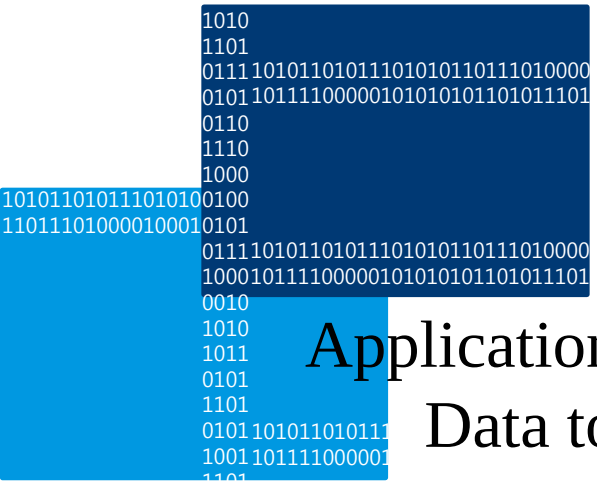

Application Method for Streetview Database as Auxiliary Data to Estimate Mobile Device Users' Location

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Geo Computing
Pukyong National University

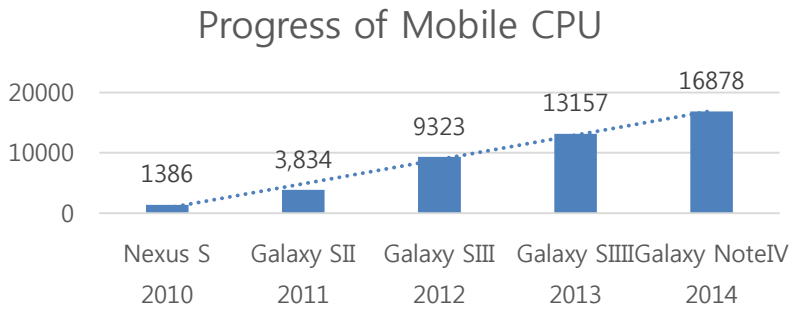
Contents

1. Introduction

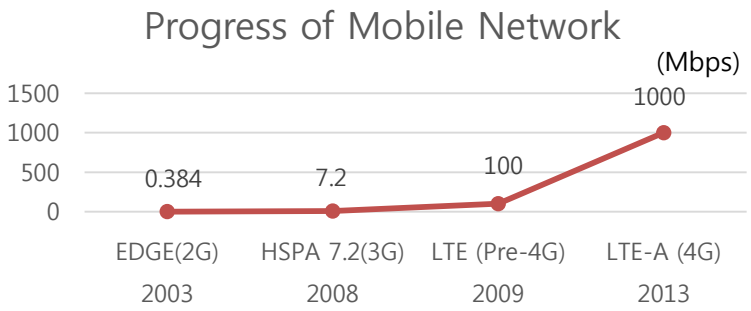
➢ Background

▪ Development of Mobile Environment

- ✓ Notable development in physical aspect
- ✓ With this, Mobile network environment has developed about 2500 times better than those of 10 years ago



(http://www.androidbenchmark.net/)



▪ Changeable Mobile Trends

- ✓ Mobile devices have evolved to be more lightweight and more comfortable
- ✓ Progressive advance of accuracy of various sensors embedded in mobile device contributes to theses change
- ✓ Release of revolutionary wearable devices can reinforce the coupling between daily lives and mobile devices

1. Introduction

➢ Background

▪ Wearable Device as Spatial Sensor in Our Life

- ✓ Wearable devices penetrated in our life make it easy to acquire sensor database collected from daily life
- ✓ Especially, the head mounted device such as Google Glass realizes environment that we can handle 3Dimensional images which can be thought invaluable
- ✓ It can make user-oriented big image database which can be utilized for analyzing mobile device users‘ external circumstance

▪ Various Spatial Web Services

- ✓ In case of the South Korea, the organizations of government directly provide 2D and 3D Web GIS services for public
  - 3D Building Models, Thematic Map, Land Cover Map, …
- ✓ Commercial portal vendors provide several kinds of GIS web services such as street view service which can provide indirect experiences at specific spot on real world and 2D Web Map Service

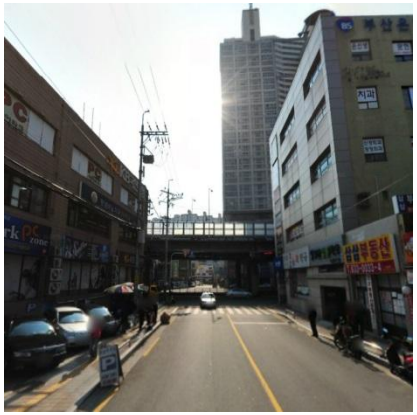
1. Introduction

➢ Street-View

- ✓ In the South Korea, Two vendors provide street view services for users' convenience and, particularly, time series street view shot in 1 or 1.5 year interval is on service by Daum Corp.
- ✓ However, There are no ways to utilize street view database directly because street view services is blocked from direct access for any kinds of users
- ✓ Google Maps API suggests a roundabout way to access and exploit it by using Javascript and http connection interface

Daum, 2014

Daum, 2008



Naver, 2013

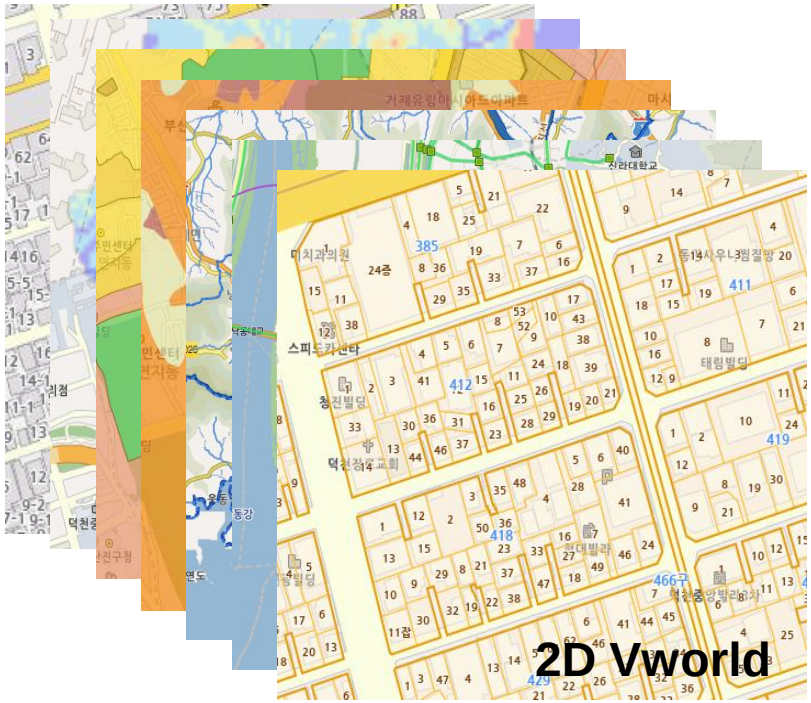
http://.../streetview?size=400x400&location=35.137347,129.071103&fov=90&heading=180&pitch=10&sensor=false

Google

1. Introduction

➢ Public Web Services

- ✓ Vworld, 3D Model view and API(Application Programming Interface) for building and infrastructure around major cities in the South Korea present artificial environment and provide their own structure and texture database
- ✓ Over 30 types of 2D GIS database such as DEM(Digital Elevation Model) and traffic map, etc., is disseminated as well



1. Introduction

➢ Objective

- Constructing base environment in which head mounted devices can estimate location coordinates by matching input image with panoramic database in street view service
- Realizing virtual client-side environment through bluetooth-link between two modifiable mobile devices
- Constructing panoramic image database on target area for system test with GPS coordinates
- Transmitting mobile image to server and processing extraction of feature between client image and street-view images
  - ✓ Feature Detection by SURF(Speed Up Robust Feature) and SIFT(Scale Invariant Feature Transform)

2. Related Technology

➢ Related Works

- A Panorama-based Method of Personal Positioning and Orientation and Its Real-Time Applications for Wearable Computers (Kourogi et al., 2001)
  - ✓ Estimating indoor position of wearable computer by comparison between specific panorama images and the input images provided from wearable camera
  - ✓ Using transformation processing of images projections and methodology for correcting lighting condition problems

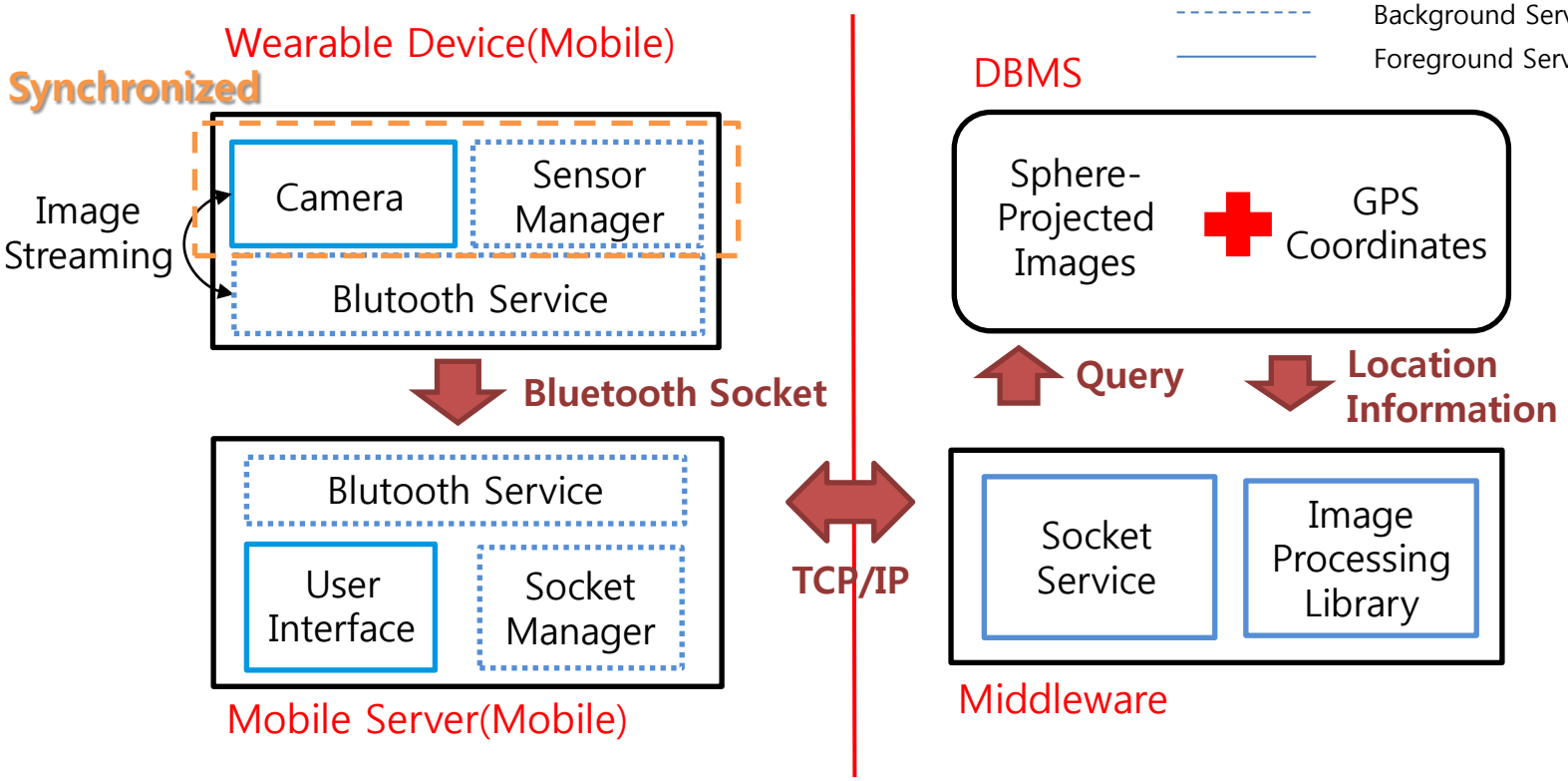
- UGV Localization based on Scene Matching and Pose Estimation (Bok et al., 2007)
  - ✓ Estimating pose and position of the camera loaded on unmanned vehicle by matching acquired image with reference image database
  - ✓ SURF(Speed Up Robust Feature) and SIFT(Scale Invariant Feature Transform) Algorithm is used for extracting feature point and Homography and P3P(Perspective 3Point) algorithm is used for pose and position estimation

➢ Adoptable Sensors

- Sensors which can reflect the status of mobile device such as Gyroscope, Compass, Accelerometer, etc.
- In this research, angles gauged by Gyroscope and direction obtained by compass is provided as parameters for street view web service

3. Application Method

➢ System Structure



- Sequence images around mobile user can be collected by wearable device and the images is transmitted to middleware for image processing
- After transmission, middleware abstracts features from received images and compares them with reference database in sphere projection

3. Application Method

➢ Client-Side

IP address of web service
+
Params{ AOVx=…&AOVy=…
&Pitch=…&Roll=…&Yaw=…
&Direction=… }
+
Image(3Band)

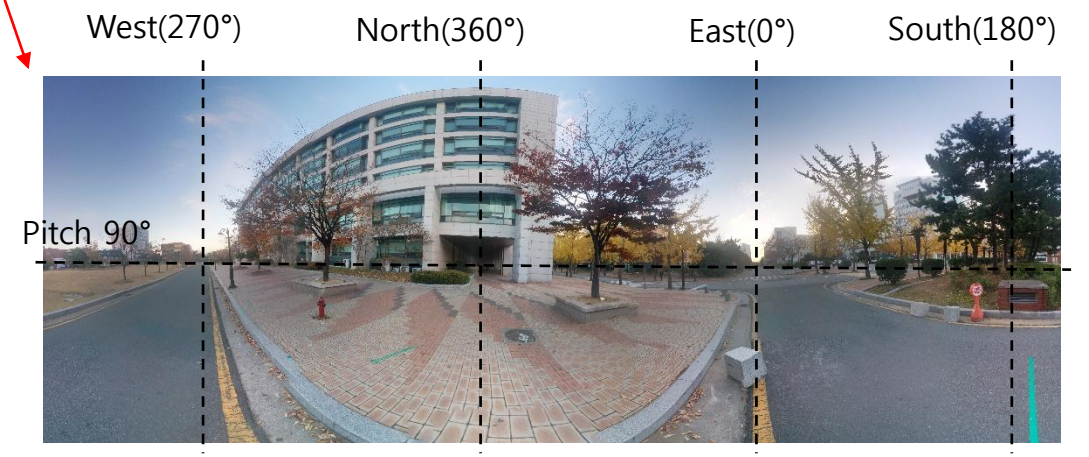
- Realizing client side by using two android devices Nexus 5 and Nexus S, to reproduce modifiable head mounted device (Google Glass)
- Multiple channel Image buffer accumulated by camera of wearable device is transmitted to mobile server with the data about angle of view, pose, direction through Bluetooth link
- Transmitted data on mobile server is handed to street-view web service through web socket connection

3. Application Method

➢ Server-Side

P8 (35.13485, 129.106689)

- ✓ Selected 43 points in Pukyong National University as reference location for constructing panoramic image database
- ✓ So far, 20 point's image database and GPS coordinates has been obtained
- ✓ In case of panoramic image, sphere image algorithm provided by Android is utilized



- ✓ Panoramic image indexed from 0° to 360° in horizontal direction and indexed from 0° to 180° in vertical direction
- ✓ Postgresql and PostGIS Extension was selected

4. Result and Future Works

➢ Result

- SURF Algorithm can show better performance than SIFT Algorithm in the time waste (Bok et al., 2007) so SURF was selected in this research
- Wasting Time from transmission of image to image matching is 9088ms in case of 1080*1920 Image
- Main reason of delayed time is in image matching algorithm and clip operation by DBMS
- As a result of manual matching operation between panoramic images and the input image which contains feature of specific location, accuracy rate of matching algorithm recorded under than what we expected (Under 5%)

➢ Future Works

- Adopting and evaluating several different feature extraction algorithms such as histogram matching or LSD algorithm
- Adding preprocessing procedure for security of database consistency
- Adopting distributed DBMS environment for improved database query

Thank you

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