Augmented Reality & Video Service Emerging Technologies

Introduction

Prof. Jong-Moon Chung

Emerging Technologies:
        From Smartphones to IoT to Big Data

Augmented Reality
& Video Service
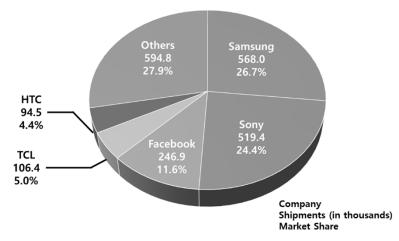# Emerging Technologies

Prof. Jong-Moon Chung
Yonsei University

Augmented Reality & Video Service Emerging Technologies

❖ **Modules**
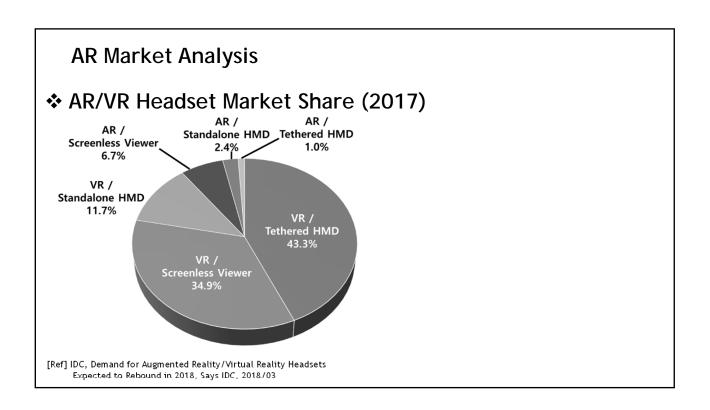
1. AR Applications, Products & Business

2. AR Technology

3. SIFT SURF FAST BRIEF ORB BRISK

4. Skype, YouTube & H.264/MPEG-4 AVC

5. Video Streaming & MPEG-DASH

6. CDN Video Streaming Technology

7. AR Smartphone Project

AR Market Analysis
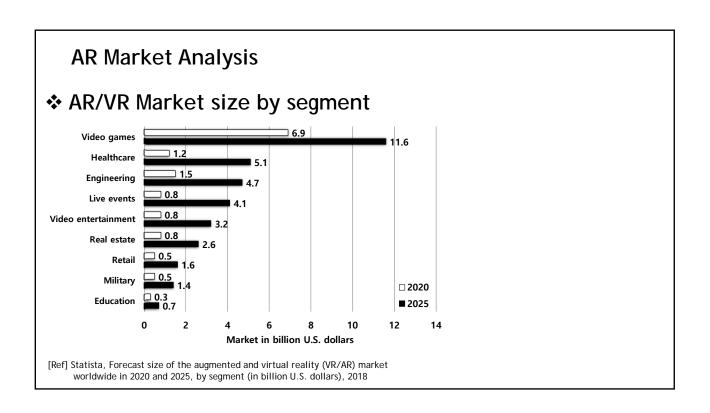
❖ **AR/VR Headset Market Share** (Q2 2017)

Others 594.8 27.9%
Samsung 568.0 26.7%
HTC 94.5 4.4%
TCL 106.4 5.0%
Facebook 246.9 11.6%
Sony 519.4 24.4%

Company
Shipments (in thousands)
Market Share

[Ref] IDC, Worldwide Shipments of AR/VR Headsets Maintain Solid
Growth Trajectory in the Second Quarter, According to IDC, 2017/09

AR Market Analysis

❖ AR/VR Headset Market Share (2017)

AR /
Screenless Viewer
6.7%

AR /
Standalone HMD
2.4%

AR /
Tethered HMD
1.0%

VR /
Standalone HMD
11.7%

VR /
Tethered HMD
43.3%

VR /
Screenless Viewer
34.9%

[Ref] IDC, Demand for Augmented Reality/Virtual Reality Headsets
Expected to Rebound in 2018, Says IDC, 2018/03

AR Market Analysis

❖ AR/VR Market size by segment

Segment	2020	2025
Video games	6.9	11.6
Healthcare	1.2	5.1
Engineering	1.5	4.7
Live events	0.8	4.1
Video entertainment	0.8	3.2
Real estate	0.8	2.6
Retail	0.5	1.6
Military	0.5	1.4
Education	0.3	0.7

Market in billion U.S. dollars

[Ref] Statista, Forecast size of the augmented and virtual reality (VR/AR) market
worldwide in 2020 and 2025, by segment (in billion U.S. dollars), 2018

AR Devices

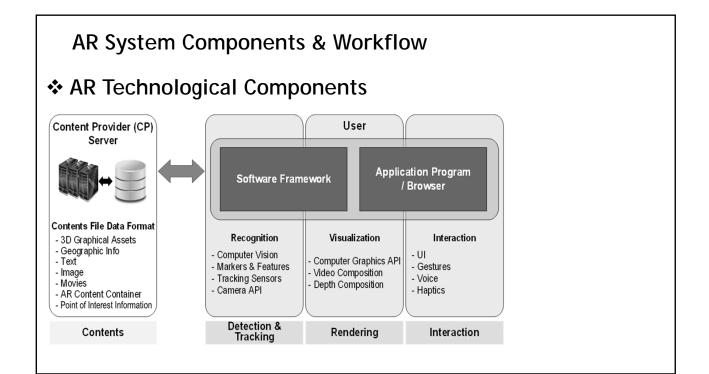**Source: Flickr: UAR NAi Best Practice Poster**
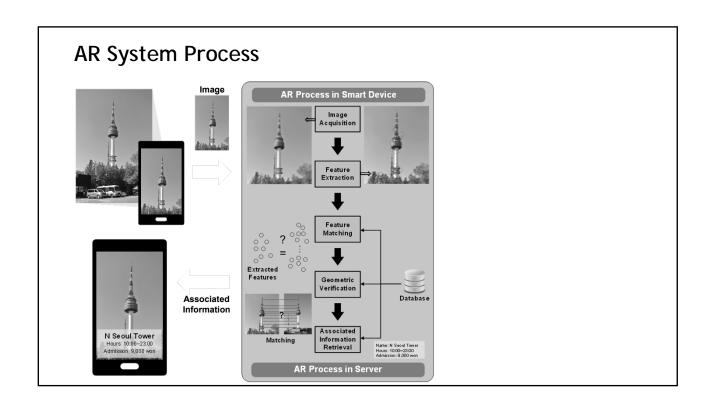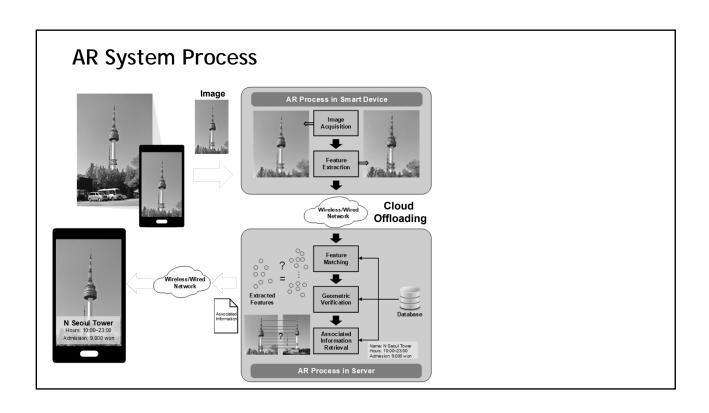

Source: Flickr: Loïc Le Meur on Google Glass
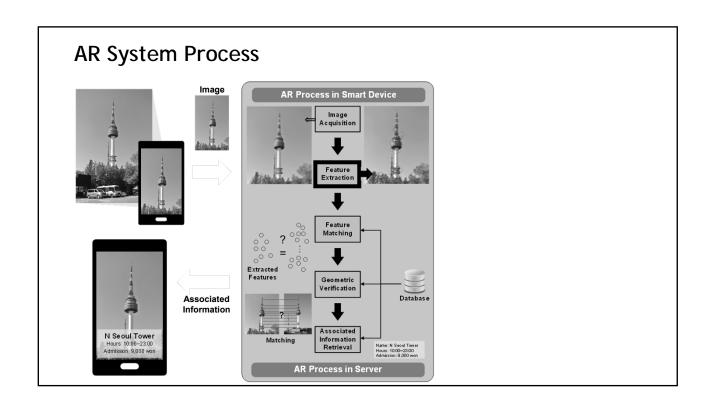

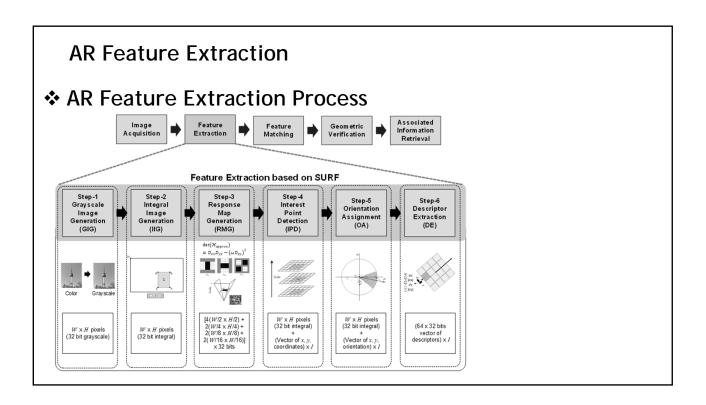**Source: Creative Commons Attribution-Share
Alike 3.0 Unported**
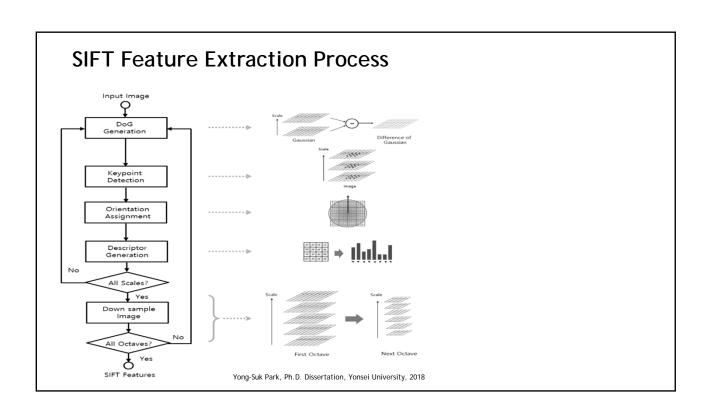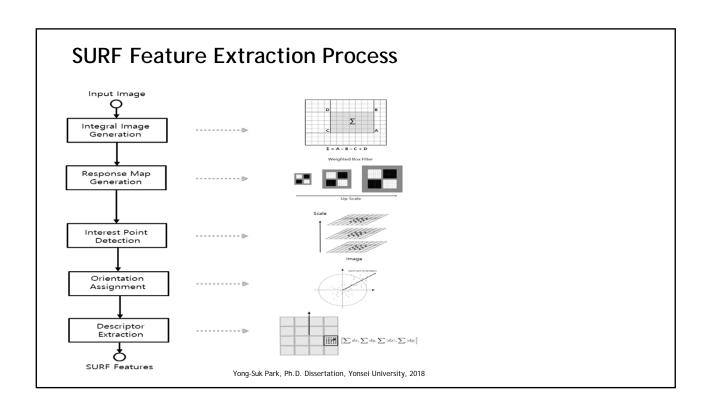

**Prof. Jong-Moon Chung's
AR CNL Lab, Yonsei University**

AR System Components & Workflow

❖ AR Technological Components

Content Provider (CP) Server	User		
	Software Framework	Application Program / Browser	
Contents File Data Format - 3D Graphical Assets - Geographic Info - Text - Image - Movies - AR Content Container - Point of Interest Information	**Recognition** - Computer Vision - Markers & Features - Tracking Sensors - Camera API	**Visualization** - Computer Graphics API - Video Composition - Depth Composition	**Interaction** - UI - Gestures - Voice - Haptics
Contents	Detection & Tracking	Rendering	Interaction

AR System Process

AR System Process

AR System Process

AR Feature Extraction

❖ AR Feature Extraction Process

AR Feature Detection & Description Method Comparison
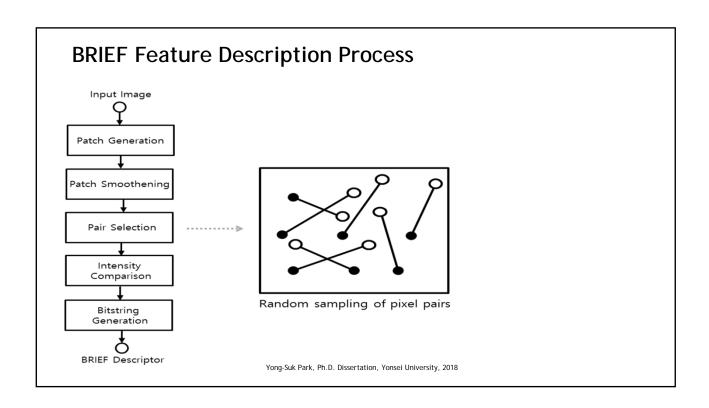
	SIFT	SURF	FAST	BRIEF	ORB	BRISK
Year	1999	2006	2006	2010	2011	2011
Feature Detector	Difference of Gaussian	Fast Hessian	Binary comparison	N/A	FAST	FAST or AGAST
Spectra	Local gradient magnitude	Integral box filter	N/A	Local binary	Local binary	Local binary
Orientation	Yes	Yes	N/A	No	Yes	Yes
Feature Shape	Square	HAAR rectangles	N/A	Square	Square	Square
Feature Pattern	Square	Dense	N/A	Random point-pair pixel compares	Trained point-pair pixel compares	Trained point-pair pixel compares

Yong-Suk Park, Ph.D. Dissertation, Yonsei University, 2018

SIFT Feature Extraction Process

Yong-Suk Park, Ph.D. Dissertation, Yonsei University, 2018

SURF Feature Extraction Process

Input Image

Integral Image Generation

Response Map Generation

Interest Point Detection

Orientation Assignment

Descriptor Extraction

SURF Features

$\Sigma = A - B - C + D$

Weighted Box Filter
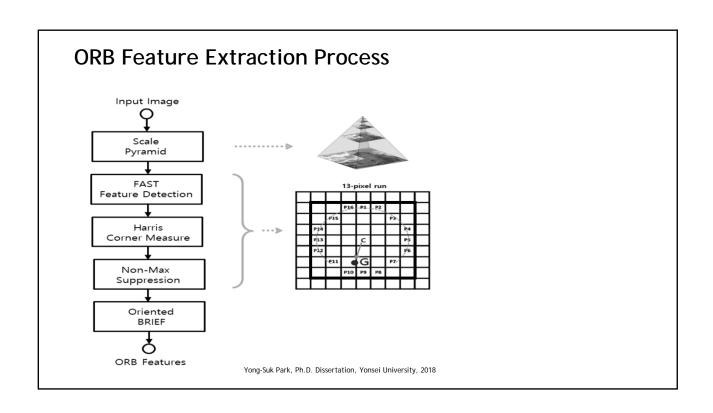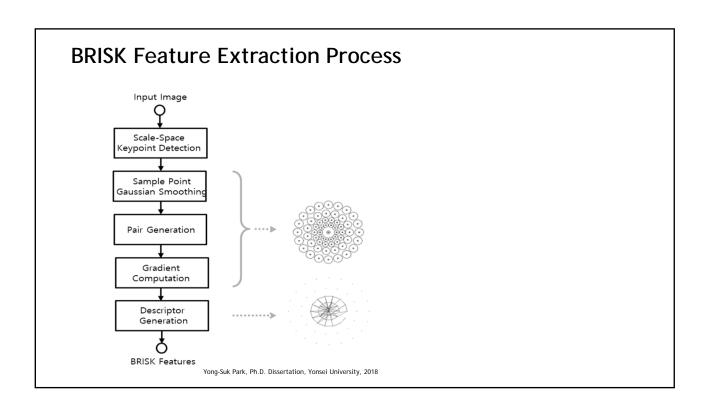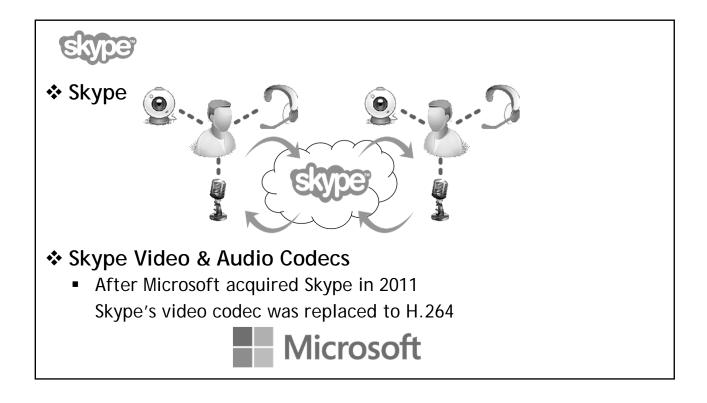
Up Scale

Scale

Image

$[\sum dx, \sum dy, \sum |dx|, \sum |dy|]$

Yong-Suk Park, Ph.D. Dissertation, Yonsei University, 2018

FAST Feature Detection Process

Input Image

Pixel Selection

Bresenham Circle Computation

Threshold Comparison

All pixels?

No

Yes

FAST Interest Points

P16 P1 P2
P15 P3
P14 P4
P13 P P5
P12 P6
P11 P7
P10 P9 P8

Yong-Suk Park, Ph.D. Dissertation, Yonsei University, 2018

BRIEF Feature Description Process

Input Image

Patch Generation

Patch Smoothening

Pair Selection

Intensity Comparison

Bitstring Generation

BRIEF Descriptor

Random sampling of pixel pairs

Yong-Suk Park, Ph.D. Dissertation, Yonsei University, 2018

ORB Feature Extraction Process

Input Image

Scale Pyramid

FAST Feature Detection

Harris Corner Measure

Non-Max Suppression

Oriented BRIEF

ORB Features

13-pixel run

P16 P1 P2
P15 P3
P14 P4
P13 C P5
P12 P6
P11 G P7
P10 P9 P8

Yong-Suk Park, Ph.D. Dissertation, Yonsei University, 2018

BRISK Feature Extraction Process

Input Image

Scale-Space
Keypoint Detection

Sample Point
Gaussian Smoothing

Pair Generation

Gradient
Computation

Descriptor
Generation

BRISK Features

Yong-Suk Park, Ph.D. Dissertation, Yonsei University, 2018

❖ **Skype**

❖ **Skype Video & Audio Codecs**
  ▪ After Microsoft acquired Skype in 2011
    Skype's video codec was replaced to H.264
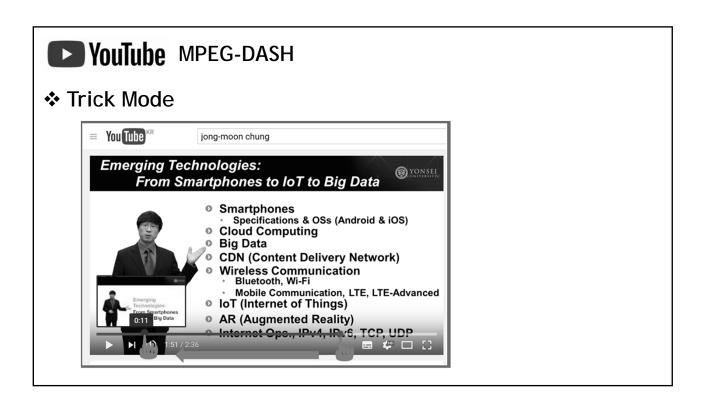
Microsoft

▶ YouTube

❖ **YouTube Video Technology**

▪ 2015 January 27, **HTML5** was announced
as the default playback method

- HTML5 video streaming
  uses **MPEG-DASH**

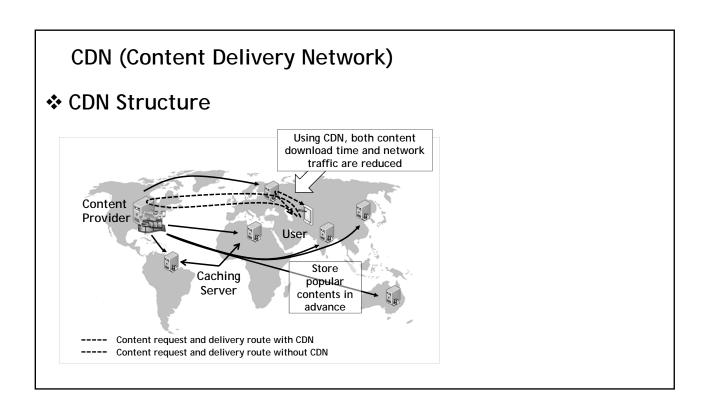❖ **YouTube
MPEG-DASH
8 Video Resolutions** ➜

Resolution	Pixels (width x height)
144p	256 x 144
240p	426 x 240
360p	640 x 360
480p	854 x 480
720p	1280 x 720
1080p	1920 x 1080
1440p	2560 x 1440
2160p	3840 x 2160

▶ YouTube MPEG-DASH

❖ **Pull based Adaptive Media Streaming**

Pull based adaptive streaming bitrate adaptation example under varying network conditions

▶ YouTube MPEG-DASH

❖ Pull based Adaptive Media Streaming

Fragmented
MP4 file format
structure

▶ YouTube MPEG-DASH

❖ Progressive Downloading

▶ YouTube MPEG-DASH

❖ Trick Mode

CDN (Content Delivery Network)

❖ CDN Structure

- - - - - Content request and delivery route with CDN
- - - - - Content request and delivery route without CDN

CDN Market

❖ CDN Service Providers

CDN (Content Delivery Network)

❖ Hierarchical CDN

CDN (Content Delivery Network)

❖ **Hierarchical CDN Delivery Procedures**

AR Smartphone Testing Project

IKEA Catalog
Available at Google Play Store and Apple App Store

AR Smartphone Testing Project

Google Translate
Available at Google Play Store and Apple App Store

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