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Final project presentation 17th April 2015, Bremen

Motivation

- Modern games focus on visual effects and natural interaction



Motivation

- Virtual 3D games are not accessible for blind people





Blind Guitar Hero , Yuan & Folmer
ACM SIGACCESS 2008



Audiopolis, Sánchez et al.
UAHCI 2011



AudioBattleship, Sánchez et al.
CHI 2003

Limitations

- No interaction between blind and sighted players in a 3D environment
- No realistic 3D sound
- Support up to 2 feedback devices for nonvisual senses



Goal

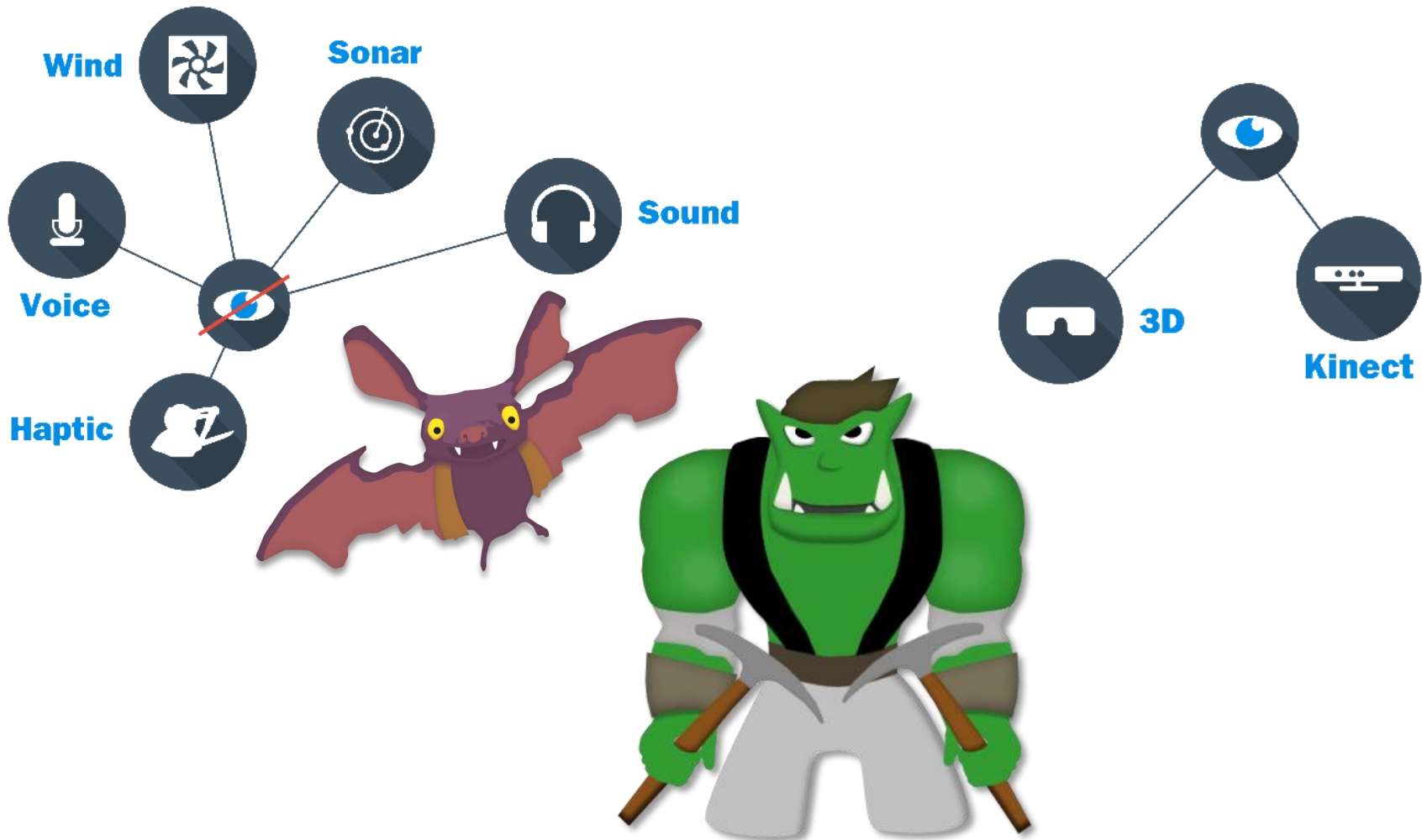


- ☑ Real-time interaction
- ☑ Shared virtual 3-dimensional environment
- ☑ Equality of opportunity
- ☑ Additional feedback options (haptic & audio)
- ☑ Kinect as an input device

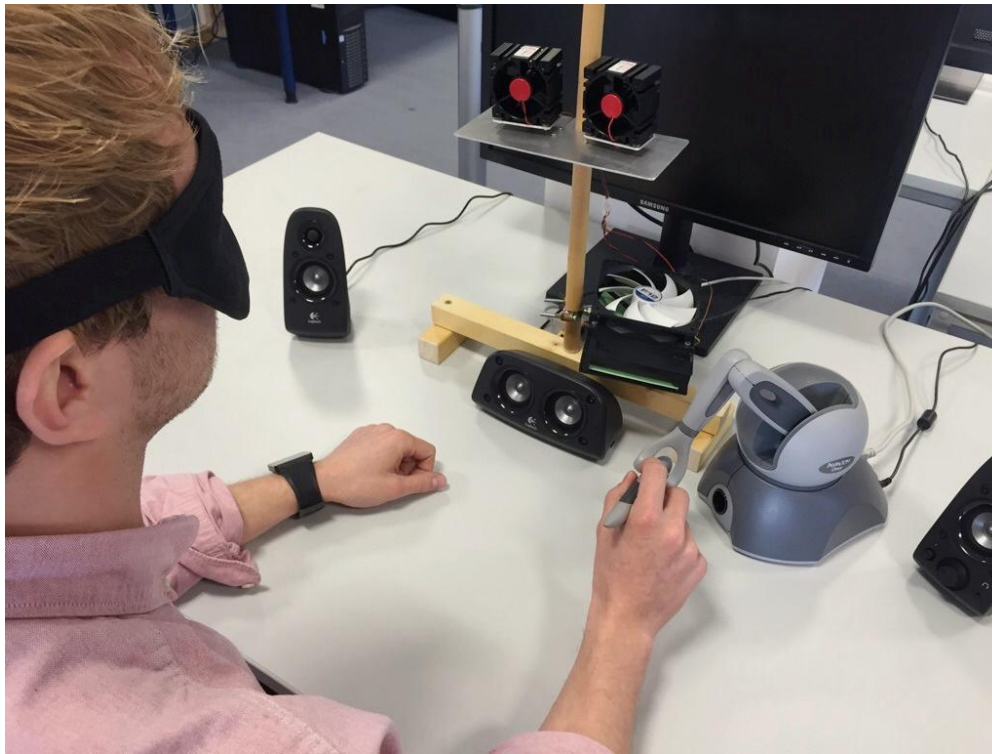
An inclusion game for visually impaired people

Concept

- 5 in- and output devices, 2 player, 1 chase

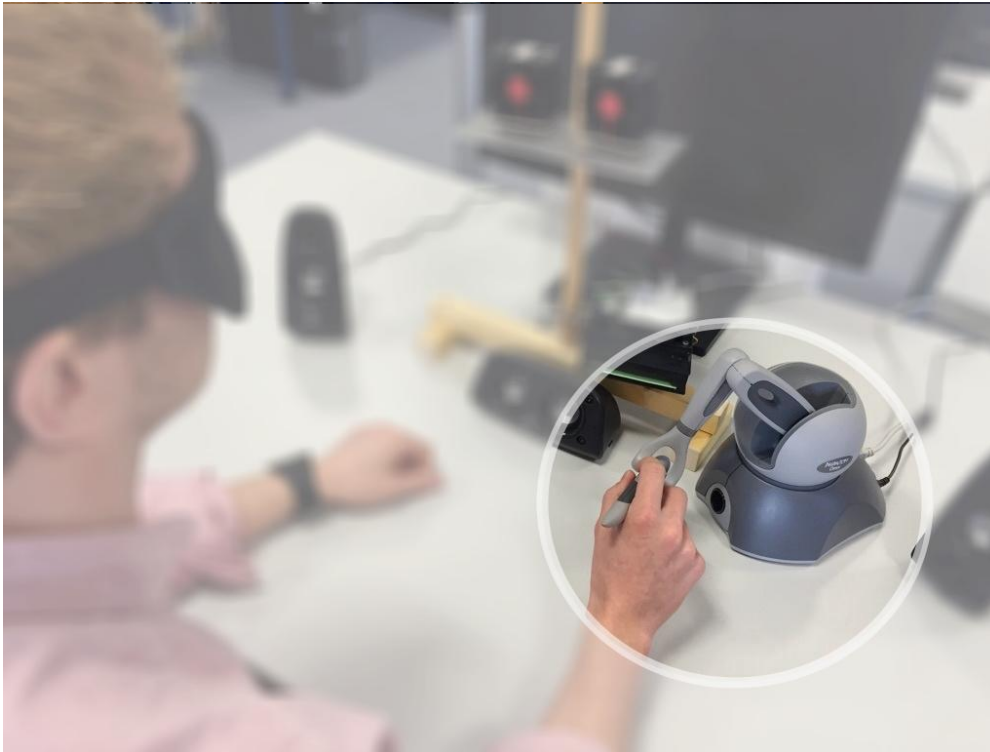


Setup 1 – The Blind Player



- Haptic Device (6 DOF)
- 5.1 Sound System
- Wind Simulation

Setup 1 – The Blind Player



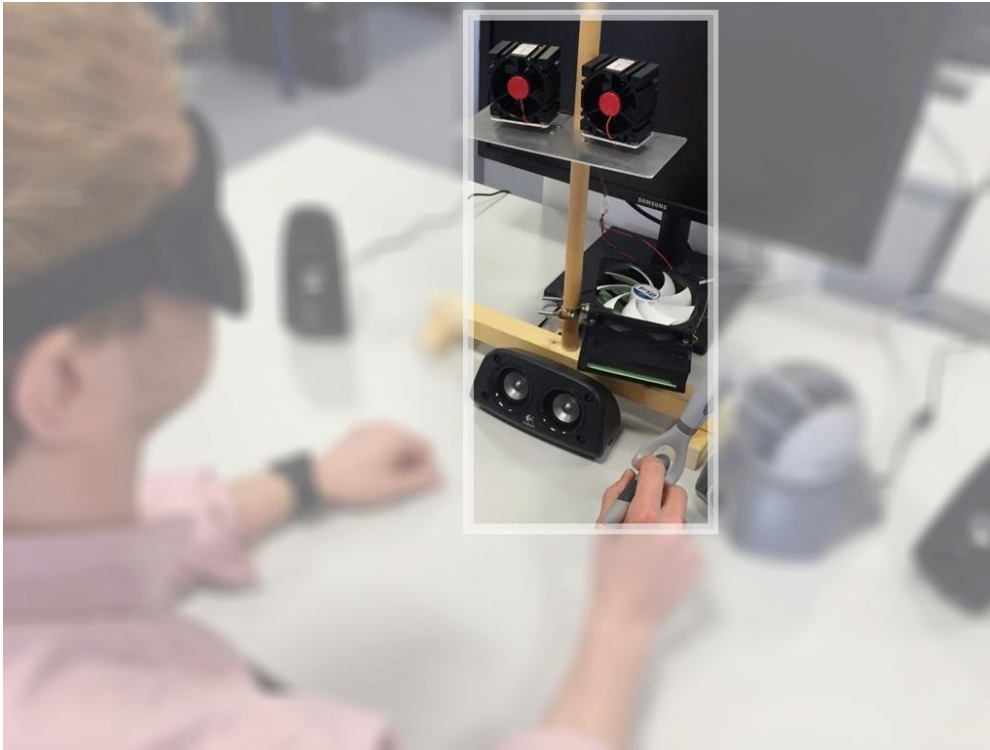
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Setup 1 – The Blind Player



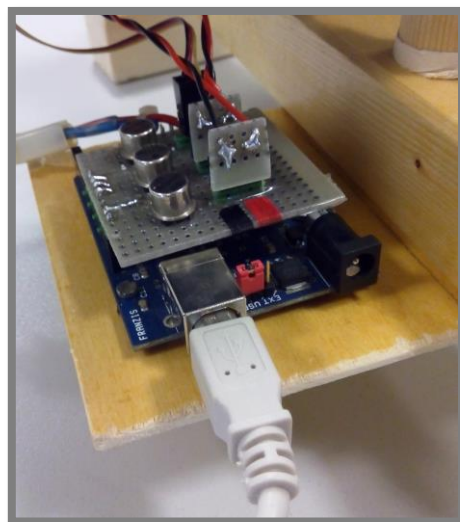
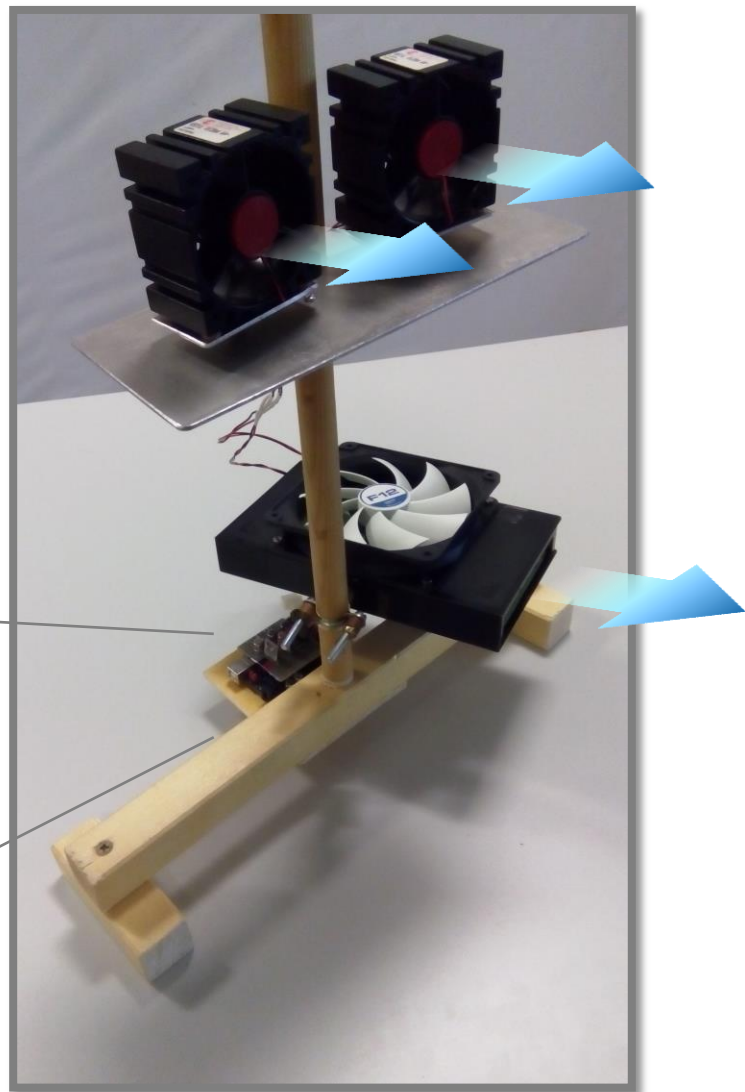
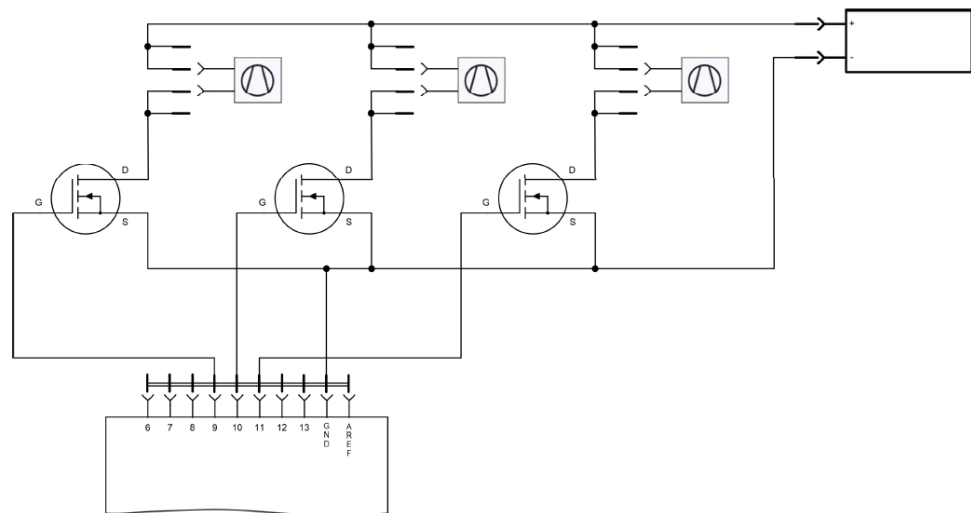
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Setup 1 – The Blind Player



- Haptic Device (6 DOF)
- 5.1 Sound System
- Wind Simulation

Setup 1 – The Blind Player



Setup 2 – The Sighted Player



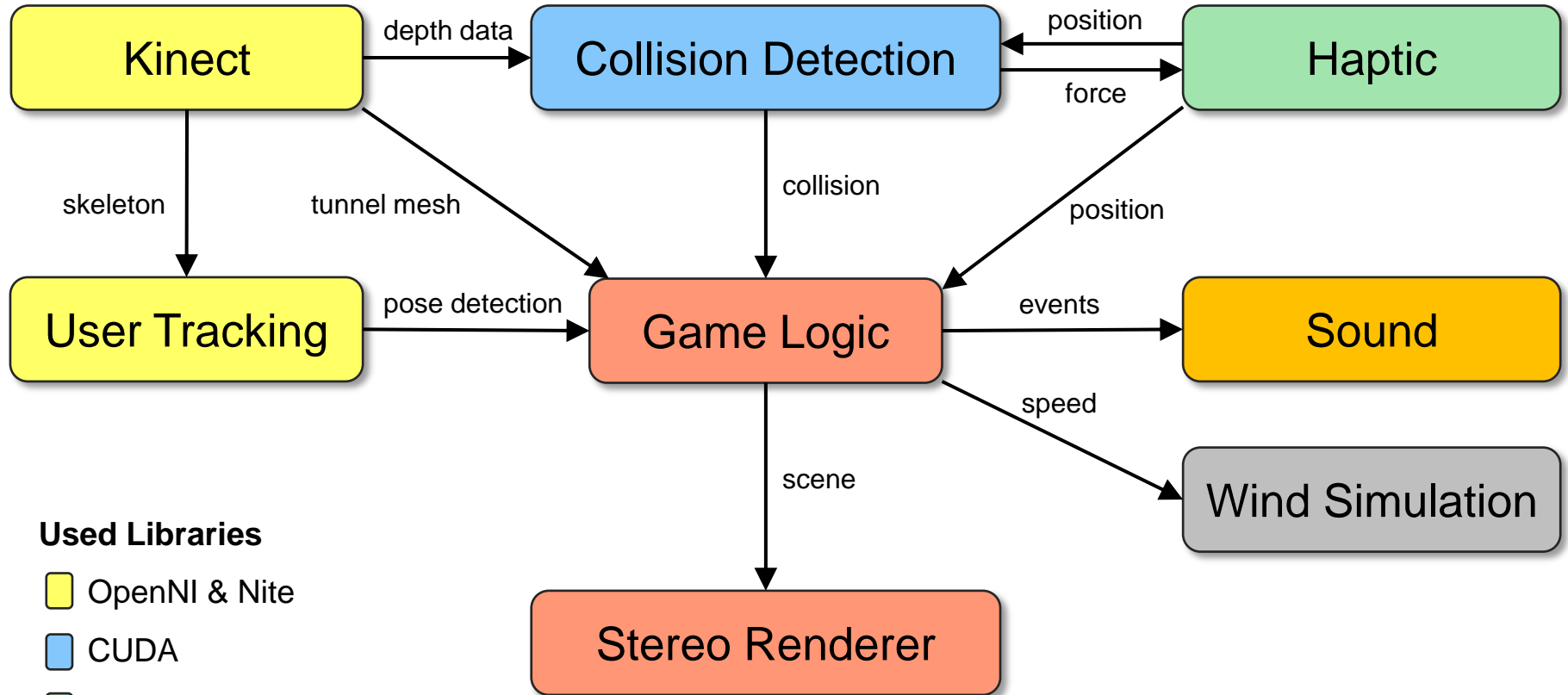
- High definition stereo display
- Depth camera (kinect)



Demo



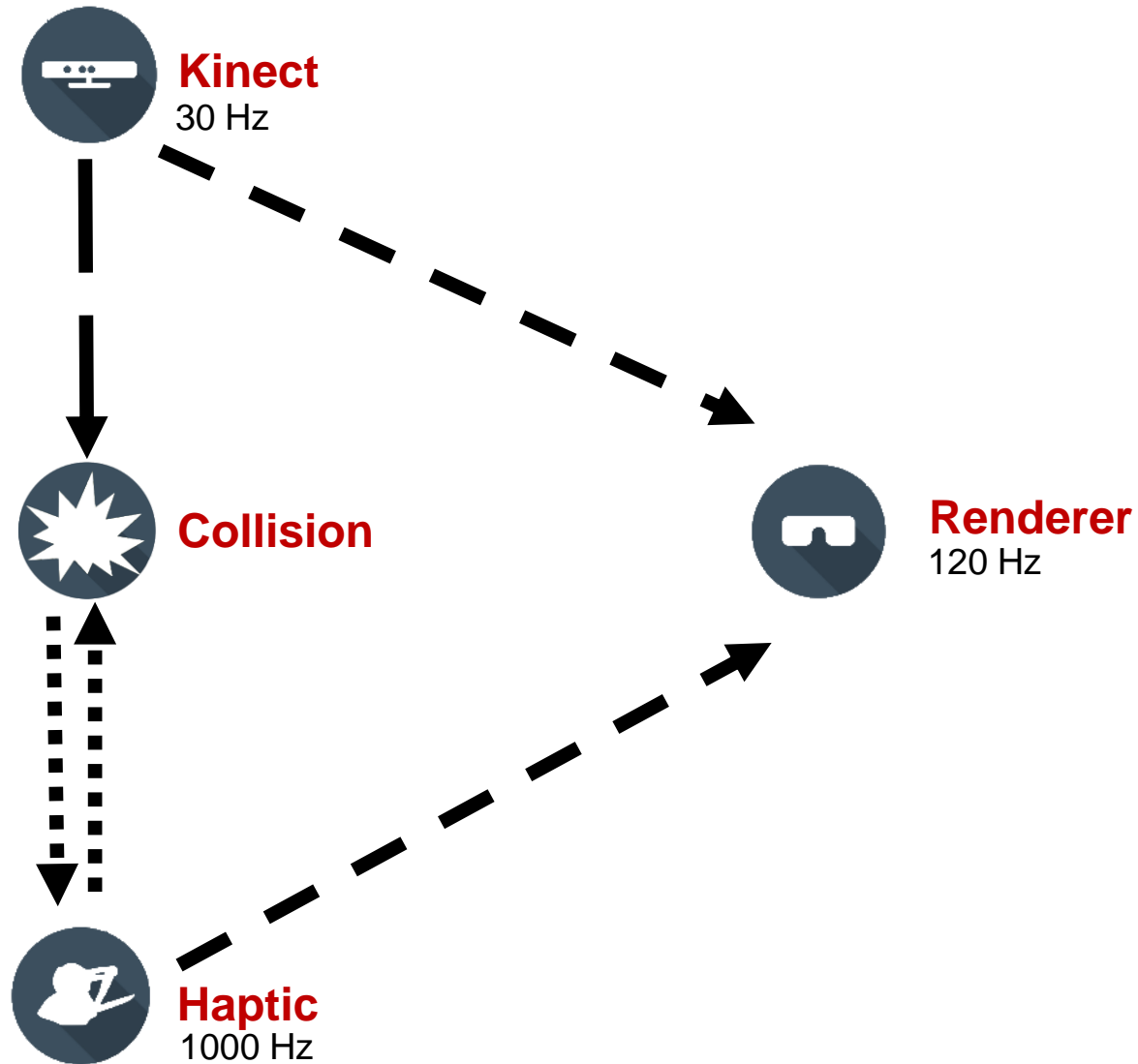
System Overview



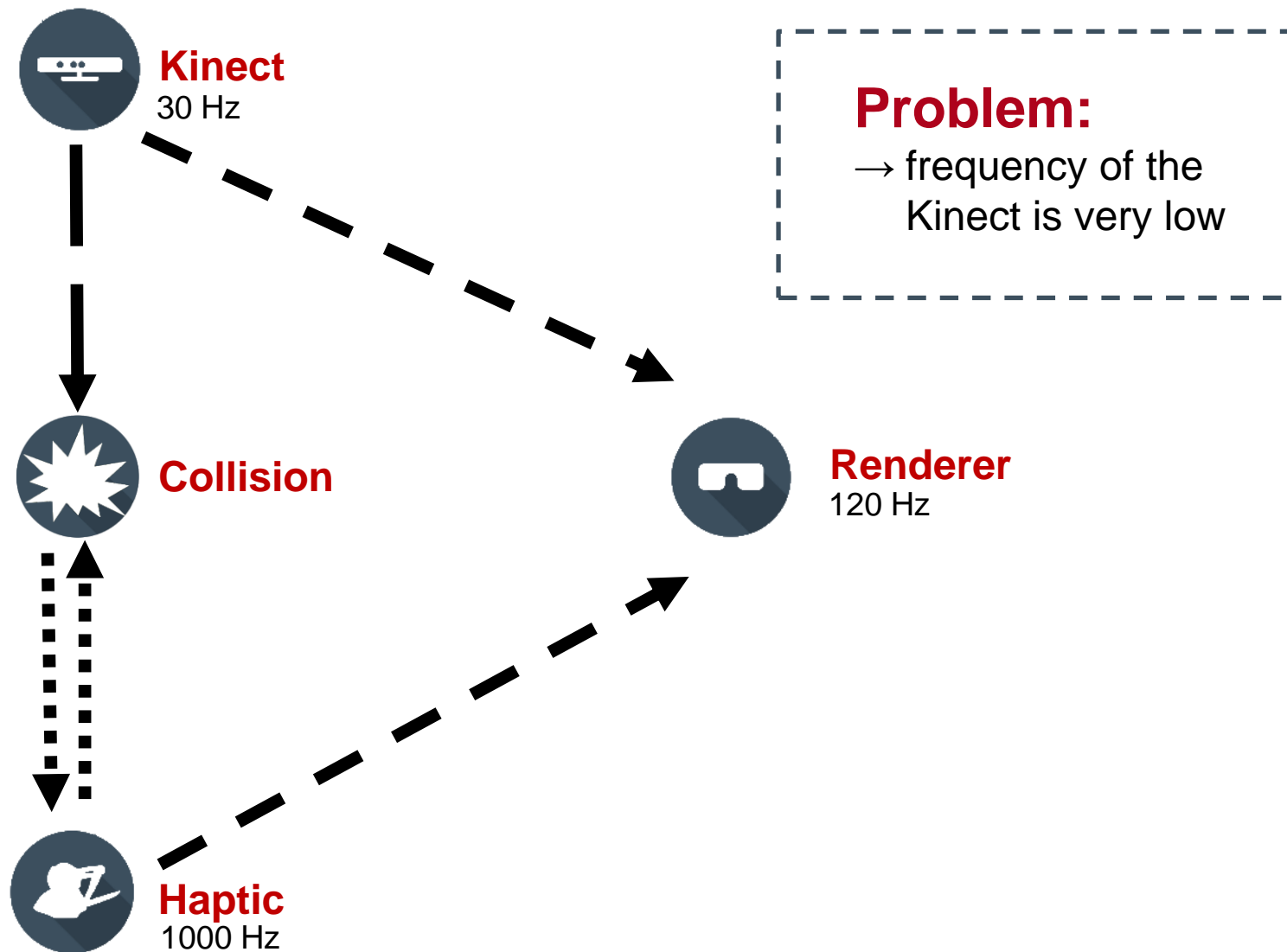
Used Libraries

- OpenNI & Nite
- CUDA
- Chai3D
- irrKlang
- Ogre3D

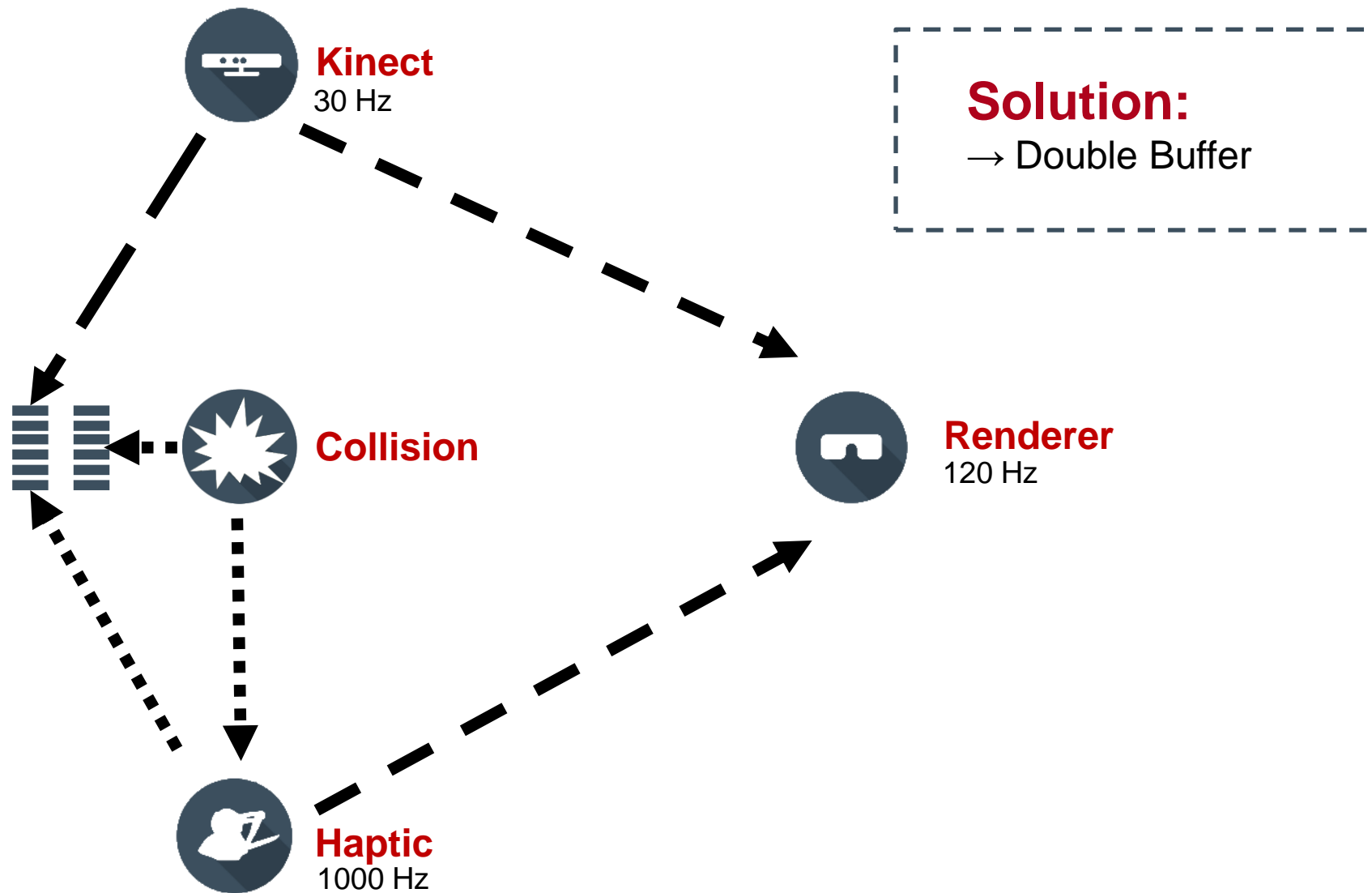
System Overview



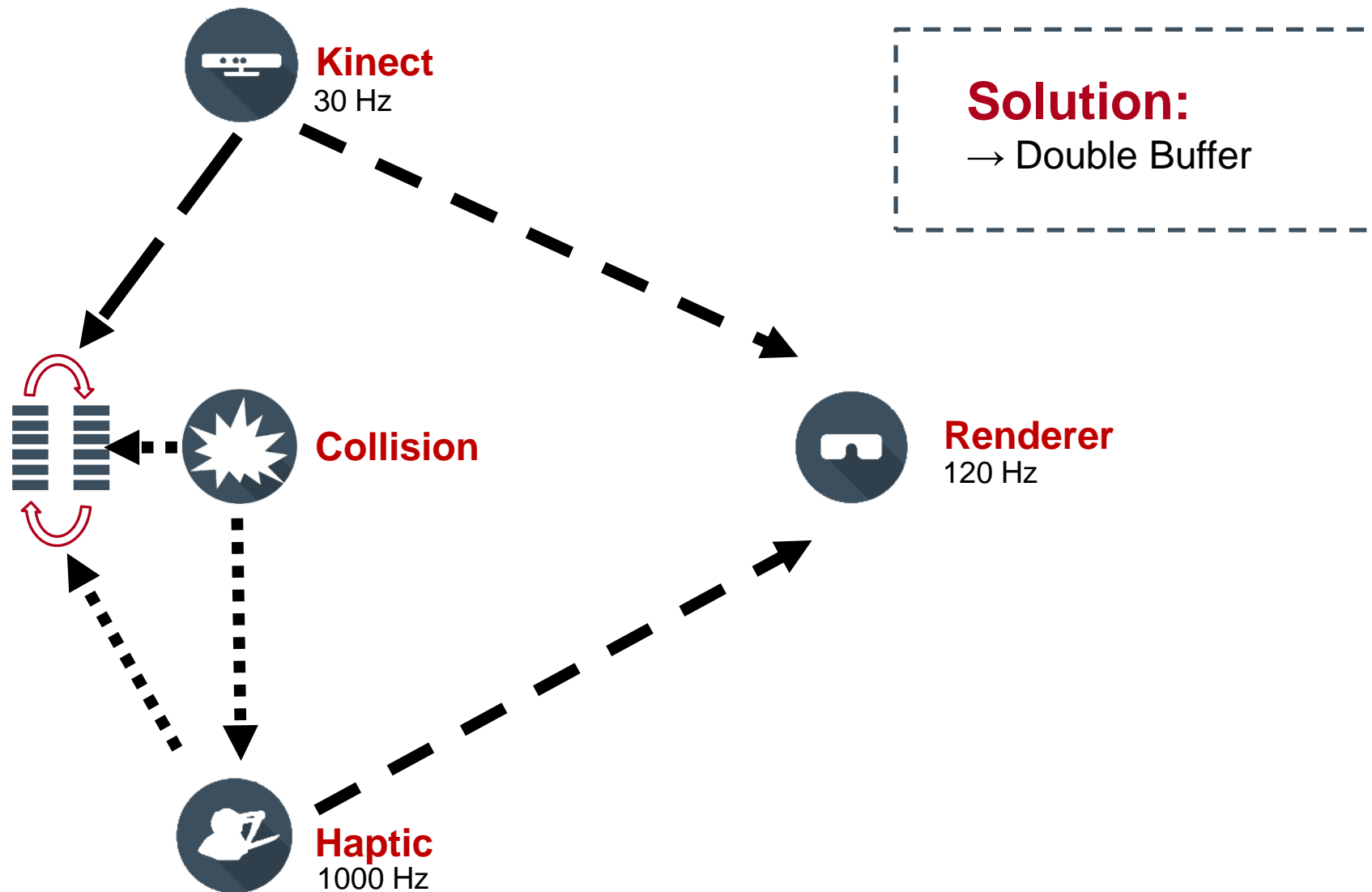
System Overview



System Overview



System Overview



Component Highlights: Kinect

- User-Tracking (skeleton)
- Tunnel Mesh (point cloud)



Simple point cloud

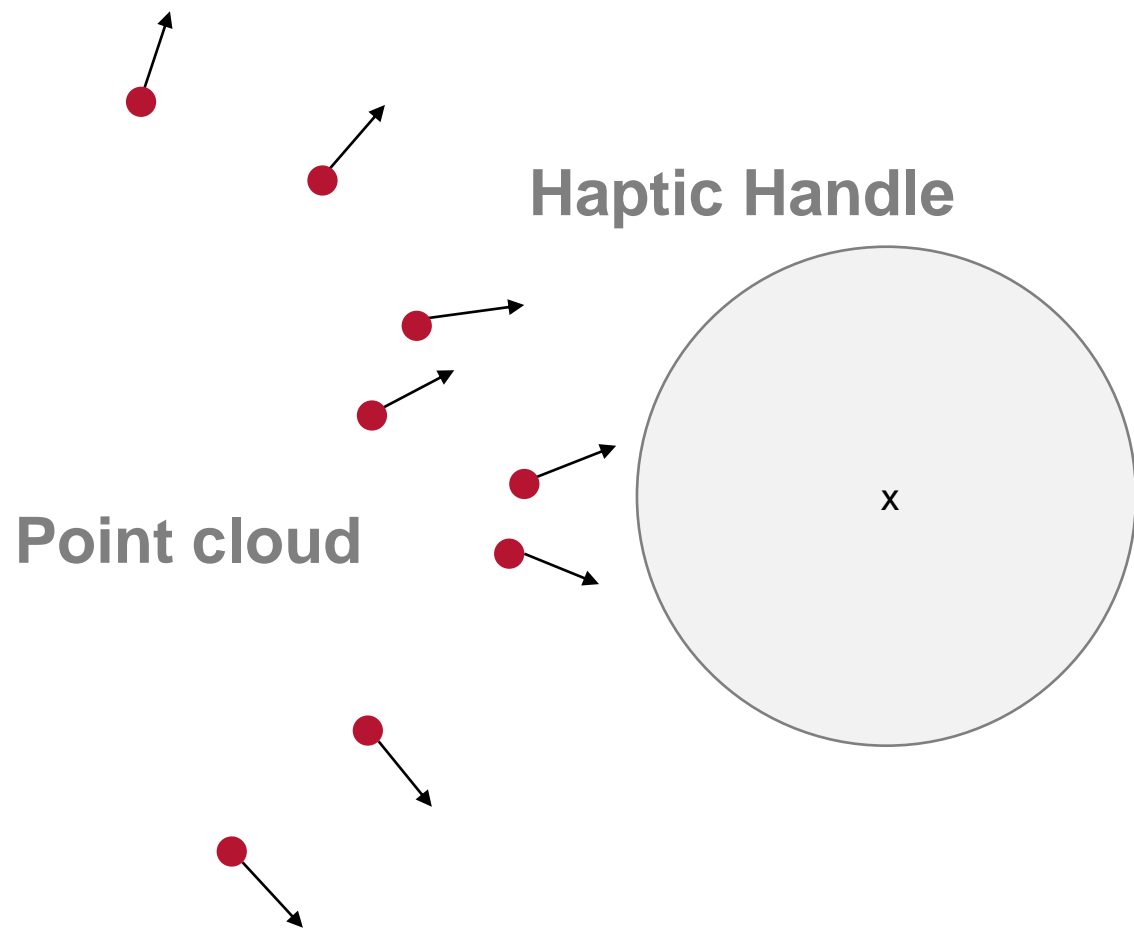
Extracted silhouette

Simplified silhouette

*Interpolation over time
and mesh generation*

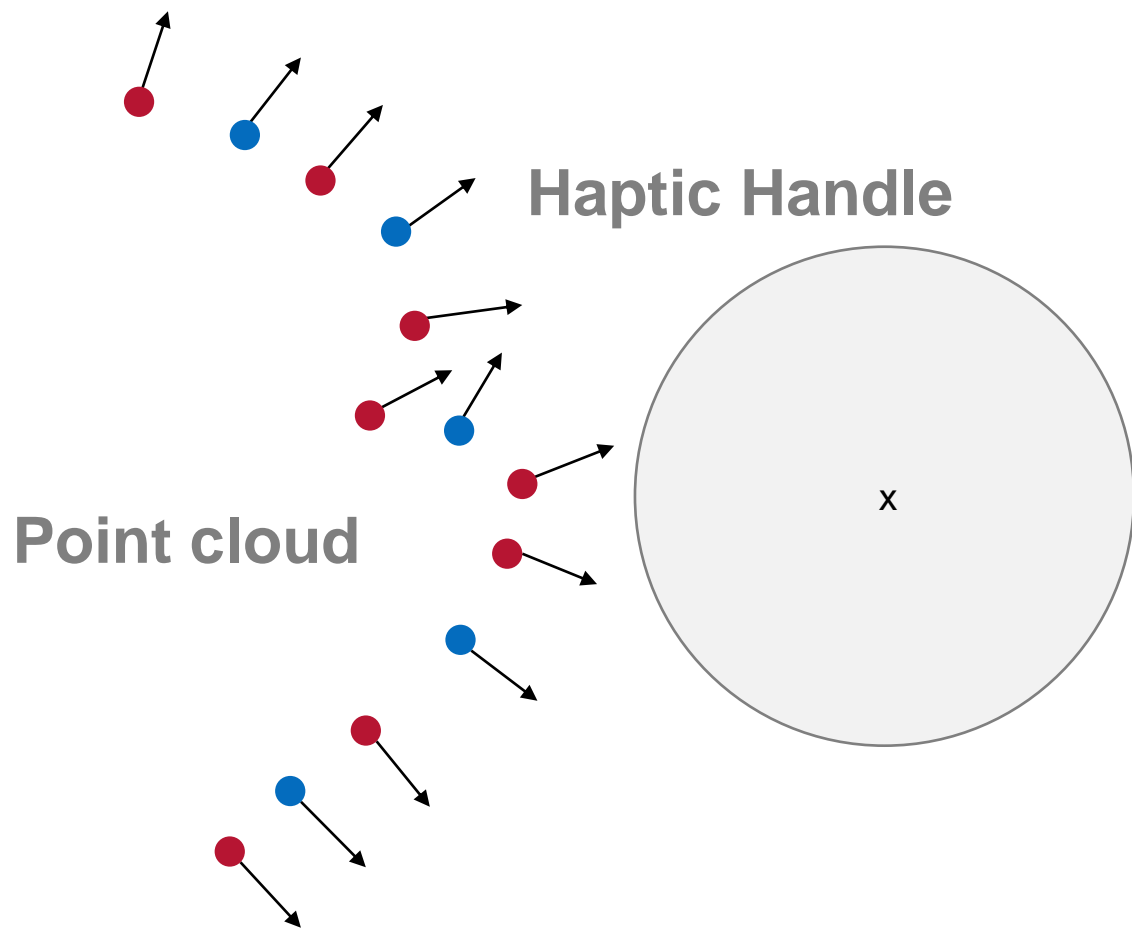
*Mesh smoothing and bump
mapping*

Component Highlight: Force Feedback



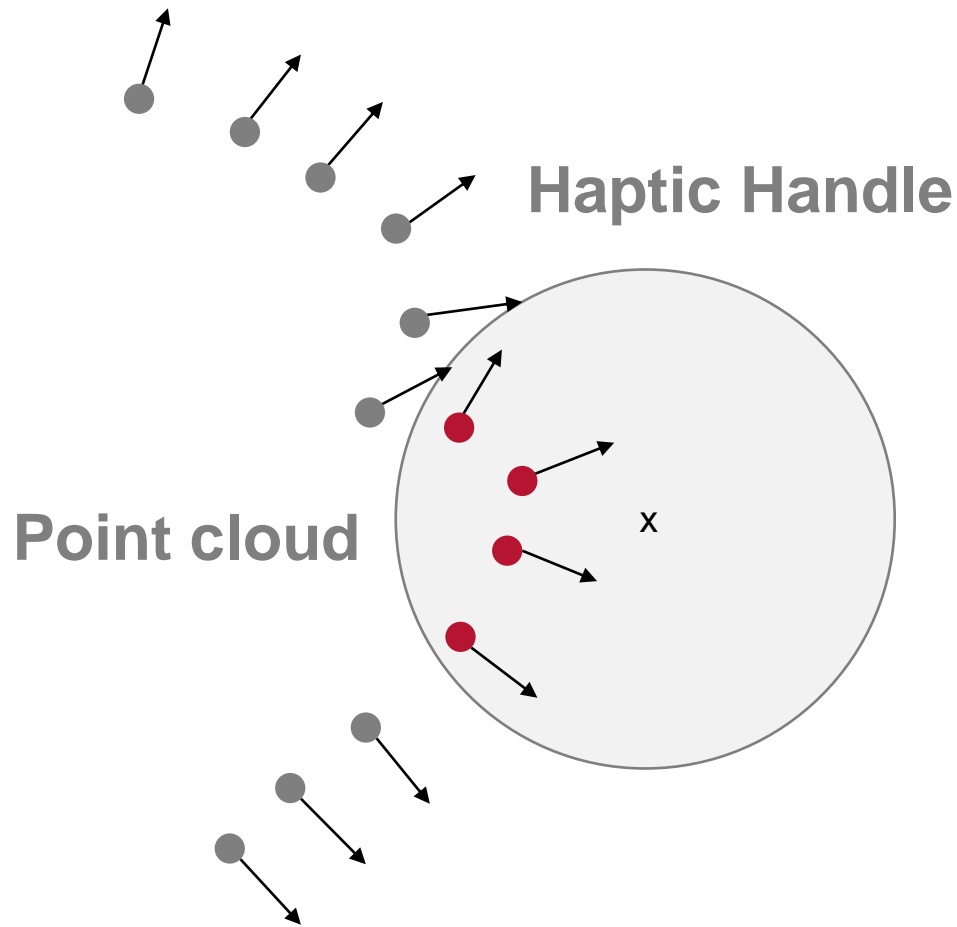
- Filtering of the point cloud to a small set of points

Component Highlight: Force Feedback



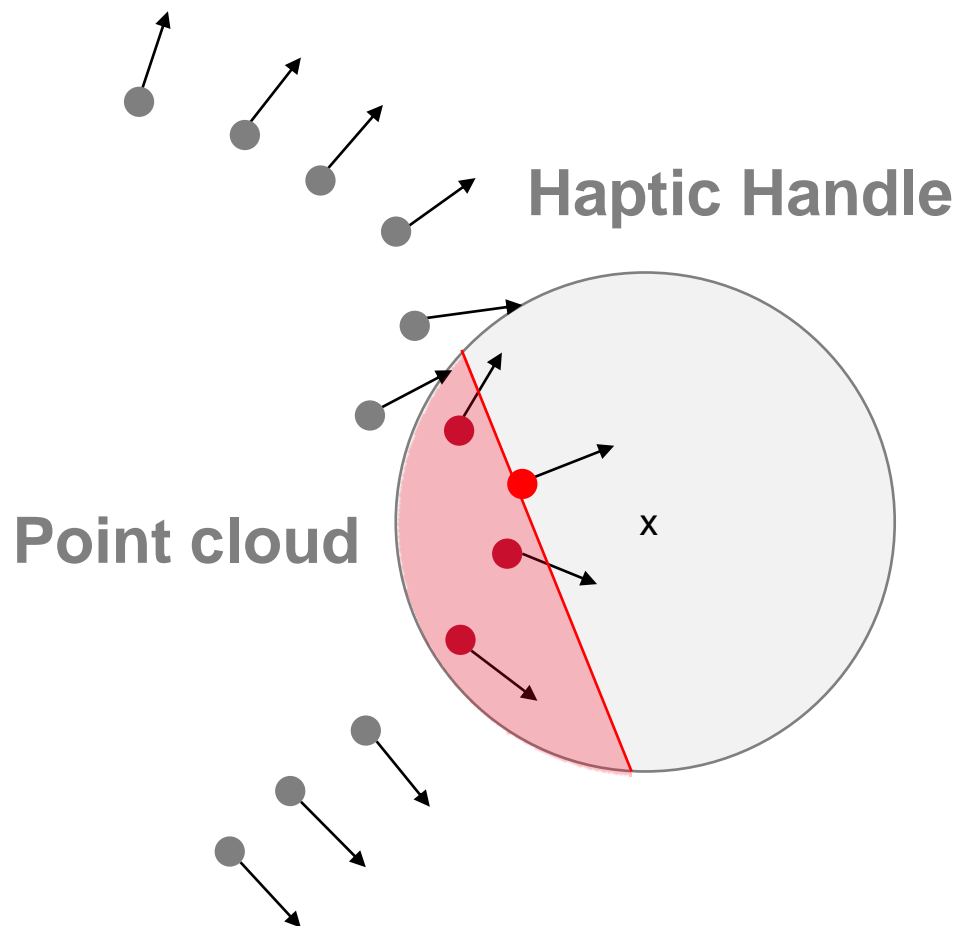
- Filtering of the point cloud to a small set of points
- Adaptively insert points until a defined density

Component Highlight: Force Feedback



- Filtering of the point cloud to a small set of points
- Adaptively insert points until a defined density
- Intersection test of every point with the haptic handle mesh

Component Highlight: Force Feedback



- Filtering of the point cloud to a small set of points
- Adaptively insert points until a defined density
- Intersection test of every point with the sphere
- Calculate penetration volume/depth with spherical cap along the normal

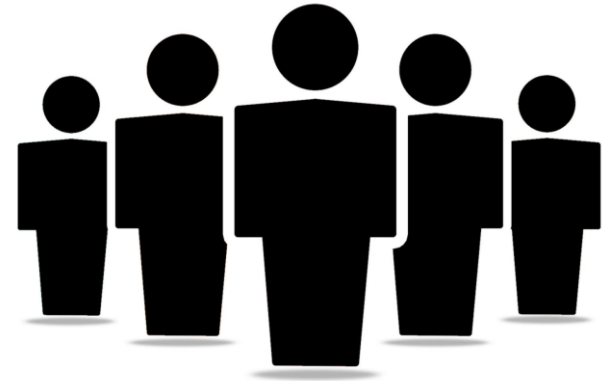
$$\overrightarrow{force} = V_{avg} \cdot \vec{n}_{avg}$$

System Evaluation

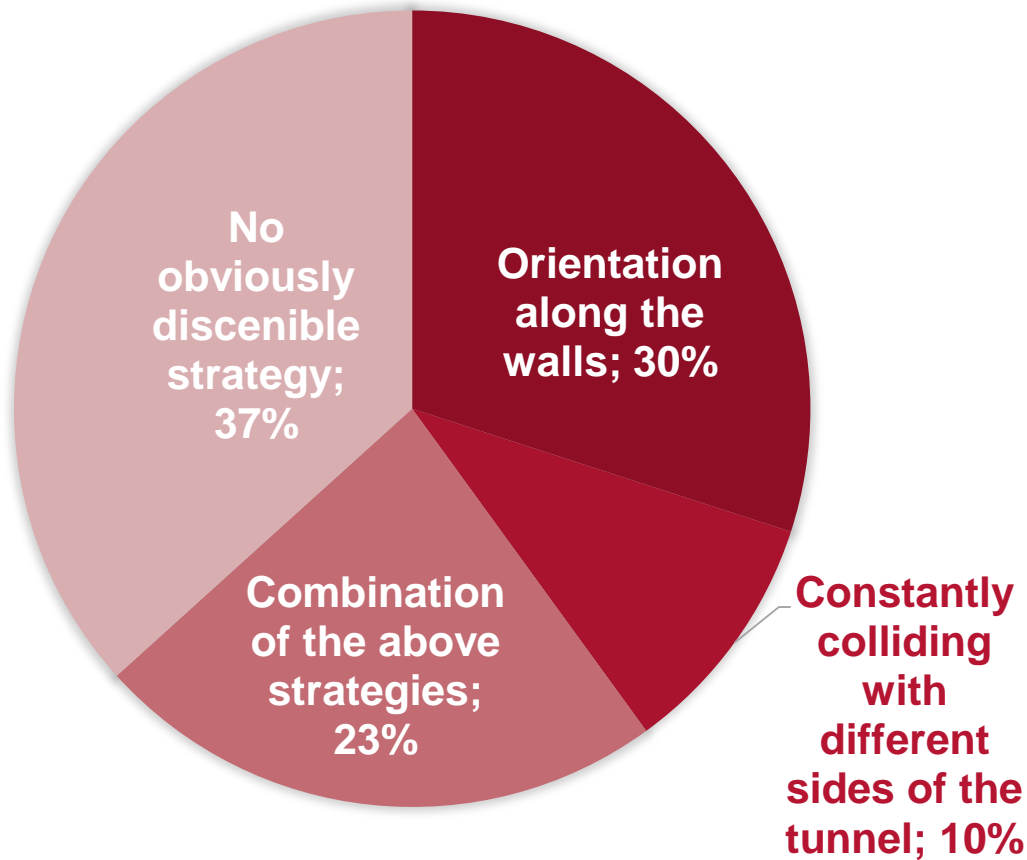
- Pre-Study
 - 3 visually impaired participants
 - Iteratively improved system



- User-Study
 - 30 (sighted) participants
 - Age: 18 – 34
 - 70 % male, 30 % female



STRATEGY FREQUENCIES



50 % are aware of the distance to the walls.



30 % are aware of the tunnel structure.



20 % are aware of the distance to the opponent.

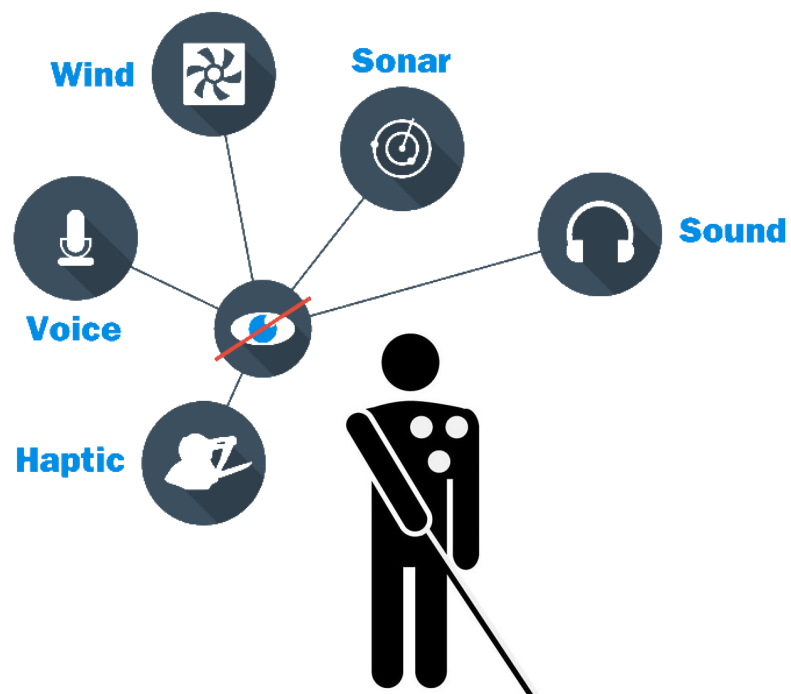


Conclusion

- It is possible to include blind player in a 3D multiplayer game
- Mostly environment sound and haptics helped for navigation
- Balancing / Fairness with asymmetric interfaces is not easy

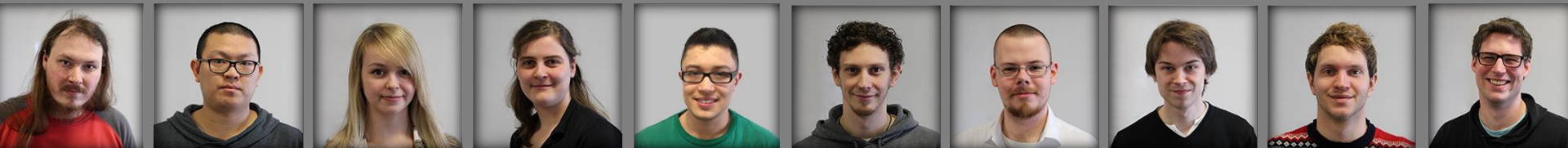
Future work:

- Validate results with real blind people
- Make 3D sound more realistic
- Is there a difference in the navigation in virtual 3D-environments between sighted and blind players?



KIN ΔΡΤΙΚ

VISIT US!



Sources of images

- **Battlefield 4**
<http://8bitchimp.com/wp-content/uploads/2014/04/Screen-Shot-2013-03-26-at-10.33.26-PM.png>
- **Cartoon**
<http://grundbildung.org/files/pc-cartoon.png>
- **Wii**
http://static1.gamespot.com/uploads/original/mig/7/4/7/3/917473-zanzibar_004.jpg**Group people**
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- **GTA V**
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- **Piktogram**
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- **Kinect**
<http://www.kurzweilai.net/images/kinect.jpg>
- **Tracking Modes (Seated and Default)**
<https://i-msdn.sec.s-msft.com/dynimg/IC584441.png>

All website: last visited at 23.03.2015

- Bei Yuan and **Eelke Folmer**. Blind hero: Enabling guitar hero for the visually impaired. *In Proceedings of the 10th international ACM SIGACCESS conference on Computers and Accessibility*, pages 169-176, Halifax, Nova Scotia, Canada, October 2008.