

Digital Image Processing

RealSense SDK Sample

Ping-Hsuan Han

Acknowledgement

感謝imLab同學們(淵神、捷文、雷雷、彥瑩、雋睿、家緯、昱琪、家齊、鈞堯、睿均、Ray、誌鴻、郁傑、冠穎、蔡伶、天翼、禕偉、毅倫)的測試與協助。

Common Samples (F200 和 R200 都可以 Run)	Type	Example	測試人
	C#	3D Scan	淵神
		Blob Viewer	捷文
		Face Tracking	雷雷
		Raw Streams	淵神
		Speech Recognition	彥瑩
		Speech Synthesis	文慶
		Camera Viewer	淵神
	C++	Blob Viewer	
		Face Tracking	
		Projection	雋睿
		Raw Streams	
		Speech Recognition	
		Speech Synthesis	
		Blob Viewer	
	JavaScript	CommonAndControl	
		Face Tracking	
	Java	Camera Viewer	
		Face Tracking	

F200 Samples (僅 F200 可以 Run)	Type	Example	測試人
	C#	3D Segmentation	家緯
		Emotion Viewer [Preview]	昱琪
		Hands Viewer	
		IQ Sample Tool	家齊
		Object Tracking	昱琪
		Touchless Controller Viewer	鈞堯
	C++	Touchless List Box	睿均
		3D Segmentation	
		Emotion Viewer [Preview]	
		Eye Tracking	Ray
		Hands 3D Viewer	誌鴻
		Hands Console	誌鴻
		Hands Viewer	郁傑
	JavaScript	Object Tracking	
		Hands Viewer	
	Java	HandsViewer	
	Unity	Hands Animation	冠穎
		Nice Cubes	蔡伶
	Processing	HandTracking	
	Unity Toolkit	Sample1 - Translation	蔡伶
		Sample2 - Rotation & Scale	蔡伶
		Sample3 - AR Mirror	天翼
		Sample4 - Falling Balls	禕偉
		Sample5 - Send Message Mechanism	
		Sample6 - Point Cloud	毅倫
		Sample7 - Object Tracking	家緯
			昱琪

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Outline

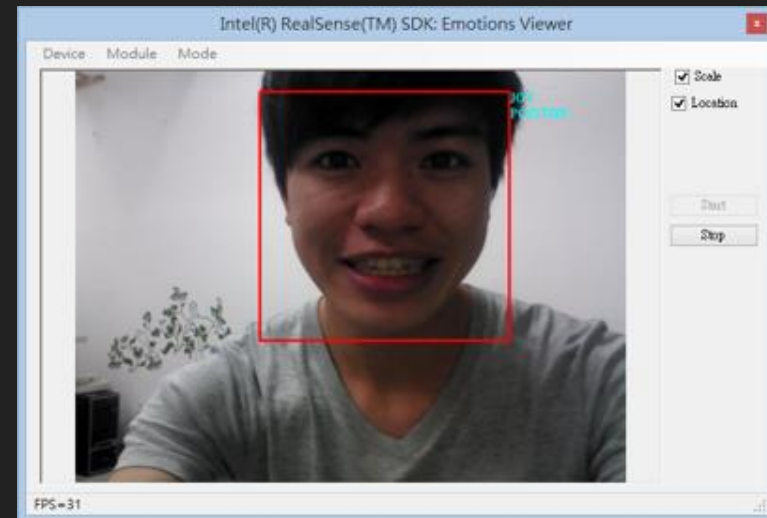
- General Sample
 - Emotion Viewer [Preview]
 - Object Tracking
 - 3D Segmentation
 - Hands 3D Viewer & Console
 - Touchless List Box
 - Speech Recognition
- Unity3D Sample
 - Nice Cubes
 - Sample1 - Translation
 - Sample2 - Rotation & Scale
 - Hands Animation
 - Sample3 - AR Mirror
 - Sample4 - Falling Balls
 - Sample6 - Point Cloud

INTEL REALSENSE

EMOTION VIEWER AND
OBJECT TRACKING

EMOTION VIEWER

- ▶ Recognize 7 emotions (Anger, Contempt, Disgust, Fear, Joy, Sadness and Surprise) and 3 sentiment (Positive, Neutral, Negative).
- ▶ Each emotions and sentiments have evidences and intensities to further determine the likelihood and strength of the expressions.



CAPABILITY AND PERFORMANCE

Emotions



ANGER



DISGUST



FEAR



JOY



SURPRISE



-
- ▶ Emotion viewer module is deprecated, no further maintenance for the module.
 - ▶ The distance limit is the same as face tracking.
 - ▶ Sentiment recognition is not robust. Better use the module as facial expression recognizer.

OBJECT TRACKING

- ▶ Tracking multiple 2D or 3D targets from user-defined model.



CAPABILITY AND PERFORMANCE

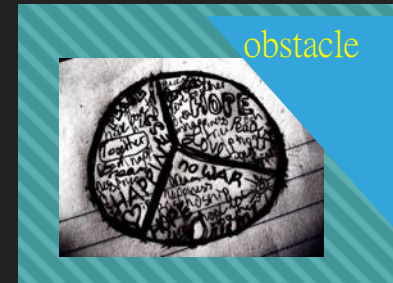
- ▶ Tracking is pretty accurate, but can't track object that are partially blocked or too small.



Target



Traceable



Non-traceable

- ▶ Unity toolkit version available!

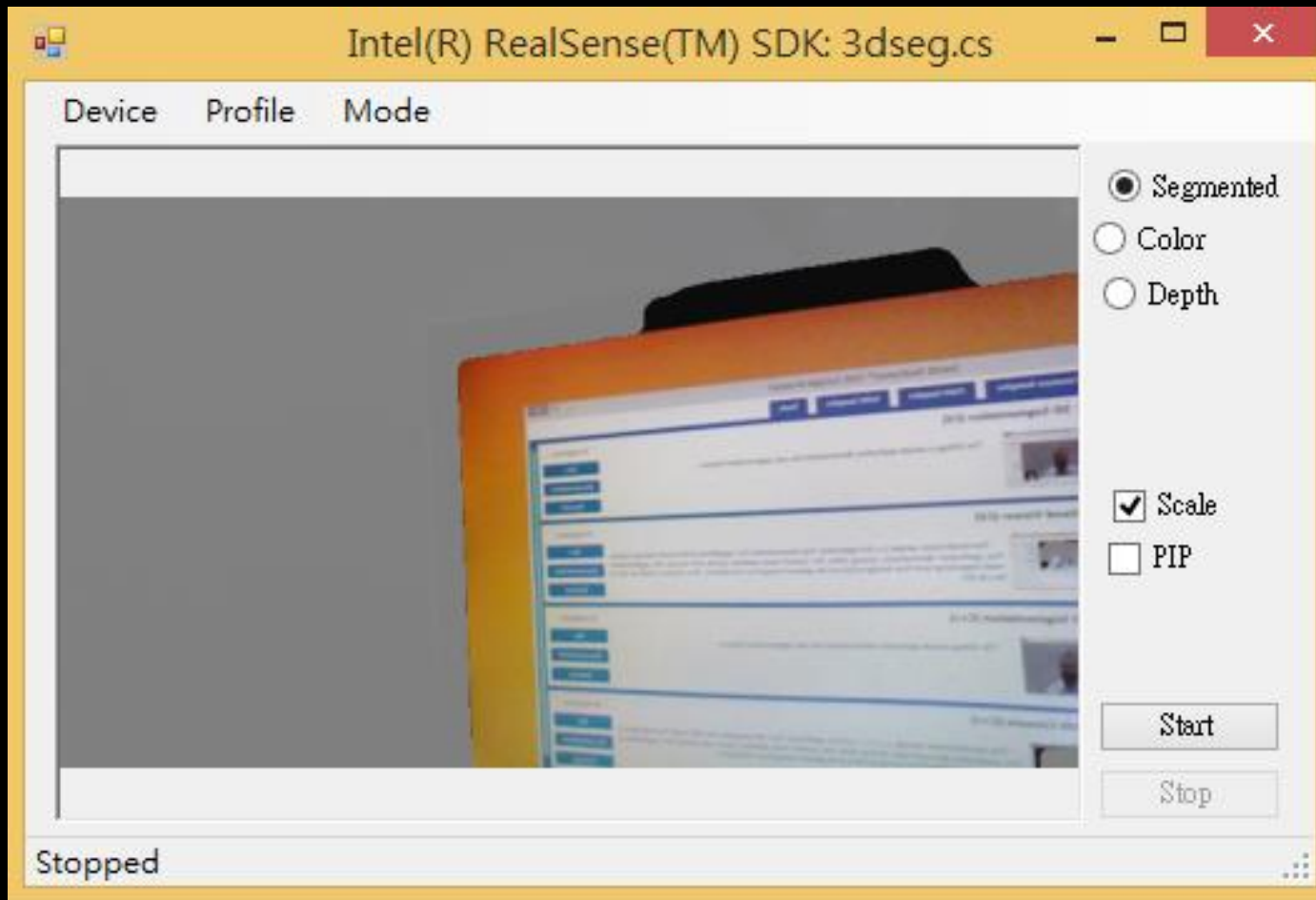
RealSense SDK

3D Segmentation

林家緯

3D Segmentation

- C# GUI application



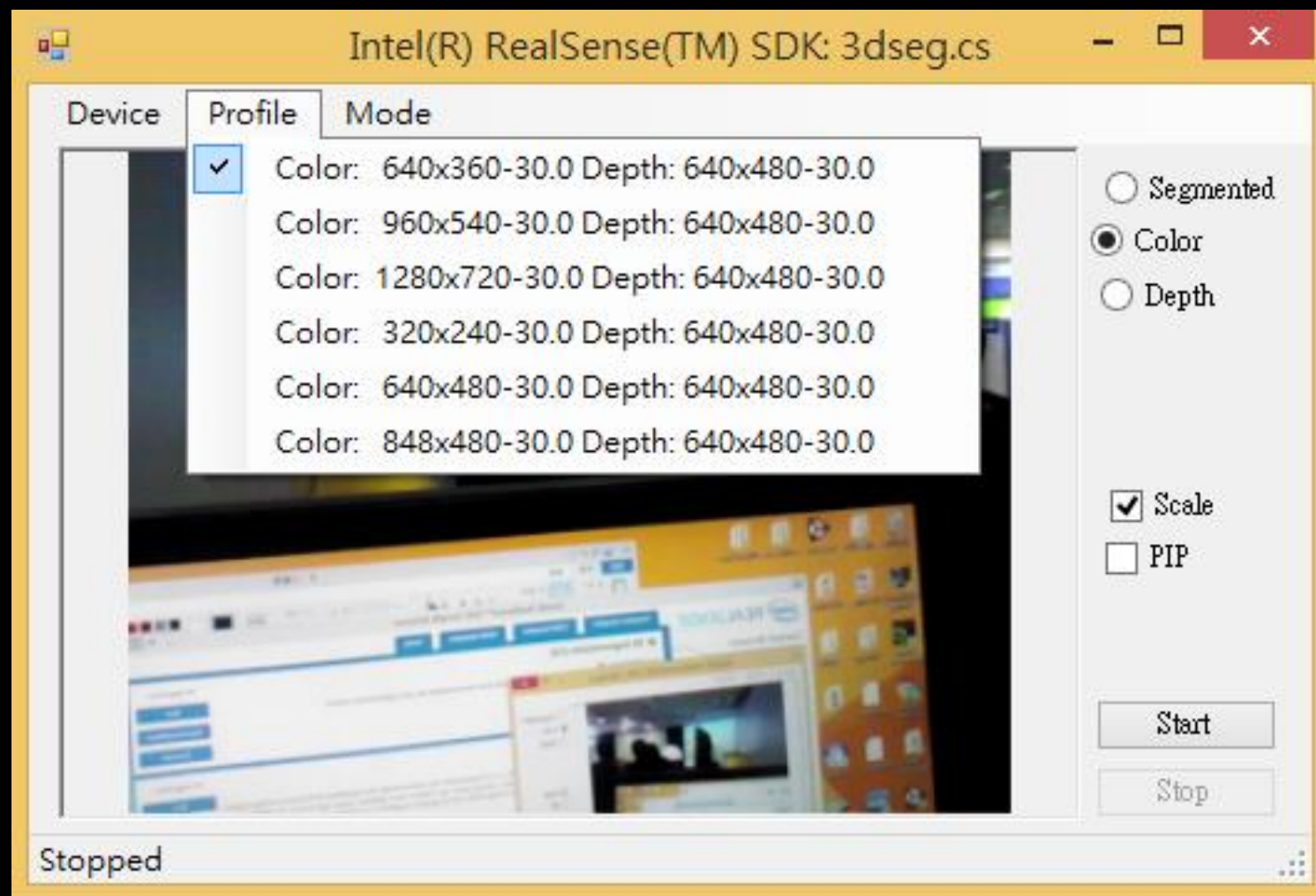
Main Menu

- Device: Select the input device.
- Profile: Select the input stream resolutions.
- Mode: Select the operating mode as follows:
 - Live: Streaming from the live camera.
 - Playback: Streaming from a file.
 - Record: Streaming from the live camera and save the content to a file.

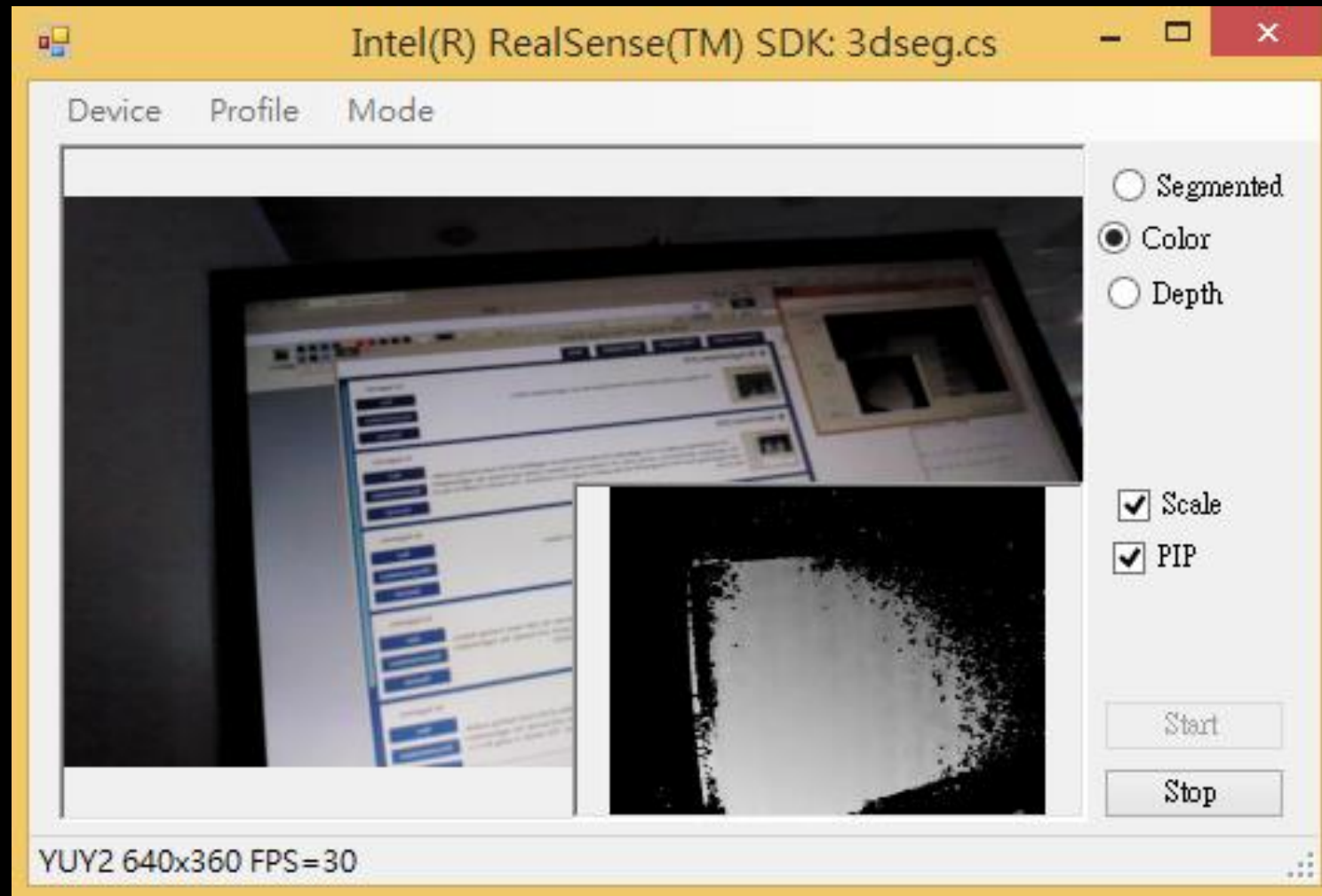
Control Options

- Segmented: Display the segmented image.
- Color: Display the color image.
- Depth: Display the depth image.
- Scale: scale the image to the display panel resolution.
- PIP: show the last two image types selected in the picture in picture mode.

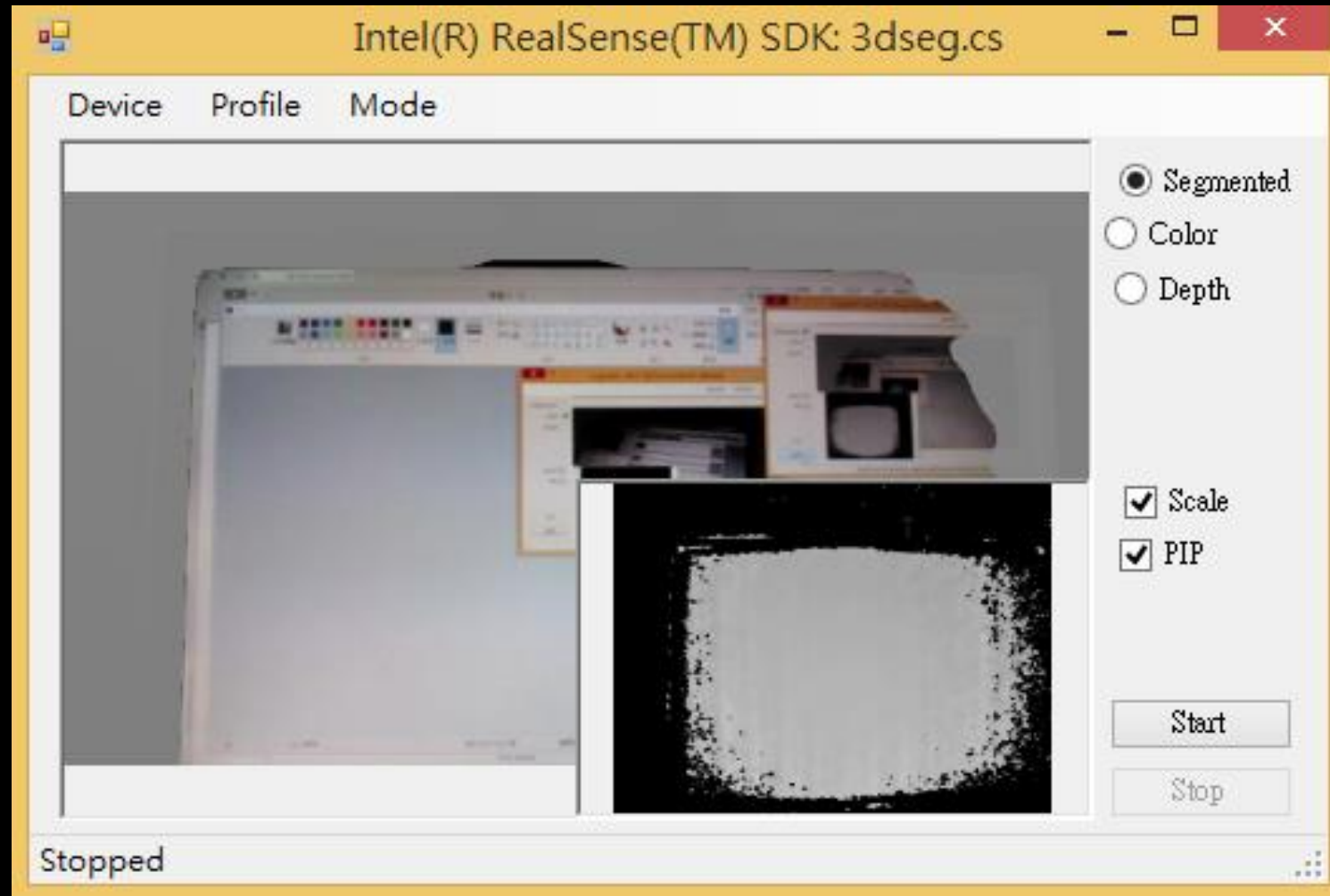
3D Segmentation



3D Segmentation



3D Segmentation



3D Segmentation

- C++ application
- Command line options:
 - load: Explicitly load the specified module.
 - record: Enable file recording. Use the -file option to specify the recording file name.
 - file: If -record is not specified, the sample plays back the specified file. Otherwise, the sample records the camera data to the specified file.
 - nframes: Specify the maximum number of frames to record.
 - help: Print out the help message.

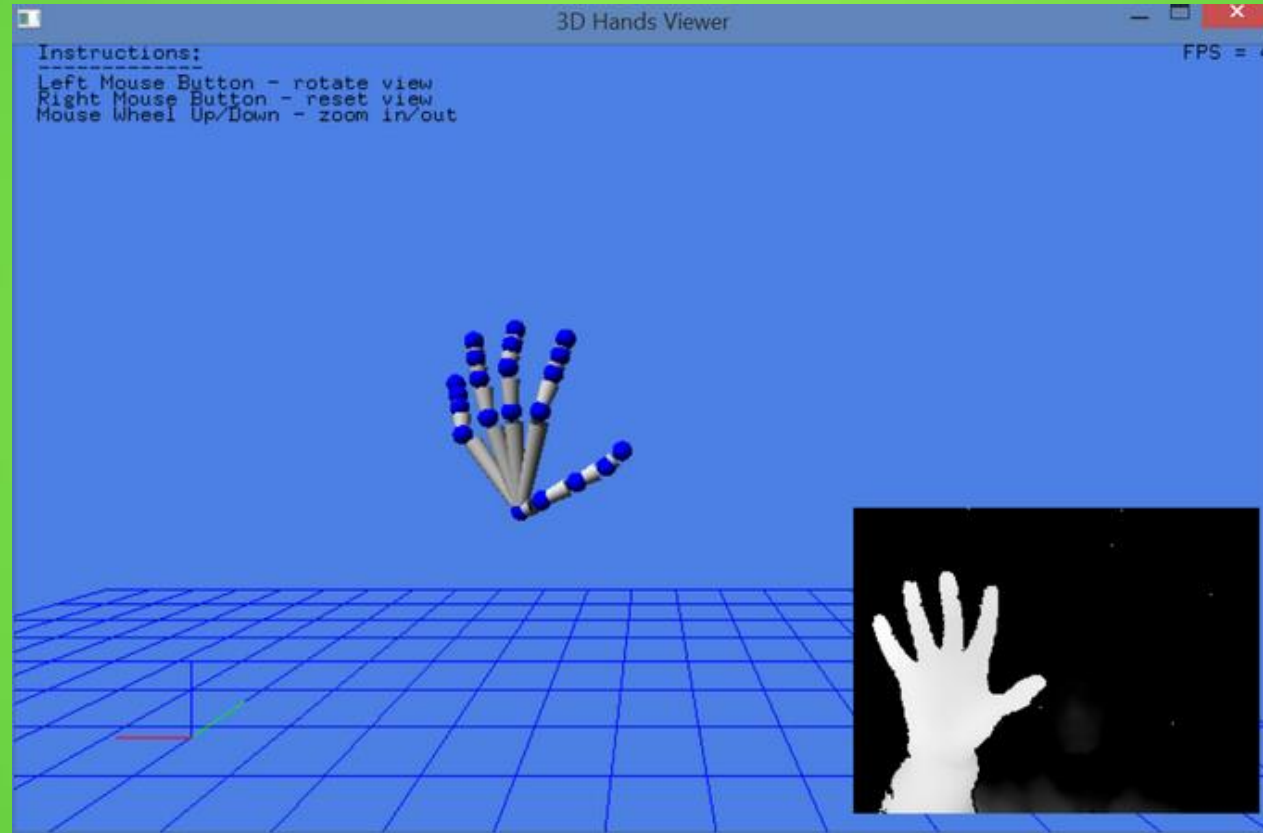
Intel Realsense

Hands 3D Viewer, Hands Console

徐誌鴻

2015.10.23

Hands 3D Viewer



Hands Console

```
C:\windows\system32\cmd.exe - FF_HandsConsole.exe -live -skeleton

Left Hand
=====
JOINT_WRIST)      X: 0.040423, Y: -0.058610, Z: 0.233016
JOINT_CENTER)     X: 0.037822, Y: -0.018009, Z: 0.238308
JOINT_THUMB_BASE) X: 0.020717, Y: -0.049088, Z: 0.236964
JOINT_THUMB_JT1)  X: -0.008797, Y: -0.030674, Z: 0.235989
JOINT_THUMB_JT2)  X: -0.028836, Y: -0.015135, Z: 0.233725
JOINT_THUMB_TIP)  X: -0.038068, Y: -0.000901, Z: 0.233052
JOINT_INDEX_BASE) X: 0.012056, Y: 0.023423, Z: 0.247160
JOINT_INDEX_JT1)  X: -0.001421, Y: 0.053343, Z: 0.250466
JOINT_INDEX_JT2)  X: -0.006871, Y: 0.062387, Z: 0.237940
JOINT_INDEX_TIP)  X: -0.011273, Y: 0.071104, Z: 0.224752
JOINT_MIDDLE_BASE) X: 0.036048, Y: 0.023670, Z: 0.243638
JOINT_MIDDLE_JT1) X: 0.029724, Y: 0.056188, Z: 0.232688
JOINT_MIDDLE_JT2) X: 0.027244, Y: 0.071367, Z: 0.218905
JOINT_MIDDLE_TIP) X: 0.028725, Y: 0.084579, Z: 0.210589
JOINT_RING_BASE)  X: 0.056120, Y: 0.020394, Z: 0.240337
JOINT_RING_JT1)   X: 0.056420, Y: 0.050366, Z: 0.229581
JOINT_RING_JT2)   X: 0.059347, Y: 0.067196, Z: 0.222165
JOINT_RING_TIP)   X: 0.060230, Y: 0.080209, Z: 0.213176
JOINT_PINKY_BASE) X: 0.079772, Y: 0.008053, Z: 0.235748
JOINT_PINKY_JT1)  X: 0.079515, Y: 0.032084, Z: 0.226992
JOINT_PINKY_JT2)  X: 0.080649, Y: 0.043516, Z: 0.222522
JOINT_PINKY_TIP)  X: 0.081369, Y: 0.053703, Z: 0.218341
```

Command Options

Command Options




Run the sample executable without any command line options shows the help message. The sample uses the following command line options:

Option	Description
<code>-live</code>	Stream data through a live camera. The option <code>-live</code> or <code>-seq</code> must present but not both.
<code>-seq <file></code>	Stream data through a recorded file. The option <code>-live</code> or <code>-seq</code> must present but not both.
<code>-skeleton</code>	Print out joint world position information.
<code>-alerts</code>	Print out fired alerts.
<code>-gestures</code>	Print out fired gestures.

Alerts

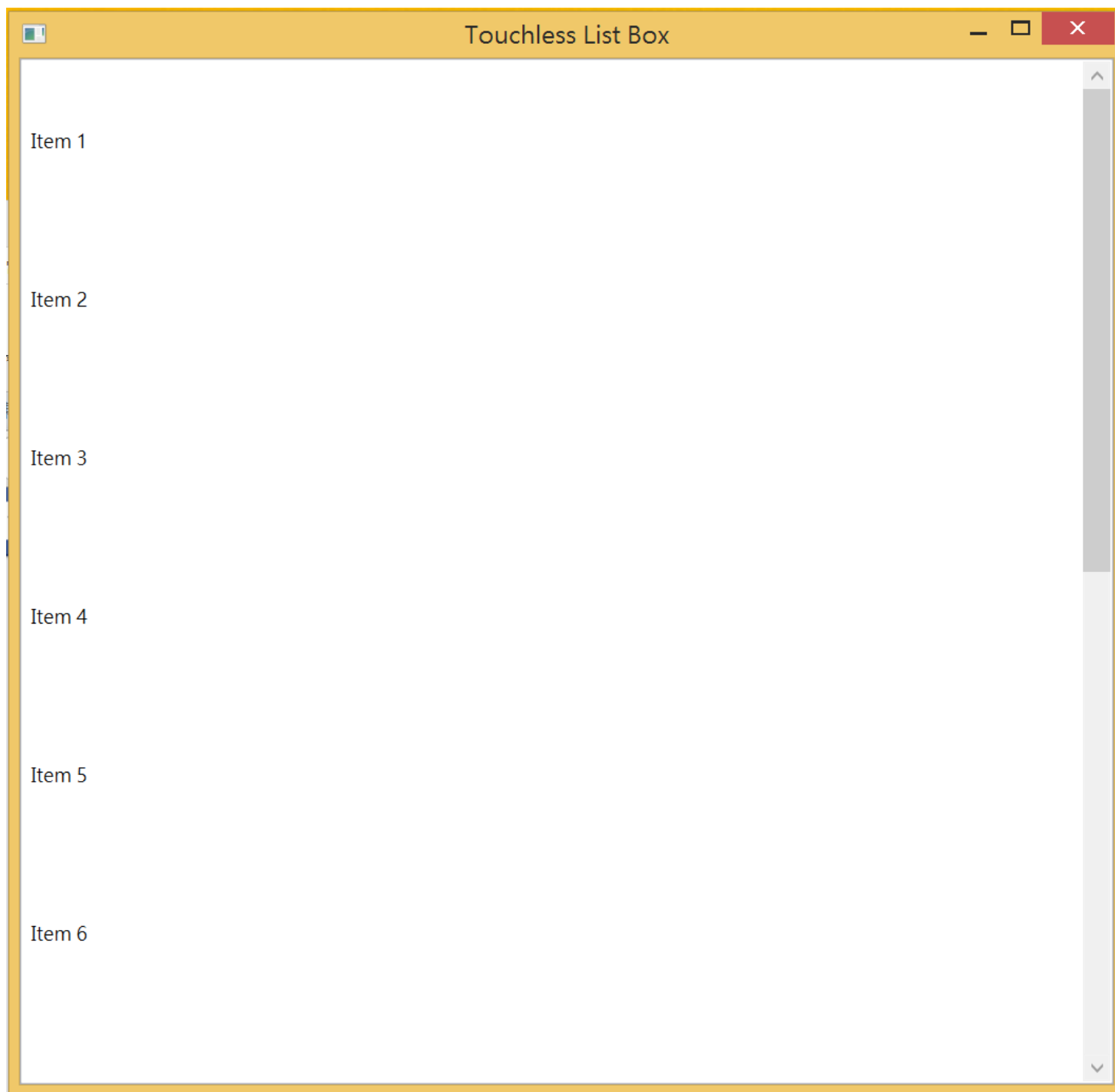
Alert Type	Description
ALERT_HAND_DETECTED	A hand is identified and its mask is available.
ALERT_HAND_NOT_DETECTED	A previously detected hand is lost, either because it left the field of view or because it is occluded (hidden by another object).
ALERT_HAND_TRACKED	Full tracking information is available for a hand.
ALERT_HAND_NOT_TRACKED	Tracking information is no longer available for a hand (none of the joints are tracked).
ALERT_HAND_CALIBRATED	Hand measurements are ready and accurate.
ALERT_HAND_NOT_CALIBRATED	Hand measurements are not yet finalized, and are not fully accurate.
ALERT_HAND_OUT_OF_BORDERS	Hand is outside of the tracking boundaries.
ALERT_HAND_INSIDE_BORDERS	Hand has moved back inside the tracking boundaries.
ALERT_HAND_OUT_OF_LEFT_BORDER	The tracked object is touching the left border of the field of view.
ALERT_HAND_OUT_OF_RIGHT_BORDER	The tracked object is touching the right border of the field of view.
ALERT_HAND_OUT_OF_TOP_BORDER	The tracked object is touching the upper border of the field of view.
ALERT_HAND_OUT_OF_BOTTOM_BORDER	The tracked object is touching the lower border of the field of view.
ALERT_HAND_TOO_FAR	The tracked object is too far to be tracked.
ALERT_HAND_TOO_CLOSE	The tracked object is too close to be tracked.

Gestures

Gesture	Illustration	Don't Enable with:	Description
<code>click</code>		<code>two_fingers_pinch_open</code>	Open hand facing the camera, moves the index finger quickly toward the palm center.
<code>fist</code>		<code>full_pinch</code>	All fingers folded into a fist. The fist can be in different orientations as long as the palm is in the general direction of the camera.
<code>full_pinch</code>		<code>fist</code>	All fingers extended and touching the thumb. The pinched fingers can be anywhere between pointing directly to the screen or in profile.

Touchless ListBox

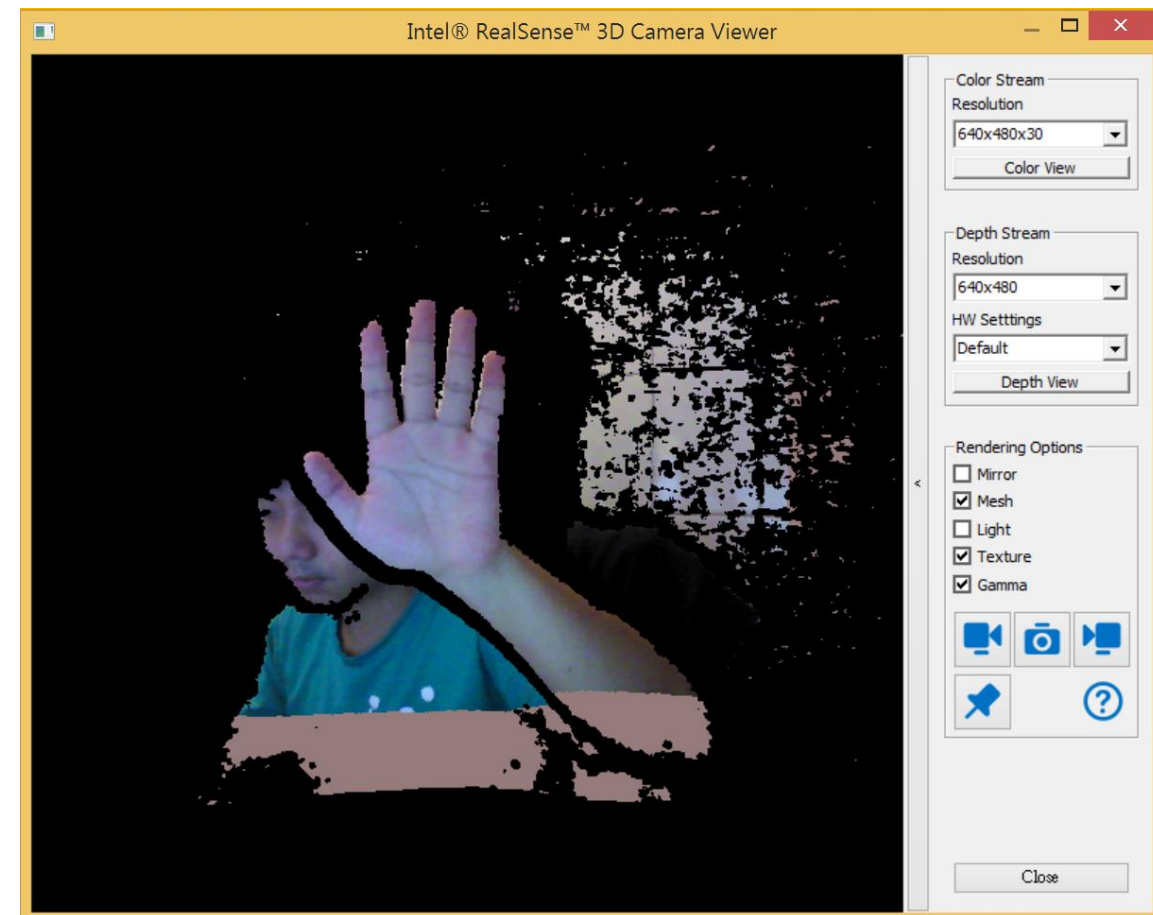
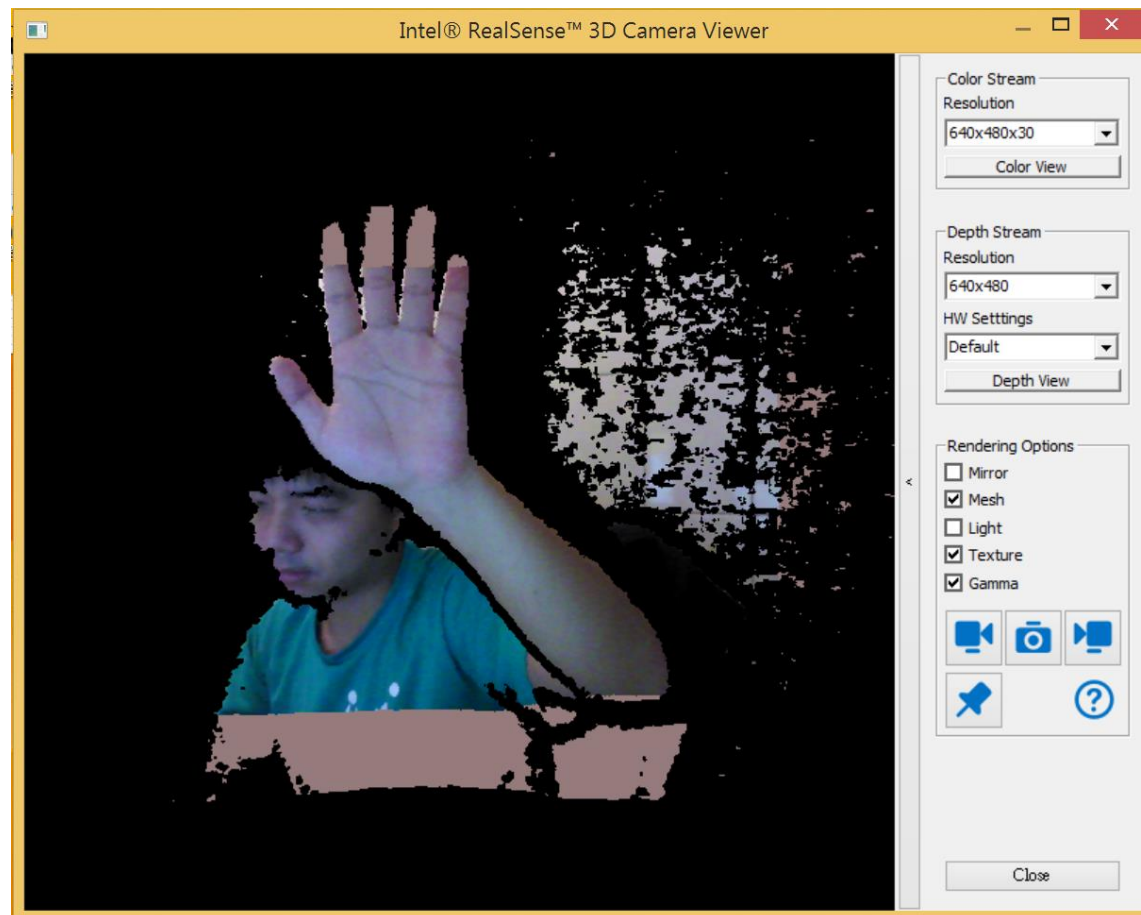
蕭睿均



作法

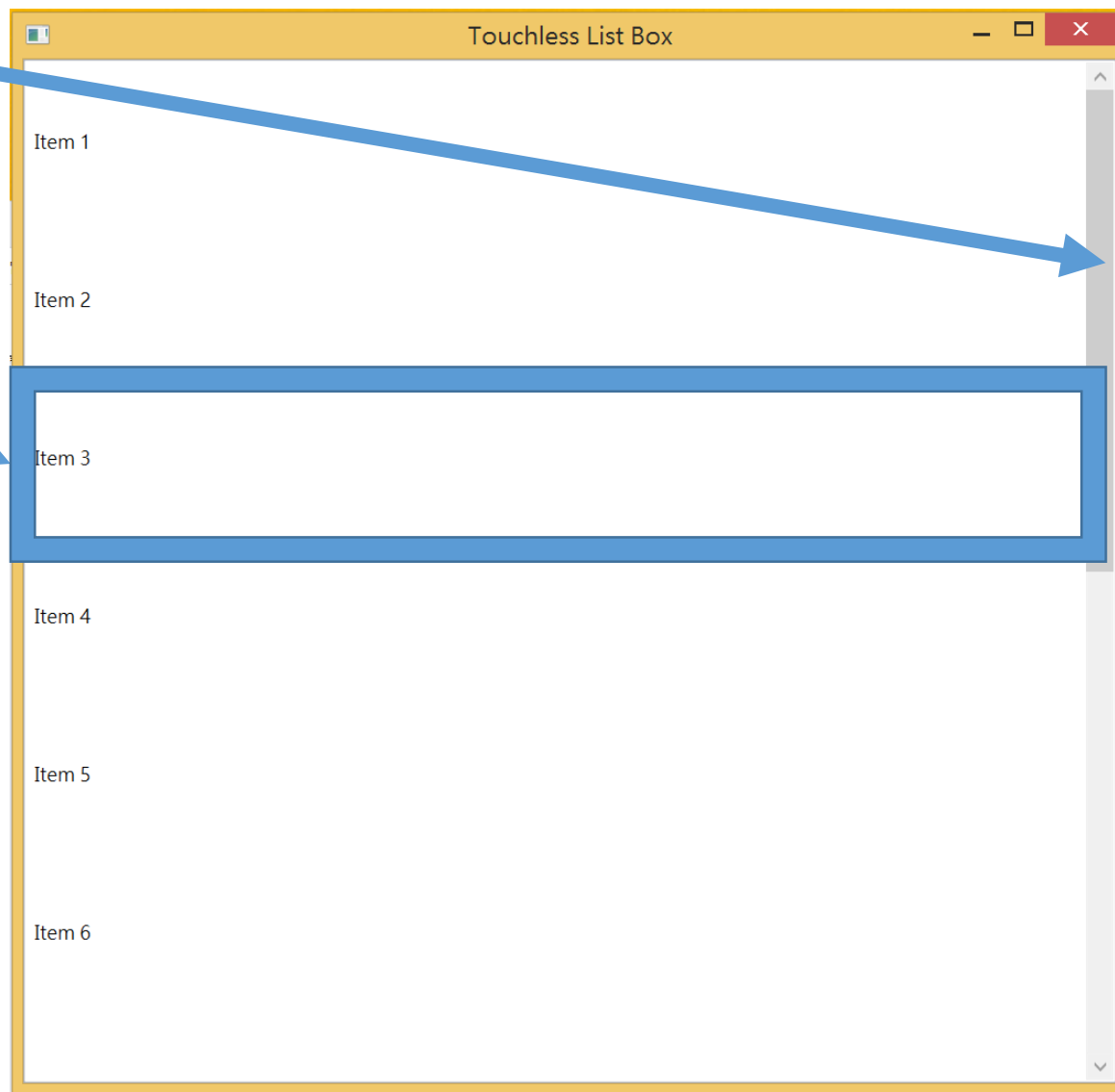
- 利用Realsense看到的影像來控制滑鼠
- 利用三種gesture來控制(移動、滑動、點選)
- (基本上touchless controller包含了touchless listbox的所有功能，唯一差別是touchless listbox是直接操縱滑鼠，controller有內建的cursor)

MOVE



SCROLL
(手捏起來)

SELECT
(手往前推)





Speech Recognition

李彦瑩

Outline

- Speech Recognition Algorithm
- Command Control and Dictation
- Sample Test

Speech Recognition Algorithm

1. Identify an Audio Source (OPTIONAL): Use the `AudioSource` interface to enumerate and select an input audio device
2. Locate the Module :
Use the `CreateImpl` function (or the `CreateInstance` function) to create an instance of the `PXCSpeechRecognition` instance
3. Configure the Module:
Get available configurations using the `QueryProfile` function and set the configuration using the `SetProfile` function.

Speech Recognition Algorithm

4. Set the Recognition mode (OPTIONAL):
configure the speech recognition module to work in the **command** and control mode or in the **dictation** mode.
5. Execution Flow: Start speech recognition using the **StartRec** function and stop with the **StopRec** function.

Command Control and Dictation

The dictation mode: The module performs recognition on any vocabulary.

The command and control mode: The module performs recognition on a list of commands (which may contain multiple words) defined by the application, and ignores any words out of this list. The commands can be specified in the following ways:

- List
- Java Speech Grammar Format (JSGF)

Sample



Test - Chinese Language

- 字詞辯認錯誤

冗長、步調節奏

書香->蘇珊

收到書 -> 說我正好舒服

- 前後文斷詞問題

增加教學趣味性->增加教學問西

Intel Real Sense

蔡伶 (Lily Tsai)

Outline

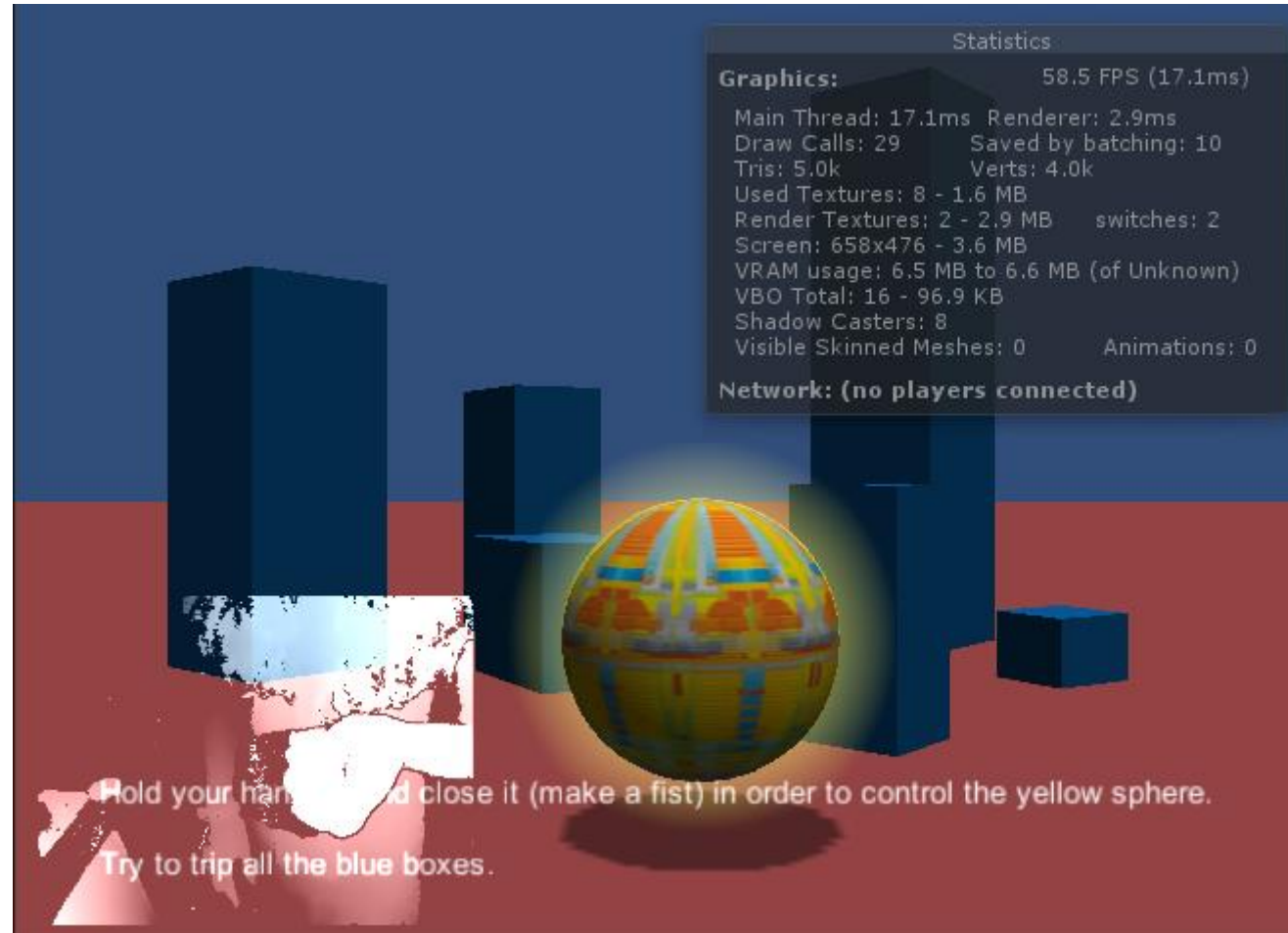
- Nine Cubes
- Translation
- Rotation & Scale

Nine Cubes



Translation

- Use your hand to move (translate) a sphere.



Rotation & Scale

- Use your hand to rotate and scale a cube.



Hands Animation (Unity)

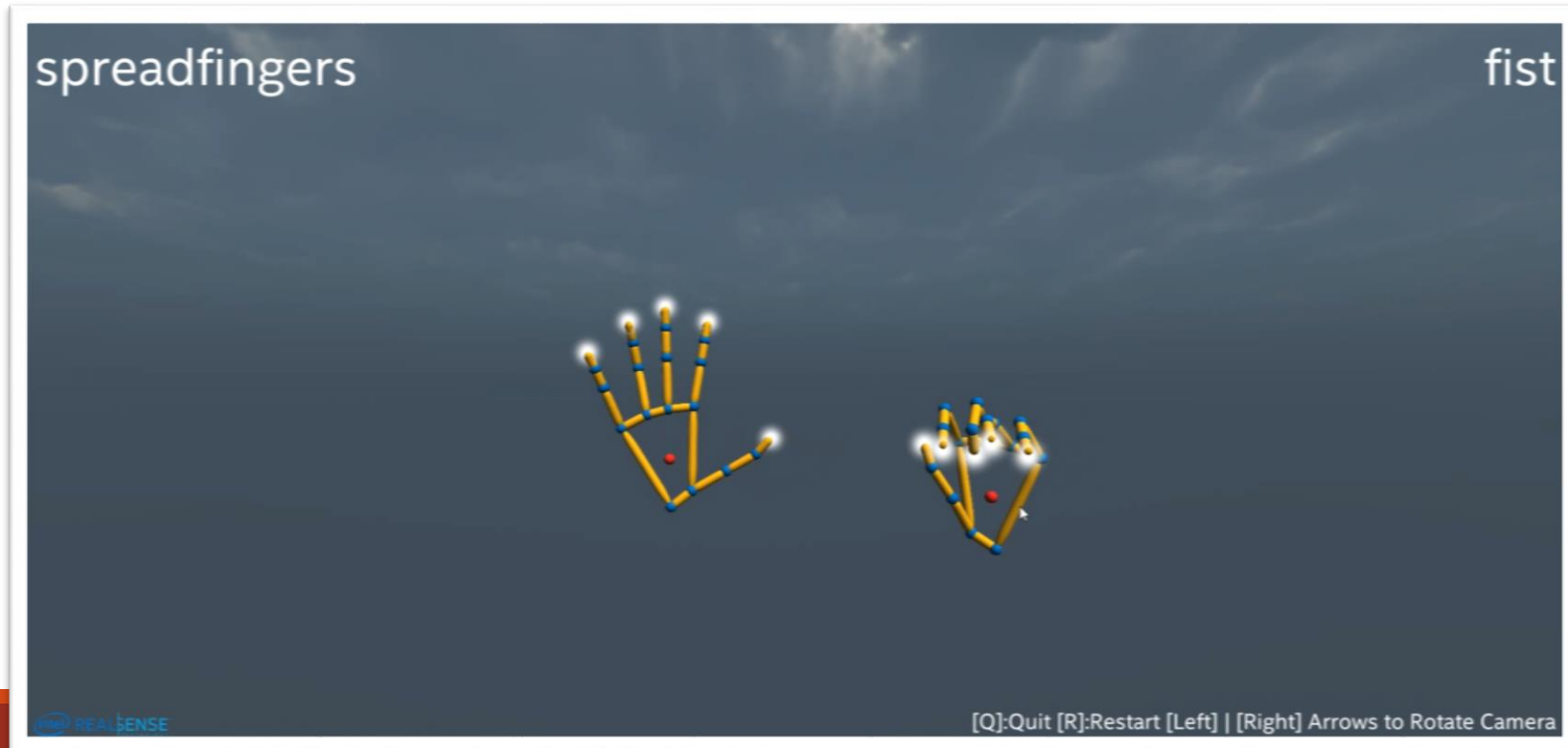
ALUMI LU

Execution Layout



Features

1. This sample visualizes a 3D hand skeleton (or **two hands**) in the scene when the sample detects that there is a hand in front of the camera.
2. If there are hand gestures, the sample displays **the recognized gesture** text on top of the screen.



Demo



Recognized Gestures

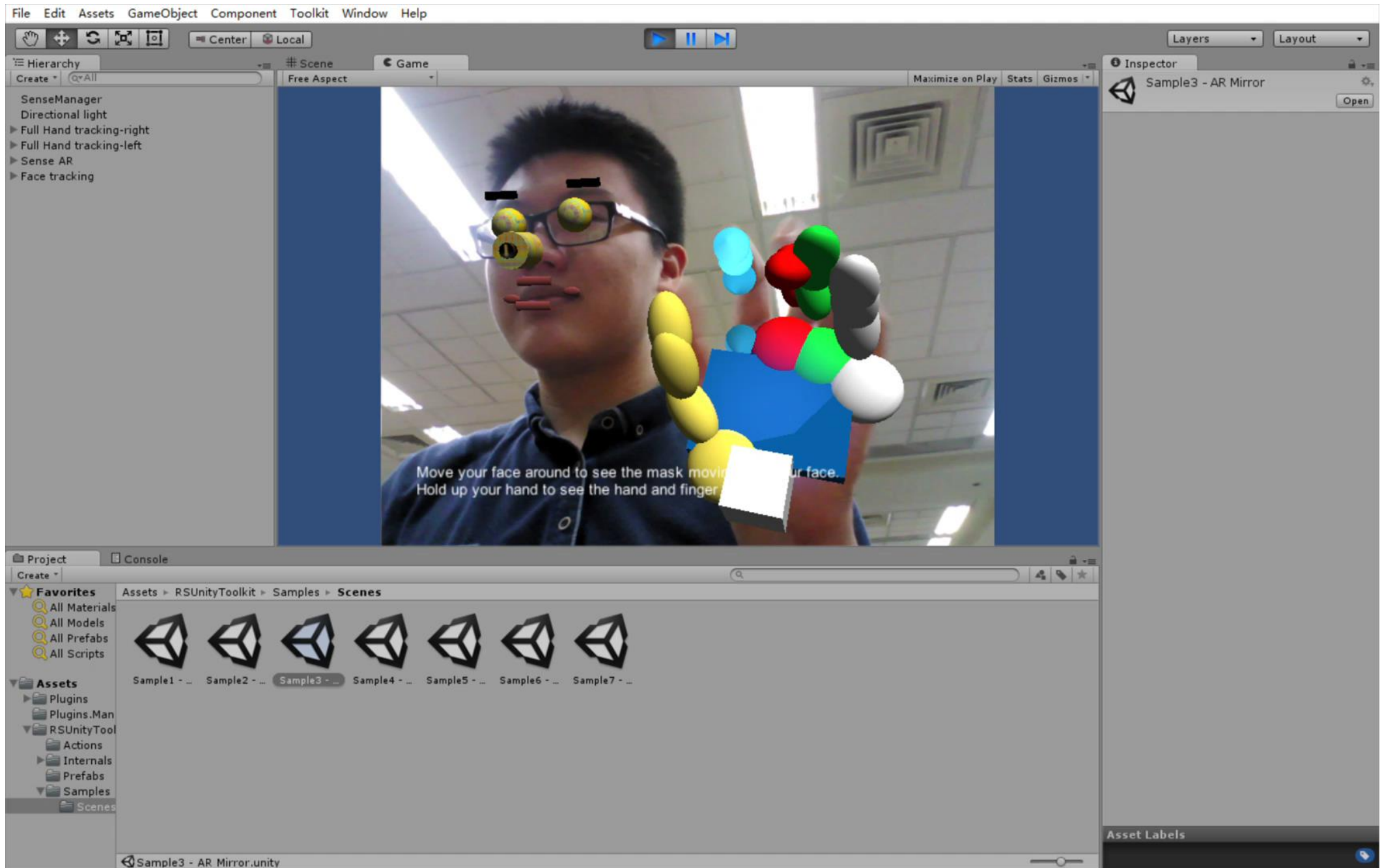
1. Fist
2. Spreadfingers
3. Two_fingers_pinch_open
4. Full_pinch
5. Click
6. V_sign

Intel Realsense

AR Mirror

-Create AR scene

沈天翼



Pros & Cons

- High face and hand tracking performance
- Some error while hand moving towards the camera
- AR mask may out of correct position

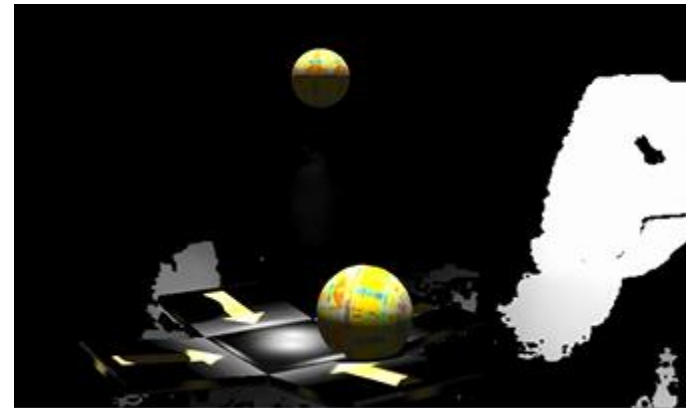
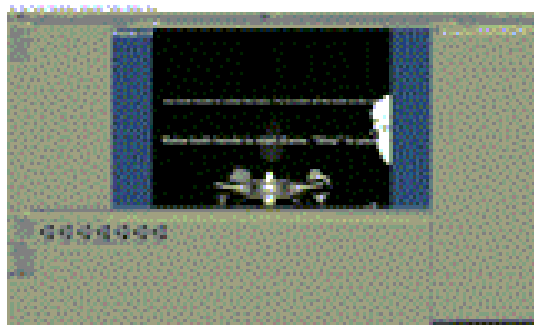
Unity-Falling Balls

郭禕偉

ro4944042@ntu.edu.tw

Falling Balls

- * This is a functional game sample where the player tries to guide falling balls into a box using hand gestures. In the scene panel you will see a perspective and a target.



Advantages&Disadvantages

- * 1.We can rotate the box by moving one hand away from the camera and at the same time a hand moving close to the camera.
- * 2. The box can be rotated in different directions.
- * 3.Sometimes it may fail to recognize the hands.
- * 4.It's very hard to recognize the depth of the balls.
- * 5.It can't recognize fast action.
- * 6.The game will crash when it finish.

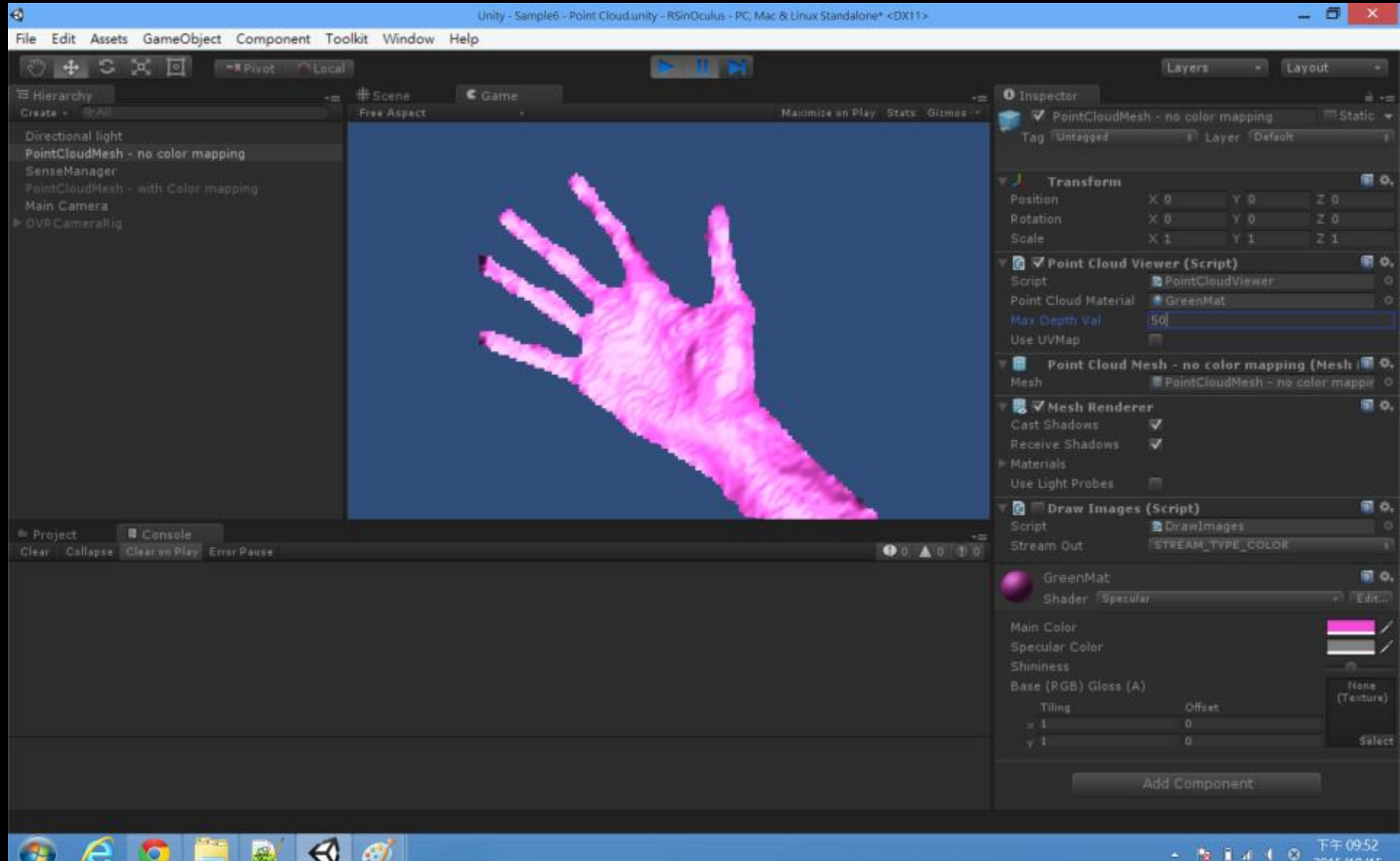
RealSense SDK
Unity Toolkit Sample6
Point Cloud

林家緯

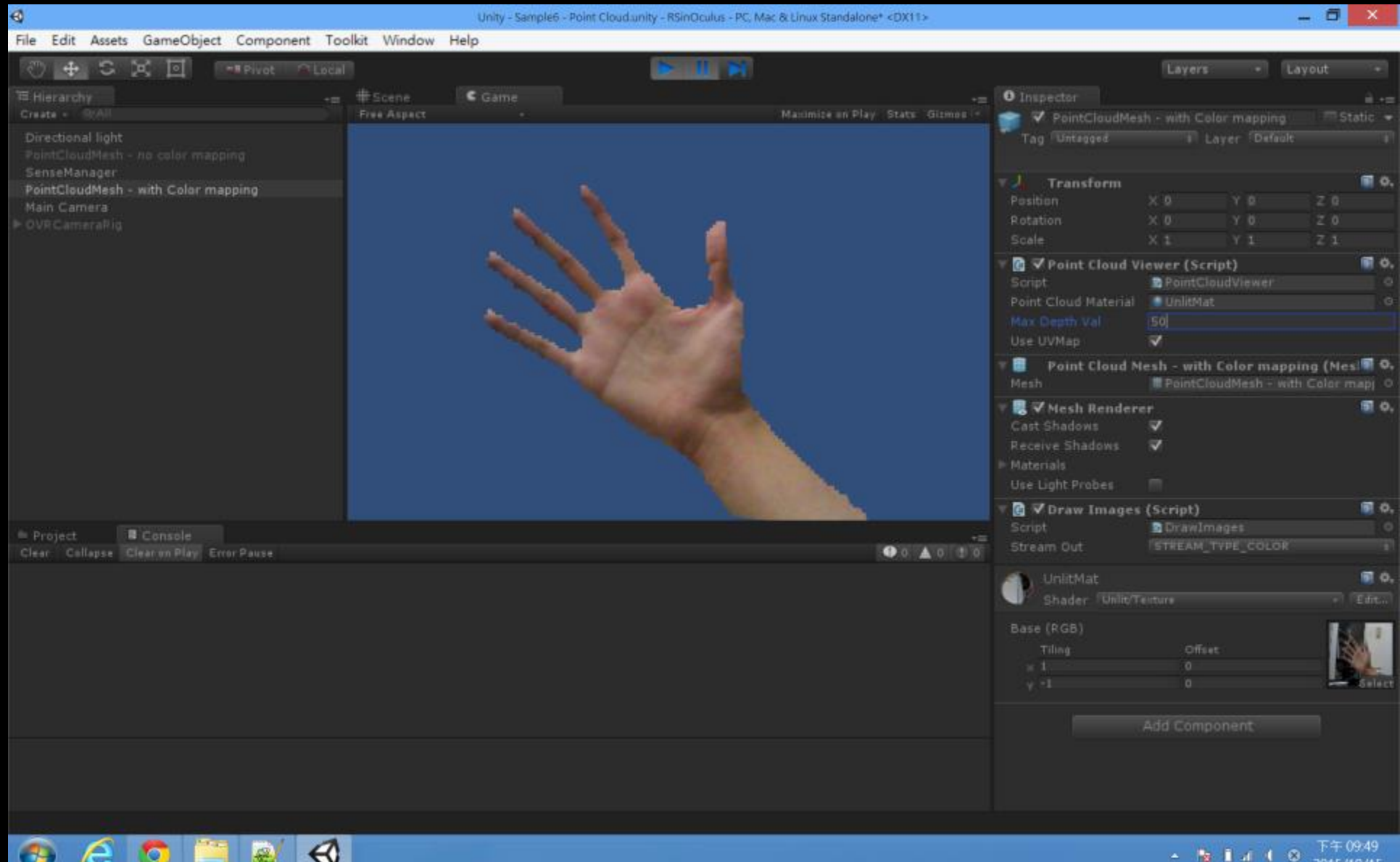
Point Cloud

- This sample shows how to use the `PointCloudMesh` prefab to create a mesh dynamically from the depth data.
- Options:
 - Max Depth Value: Remove the points with depth value bigger than the value specified.
 - Use UV-Map: If Use UVMap is checked, the RGB image will be drawn on the mesh with UV-mapping.

Point Cloud



Point Cloud



Point Cloud

- Draw the mesh of the objects within specified depth from the point cloud
 - Every grid cell output two triangles
 - Calculate vertex normals dynamically
- Set the texture with the RGB image
- Apply the texture to the mesh with UV mapping