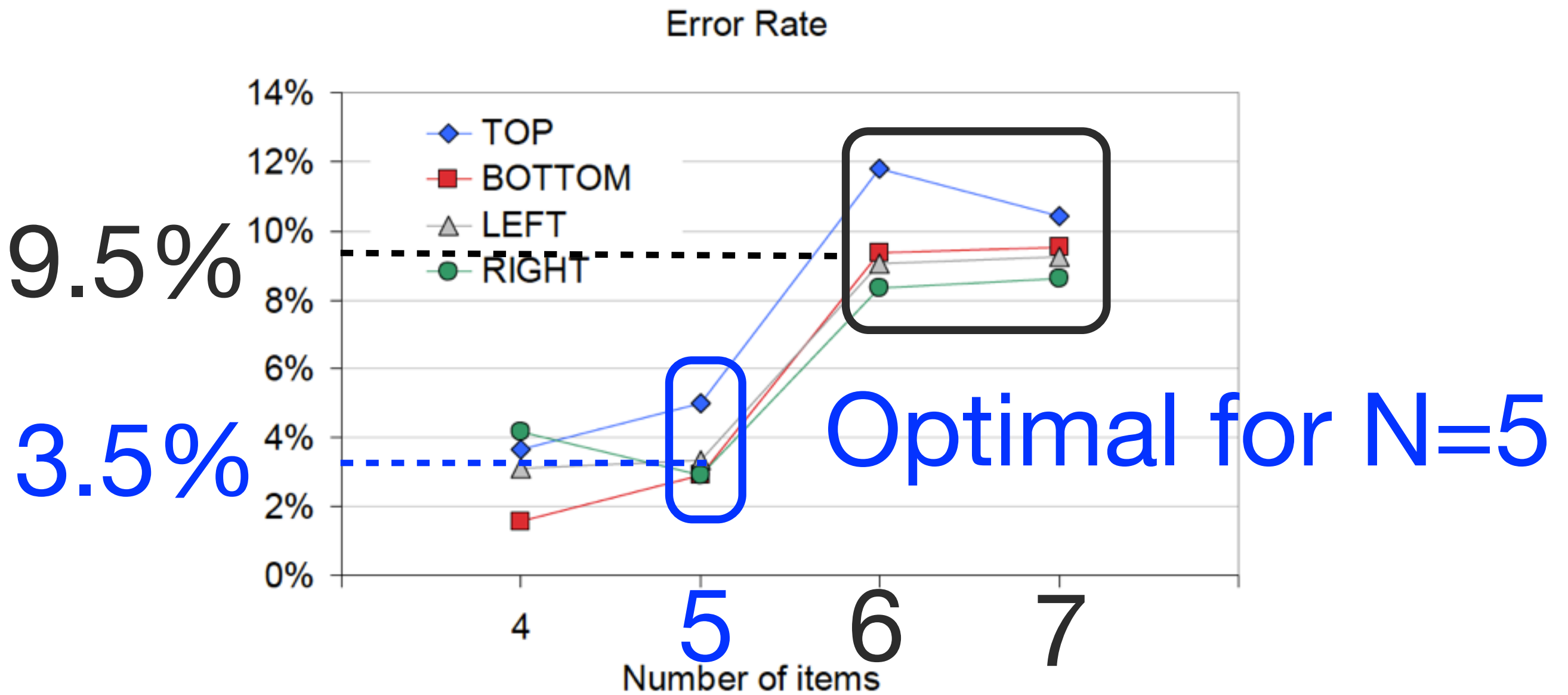
Results



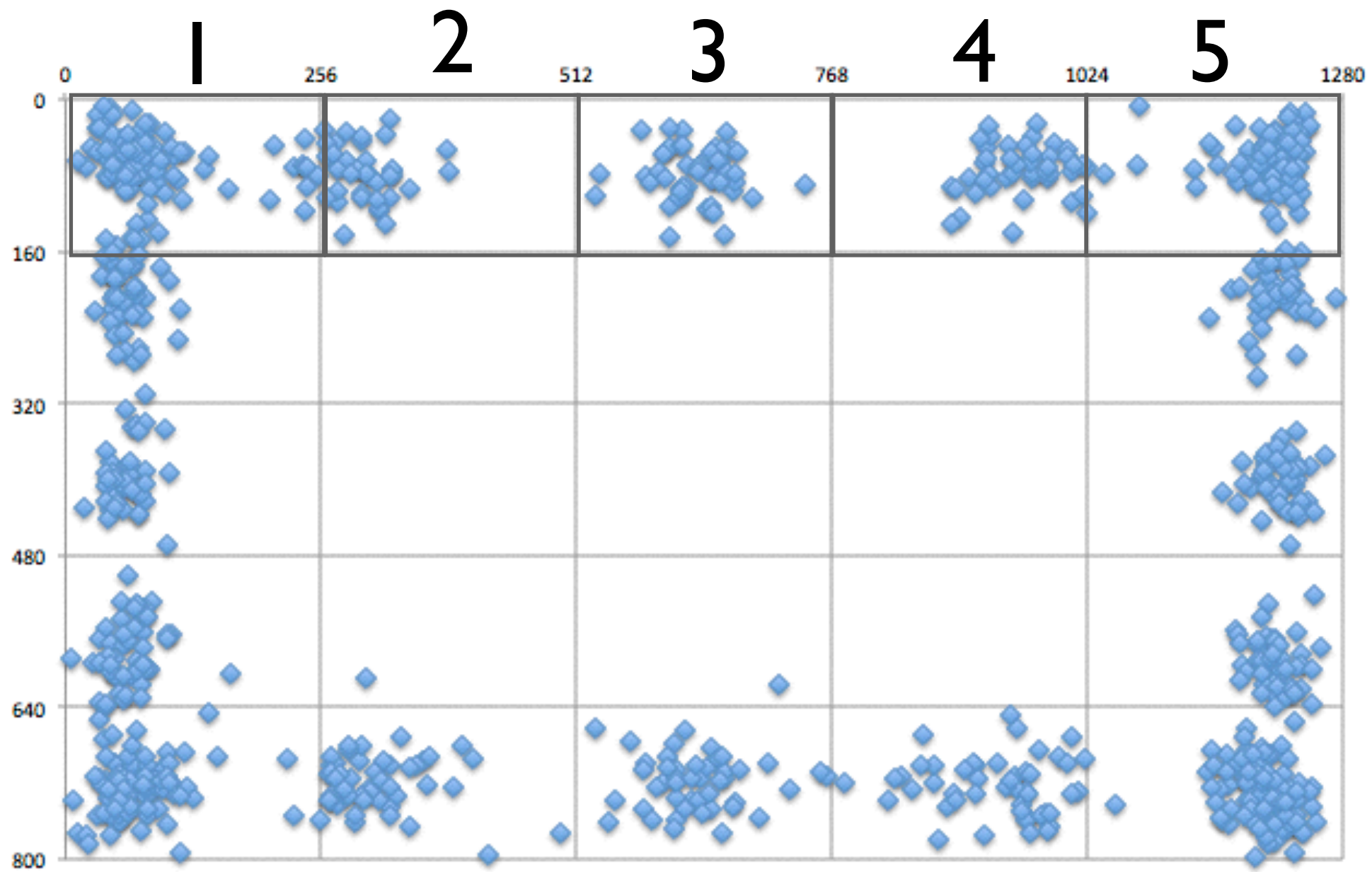
3.5%

Optimal for N=5

Results

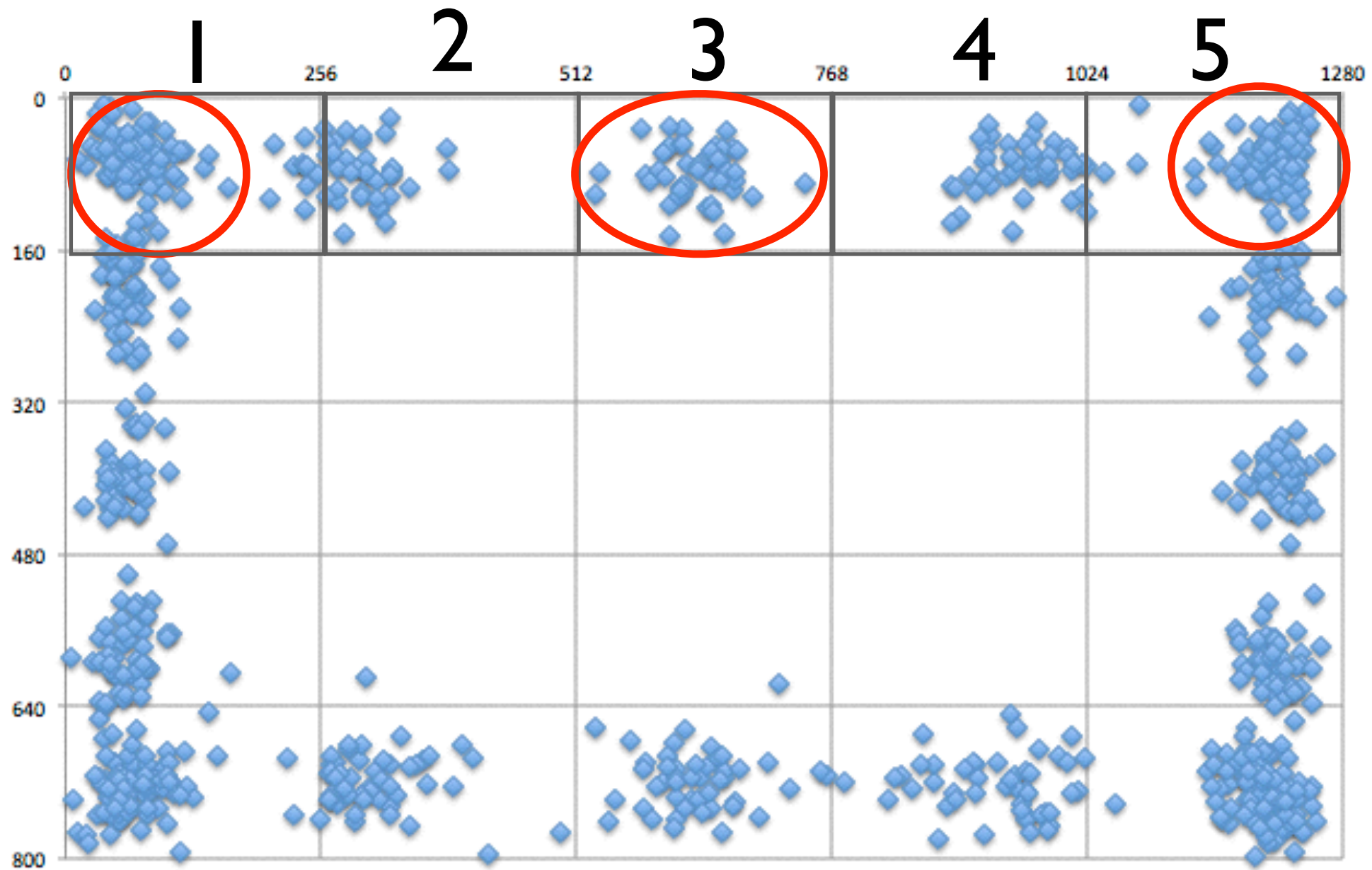


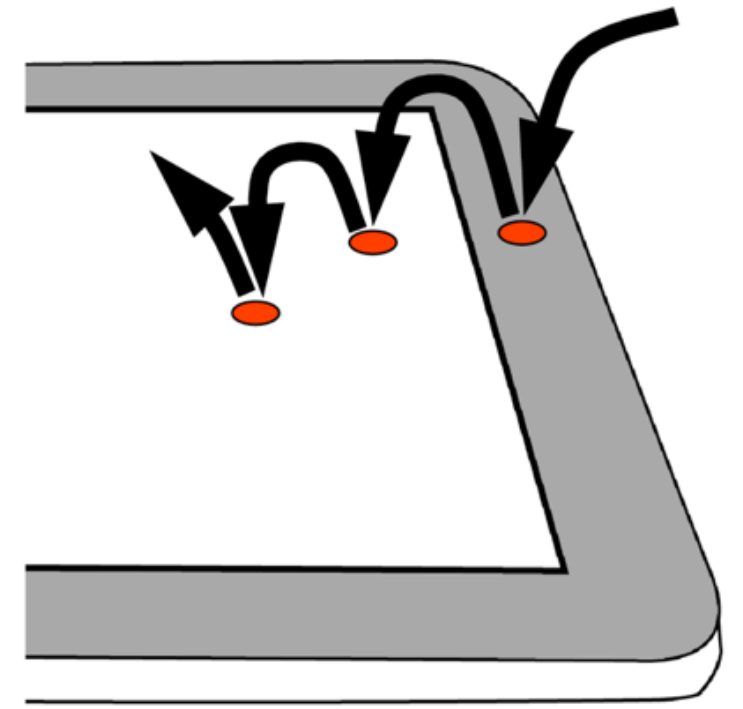
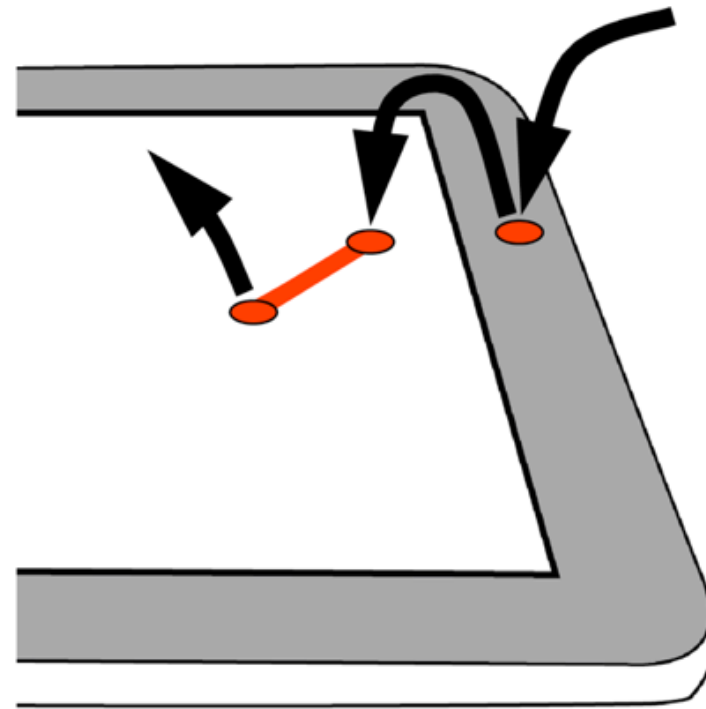
Results



Results

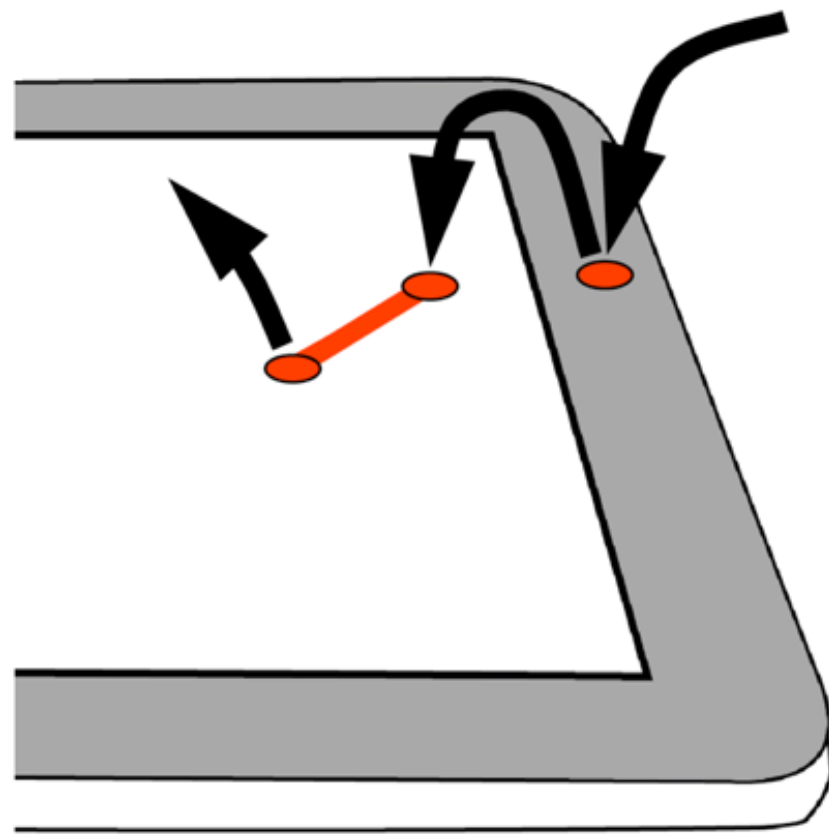
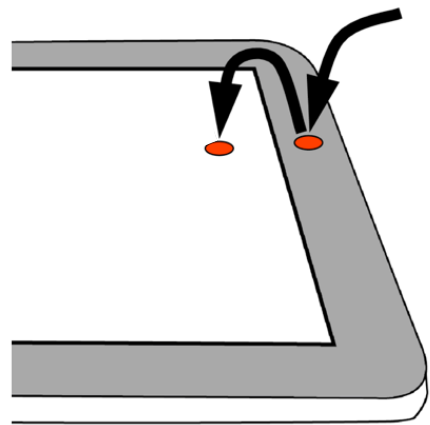
Best precision



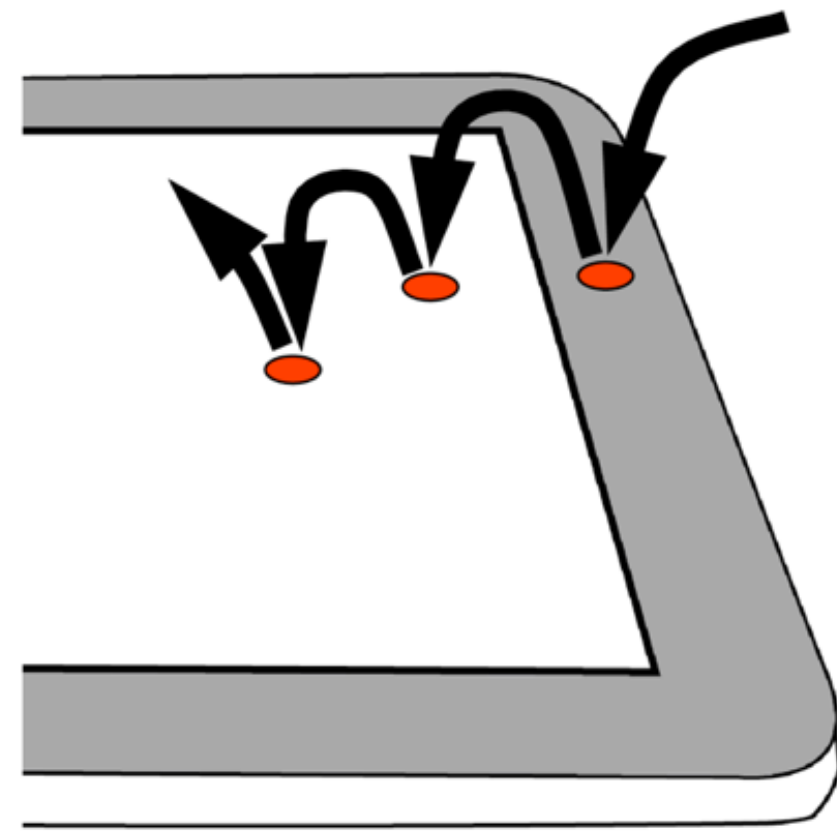


3. Hierarchical Menu

Bezel-Tap gestures



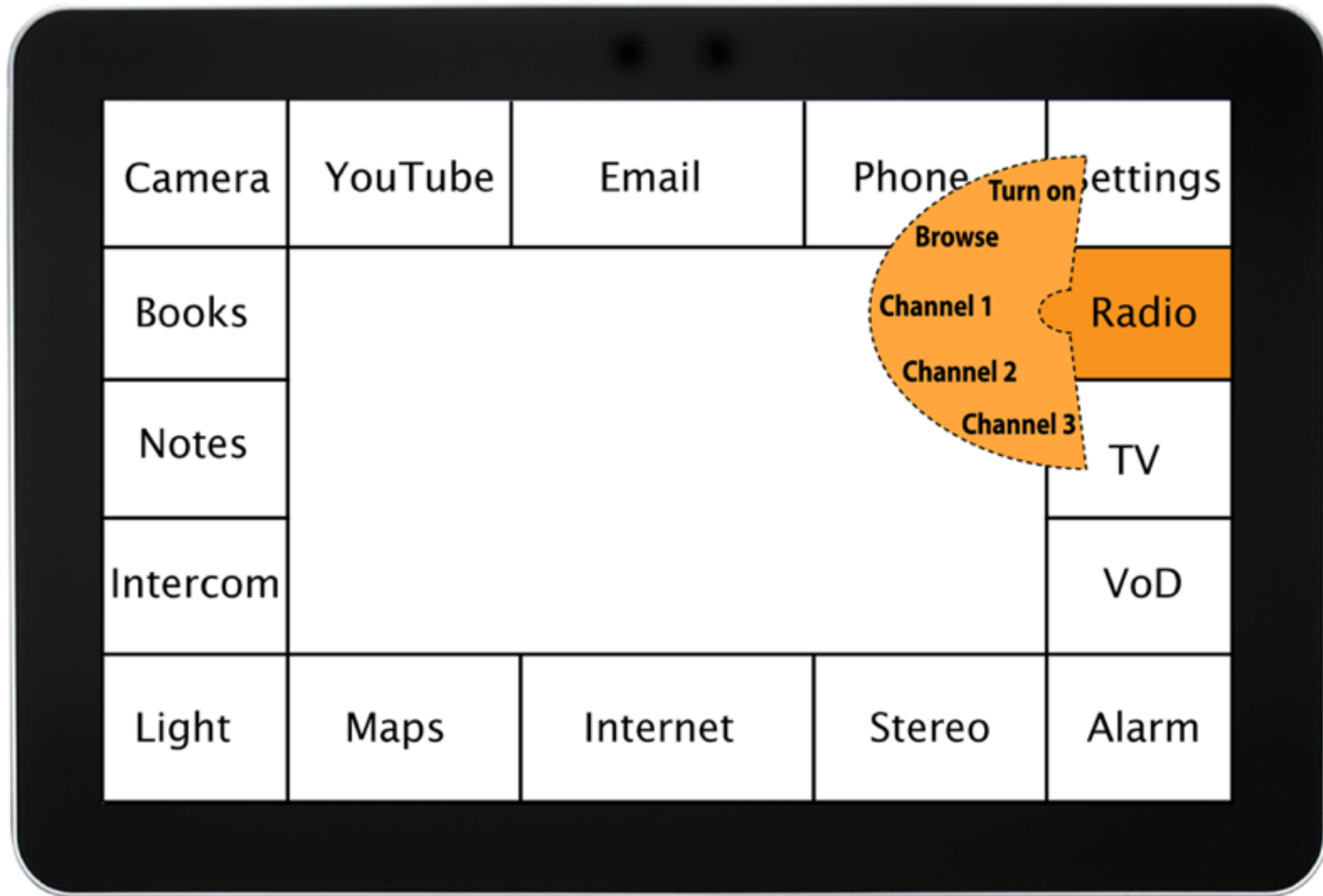
Bezel-Tap Slide



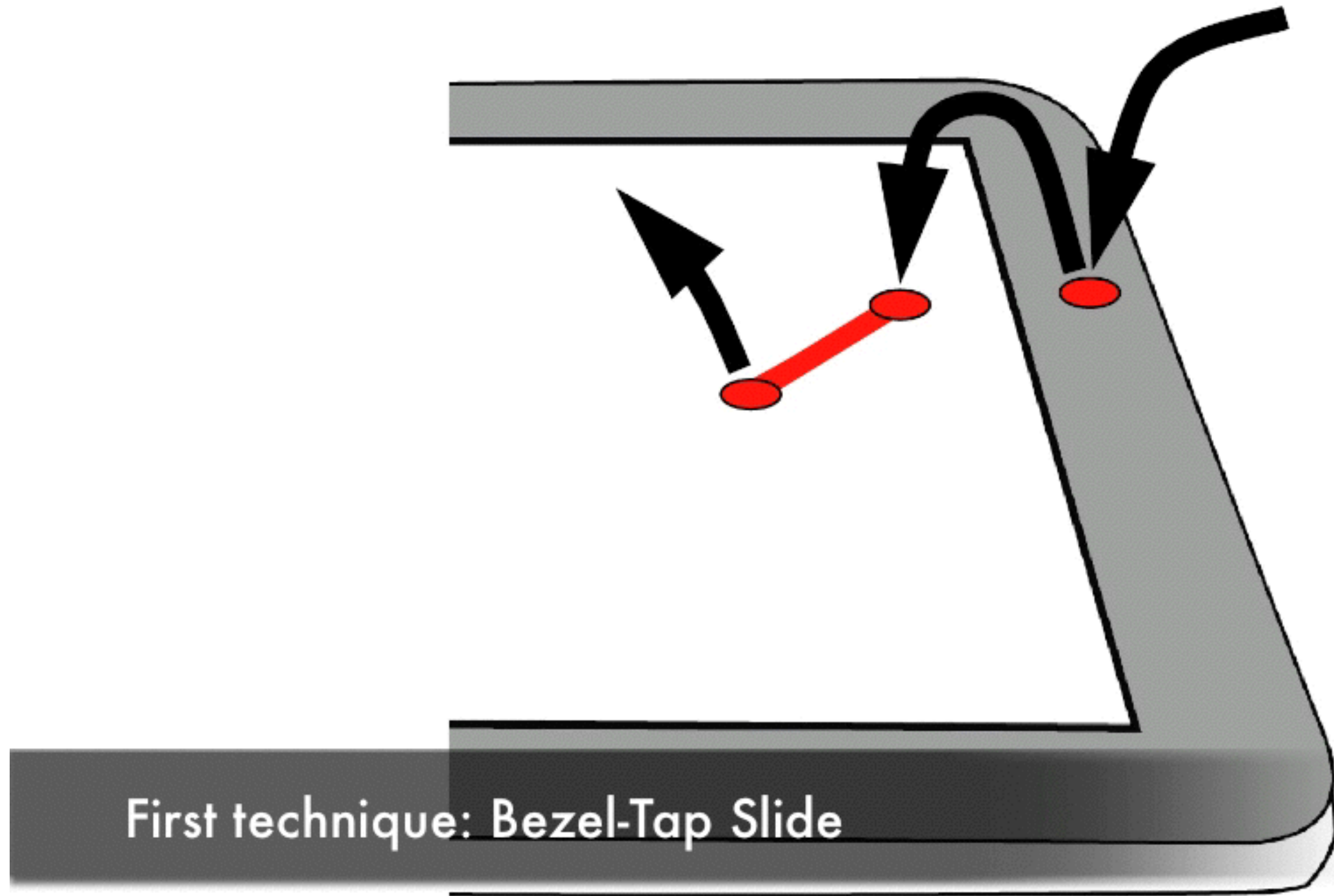
Bezel-Tap3

Hierarchical menus

64 commands: 12 menus, 4 shortcuts



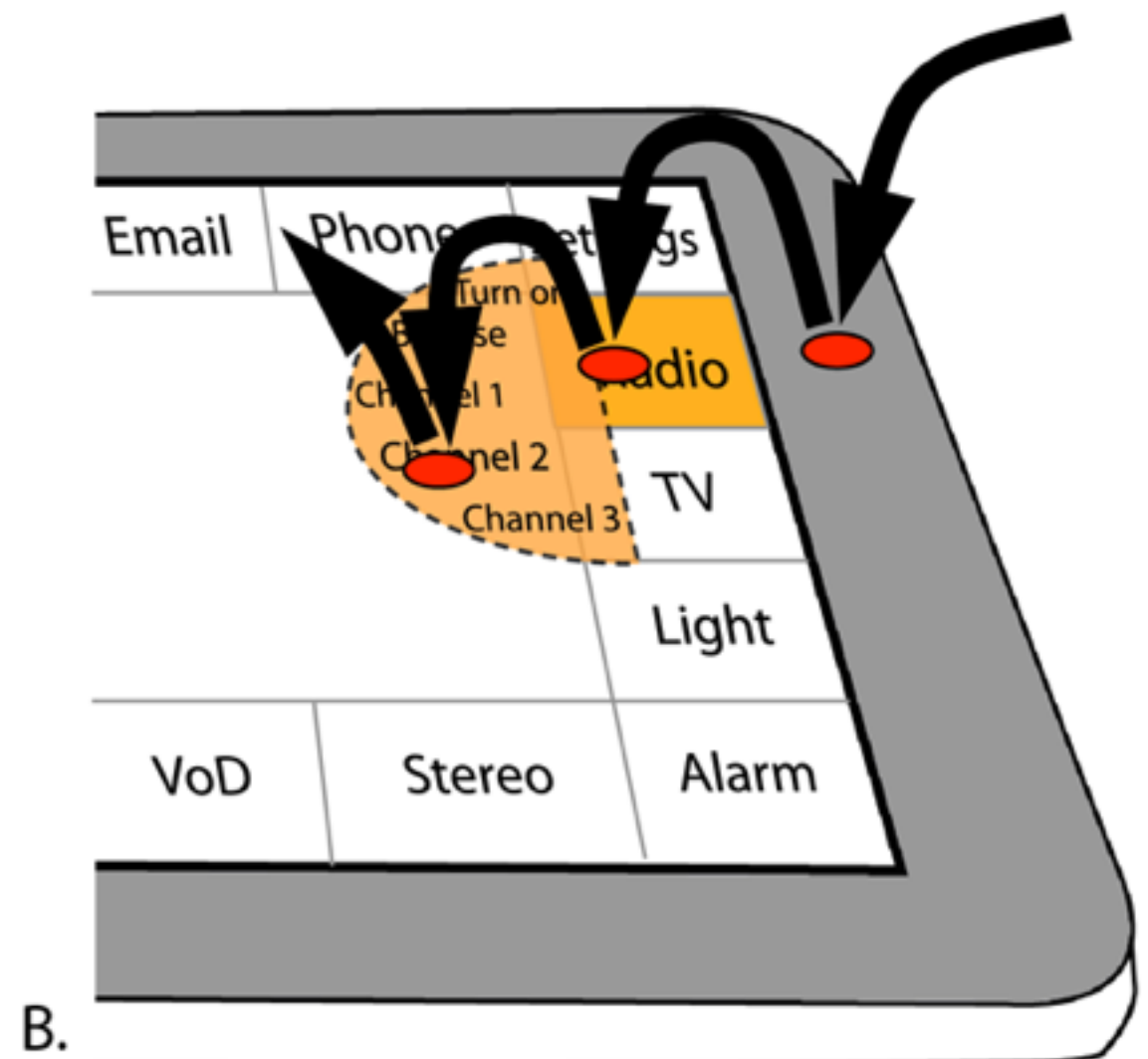
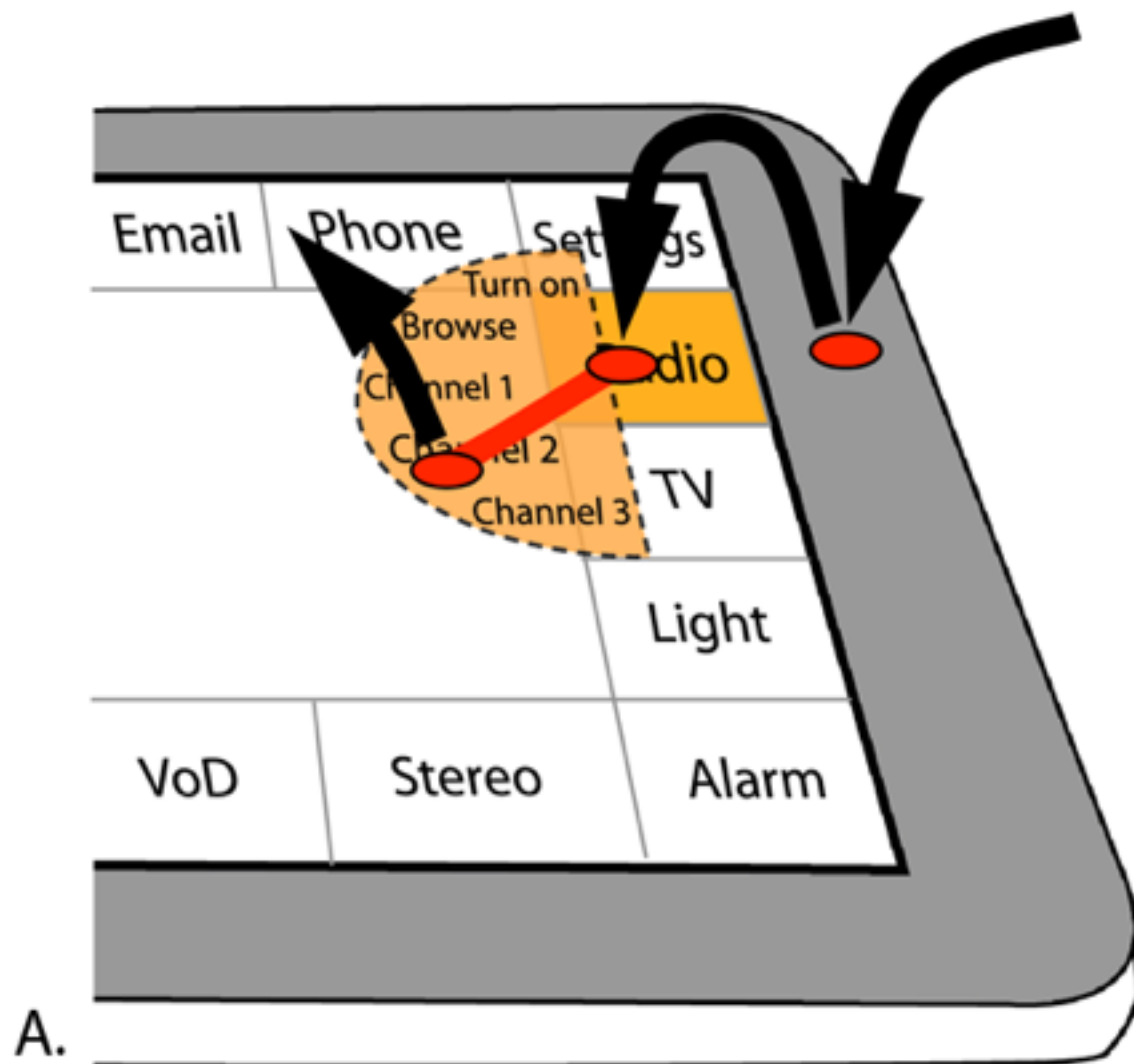
Hierarchical menus



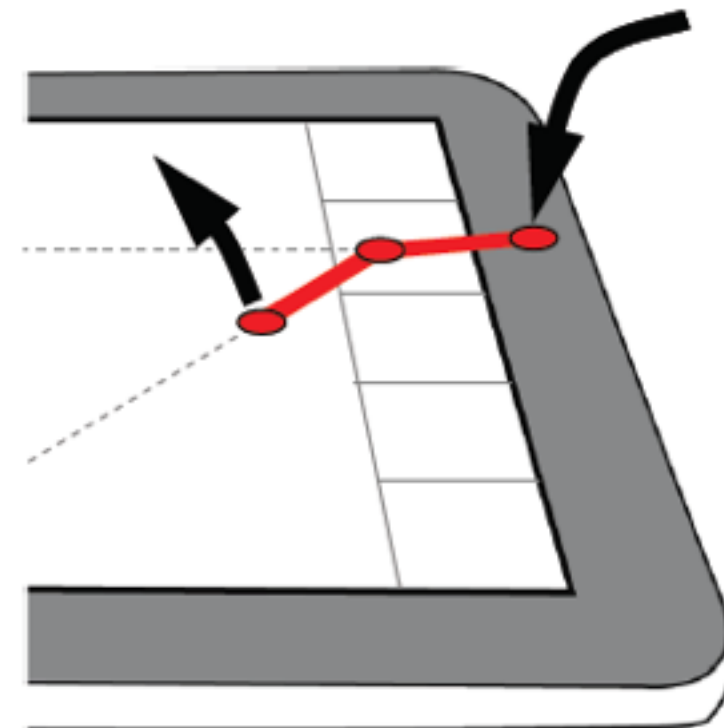
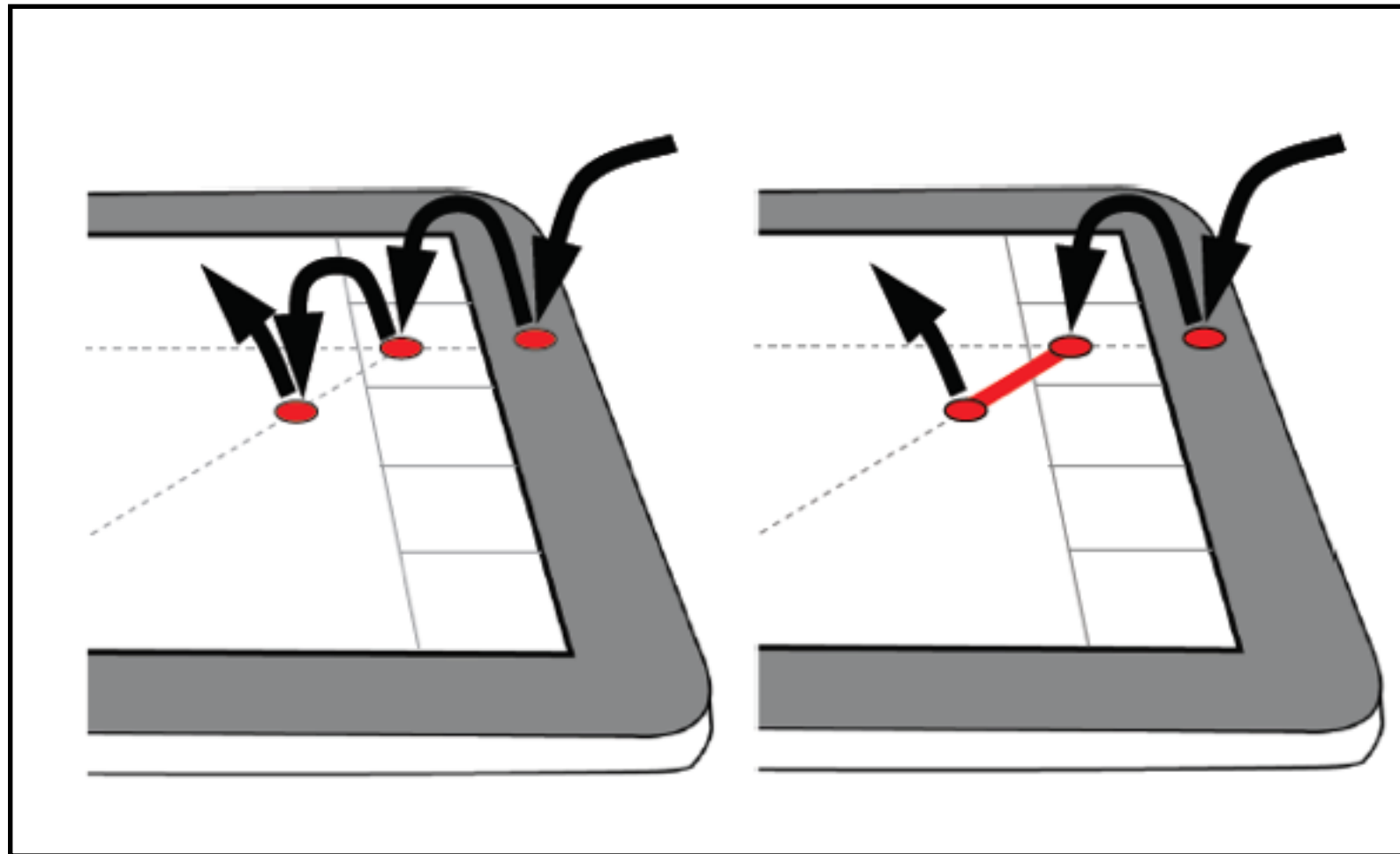
Hierarchical menus

Two techniques are compatible with each other

Also with Bezel Gestures [Bragdon11]



Evaluation



Bezel-Tap 3

Bezel-Tap Slides

Bezel Gestures
[Bragdon 10]

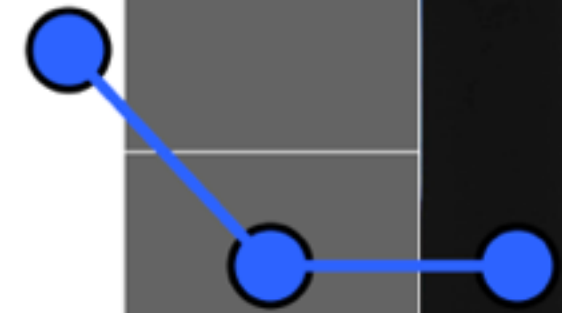
Evaluation

12 participants

297 gestures/participant

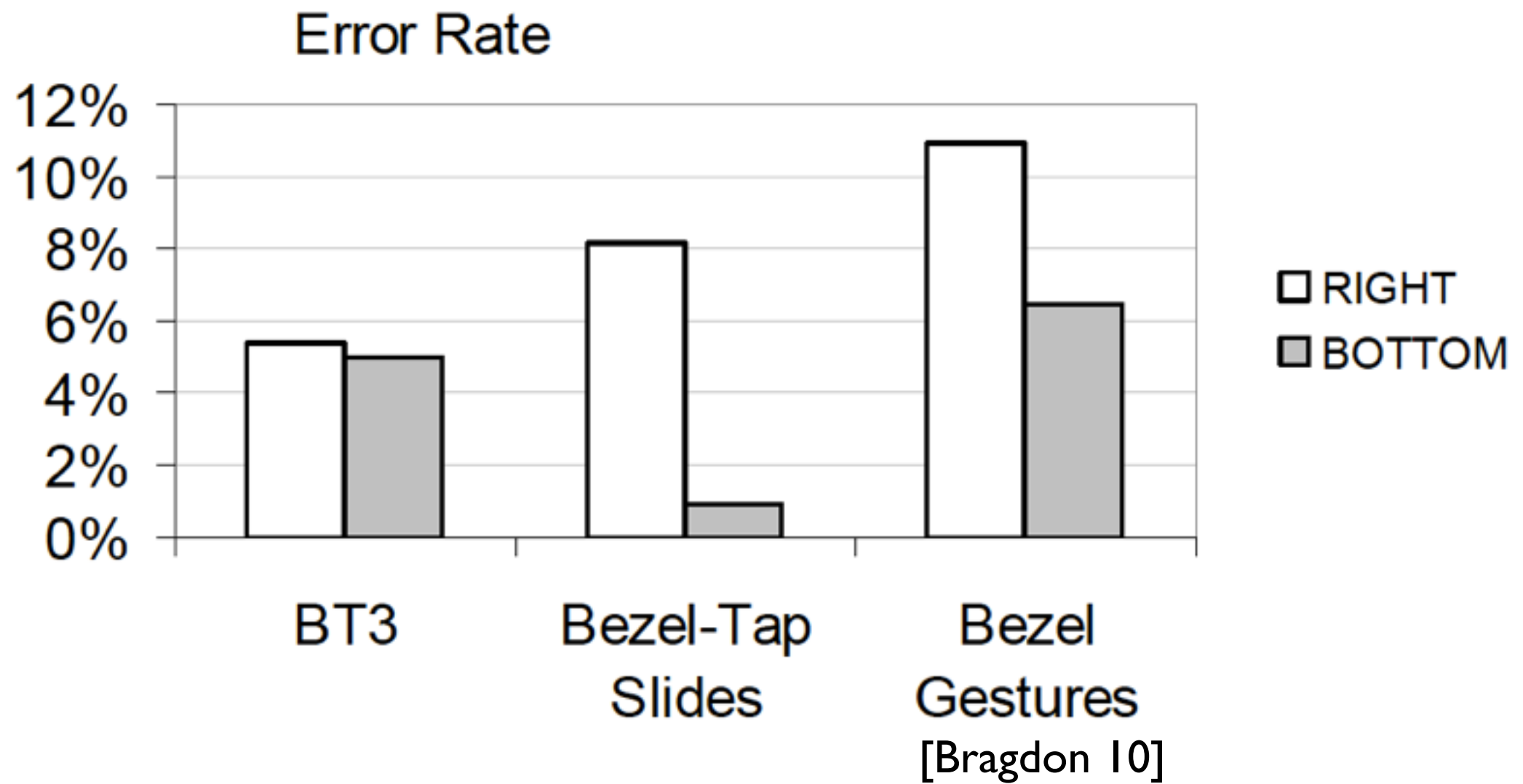
3564 gestures

Only right and bottom regions

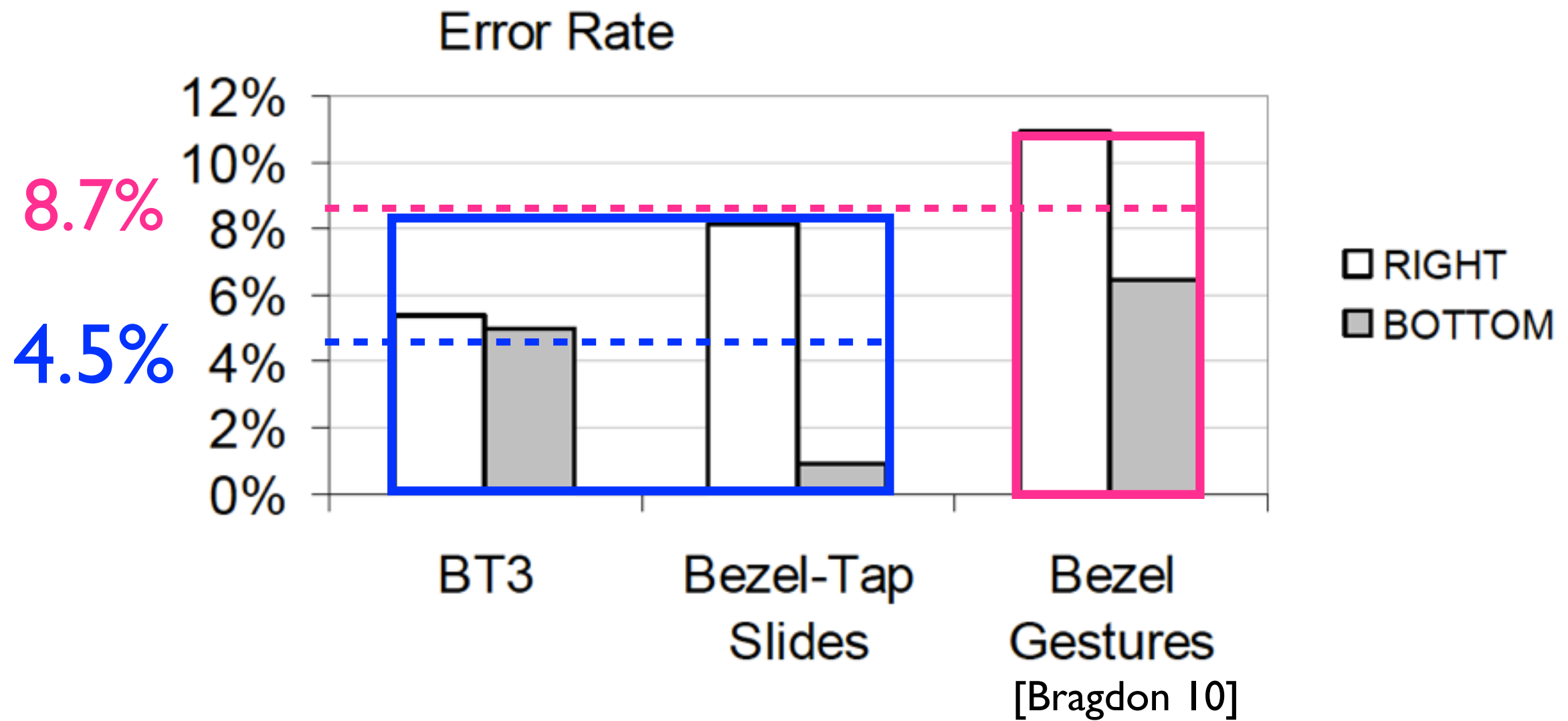


AppletViewer : bstmenuexpe3.BSTMenuExpe3.class

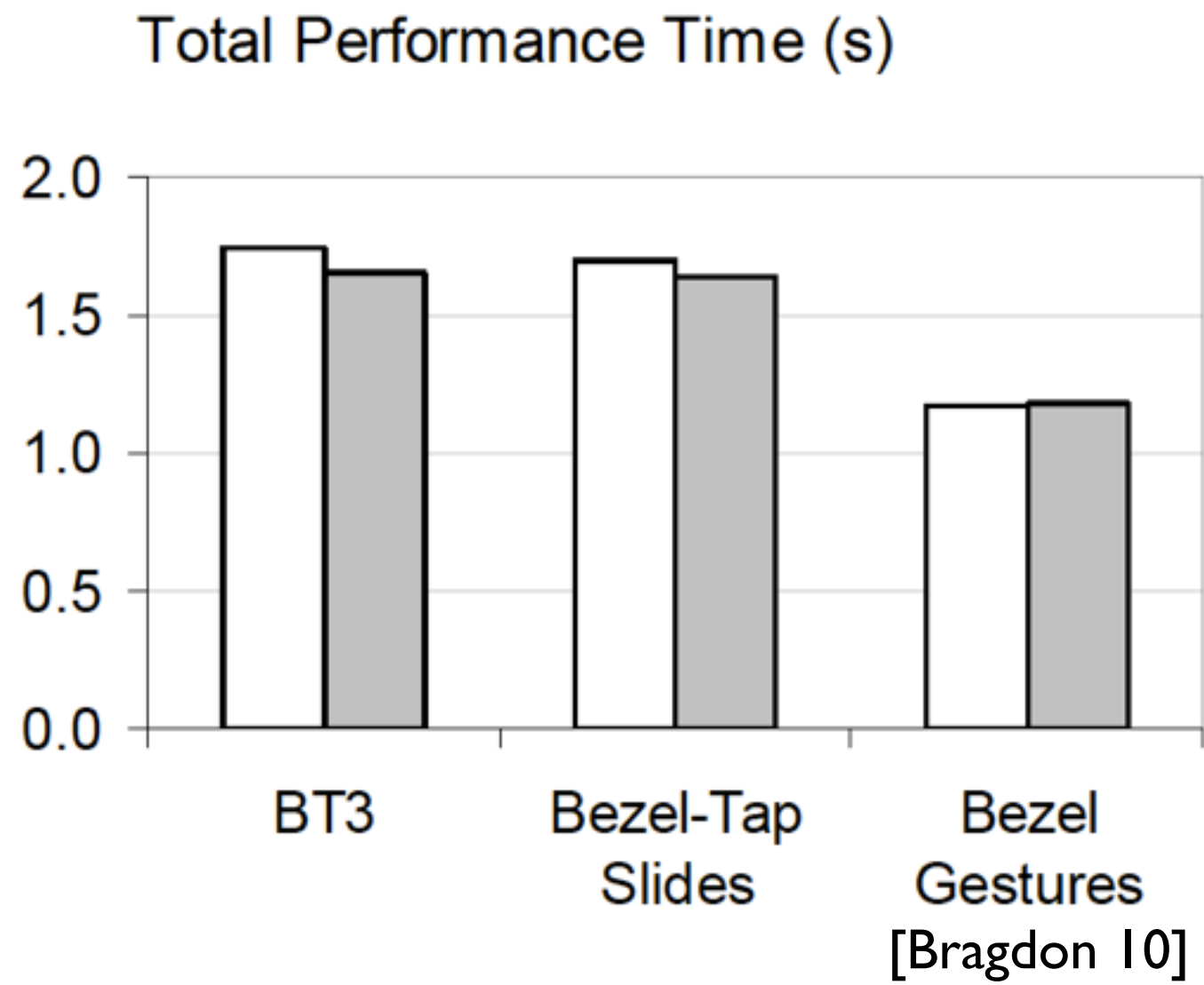
Results



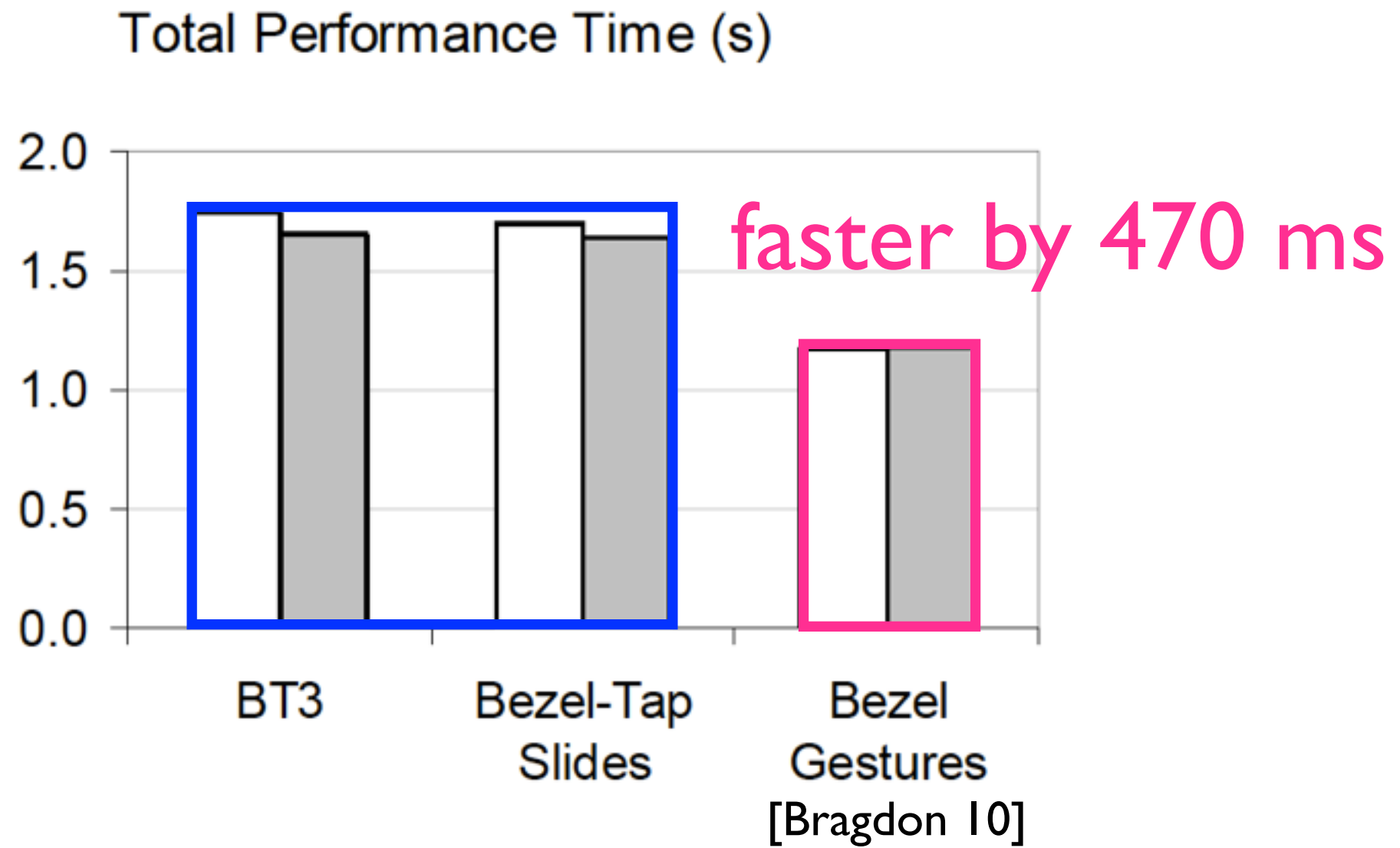
Results



Results



Results



Lessons learned

- All techniques are compatible
 - Do not rely on the same initial event
- Bezel-Tap when device is in sleep mode
- Bezel gestures when device is awake
- Large number of commands: 64 for each technique

Conclusion

Bezel-Tap Gestures allows rapid activation of commands from sleep mode

Future work

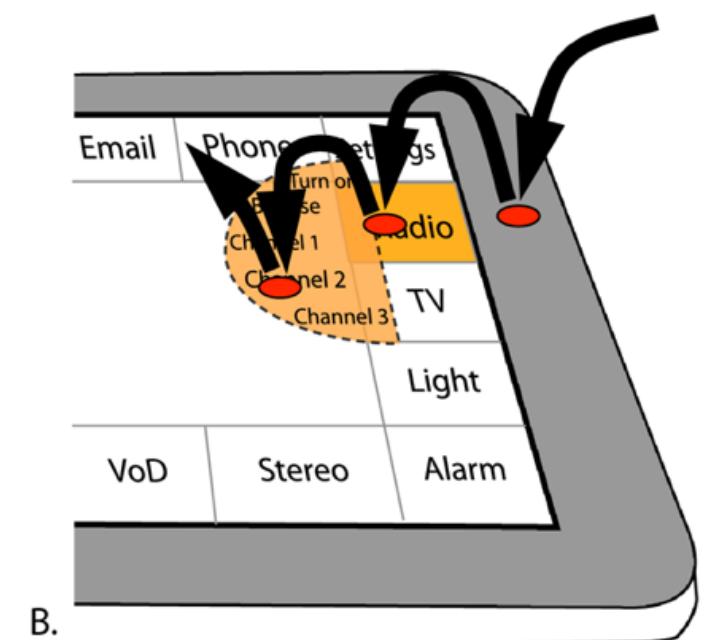
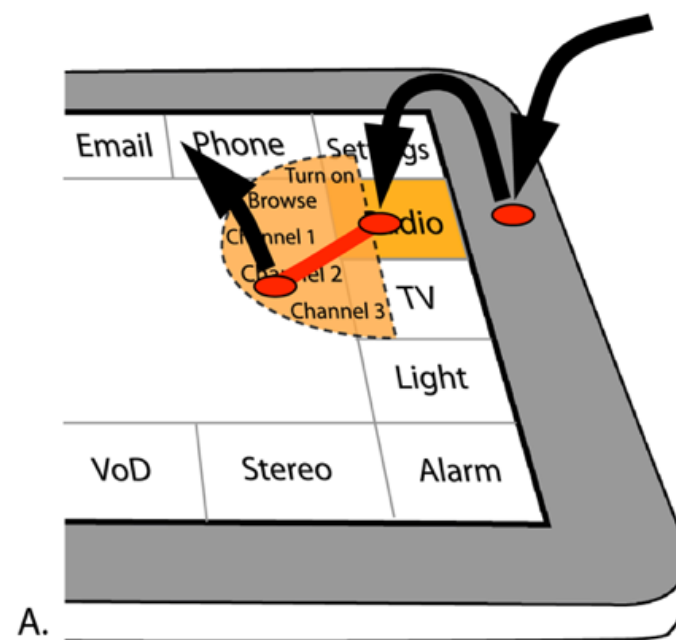
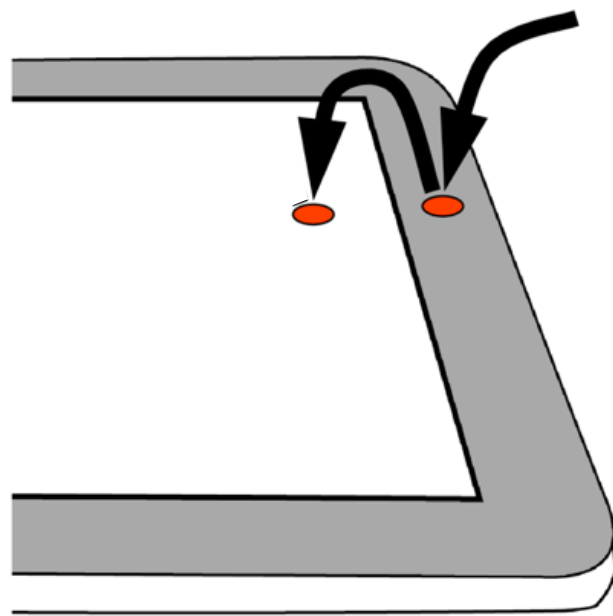
- Use of large set of commands
 - Memorization
- Small devices
 - First prototype on HTC Hero
 - 3 items per bezel region and 3 items in the radial menu

Bezel-Tap Gestures: Quick Activation of Commands from Sleep Mode on Tablets

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Paris, FRANCE



Thank you
Any questions?