



2015 移动开发者大会

Mobile Developer Conference China 2015



虚拟现实与人机交互技术

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uSens 凌感科技

2015.10.15



- **什么是凌感和印象湃？**
- **关于手势识别技术？**
- **我们要开发什么样的AR/VR游戏？**

最早的VR游戏机是哪家公司开发的？



- **什么是凌感和印象湃？**
- 关于手势识别技术？
- 我们要开发什么样的AR/VR游戏？

- 2013成立于加州硅谷的圣何塞市
- VR & AR 三维人机交互解决方案
- 第一个在移动平台上提供三维手势识别技术
- 在教育、医疗、娱乐、商务等为用户带来交互性最强的沉浸式“**超级现实**”体验



无线 - 移动平台, empower smart phones, cordless

简便的内容开发移植 - 简单易用的 SDK plug-in in C++, Java, Unity and Cardboard

超级现实 - VR & AR 自由叠加和转换

手势控制 - 三维手势手指的跟踪识别. >60fps 帧率

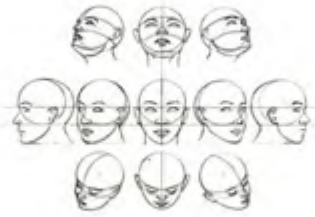
位移跟踪 - Inside-out 头部位移跟踪, 极小的延迟

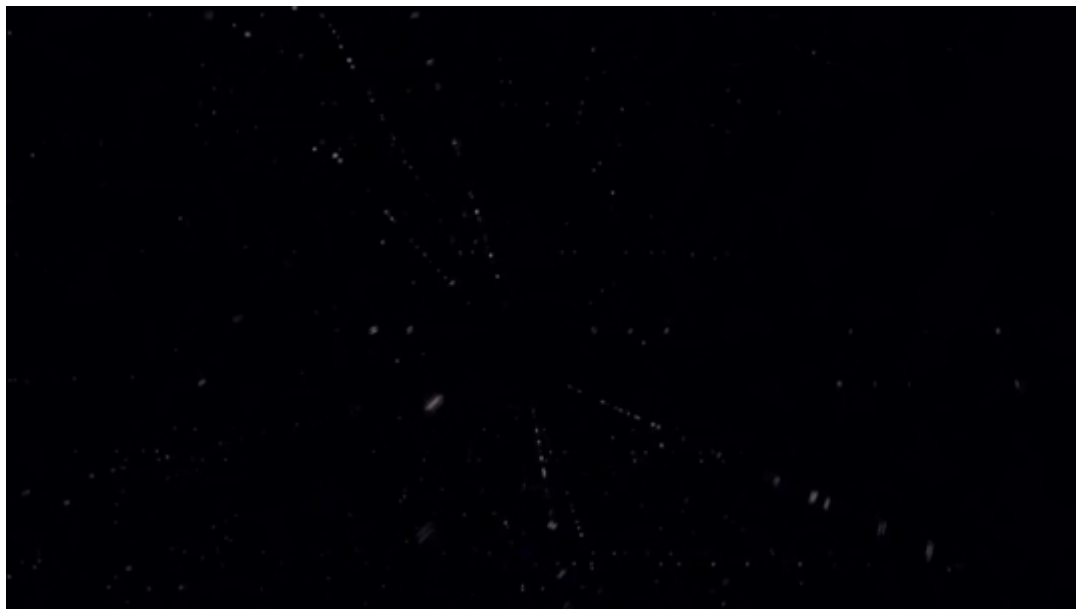


IMPRESSION PI



三维交互解决方案





Super Reality ([Combination AR + VR](#))

兵俑背后忧桑而又震撼的故事

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空气氧化使出土的兵俑鲜艳的衣着与武器消失

博物馆展出的兵俑为陶土色，手中缺少武器

通过AR看到兵俑原本的彩色衣服与武器

通过VR穿越到秦代制作兵俑的窑洞，亲手为兵俑佩戴武器

与高举武器、衣着鲜艳的兵俑回到现实



Gesture

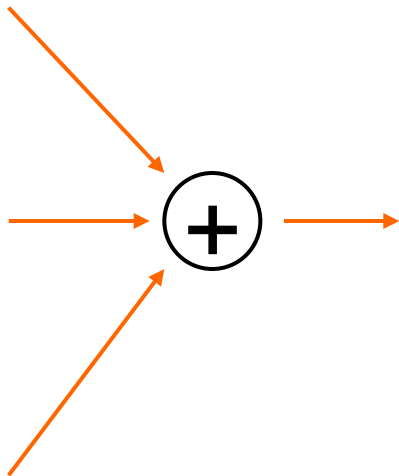
- We adopt the same hardware as Leap motion (**Dual IR camera**)

Super Reality

- To render AR, we need to get TWO images at exact position of left and right eyes.
- **Dual RGB camera** is required.

Tracking

- **IR and RGB cameras** are also used in 3D head tracking
- High performance **IMU** is also required

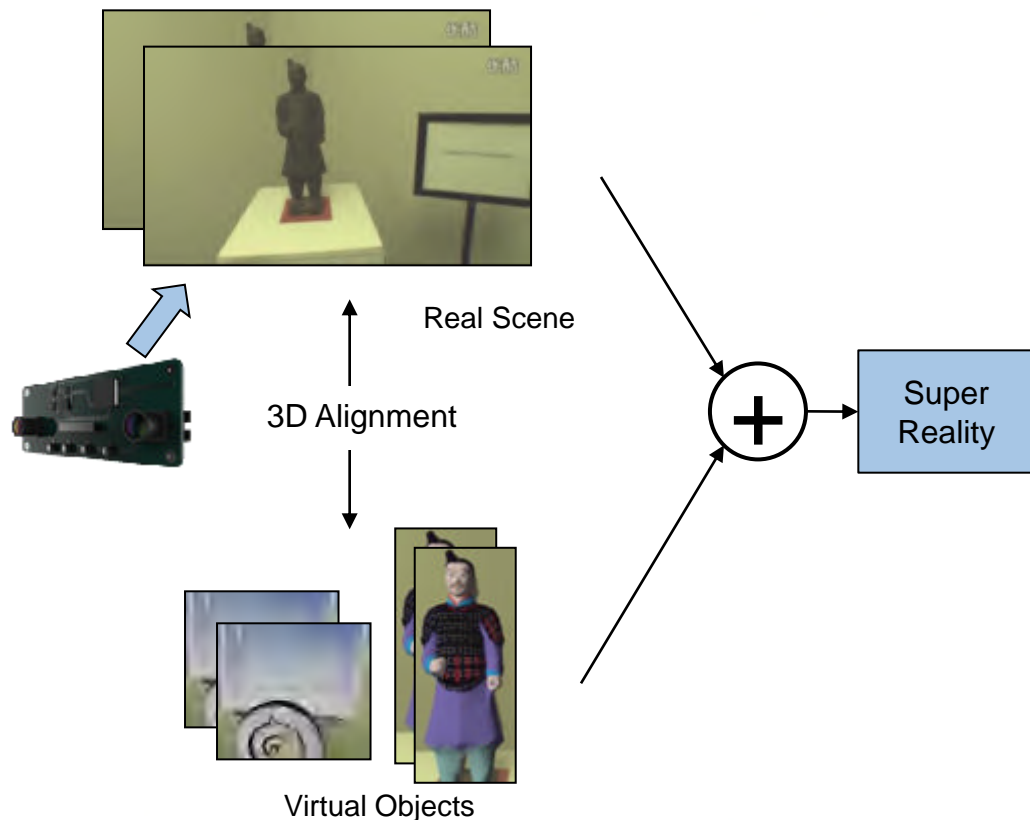


System Design

- Stereo RGB+IR camera
- IMU sensor
- Computing unit



Our Solution



Algorithm

1. Alignment:
Track head position and orientation, w.r.t the real scene. Using RGB cameras.
2. Render real scene:
 - a) Capture stereo image of the real scene. Using **Stereo RGB Cameras**
3. Render virtual objects:
 - a) Determine the position of the virtual object to be displayed.
 - b) Generate stereo image of the virtual object
 - c) Render virtual objects over the real scene.

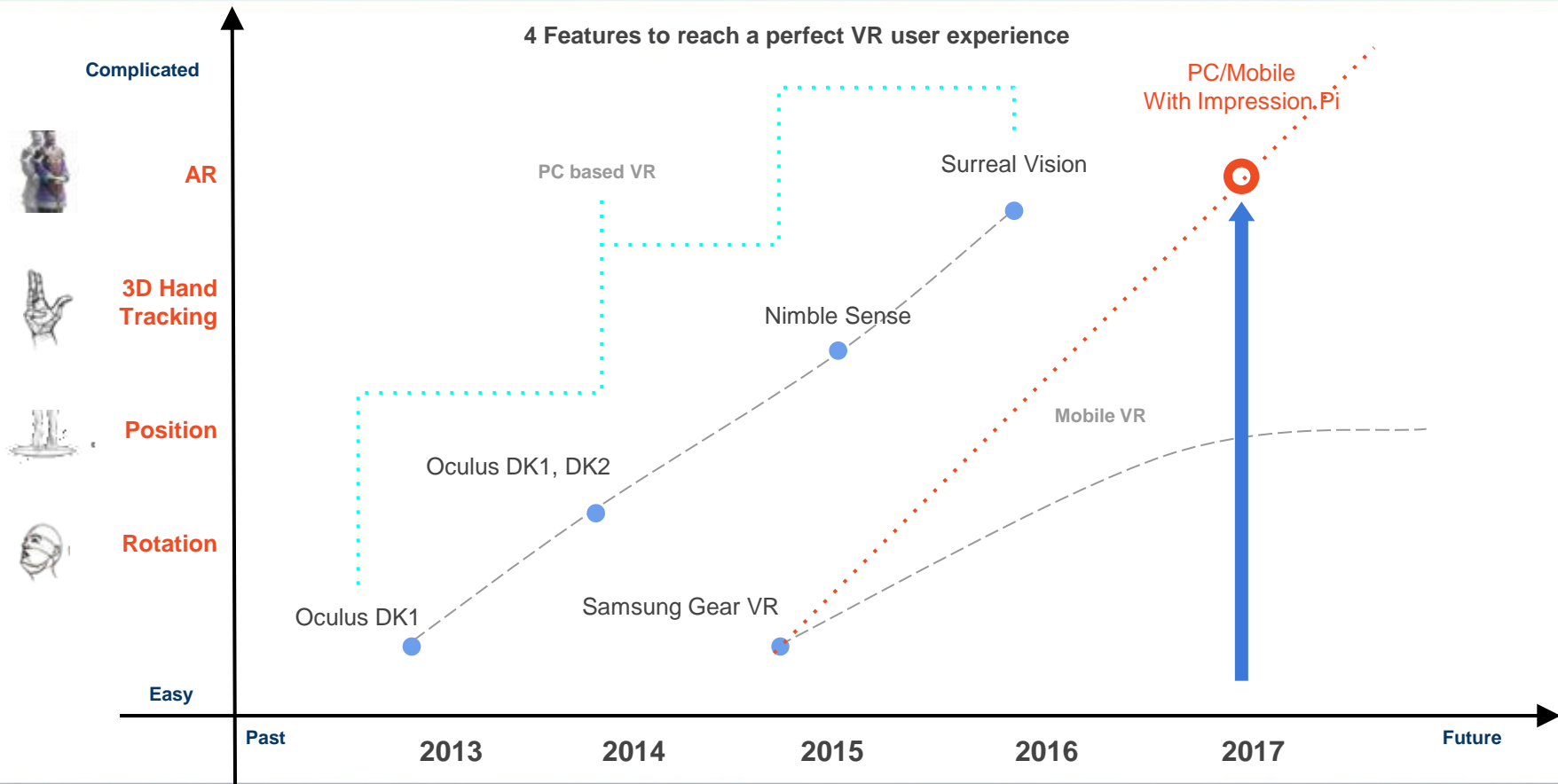
Compare with Oculus Rift



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运算功能	需要连接电脑使用	便携，不需要外接设备 自带的处理器和手机处理器协同工作
手势识别	需要外接额外的传感器 (leapmotion等)	内置传感器可以识别手势， 手势识别算法针对移动平台进行了优化，速度能达到30fps
头部运动估计	需要外置红外摄像头	通过内置的红外和彩色摄像头
显示方式	只能显示VR内容	可以显示VR和AR内容，可以任意切换显示方式

4 Features to reach a perfect VR user experience





Super Reality ([Combination AR + VR](#))



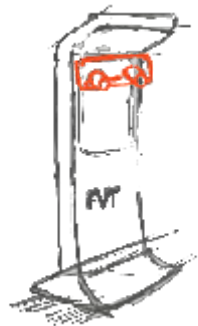
Impression Pi [Live Demo](#)



3D Fingo ([Gesture in AR](#))



Intellegent Eyes



FVT digital Signal



HUD Car



Eye for Robot



Vision Drone

- 什么是凌感和印象湃？
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游戏



3D UI



驾驶



公共显示

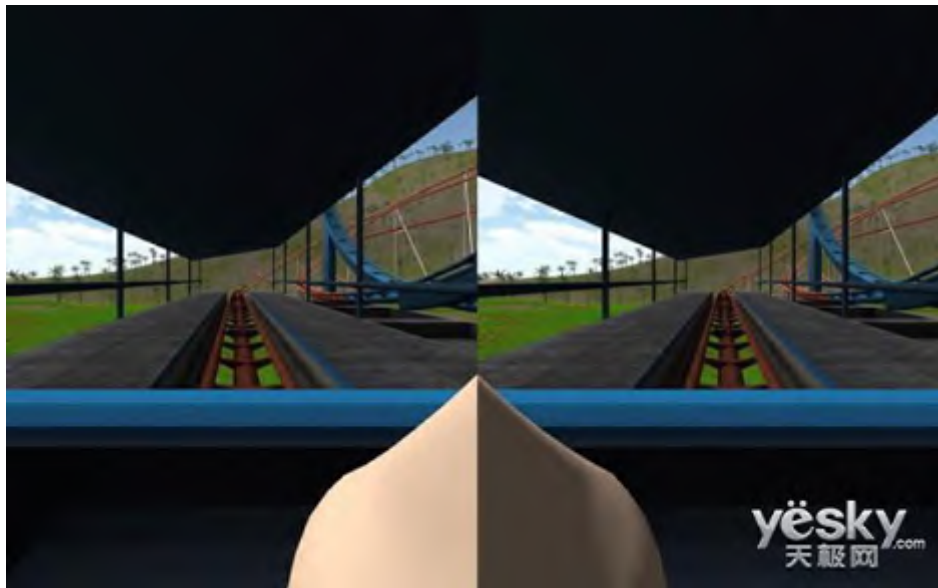


医疗



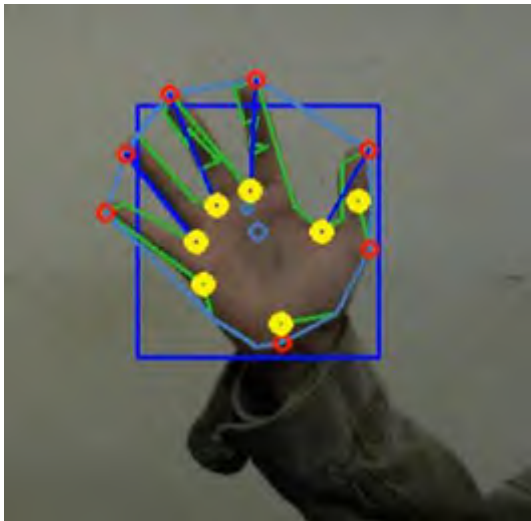
智能家居

- 当使用者戴上头盔时，他们的第一个动作就是看自己的手
- 如果用户在虚拟环境下看不到应该看到的东西，会产生眩晕



早期的手势识别算法

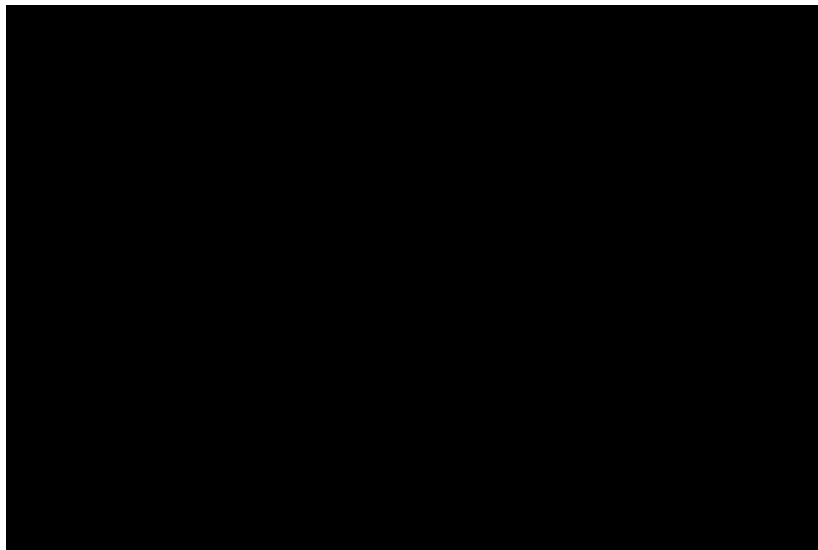
- 基于形态学运算，识别指尖位置
- 基于模板匹配，识别特定手势



<http://social.msdn.microsoft.com/Forums/getfile/134817>



<http://www.tiaozhanbei.net/project/3936/>

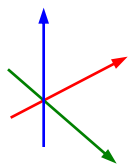


3D Fingo ([Gesture in AR](#))

Gesture | Our Approach

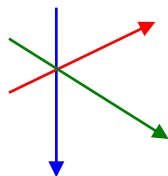
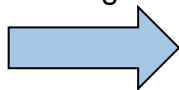
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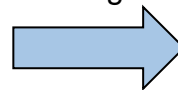
World coordinate

Head tracking



Head coordinate

Hand tracking



Finger tip in
"Head coordinate"



UI Interaction

- Only need simple gesture recognition, Pointing, Sweep, 3D touch, etc
- Need to detect finger tip quickly and accurately.



Game Interaction

- Need more complex gestures, grab, rotate
- Need to estimate hand skeleton model



Gesture | State of Arts

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Skeletal Hand Tracking Library
Released by Intel at May 2013



Real-time hand Tracking Released by Microsoft at
Aug. 2014 Robust to tracking lost, fast movement



Nimble VR, acquired by Oculus Rift at 2014



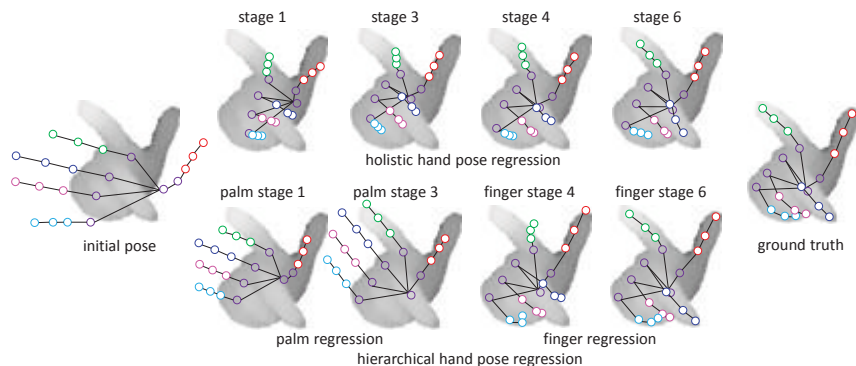
LeapMotion, released at 2013

Pose Update

- 3D Pose Indexed feature as random forest feature
- Principle hierarchical regression method in 3D space.
- Learn residue from current pose to correct pose, as SDM method for face.

$$\Theta^t = \Theta^{t-1} + R^t(I, \Theta^{t-1}).$$

- Regression in hierarchical order, from palm to finger.

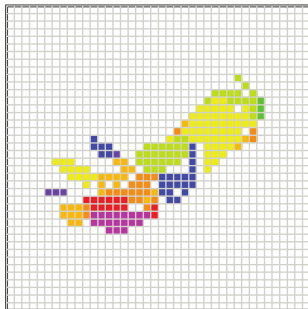


Pose Search

- Use Similarity Sensitive Coding to compress hand image to 192bit
- Use Hamming Distance for fast comparison.
DB size is 10K, retrieve time is 2ms.



Camera input image



Tiny image



Database nearest neighbors



Nearest neighbor pose

Robert Y. Wang and Jovan Popovic, Real-Time Hand-Tracking with a Color Glove, ACM Transaction on Graphics (SIGGRAPH 2009), 28(3), August 2009

Deep Learning

- Use CNN network, input is depth map, output heat maps of every joint.

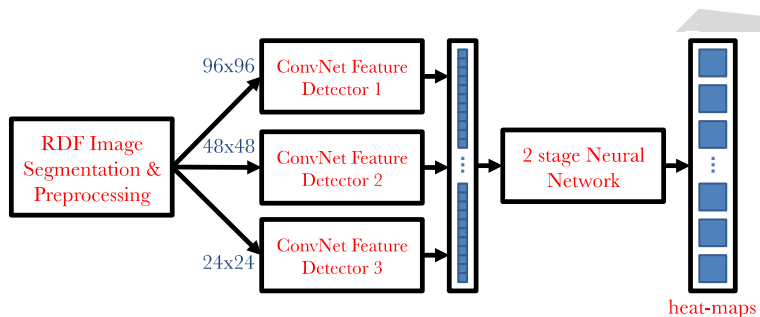


Fig. 6: Convolutional Network Architecture

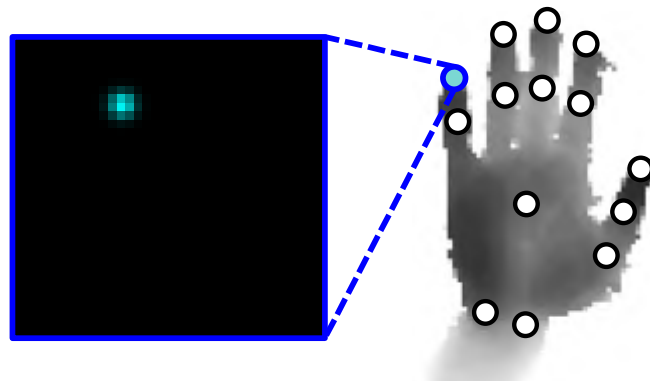
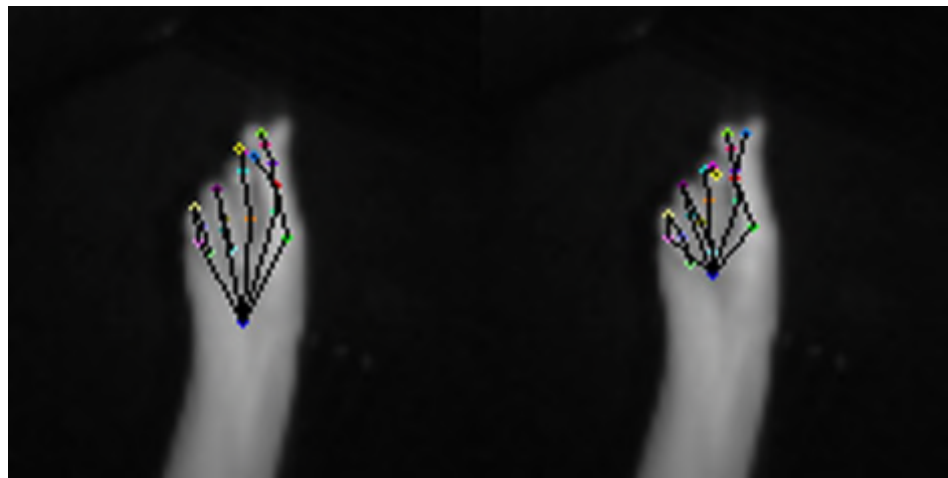


Fig. 5: Depth image overlaid with 14 feature locations and the heat-map for one fingertip feature.



Leapmotion

v.s.

Ours

- 什么是凌感和印象湃？
- 关于手势识别技术？
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体感游戏？

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V.S.



- ✓ 真实性高
- ✗ 没有触感
- ✗ 需要比较大的游戏空间
- ✗ 非常耗费体力，玩一会儿就累了
- ✗ 起初很新鲜，一段时间以后就没兴趣了
- ✗ 没有大作，都是休闲小游戏

- ✗ 真实性低
- ✓ 对空间没有限制
- ✓ 可以坐着玩一天，适合宅男
- ✓ 游戏粘性大，一般单机游戏通关要100+小时
- ✓ 销量超百万的知名游戏很多

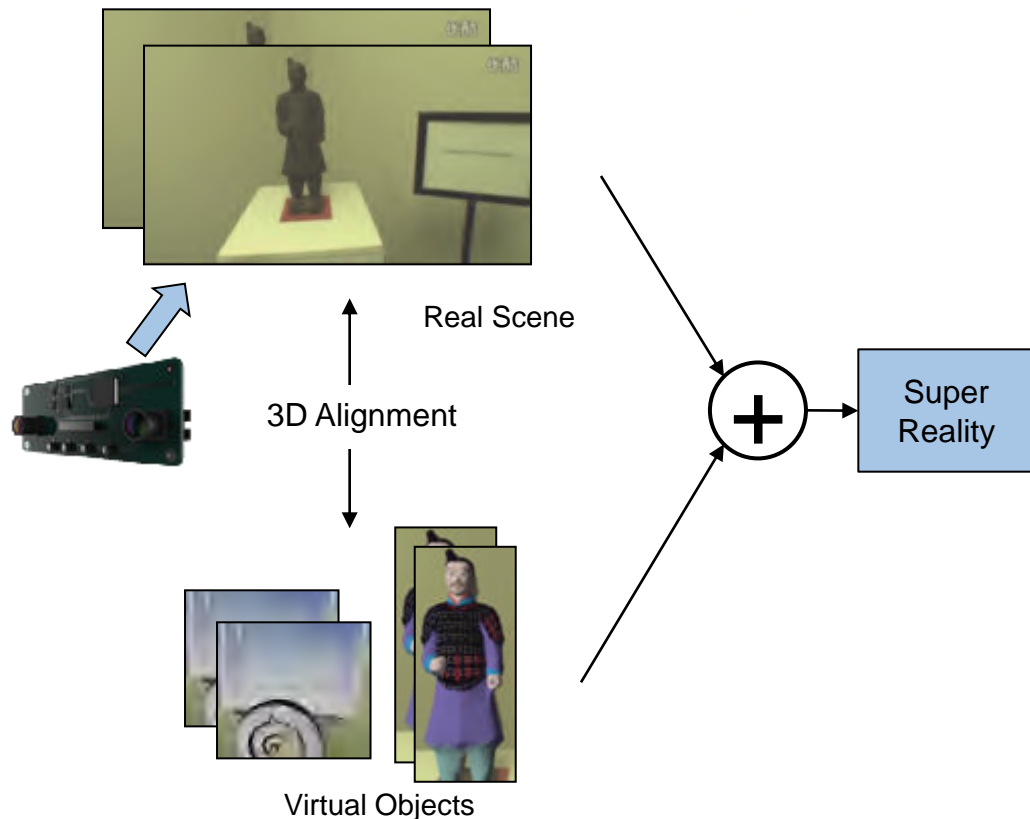
1. 坐着玩
2. 真实感强（视觉、触觉）
3. 基于现有VR技术容易实现



- 可以看到该看到的東西
 - 虚拟物体：驾驶室、各种仪表盘、室外场景
 - 真实物体：手、方向盘、换挡、飞行控制器等
- 可以摸到需要用于交互的设备
 - 方向盘、换挡、飞行控制器等

				
看到虚拟场景	✗	✓	✓	
看到真实物体	✓	✗	✗	✓
摸到真实物体	✓	✗	✓	✗

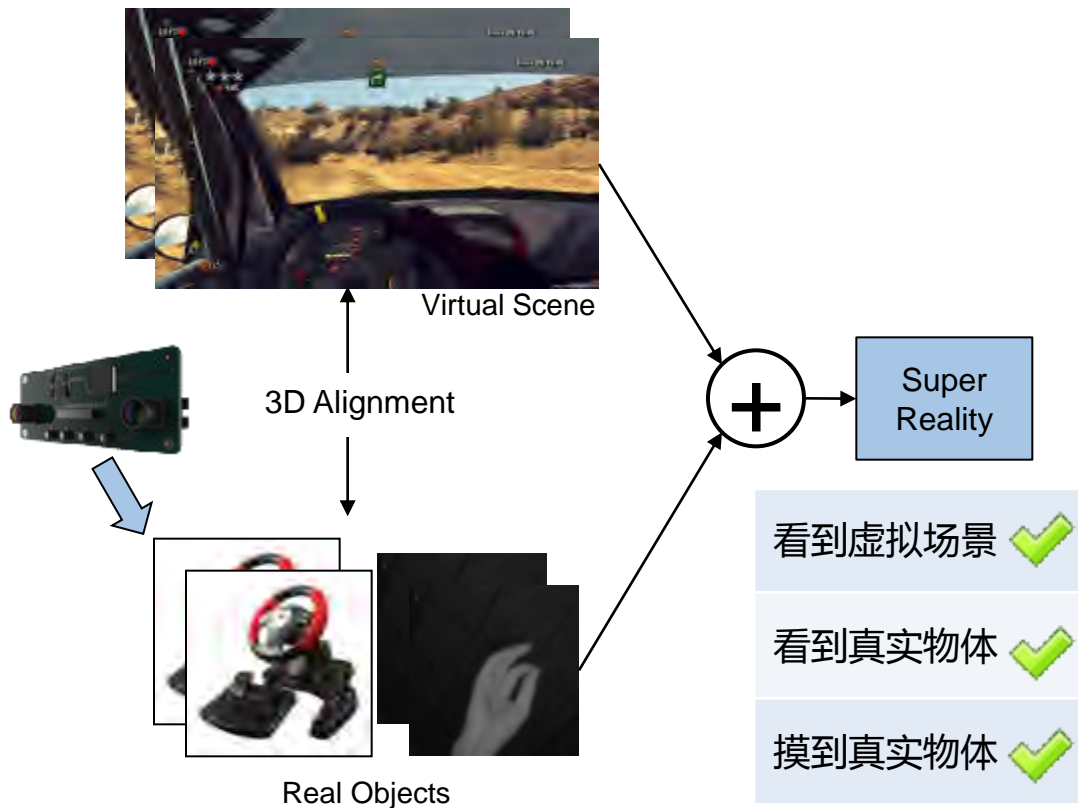
Our Solution



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3. Render virtual objects:
 - a) Determine the position of the virtual object to be displayed.
 - b) Generate stereo image of the virtual object
 - c) Render virtual objects over the real scene.

Our Solution



Algorithm

1. Alignment:
Track head position and orientation, w.r.t the controller. Using RGB or IR cameras.
2. Render virtual scenes.
3. Render real objects:
 - a) Capture stereo image of the real scene. Using **Stereo RGB Cameras**
 - b) Detect and extract real objects to be displayed.
 - c) Generate stereo image of the real objects from input stereo images.
 - d) Render the real objects over virtual scenes.

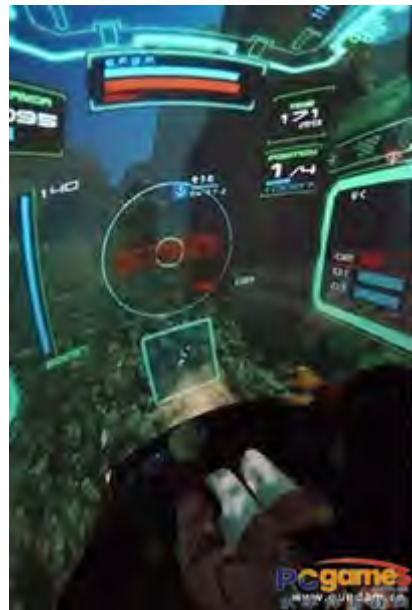
- 在一个**受限环境**下（驾驶室），真实感很强的VR/AR游戏
- 现有技术可以实现，周期短
- 不需要开发新设备，成本低

这段视频片段出自哪部动画片？



- 机动战士高达
- **1979**至今，几十部动画、游戏
- 坐在驾驶舱内操作；
- 使用控制器、键盘、踏板进行操作

- 在网络小说里经常出现的 **虚拟游戏驾驶舱**
- 日本已经发布了 **高达游戏的模拟驾驶舱**





EVE: Valkyrie

http://v.youku.com/v_show/id_XOTE1NTY1Njky.html



RIGS

http://v.youku.com/v_show/id_XMTM0MTYxNjA1Mg==.html

Super Reality交互方案还可以解决： **在虚拟环境下使用键盘**



3D虚拟键盘



Oculus专用键盘



普通键盘

更待何时！

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你，
想不想开发出下一个**愤怒小鸟**？

用**印象派**开发游戏
现在就是你一鸣惊人的**最佳时机**！