Augmented Reality & Video Service Emerging Technologies

AR Technology

Prof. Jong-Moon Chung
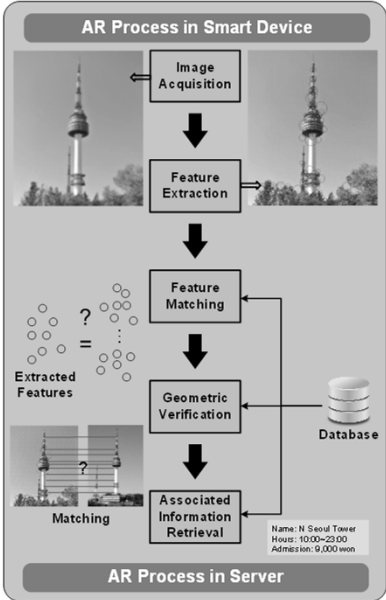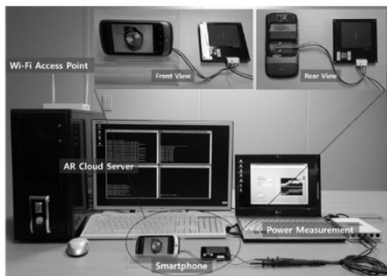
AR Technology

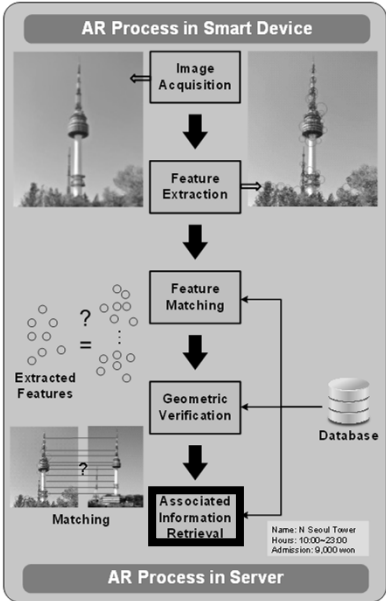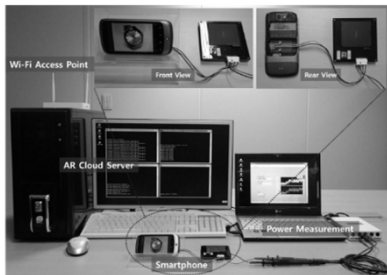# AR System Process

AR System Process

❖ AR Process

1. Image Acquisition
2. Feature Extraction
3. Feature Matching
4. Geometric Verification
5. Associated Information Retrieval

AR System Process

❖ AR Process

Associated Information
is displayed on the
Smartphone image

AR System Process

❖ AR Process

1. Image Acquisition

   - Process of retrieving an image
     from the AR camera

2. Feature Extraction

   - Based on an initial set of measured data,
     the extraction process generates informative
     non redundant values to facilitate the
     subsequent feature learning and
     generalization steps

AR System Process

❖ AR Process

3. Feature Matching

   - Process of computing abstractions of image
     information, and to make a local decision if
     there is an image feature (or not), which is
     conducted for all image points

4. Geometric Verification

   - Identification process of finding
     geometrically related images in the image
     data set (which is a subset of the overall AR
     image database)

AR System Process
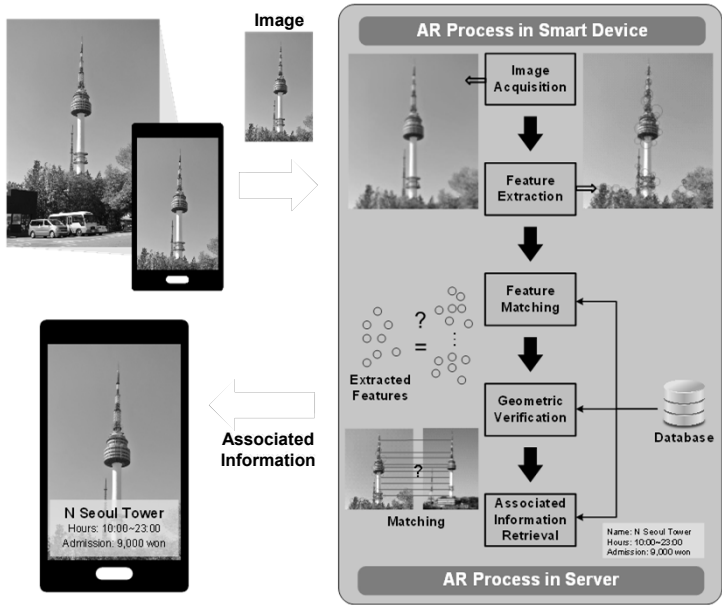
❖ AR Process

5. Associated Information Retrieval

- Process of searching and retrieving metadata, text, and/or content-based indexing information of the identified image/object

- Associated Information is used for display on the AR screen near the corresponding image/object
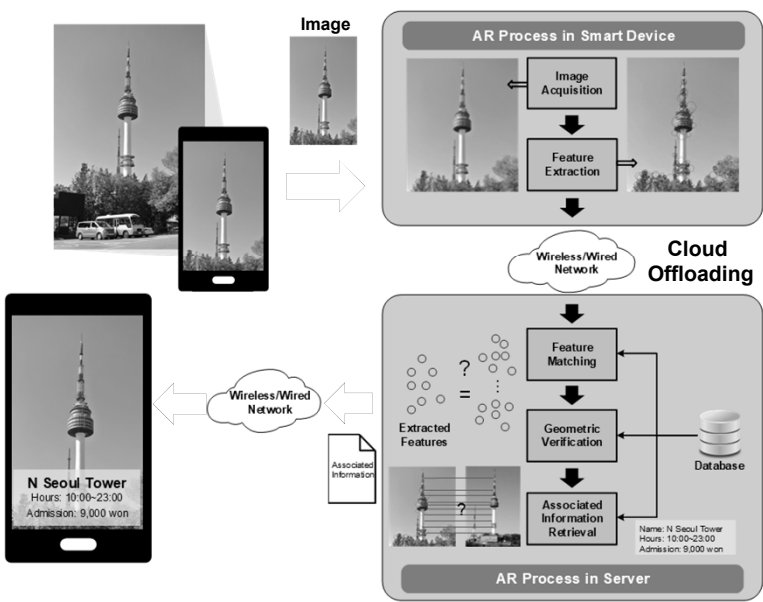
AR System Process

❖ AR Cloud Cooperative Computation

- All object information can NOT be stored on the AR device ➜ AR database needed

- AR requires a large amount of computation to complete its task ➜ The amount of AR processing directly influences the battery power consumption of the AR device

- To reduce the processing load and overcome AR database limitations of the AR device, AR Cloud Computation Offloading can be used

AR System Process

AR System Process

AR System Process

❖ **AR Cloud Offloading**

- Virtualization allows cloud server vendors to run arbitrary applications (from different customers) on VM (Virtual Machines) ➔ IaaS

- Cloud server vendors provide computing cycles ➔ AR devices can use these computing cycles to reduce their computation load

- Cloud computing (offloading) can help save energy and enhance the response speed of the AR service

AR System Process

❖ **Adaptive Cloud Offloading**

- Unconditional offloading may result excessive delay ➔ Adaptive Control needed
  - Cloud server load and network congestion status monitoring needed

- Adaptive Cloud Offloading parameters
  - Network condition
  - Cloud server status
  - Energy status of the AR device
  - Target QoE (Quality of Experience) level

AR Technology
References

References

- T. Olsson and M. Salo, "Online User Survey on Current Mobile Augmented Reality Applications," Proc. IEEE International Symposium on Mixed and Augmented Reality, pp. 75-84, Oct. 2011.

- K. Kumar and Y. Lu, "Cloud Computing for Mobile Users: Can Offloading Computation Save Energy?," IEEE Computer, vol. 43, no. 4, pp. 51-56, Apr. 2010.

- B. Girod, V. Chandrasekhar, R. Grzeszczuk, and Y. Reznik, "Mobile Visual Search: Architectures, Technologies, and the Emerging MPEG Standard," IEEE Multimedia, vol. 18, no. 3, pp. 86-94, Mar. 2011.

- D. Lowe, "Distinctive Image Features from Scale-Invariant Keypoints," International Journal of Computer Vision, vol. 60, no. 2, pp. 91-110, Nov. 2004.

- H. Bay, A. Ess, T. Tuytelaars, and L. Van Gool, "Speeded-Up Robust Features (SURF)," Computer Vision and Image Understanding, vol. 110, no. 3, pp 346-359, Jun. 2008.

References

- P. Drews, R. de Bem, and A. de Melo, "Analyzing and Exploring Feature Detectors in Images," Proc. IEEE International Conference on Industrial Informatics, pp. 305-310, Jul. 2011.

- L. Juan and O. Gwun, "A Comparison of SIFT, PCA-SIFT and SURF," International Journal of Image Processing, vol. 3, no. 4, pp. 143-152, Aug. 2009.

- D. Jin, K. Um, and K. Cho, "Development of Real-Time Markerless Augmented Reality System Using Multi-thread Design Patterns," Computer Graphics and Broadcasting Communications in Computer and Information Science, Multimedia, vol. 262, pp. 155-164, Dec. 2011.

- M. Satyanarayanan, "A Brief History of Cloud Offload: A Personal Journey from Odyssey Through Cyber Foraging to Cloudlets," GetMobile, vol. 18, no. 4, pp. 19-23, Oct. 2014.

- Y. Zhang, H. Liu, L. Jiao, and X. Fu, "To offload or not to offload: an efficient code partition algorithm for mobile cloud computing," Proc. IEEE International Conference on Cloud Networking, pp. 80-86, Nov. 2012.