SpareEye: Enhancing the Safety of Inattentionally Blind Smartphone Users

Klaus-Tycho Foerster, Alex Gross, Nino Hail, Jara Uitto, Roger Wattenhofer

People don’t pay attention when using their phone

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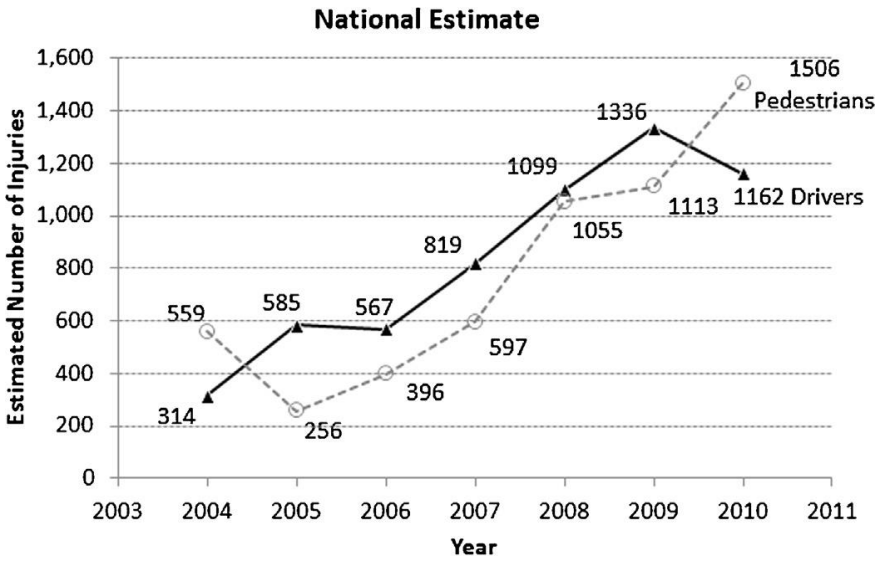
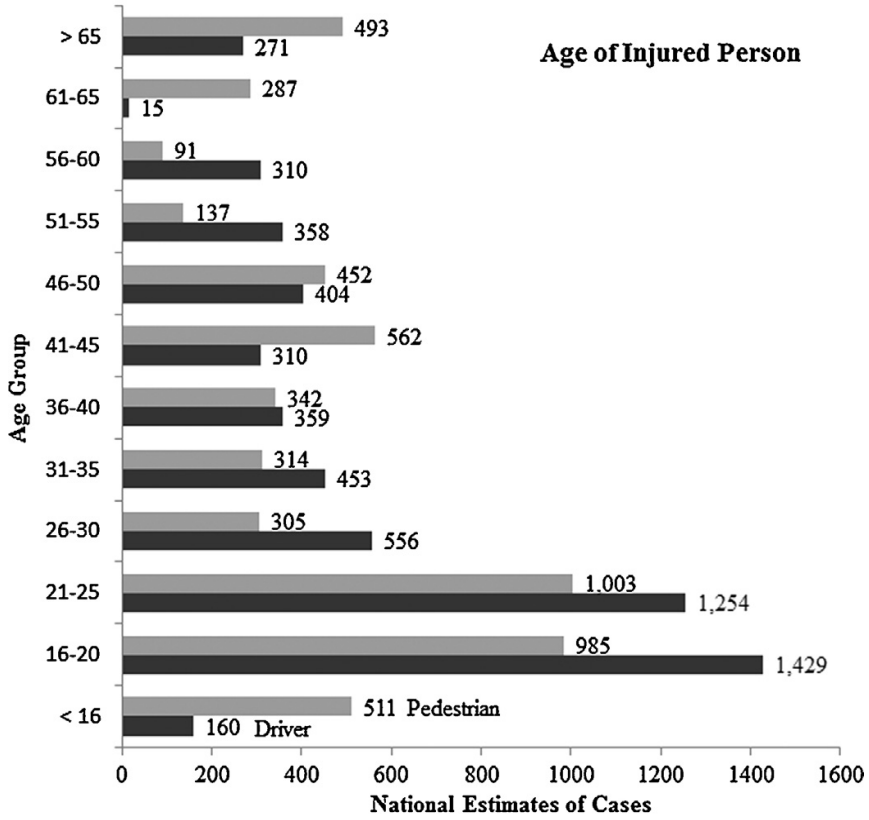
Pedestrian injuries due to mobile phone use in public places
Nasar and Troyer, Accident Analysis & Prevention 2013

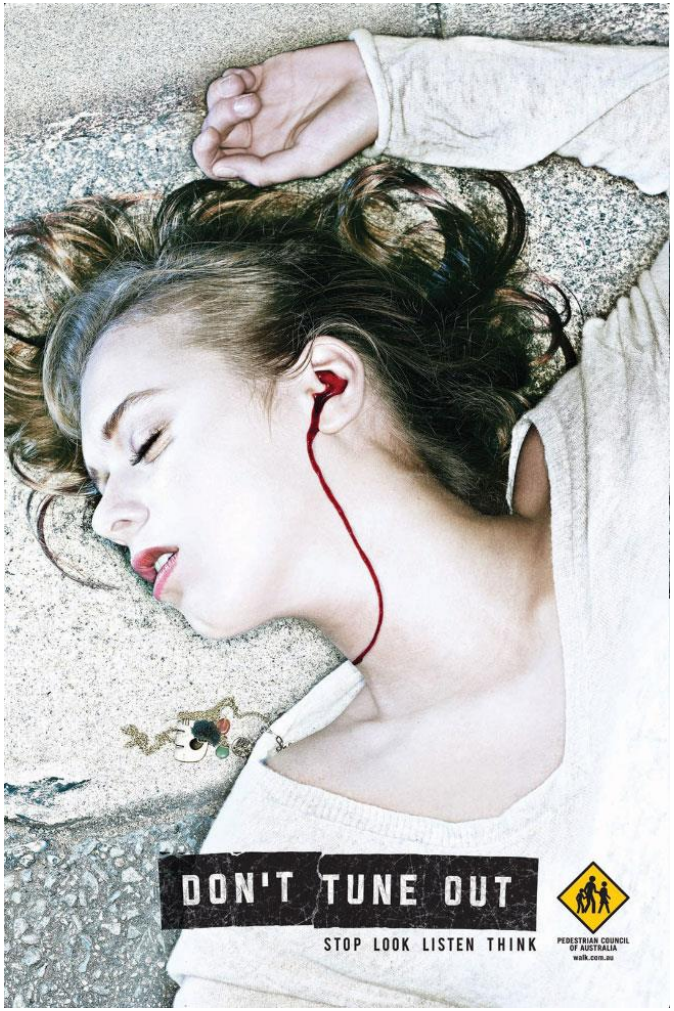


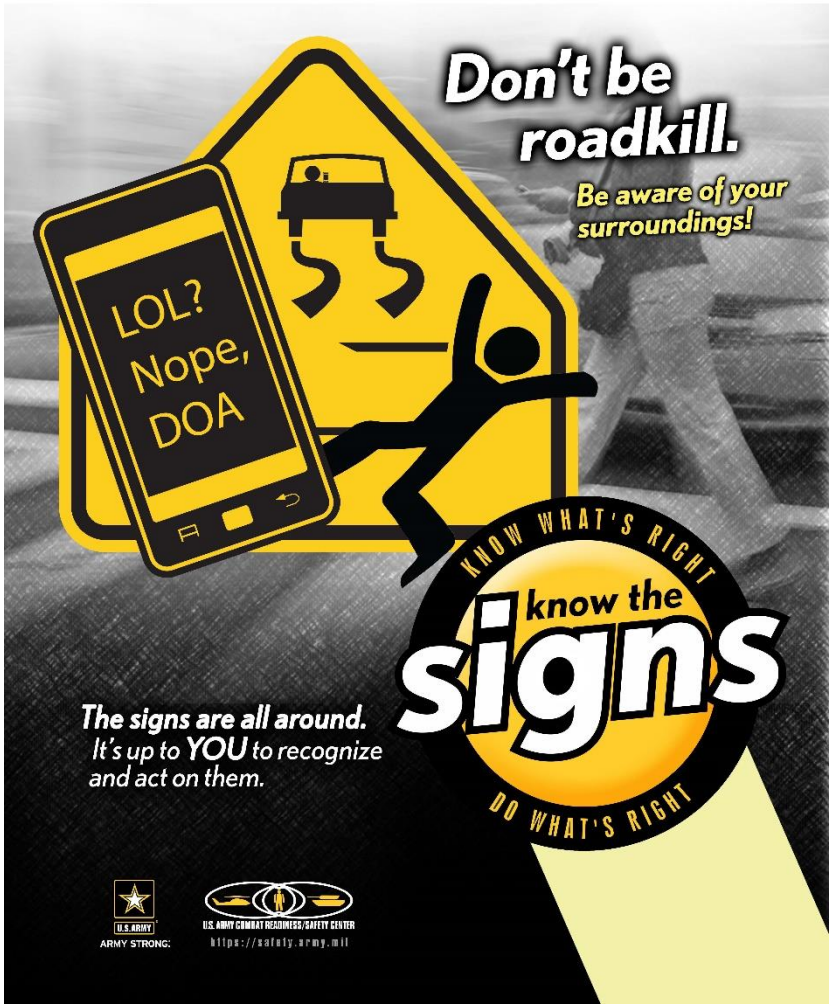


(USA)

2010

Campaigns to spread public awareness





Possible solution?

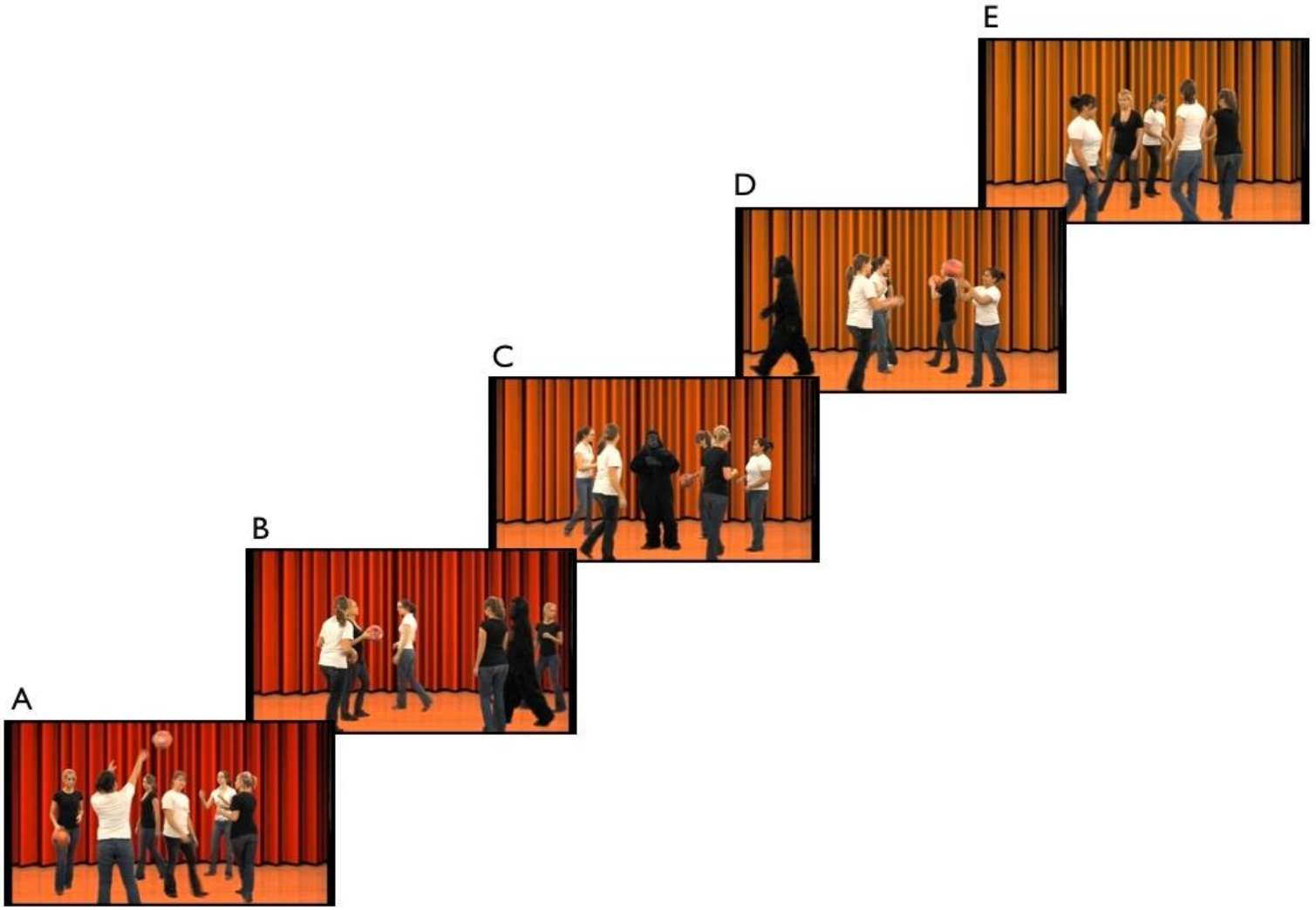
Or maybe a guide?

Maybe there should be signs?

There actually are!

Or even dedicated lanes!

Once you focus, unexpected events are hard to detect



Familiarity with an inattentional-blindness task does not improve the detection of unexpected events
Simons, i-Perception 2010

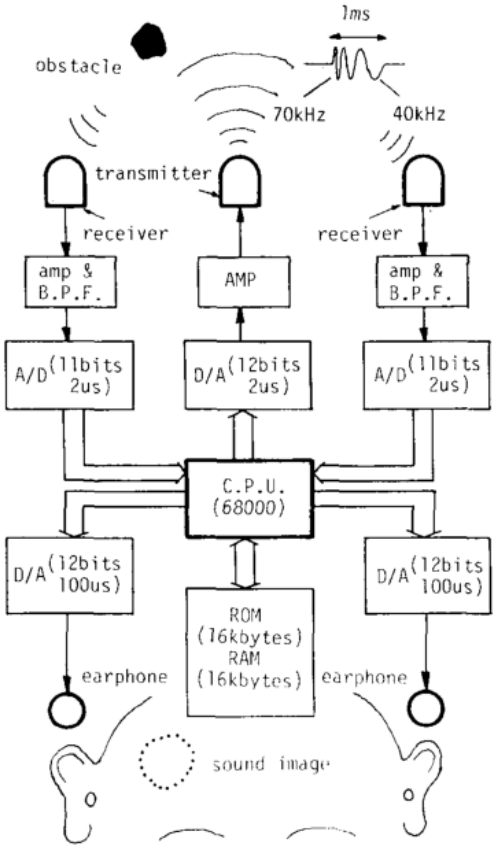
People do not pay attention (while using their phone)!

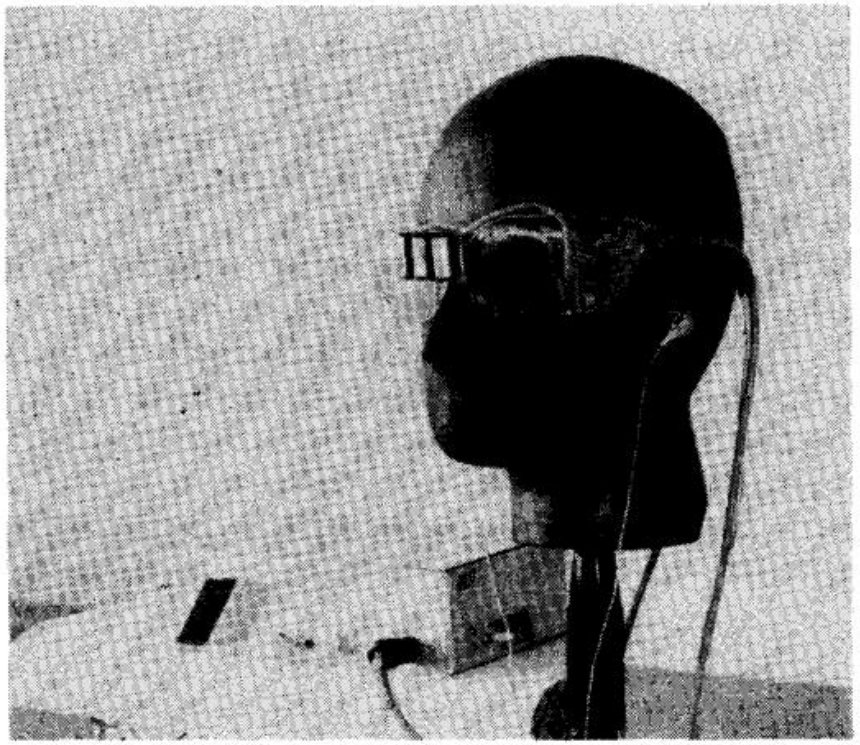
Question	Walking condition			
	Cell phone user (%)	Single (%)	Music player (%)	Pair (%)
General question	8.3	32.1	32.1	57.1
Did you see the clown?	25.0	51.3	60.7	71.4

Did you see the unicycling clown?
Inattentional blindness while walking and talking on a cell phone
Hyman et al., Appl. Cognit. Psychol. 2010

Let’s use technology!

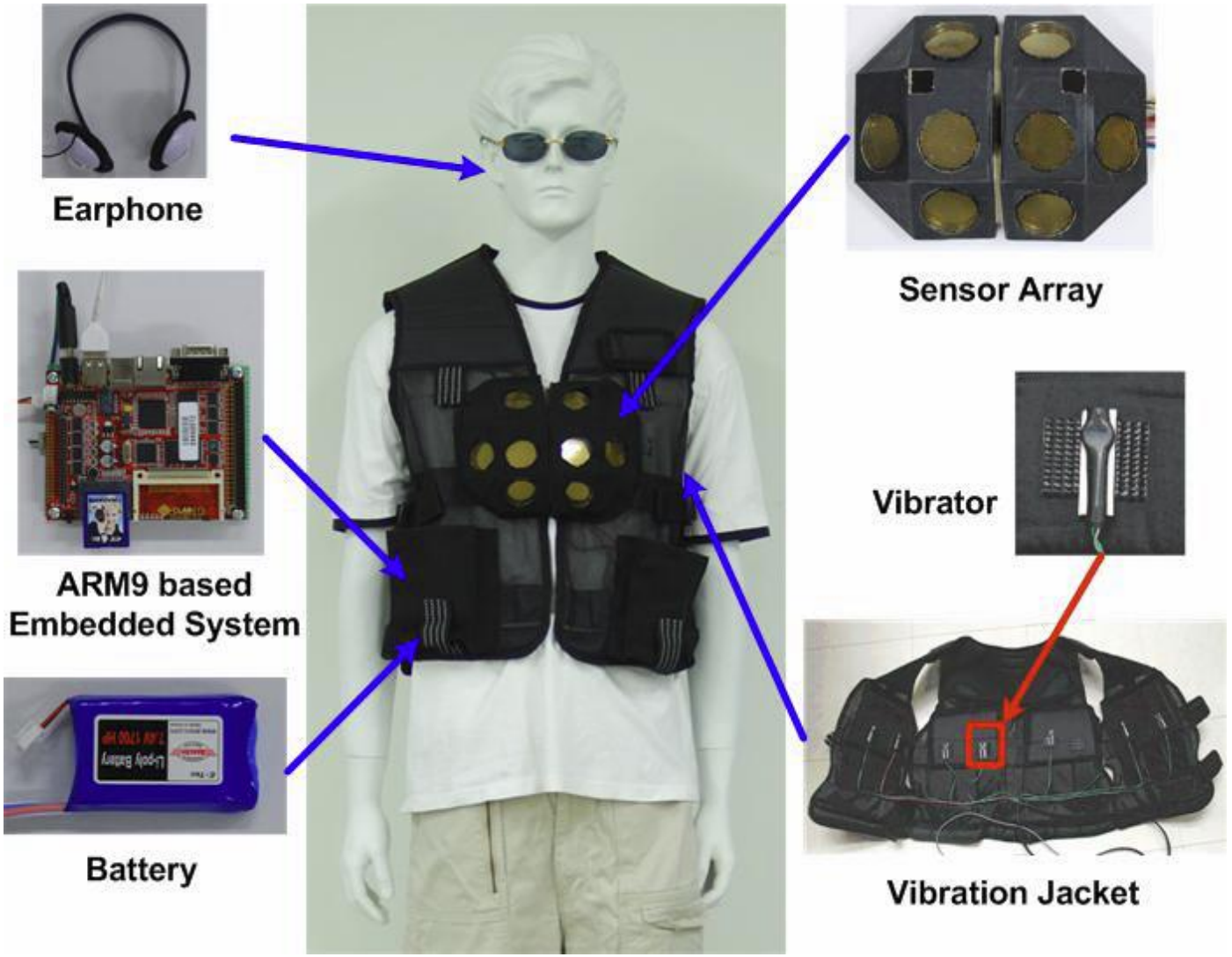
A Blind Mobility Aid Modeled After Echolocation of Bats
Ifukube et al., IEEE Tr. Biomed. Eng. 1991





Use ultrasound to recognize obstacles like bats

Obstacle Detection and Avoidance System for Visually Impaired People
Shin and Lim, HAID 2007

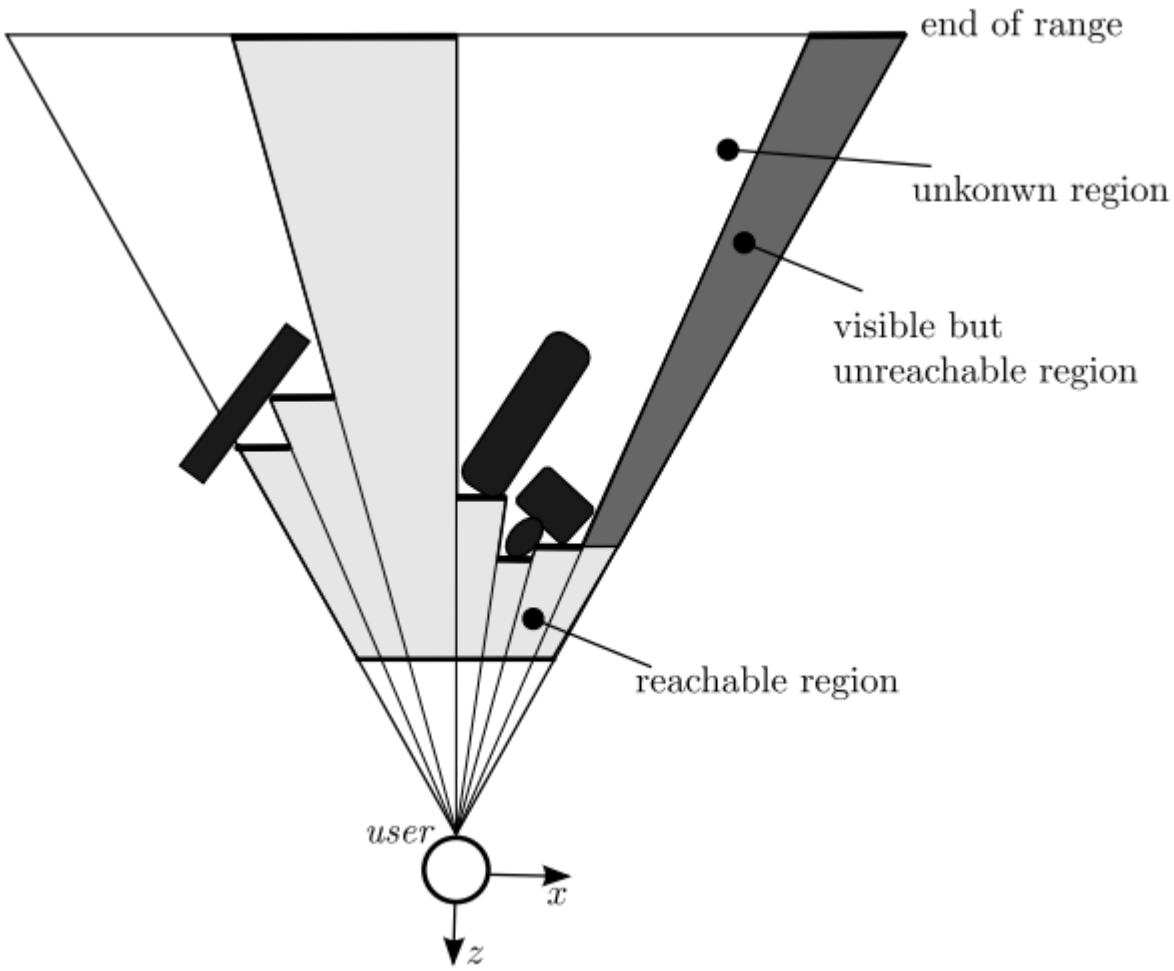


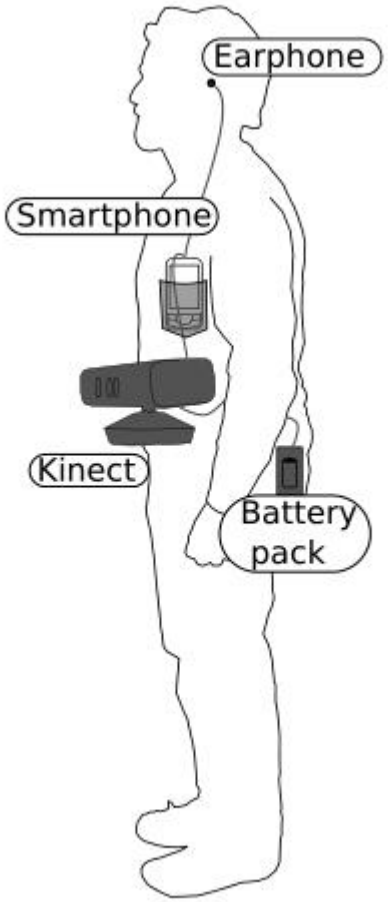
Ultrasound sensors, recommends walking directions

Ultrasonic Cover
Samsung, 2014

Ultrasound sensor, vibrates when detecting obstacle

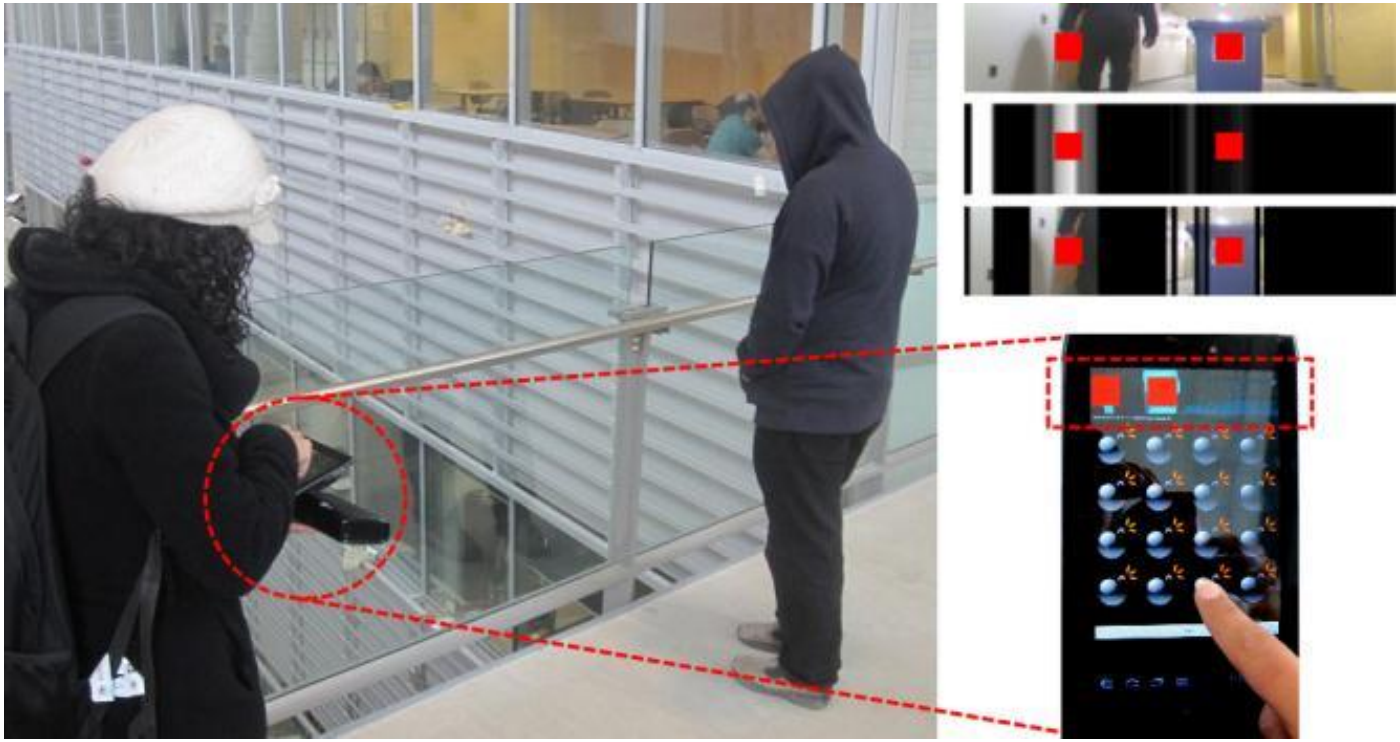
Obstacle Detection and Avoidance System for Visually Impaired People
Bernabei et al., IPIN 2007





Infrared sensor (Kinect), recommends walking directions

CrashAlert: Enhancing Peripheral Alertness for Eyes-Busy Mobile Interaction while Walking
Hincapié-Ramos and Irani, CHI 2013

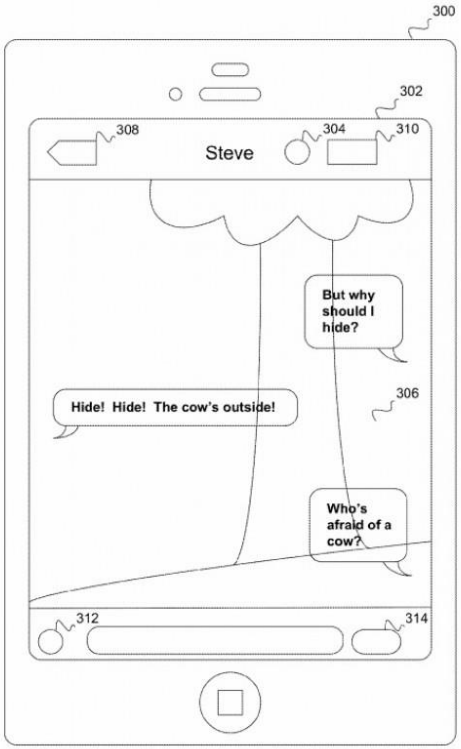


Infrared sensor (Kinect), walking user interface

Why not like this?

Just display the camera image?

Type N Walk app, 2010



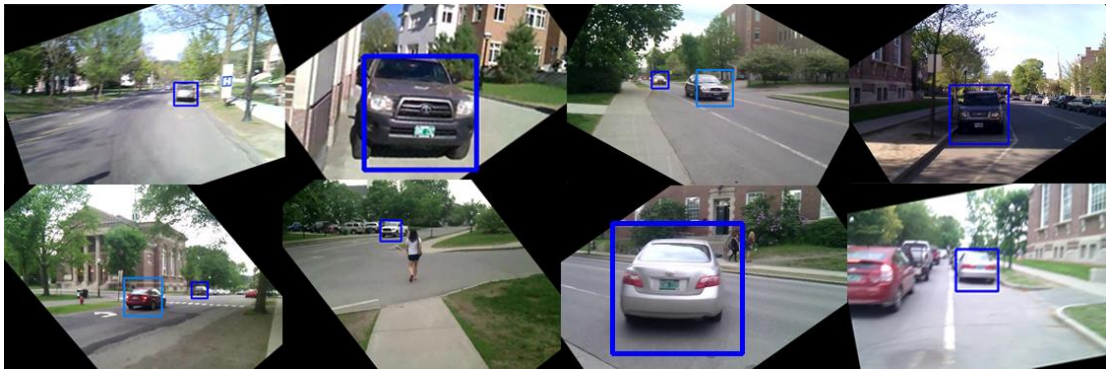
Apple patent, 2014

Does not work well in practice!

E.g., *Cognitive control in media multitaskers*
Ophir et al., PNAS 2009

Walksafe: a pedestrian safety app for mobile phone users who walk and talk while crossing roads

Wang et al., HotMobile 2012

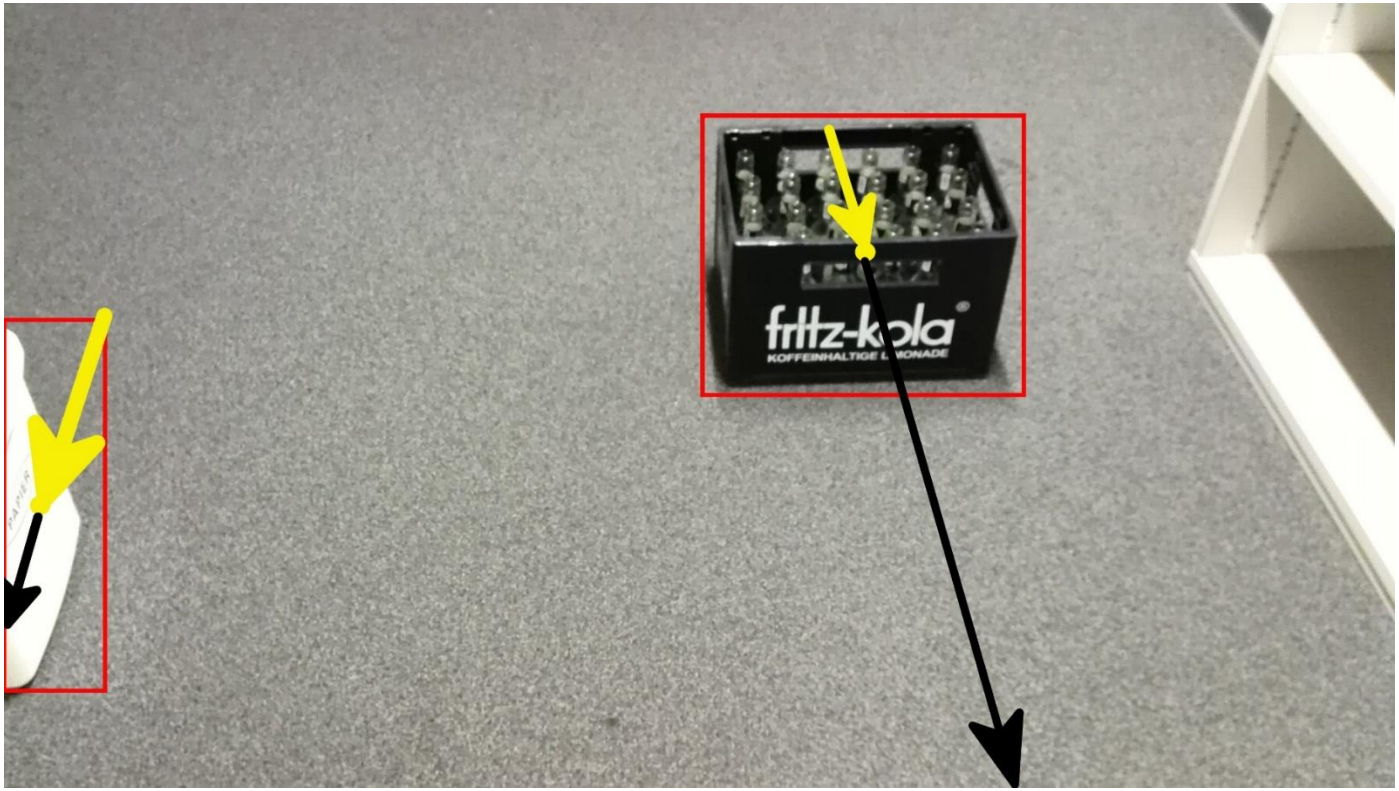


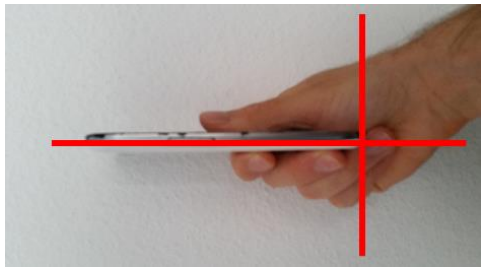
Detect cars with the camera while calling

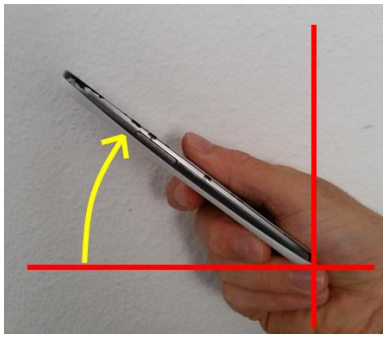
Our approach

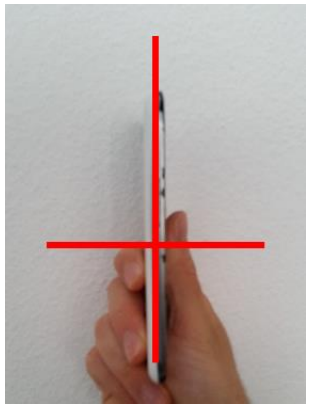
Klaus-Tycho Foerster, Alex Gross, Nino Hail, Jara Uitto, Roger Wattenhofer

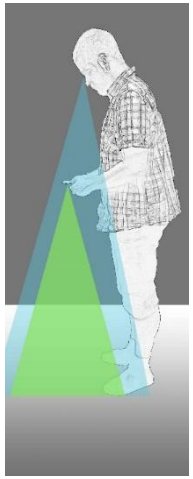

fritz-kola

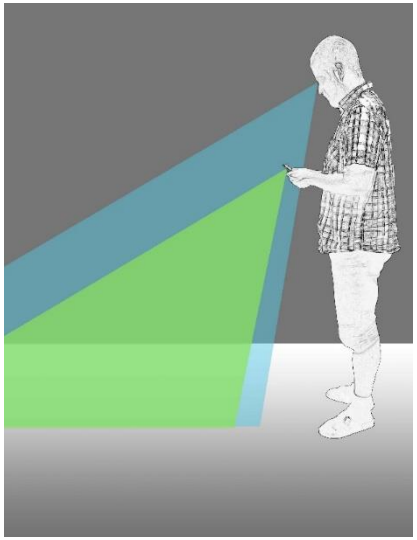

fritz-kola
KOFFEINHALTIGE

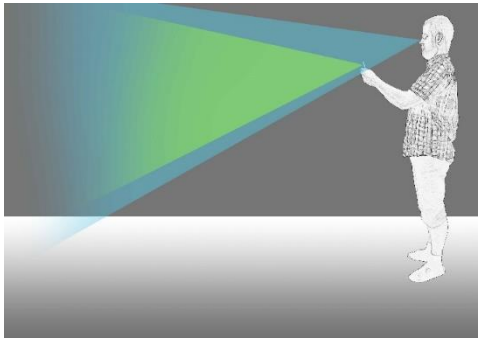


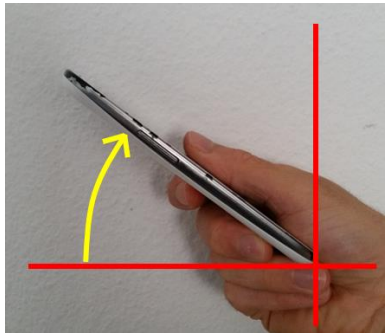


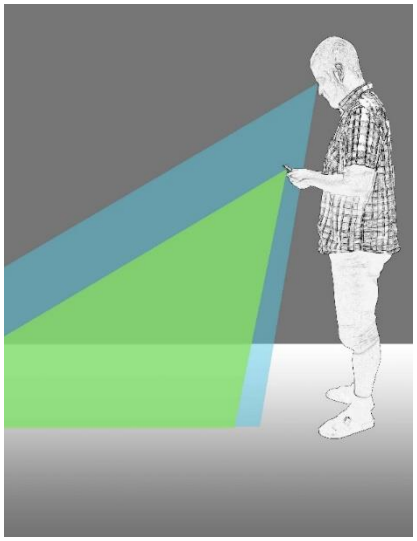






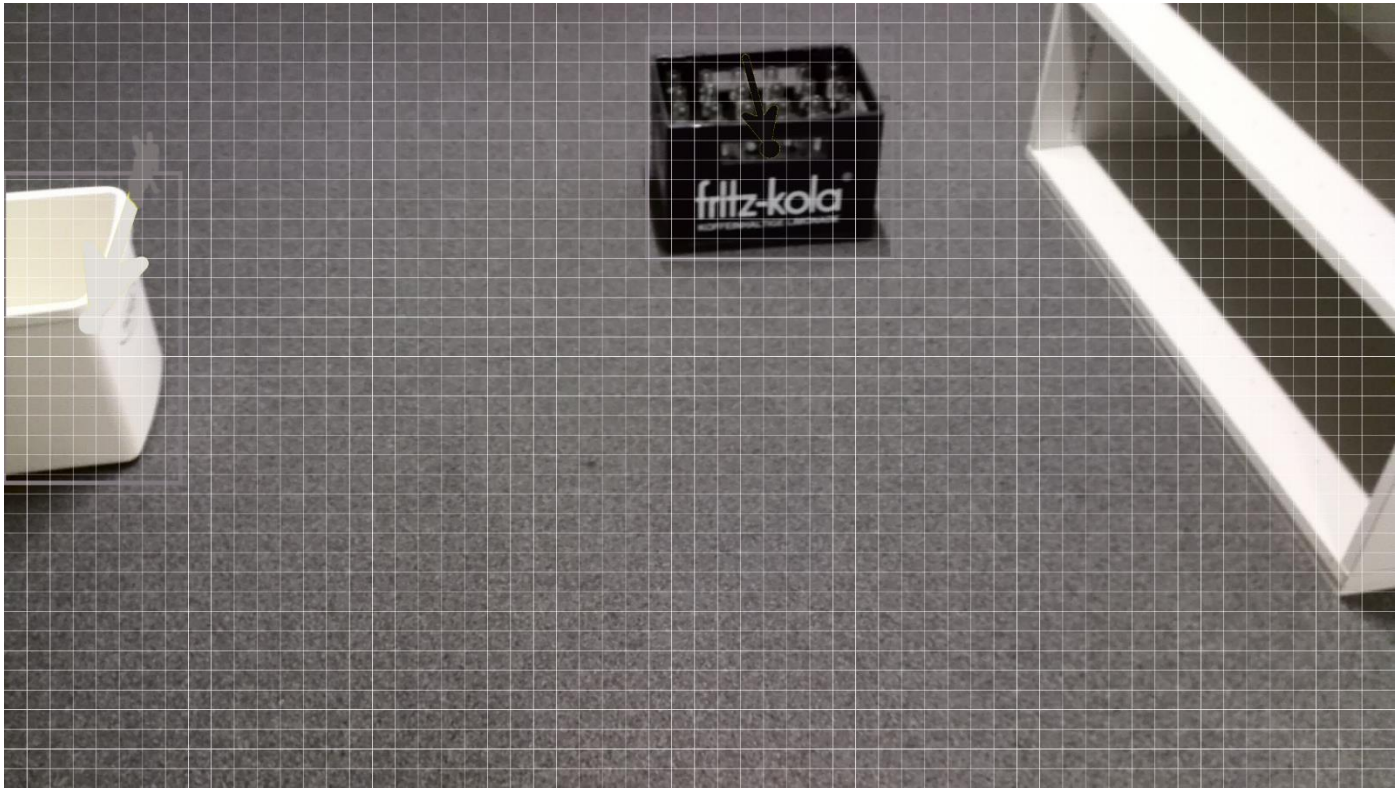


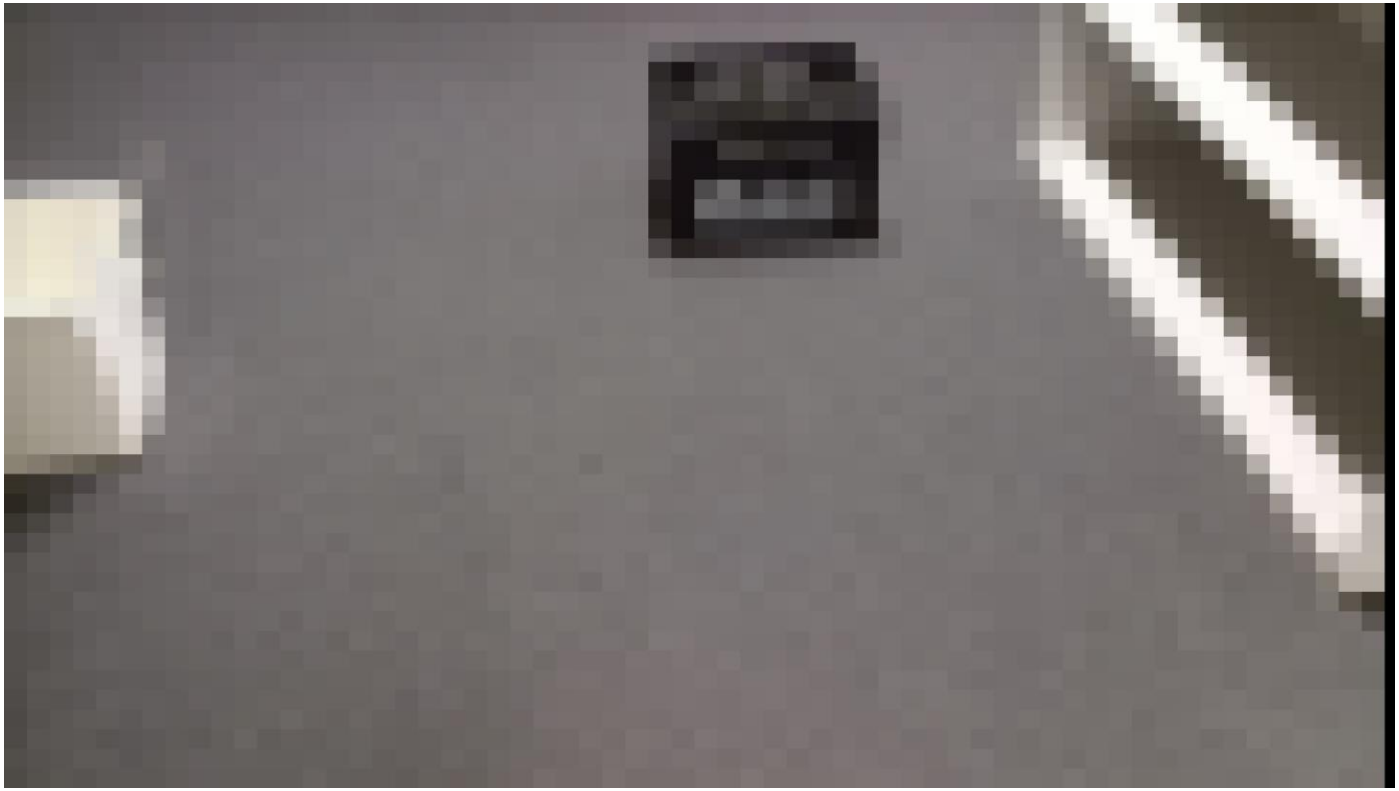


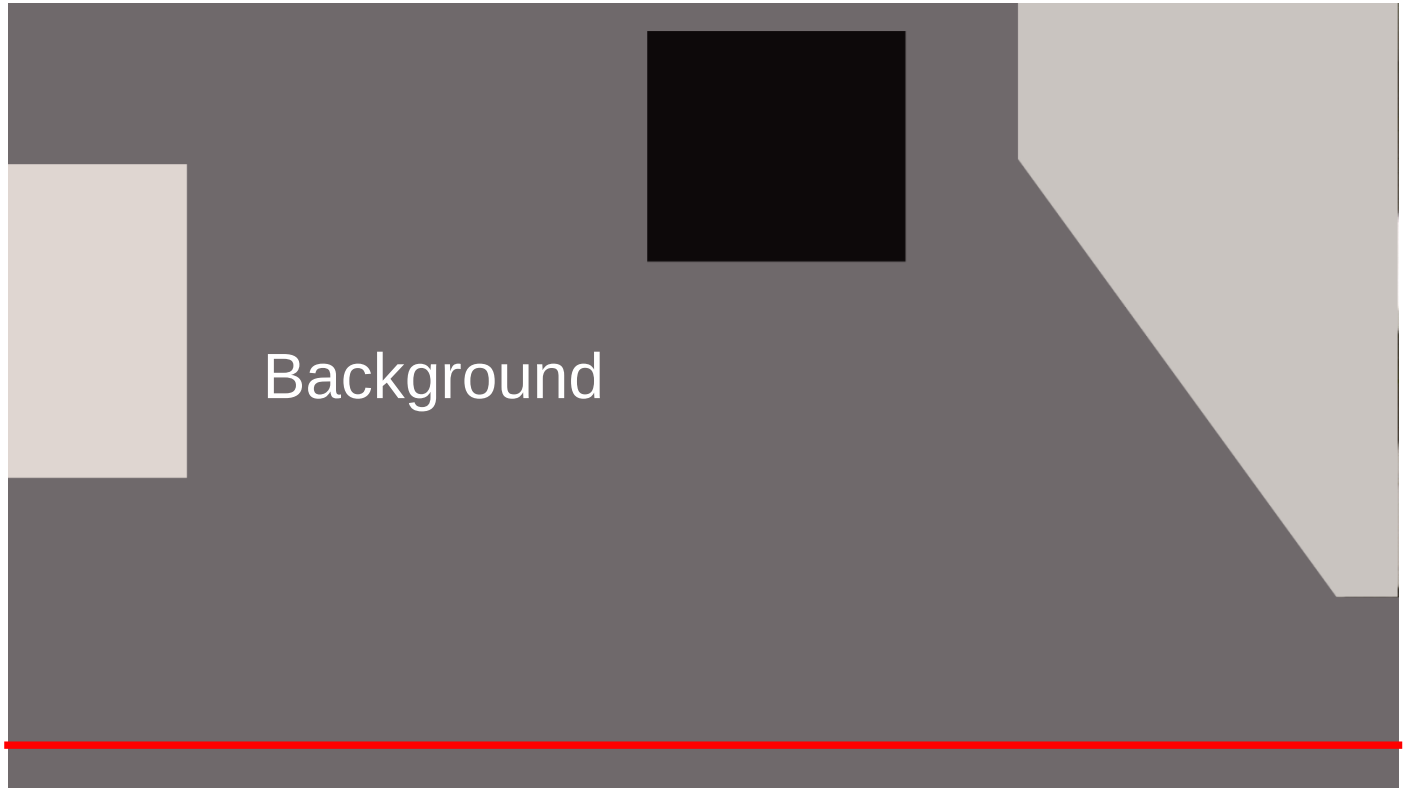


Holding angle $\sim 45°$

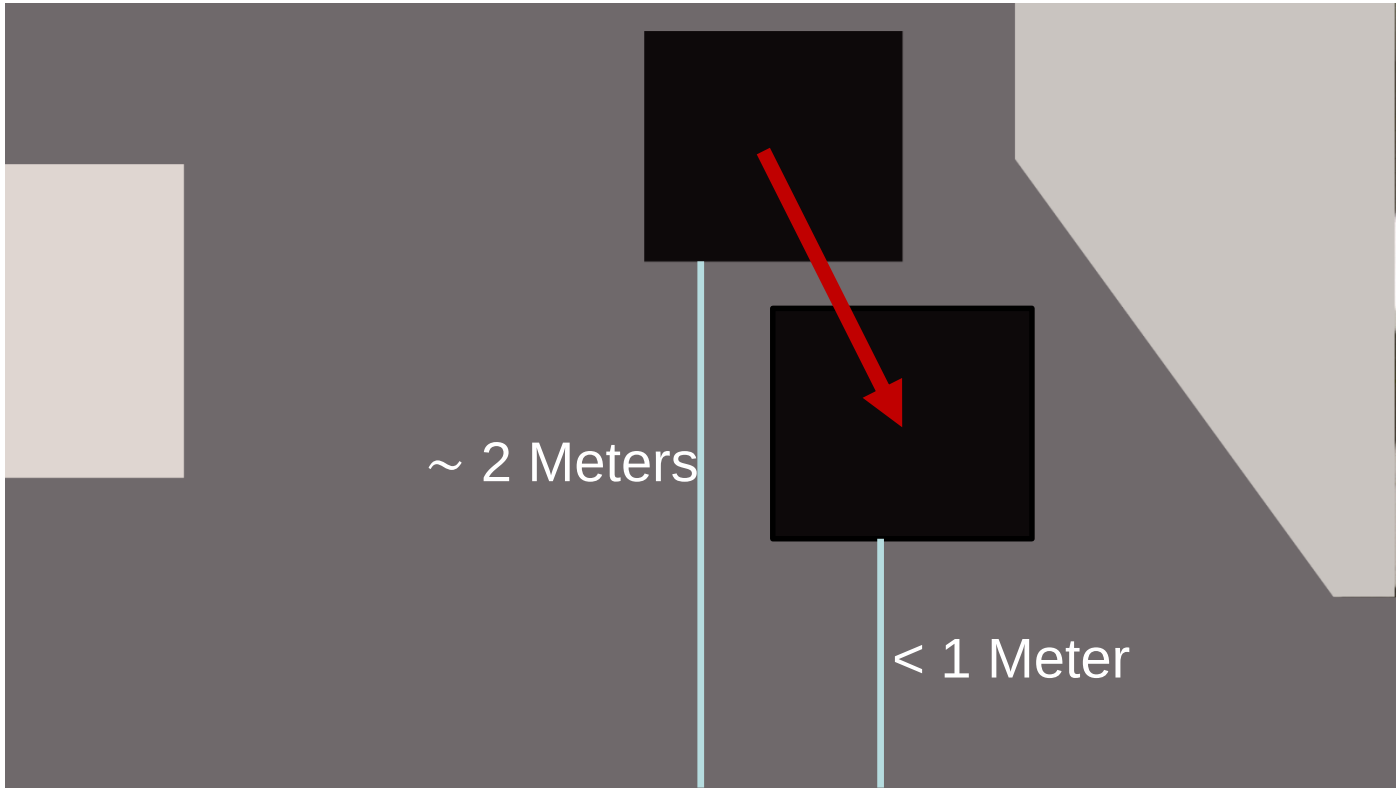

fritz-kola

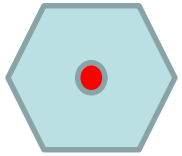

fritz-kola



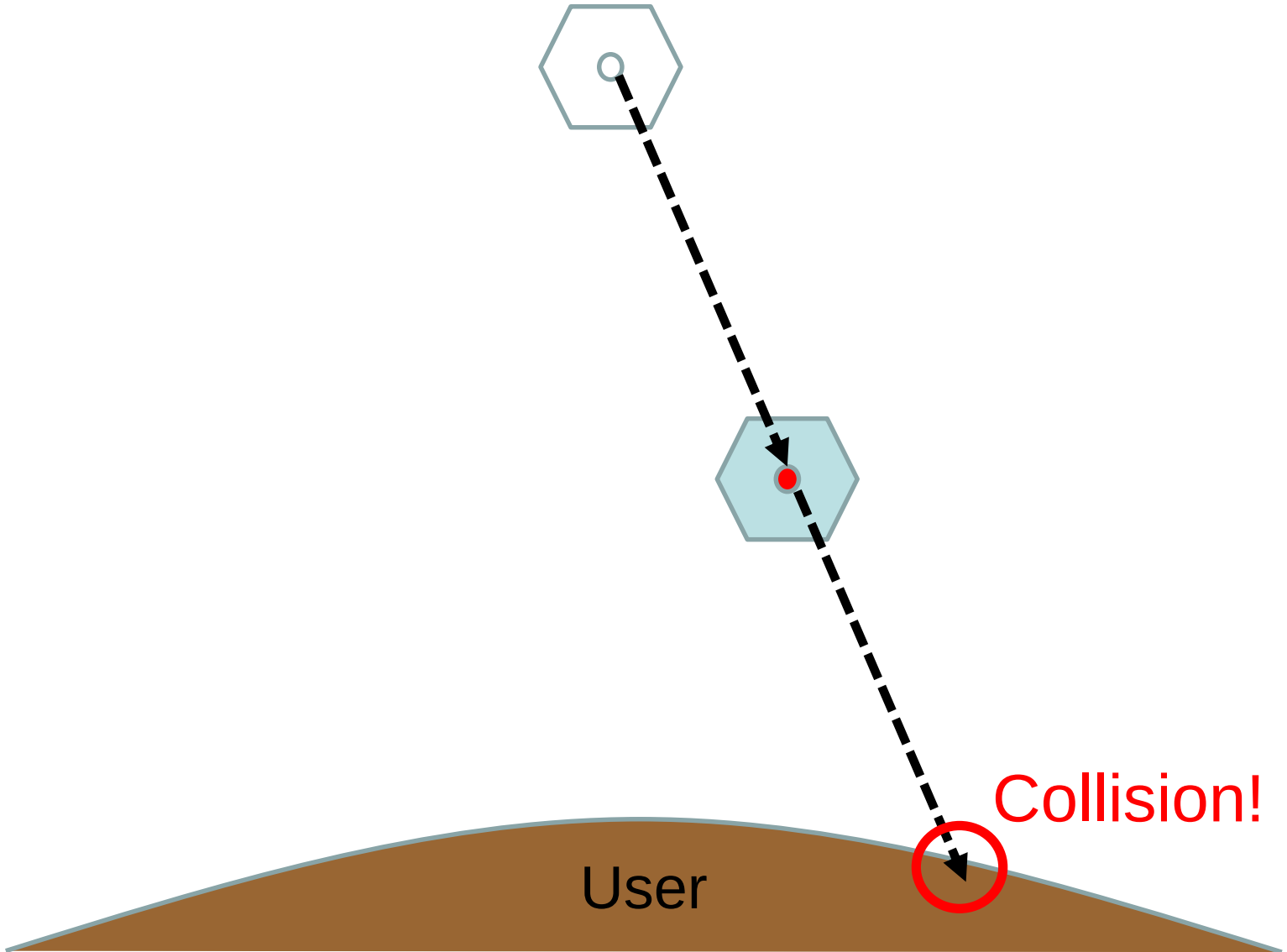

Background

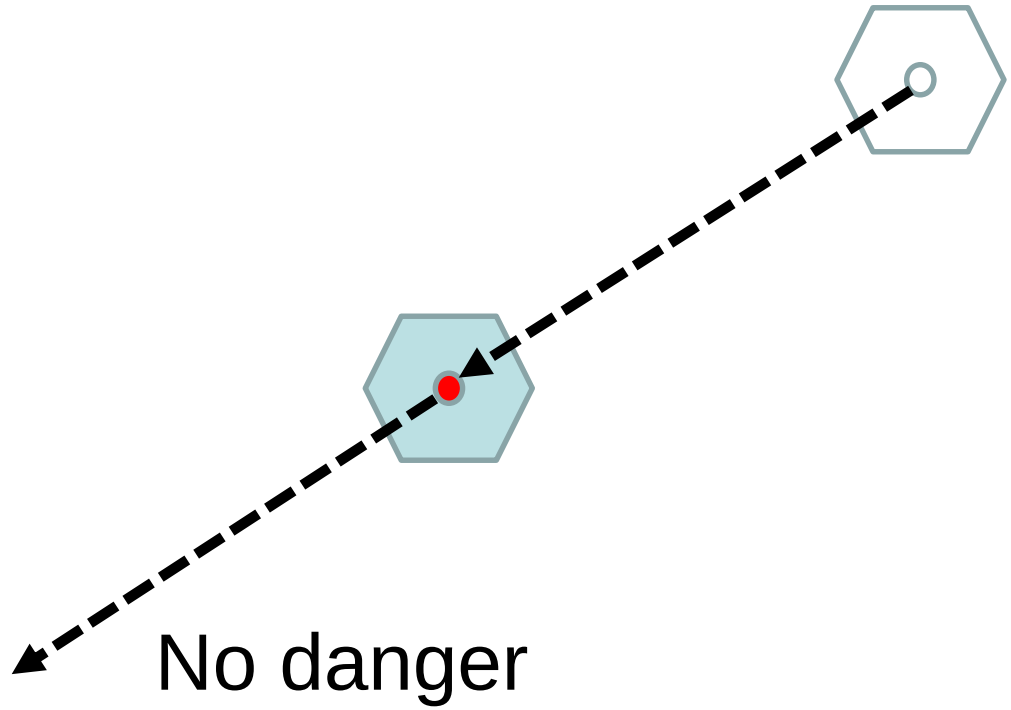

Background
Back-
ground

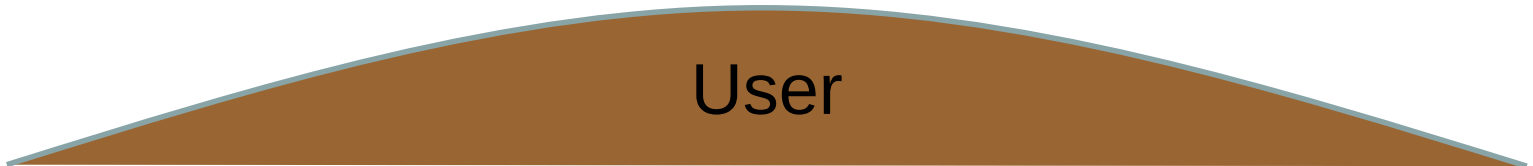

~ 2 Meters
< 1 Meter



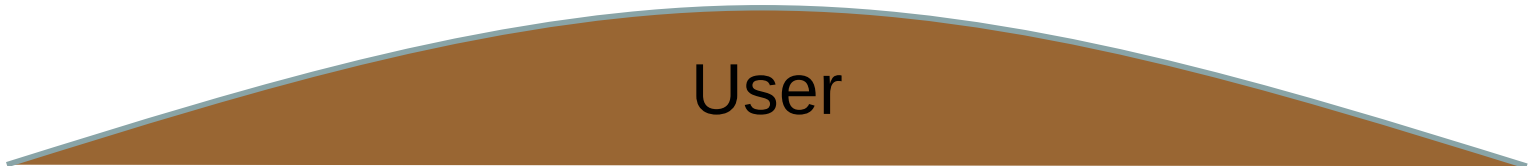
User


Collision!
User


No danger


User

Multiple Obstacles



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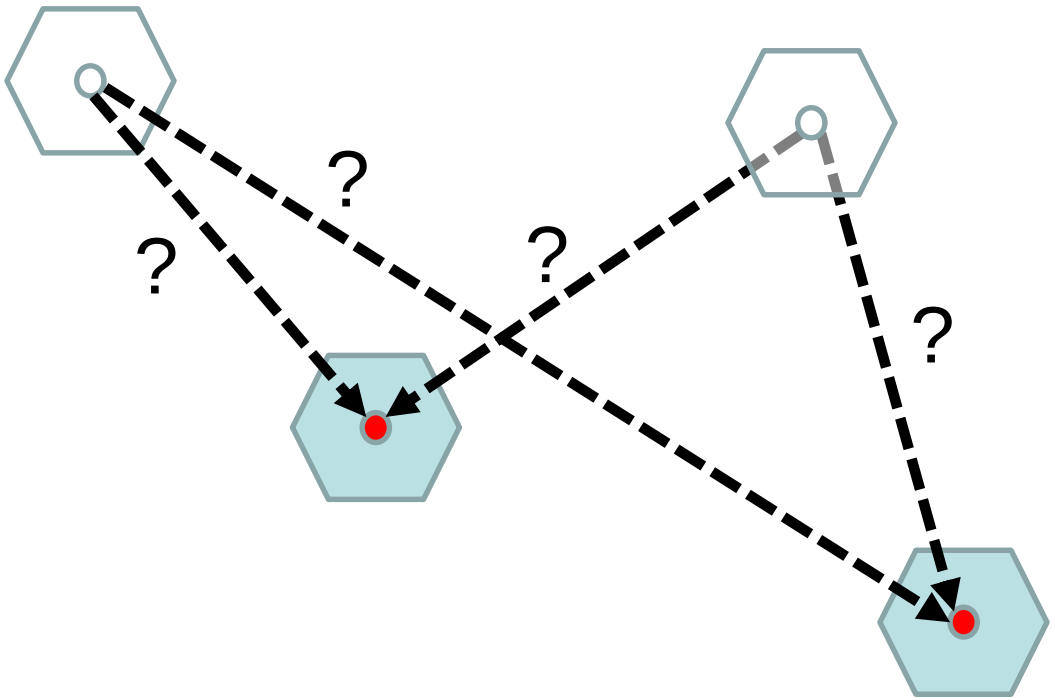
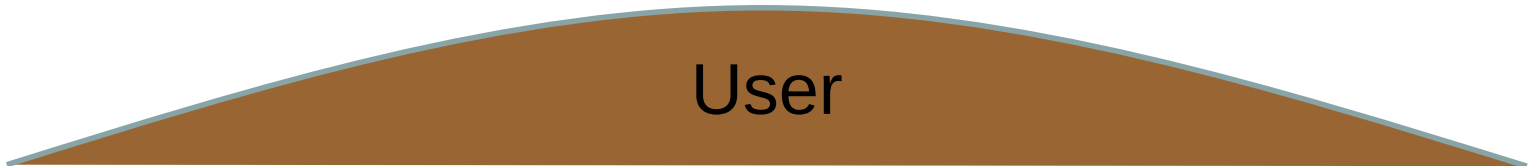
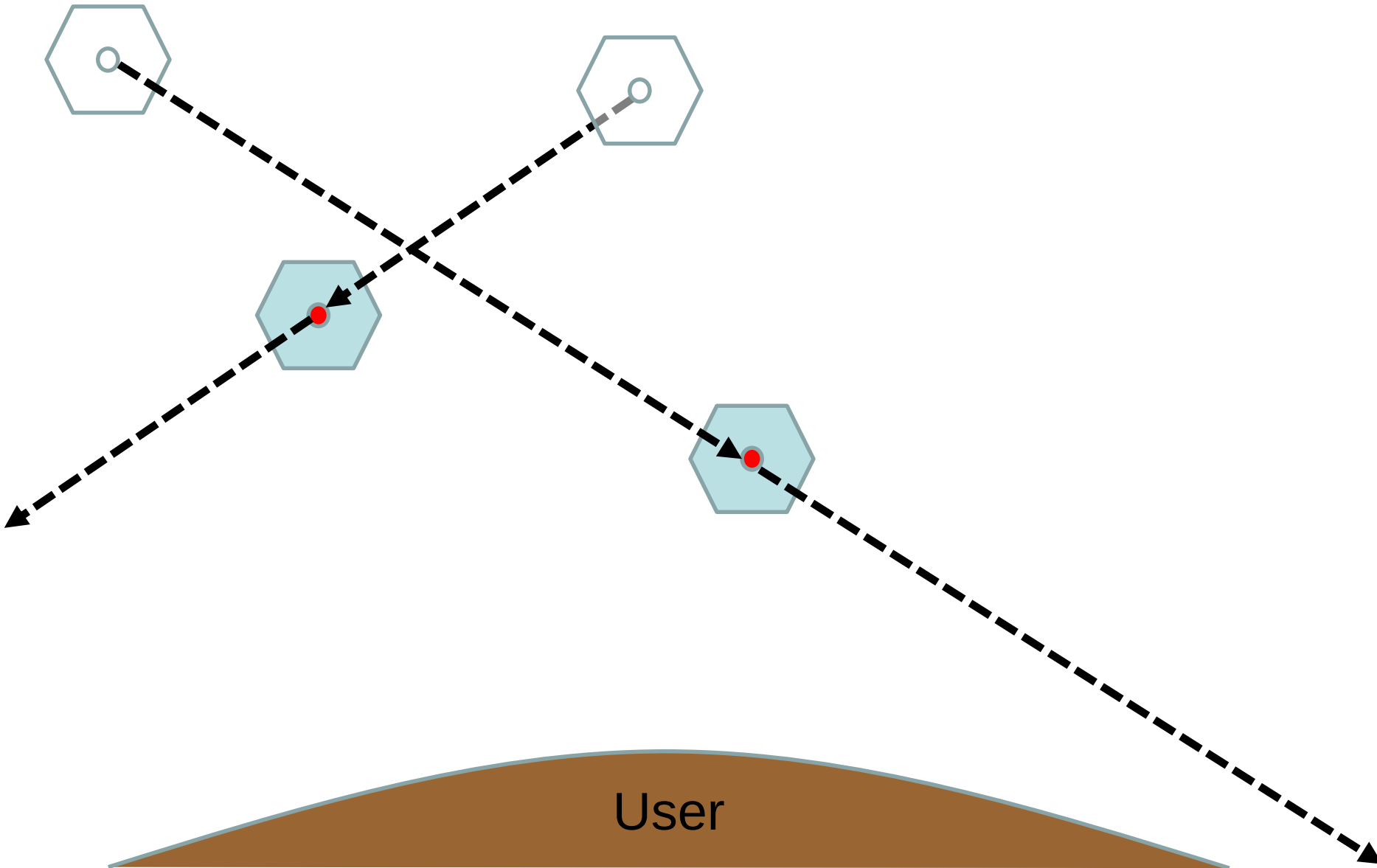
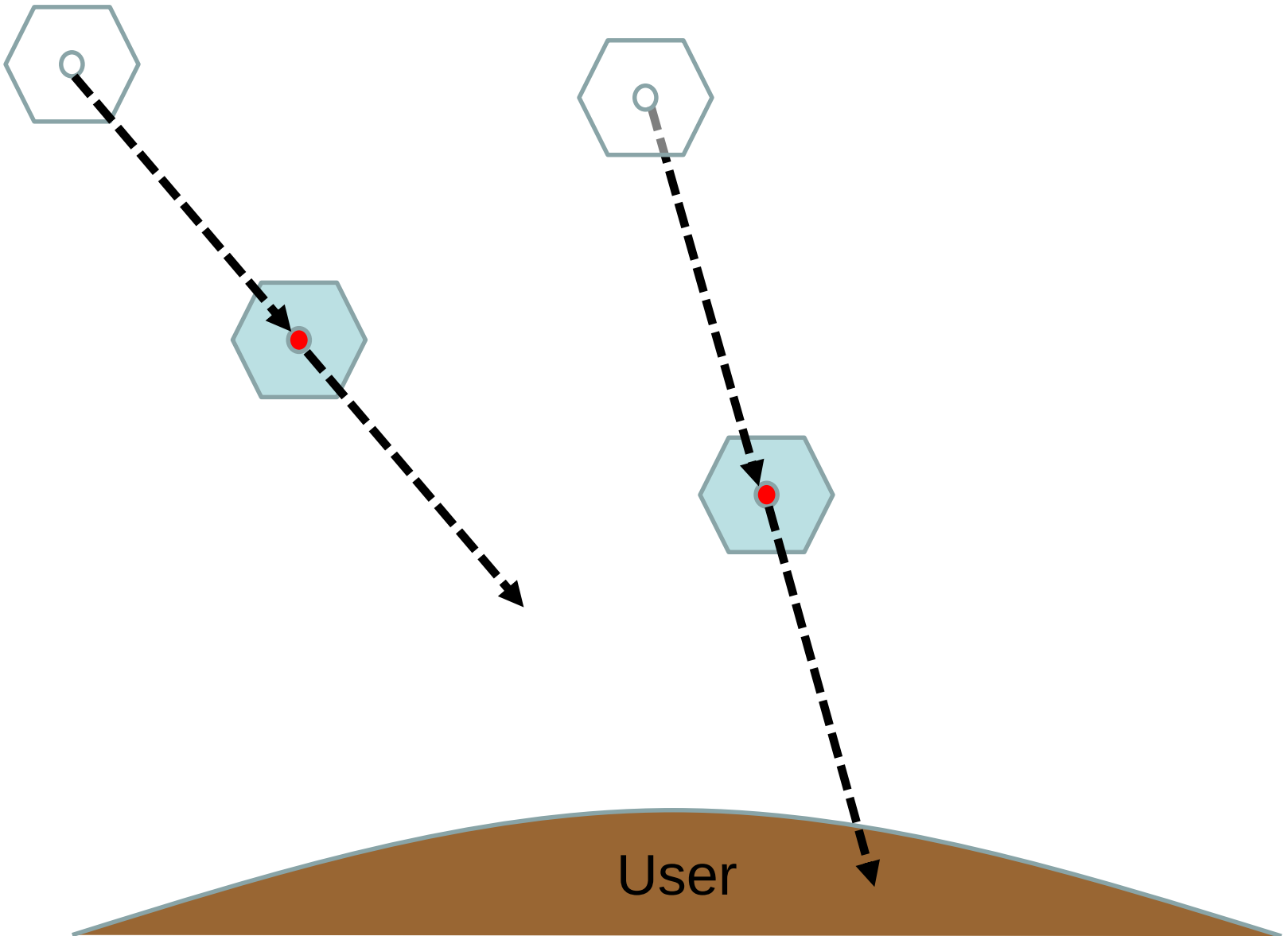


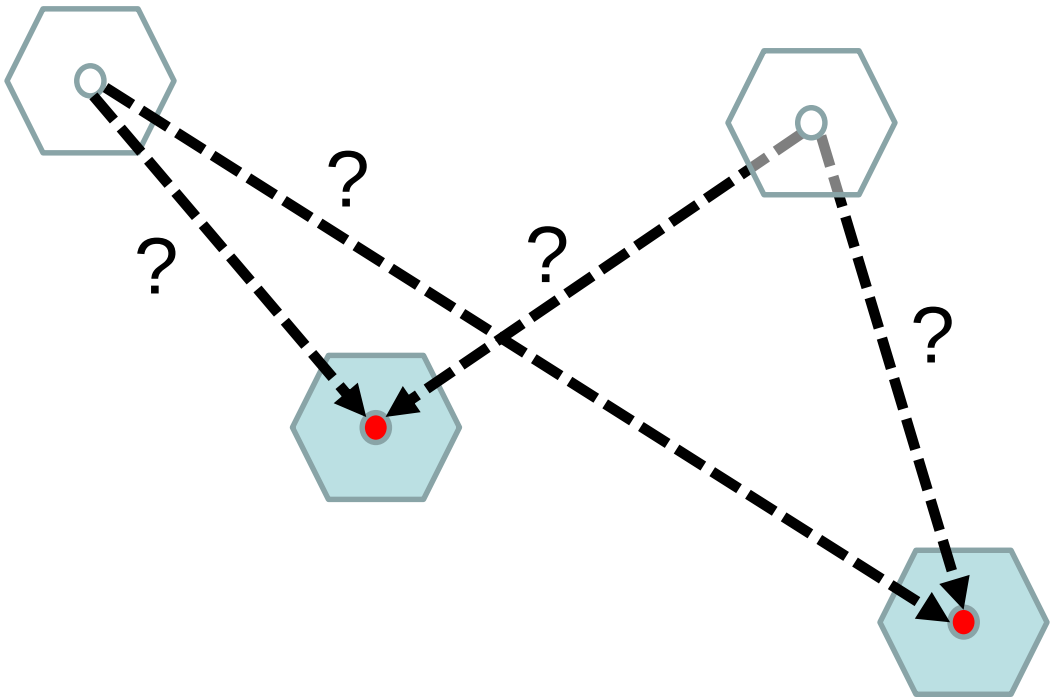


Multiple Obstacles



Multiple Obstacles

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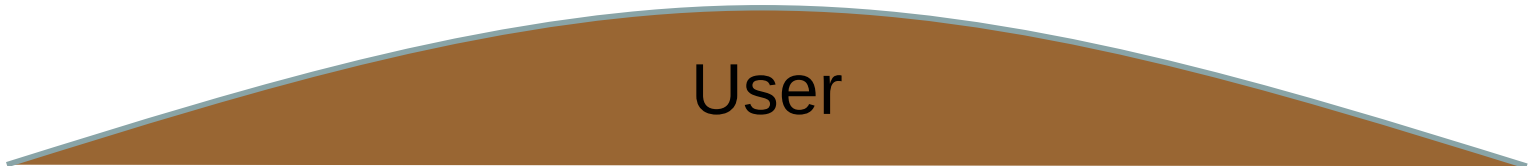
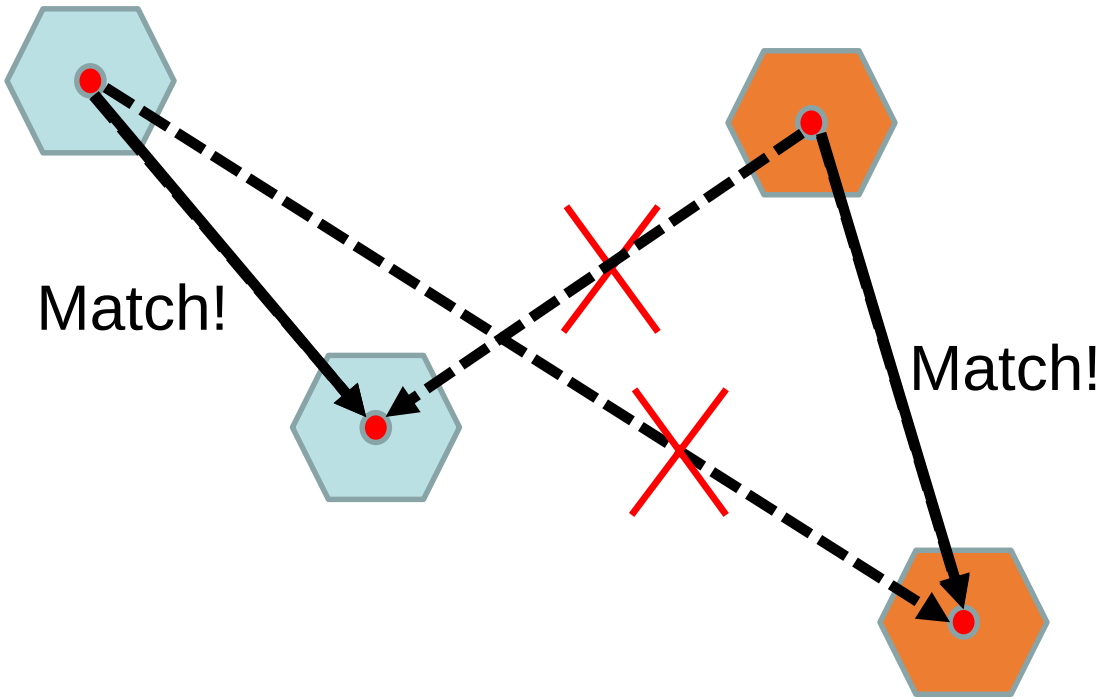

User



User

Testing scenario: university cafeteria

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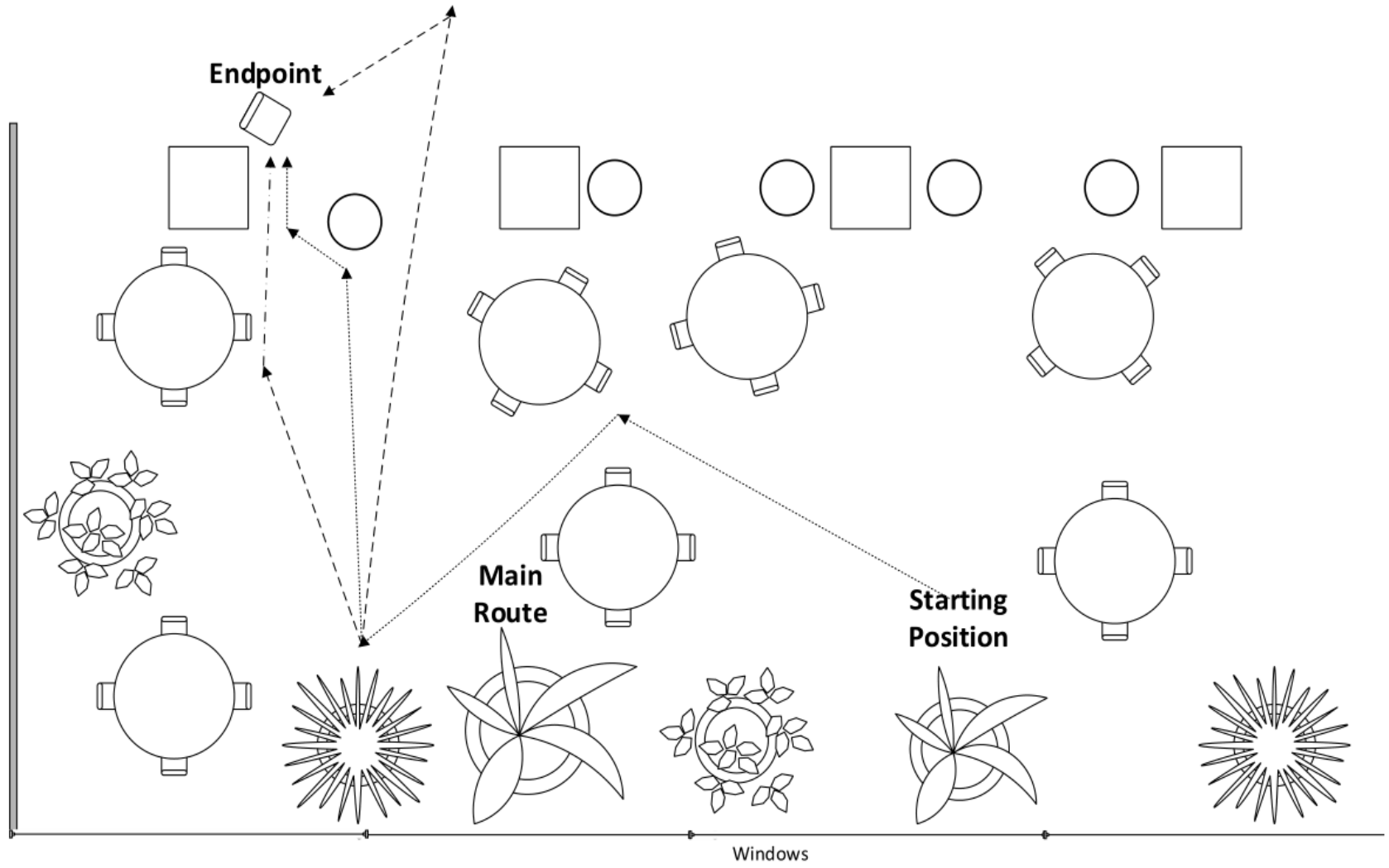


Evaluation

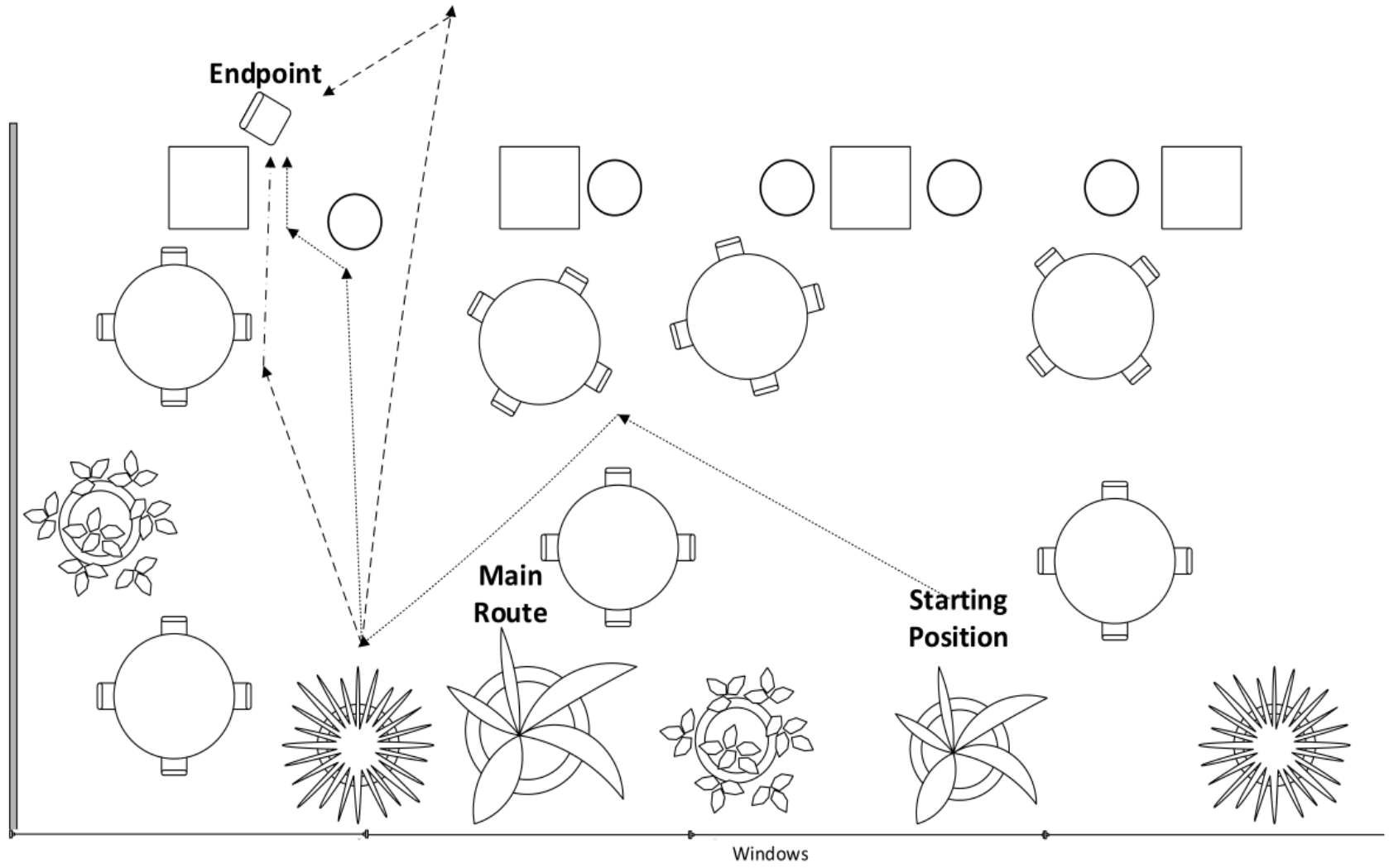
- 21 participants
  - 18 male, 3 female (mean age of 29 years)
  - walks from 26 to 97s (avg = 62.2s, sd = 21.9s, med = 58s)

- 103 warnings in total
  - 87 true positives (avg = 4.1, sd = 1.8, med = 4)
  - 16 false positives (avg = 0.8, sd = 0.8, med = 1)

- 6 failures to warn (avg = 0.3, sd = 0.5, med = 0)

- Did not warn: ~ **6%**
- False warning: ~ **15%**

Testing scenario: university cafeteria



Limitations and Future Work

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