

**Development of **Track Log**  
& **POI** Management System  
using **Free** and **Open** **Source** **Software****

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# Introduction



Recent advanced performance of **low-cost GPS** and **GPS-enabled cell-phones** has contributed a great deal to the development of location-aware services and systems.

The advancements have promoted collaborative projects such as **OpenStreetMap** or other **User Generated Contents** services.

the **ubiquity of location information** is one of the recent developments in geospatial technologies.



**Previous work @ FOSS4G2008**

# Development of Real-time Tracking & Log Management Prototype System using FOSS

An open framework for

GPS data collections and management

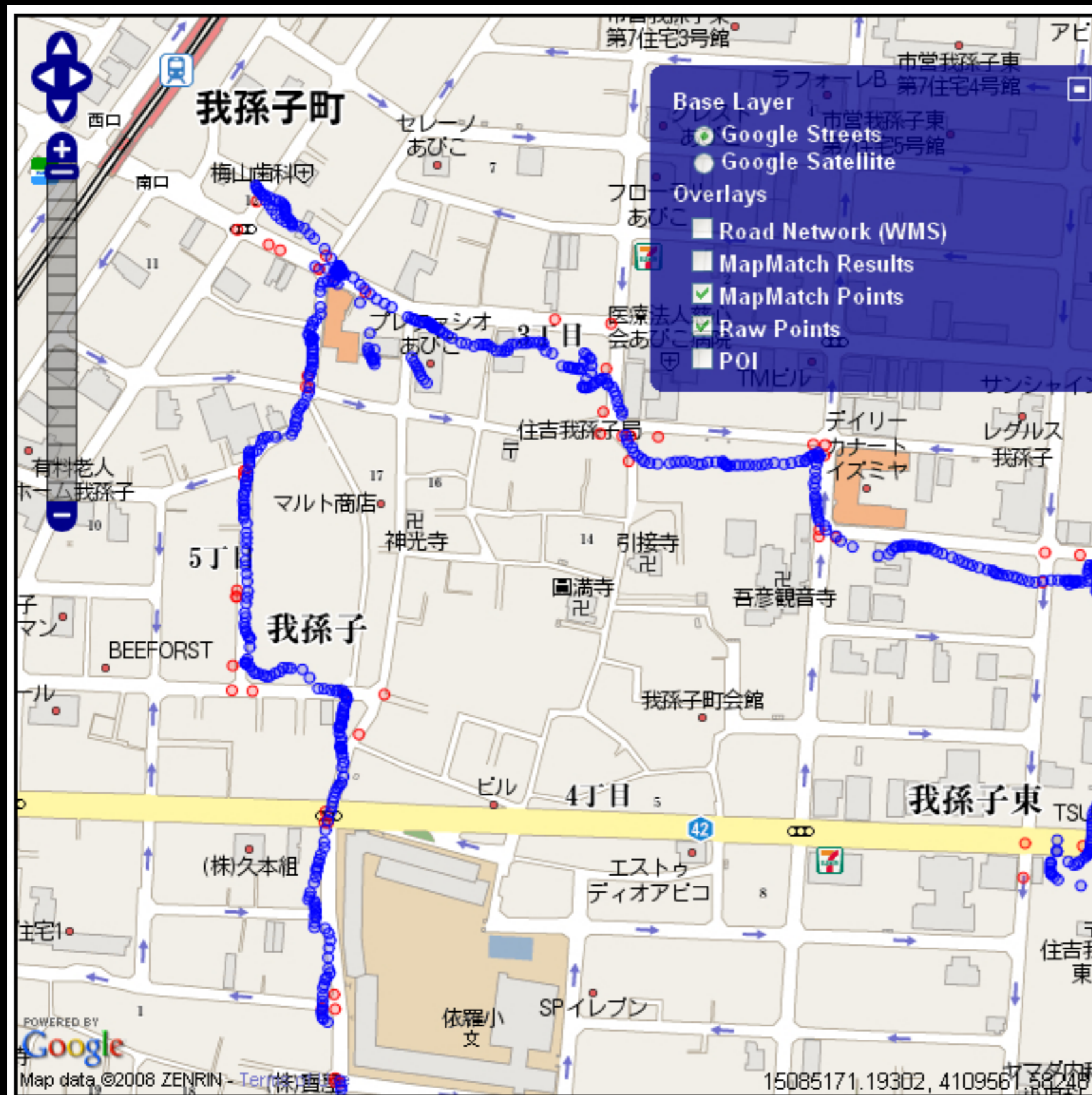
To provide **interoperable** services

and data between LBS and other geospatial services

- focused on **real-time tracking**
- Implemented **quality filtering for GPS signal**  
using **DOP** (Dilution of Precision)  
and **GPS positioning status data**  
(3D, 2D or no fix)
- Implemented **map-matching** functionality



# Interactive Track log on-the-fly Display Function



## GPS Track Log Search

IP Address: 160.193.

Date: 2008-06-09

Time Between: 0AM  To 11PM

PDOP < 2

GPS Mode 3D

[>> GPS Data Upload](#)

[>> Log Statistic Page](#)



[Download KML Track Log](#)



[Download GPX Track Log](#)

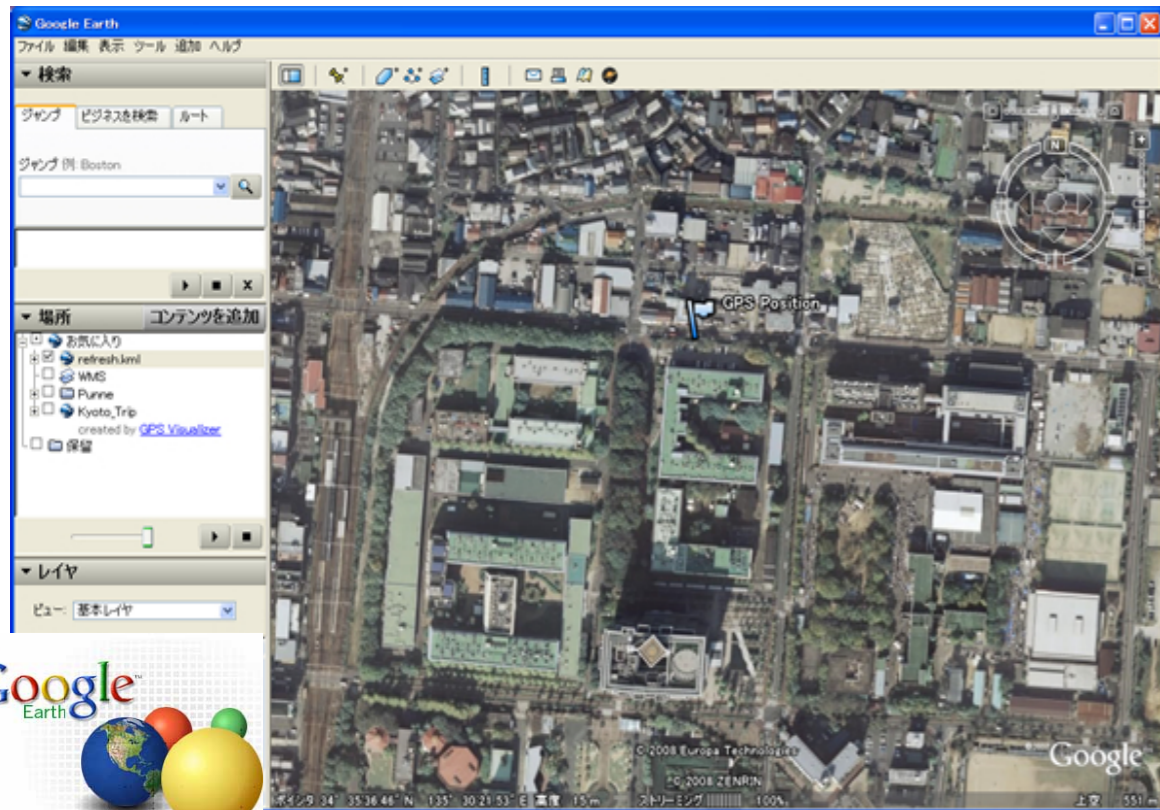
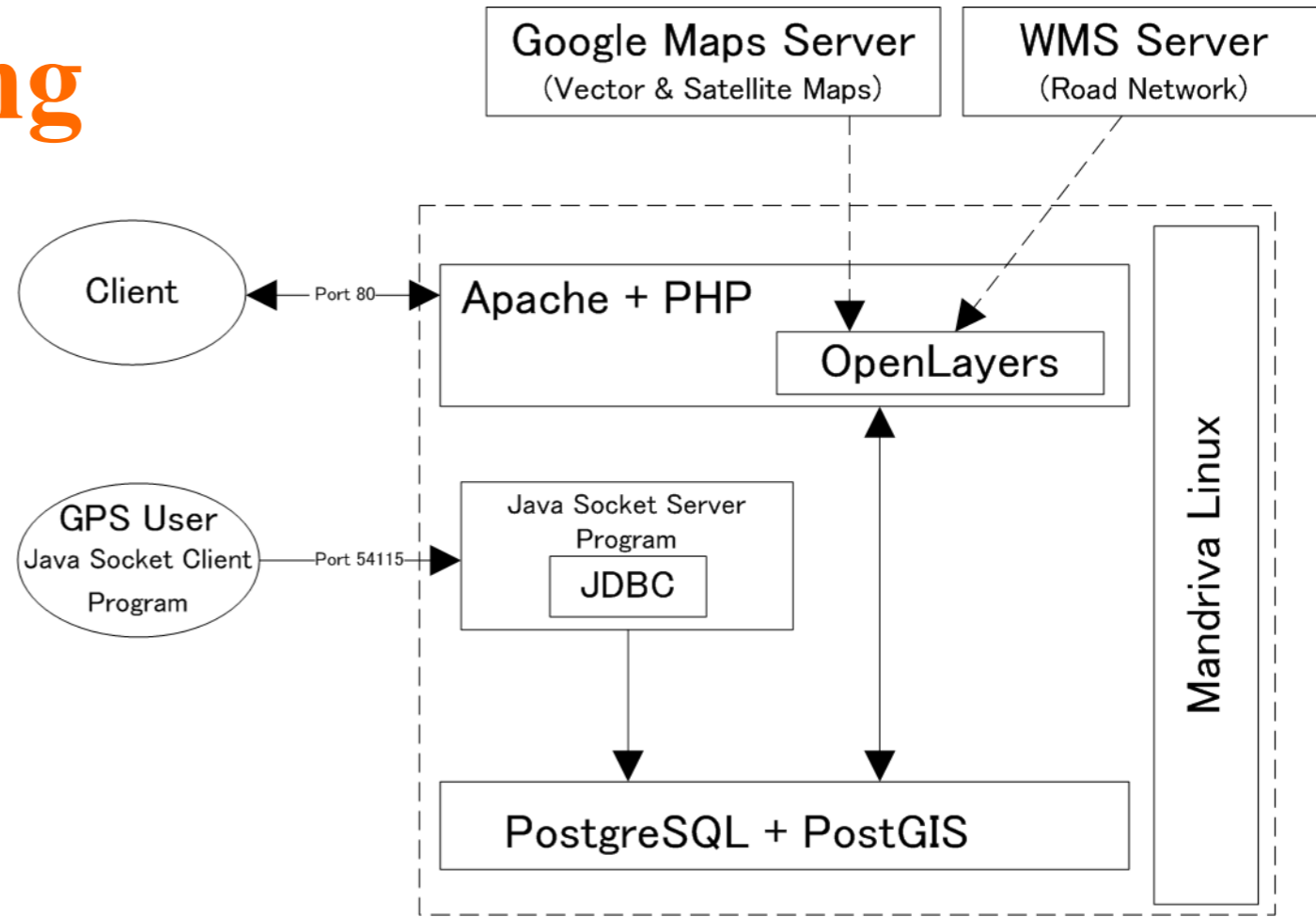


[Display Track Log using Google Earth](#)

using OpenLayers + PostGIS



# System Overview on Real-time Tracking



Hicom 406BT-C GPS



SHARP EM-ONE

Java Socket Client

Java Communication API

Mysaifu JVM

Windows Mobile

# Track Log & **POI** Management System



One of the important geospatial services is **Point of Interest (POI)** management.

POI provides vital information as contextual data **to enable spatial searching** since street maps alone are not enough to provide LBS and **POI can enhance more usabilities of LBS.**

Recently, it is becoming easier for users to make POI databases for their various purposes since,

- GPS-enabled cell-phones and digital cameras are freely used by the general public.
- many web applications for building POIs have been popular and also implementing web mapping functions, such as **Flickr** and **Google Picasa Web Album.**

# Functions and Features

- **Data Collection**
  - Real-time data collection
  - **Non real-time (using GPS loggers)**
- **Data Management**
  - Track log database
  - **POI database (Internal DB -> Flickr)**
- **Data Quality Enhancement**
  - HDOP (Horizontal Dilution of Precision)
  - Numbers of satellite
  - GPS fix mode (e.g. 3D, 2D or no fix)
  - **Line simplification** (the **Douglas-Peucker** algorithm)
  - **PgRouting shortest path functions**
- comply with **Open Geospatial Standards**



## a **Test Site** in Osaka City





## a **Test Site** in Osaka City



# Data Quality **Enhancement**



# Data Quality Enhancement 1

## GPS Signal Quality Filtering



### GPS Track Log Search

IP Address: 119.72. [dropdown]

Date: 2008-06-09 [dropdown]

Time Between: 0AM [dropdown] To 11PM [dropdown]

HDOP < [No Filtering] [dropdown]

GPS Mode [Not Fixed] [dropdown]

Number of Satellite >= 1 [dropdown]

HDOP  
GPS Mode  
Number of Satellite



### GPS Track Log Search

IP Address: 119.72. [dropdown]

Date: 2008-06-09 [dropdown]

Time Between: 0AM [dropdown] To 11PM [dropdown]

HDOP < 5 [dropdown]


GPS Mode 3D [dropdown]

Number of Satellite >= 3 [dropdown]

Display GPS Track Log

>> GPS Data Upload  
>> Log Statistic Page

 Download KML Track Log

 Download GPX Track Log

 Display Track Log using Google Earth



# Data Quality Enhancement 2

## Line Simplification (the Douglas-Peucker algorithm)



Tolerance = 0m

### GPS Track Log Search

IP Address: All  
Date: 2009-08-12  
Time Between: 0AM To 11PM  
HDOP < 3  
GPS Mode: 3D  
DP Tolerance: 0

Tolerance = 5m



### GPS Track Log Search

IP Address: All  
Date: 2009-08-12  
Time Between: 0AM To 11PM  
HDOP < 3  
GPS Mode: 3D  
DP Tolerance: 5m  
SP: None

Display GPS Track Log

- >> Track Registration
- >> GPS Data Upload
- >> Log Statistic Page



Download KML Track Log



Download GPX Track Log



Display Track Log using Google Earth

# Data Quality Enhancement 3

# PgRouting Shortest Path Function



## GPS Track Log Search

IP Address:

Date:

Time Between:  To

HDOP <

GPS Mode

DP Tolerance

SP

[Display GPS Track Log](#)

- [>> Track Registration](#)
- [>> GPS Data Upload](#)
- [>> Log Statistic Page](#)



[Download KML Track Log](#)



[Download GPX Track Log](#)



[Display Track Log using Google Earth](#)

# Track log **Request URL**

<http://gisws.media.osaka-cu.ac.jp/DP/douglas-p2.php>

[?address=%25](#)

[&stime=00%3A00%3A00](#)

[&etime=23%3A59%3A00](#)

[&sdate=2009-08-12](#)

[&sp=find\\_node\\_by\\_nearest\\_link](#)

[&hdop=3](#)

[&gpsmode=3](#)

[&dp=10](#)

```
-<route>
- <edge id="1">
  <id>DK27120001585</id>
  - <wkt>
    MULTILINESTRING((15085204.3580346 4109394.21506489,15085122.4145205 4109398.0091607))
  </wkt>
  <length>0.082</length>
</edge>
- <edge id="2">
  <id>DK27120000855</id>
  - <wkt>
    MULTILINESTRING((15085122.4145205 4109398.0091607,15085126.2179365 4109470.43531466))
  </wkt>
  <length>0.155</length>
</edge>
- <edge id="3">
  <id>DK27120000855</id>
  - <wkt>
    MULTILINESTRING((15085122.4145205 4109398.0091607,15085126.2179365 4109470.43531466))
  </wkt>
  <length>0.227</length>
</edge>
- <edge id="4">
  <id>DK27120001589</id>
  - <wkt>
    MULTILINESTRING((15084963.8770124 4109402.59212963,15085004.8178473 4109402.59212963,15085122.4145205 4109398.0091607))
  </wkt>
  <length>0.386</length>
</edge>
```

# **POI** Management



# POI Management using flickr

The screenshot shows a Flickr photo page for a user named Daisuke Yoshida. The photo is titled "foss4g2009osaka\_mambow\_v01" and features a logo for "FOSS4G Free&Open Source Software for Geospatial 2009 OSAKA". The page includes navigation links like Home, You, Organize, Contacts, Groups, and Explore. There are also various photo management tools such as Add Note, Send to Group, Add to Set, Blog This, All Sizes, Order Prints, Rotate, Edit Photo, and Delete. A "Share This" button is visible. The photo was uploaded on October 12, 2009, and is part of a photostream with 134 uploads.

## Edit the photo date


**Date Taken** **Date Posted**

06/09/2008 at 17:48:48

(This form uses a mm/dd/yyyy format for the date, and 24hr format for the time.)

**SAVE**

Or, [click here if you are not sure of the date.](#)



Date Taken displays in the owner's timezone.

## EXIF Data

Taken Date & Time  
Location Information  
many other information



Taken on [June 9, 2008](#) at 5.58pm PDT

Posted to Flickr [October 5, 2009](#) at 4.28PM PDT

[Edit the photo dates](#)

### What is EXIF data?

Almost all new digital cameras save JPEG (.jpg) files with EXIF (Exchangeable Image File) data. Camera settings and scene information are recorded by the camera into the image file. Examples of stored information are shutter speed, date and time, focal length, exposure compensation, metering pattern and if a flash was used.

Source: [Digicamhelp](#).

### Your privacy

If you like, you can prevent the link to your EXIF data from displaying on the photo page. Set this in your [privacy options](#).

Camera: [Canon IXY Digital 700](#)

Exposure: 0.1 sec (1/10)

Aperture: f/2.8

Focal Length: 7.7 mm

Exposure Bias: 0 EV

Flash: Off, Did not fire

ISO Speed: 50

File Size: 175 kB

File Type: JPEG

MIME Type: image/jpeg

Image Width: 800

Image Height: 600

Encoding Process: Baseline DCT, Huffman coding

Bits Per Sample: 8

Color Components: 3

X-Resolution: 180 dpi

Y-Resolution: 180 dpi

Orientation: Horizontal (normal)

Date and Time (Modified): 2009:08:24 12:59:24

YCbCr Positioning: Centered

Related Image Width: 3072

Related Image Height: 2304

Padding: (Binary data 2060 bytes, use -b option to extract)

Date and Time (Original): 2009:08:24 03:59:24Z

Date and Time (Digitized): 2009:08:24 12:59:24

Compressed Bits Per Pixel: 3

Max Aperture Value: 2.8

Metering Mode: Multi-segment

Color Space: sRGB

Focal Plane X-Resolution: 10816.90141 dpi

Focal Plane Y-Resolution: 10816.90141 dpi

Sensing Method: One-chip color area

# flickr API

<http://www.flickr.com/services/rest/>

[method=flickr.photos.search](#)

[&format=rest](#)

[&api\\_key=d87af44aa963d0488f3b7f640239e22c](#)

[&per\\_page=10](#)

[&user\\_id=8105900@N03](#)

[&max\\_taken\\_date=2008-10-09+15:05:11](#)

[&min\\_taken\\_date=2008-10-09+01:02:33](#)

[&extras=geo,date\\_taken](#)

```
-<rsp stat="ok">
- <photos page="1" pages="1" perpage="10" total="5">
  <photo id="3018915924" owner="8105900@N03" secret="7dfe7e7e4e" server="3152" farm="4" title="Dubai 2008" ispublic="1" isfriend="0" isfamily="0"
  latitude="0" longitude="0" accuracy="0" datetaken="2008-10-09 15:05:11" datetakengrgranularity="0"/>
  <photo id="3018086091" owner="8105900@N03" secret="5cd301e744" server="3036" farm="4" title="Dubai 2008" ispublic="1" isfriend="0" isfamily="0"
  latitude="0" longitude="0" accuracy="0" datetaken="2008-10-09 13:27:43" datetakengrgranularity="0"/>
  <photo id="3018915228" owner="8105900@N03" secret="2b84360151" server="3159" farm="4" title="Dubai 2008" ispublic="1" isfriend="0" isfamily="0"
  latitude="0" longitude="0" accuracy="0" datetaken="2008-10-09 02:21:45" datetakengrgranularity="0"/>
  <photo id="3018084783" owner="8105900@N03" secret="f2949315b6" server="3062" farm="4" title="Dubai 2008" ispublic="1" isfriend="0" isfamily="0"
  latitude="0" longitude="0" accuracy="0" datetaken="2008-10-09 01:11:01" datetakengrgranularity="0"/>
  <photo id="3018913712" owner="8105900@N03" secret="a7993c77c0" server="3215" farm="4" title="Dubai 2008" ispublic="1" isfriend="0" isfamily="0"
  latitude="0" longitude="0" accuracy="0" datetaken="2008-10-09 01:02:33" datetakengrgranularity="0"/>
</photos>
</rsp>
```

# POI Management using flickr

The map displays a GPS track log in the Abiko area of Osaka. A photo overlay is visible, featuring the FOSS4G logo and the text "FOSS4G Free&Open Source Software for Geospatial 2009 OSAKA". The photo is attributed to "foss4g2009osaka\_mambow\_v01" by "Daisuke Yoshida", dated "2008-06-09" at "17:57:38". The tags are "osaka foss4g2009". The map includes various landmarks such as "アビコ", "アトレあびこ", "アトレあびこ2", "アトレあびこ3", "アトレあびこ4", "アトレあびこ5", "アトレあびこ6", "アトレあびこ7", "アトレあびこ8", "アトレあびこ9", "アトレあびこ10", "アトレあびこ11", "アトレあびこ12", "アトレあびこ13", "アトレあびこ14", "アトレあびこ15", "アトレあびこ16", "アトレあびこ17", "アトレあびこ18", "アトレあびこ19", "アトレあびこ20", "アトレあびこ21", "アトレあびこ22", "アトレあびこ23", "アトレあびこ24", "アトレあびこ25", "アトレあびこ26", "アトレあびこ27", "アトレあびこ28", "アトレあびこ29", "アトレあびこ30", "アトレあびこ31", "アトレあびこ32", "アトレあびこ33", "アトレあびこ34", "アトレあびこ35", "アトレあびこ36", "アトレあびこ37", "アトレあびこ38", "アトレあびこ39", "アトレあびこ40", "アトレあびこ41", "アトレあびこ42", "アトレあびこ43", "アトレあびこ44", "アトレあびこ45", "アトレあびこ46", "アトレあびこ47", "アトレあびこ48", "アトレあびこ49", "アトレあびこ50", "アトレあびこ51", "アトレあびこ52", "アトレあびこ53", "アトレあびこ54", "アトレあびこ55", "アトレあびこ56", "アトレあびこ57", "アトレあびこ58", "アトレあびこ59", "アトレあびこ60", "アトレあびこ61", "アトレあびこ62", "アトレあびこ63", "アトレあびこ64", "アトレあびこ65", "アトレあびこ66", "アトレあびこ67", "アトレあびこ68", "アトレあびこ69", "アトレあびこ70", "アトレあびこ71", "アトレあびこ72", "アトレあびこ73", "アトレあびこ74", "アトレあびこ75", "アトレあびこ76", "アトレあびこ77", "アトレあびこ78", "アトレあびこ79", "アトレあびこ80", "アトレあびこ81", "アトレあびこ82", "アトレあびこ83", "アトレあびこ84", "アトレあびこ85", "アトレあびこ86", "アトレあびこ87", "アトレあびこ88", "アトレあびこ89", "アトレあびこ90", "アトレあびこ91", "アトレあびこ92", "アトレあびこ93", "アトレあびこ94", "アトレあびこ95", "アトレあびこ96", "アトレあびこ97", "アトレあびこ98", "アトレあびこ99", "アトレあびこ100".

Photo from Flickr

POWERED BY Google

地図データ ©2009 ZENRIN - 利用規約

15084947.85358, 4109632.04787

## GPS Track Log Search

IP Address:

Date:

Time Between:  To


HDOP <


GPS Mode

Number of Satellite

[Display GPS Track Log](#)

[>> GPS Data Upload](#)  
[>> Log Statistic Page](#)

 [Download KML Track Log](#)

 [Download GPX Track Log](#)

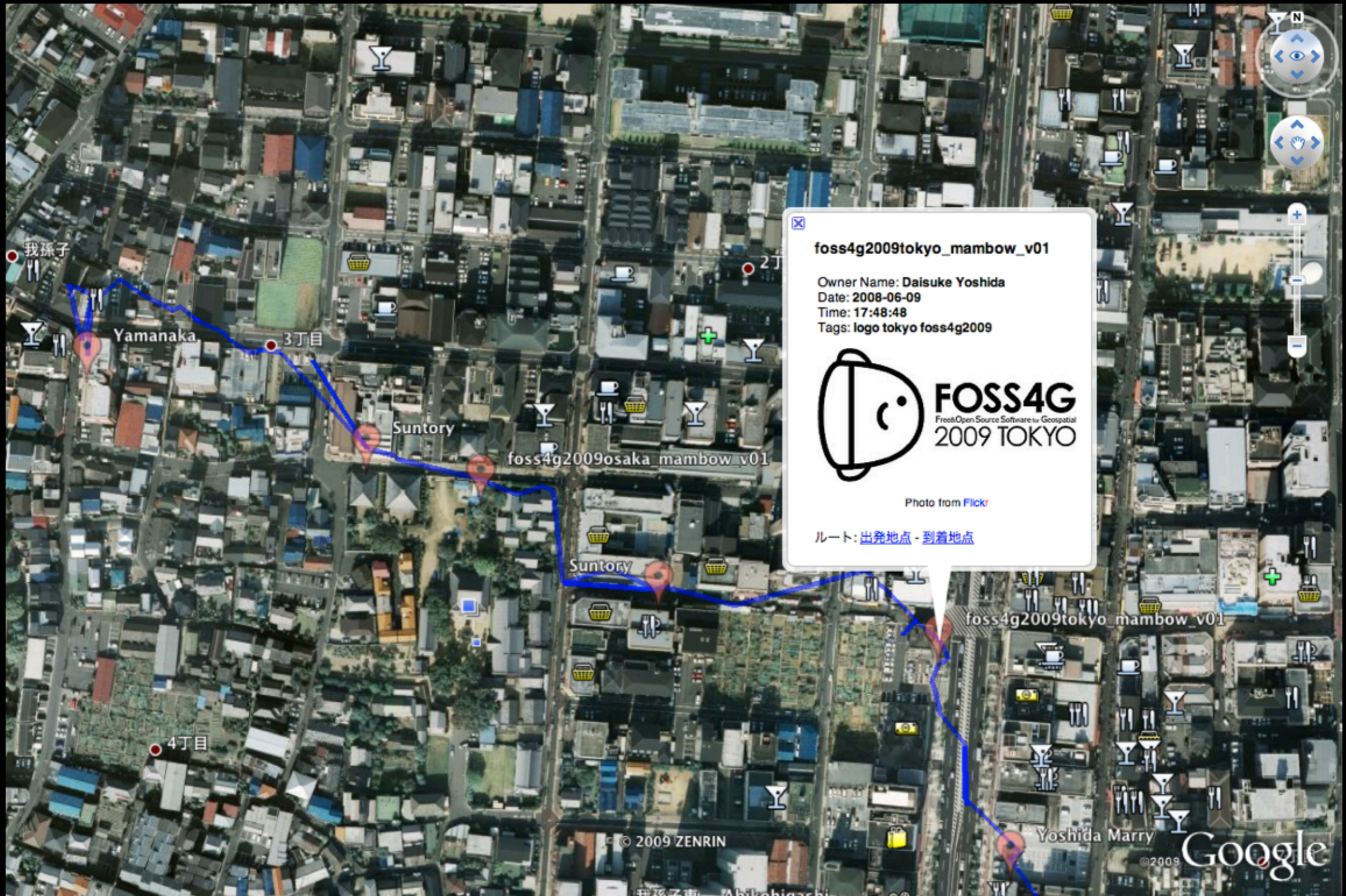
 [Display Track Log using Google Earth](#)

# Data **Export** Function



# Exported as **KML**

# Google Earth





# Exported as KML

# Google Maps

Google maps <http://gisws.media.osaka-cu.ac.jp/tmp/track.kml> 地図を検索 検索オプションを表示  
お店やサービス、住所、場所を検索 詳細

ルート・乗換案内 マイマップ

Google Earth で表示 印刷 送信 リンク

その他... 地図 航空写真 地形

マイマップに保存

コンテンツ

- Track Log Export
- Exported on 2009-10-13T14:00:36
- [Suntory](#)  
Owner Name: Daisuke Yoshida
- [Suntory](#)  
Owner Name: Daisuke Yoshida
- [Yamanaka](#)  
Owner Name: Daisuke Yoshida
- [Yoshida Marry](#)  
Owner Name: Daisuke Yoshida
- [foss4g2009osaka\\_mambow\\_v01](#)  
Owner Name: Daisuke Yoshida
- [foss4g2009tokyo\\_mambow\\_v01](#)  
Owner Name: Daisuke Yoshida
- [Raw Data](#)  
by Daisuke Yoshida, OCU, JAPAN

[gisws.media.osaka-cu.ac.jp](http://gisws.media.osaka-cu.ac.jp)  
のコンテンツの表示

このマップ上のコンテンツはサードパーティによって提供されたもので、その内容について Google は一切の責任を負いかねます。

**foss4g2009tokyo\_mambow\_v01**  
Owner Name: Daisuke Yoshida  
Date: 2008-06-09  
Time: 17:48:48  
Tags: logo tokyo foss4g2009


 **FOSS4G**  
Free & Open Source Software for Geospatial  
2009 TOKYO

Photo from Flickr

[付近を検索](#) - [マイマップに保存](#)  
[送信](#)

# Exported as KML

# Virtual Earth

The screenshot shows a Bing map interface with a KML track overlaid. The track consists of several numbered points (1-17) connected by a blue line. A detailed popup window is open for point 1, 'Yoshida Marry', showing a photo of a dog and associated metadata.

**Map Interface:**

- Search bar: "Business name or category ..." and "Address, location, or landmark"
- Navigation: "view collection", "welcome", "directions", "collections", "options", "share", "print"
- Map controls: "2D 3D", "Road", "Aerial", "Bird's eye", "Labels"

**Track Points:**

- 1. Yoshida Marry (Detailed popup)
- 2. 茶平ビル
- 3. 我孫子東第7住宅
- 4. あびこ病院
- 5. 野口川
- 6. 山田コホ
- 7. 茶平ビル
- 8. 梅山歯科
- 9. 室生会松井医院
- 10. ドキン
- 11. 我孫子町駅
- 12. 北谷医院
- 13. 我孫子南
- 14. 神光寺
- 15. 引接寺
- 16. 神光寺
- 17. 宮崎鍼灸院

**Yoshida Marry Popup:**

- Owner Name: Daisuke Yoshida
- Date: 2008-06-09
- Time: 17:47:48
- Tags: marry yoshida
- Photo from Flickr
- Buttons: "Add to collection", "Drive from here or Drive to here", "Zoom to: street | city | region"

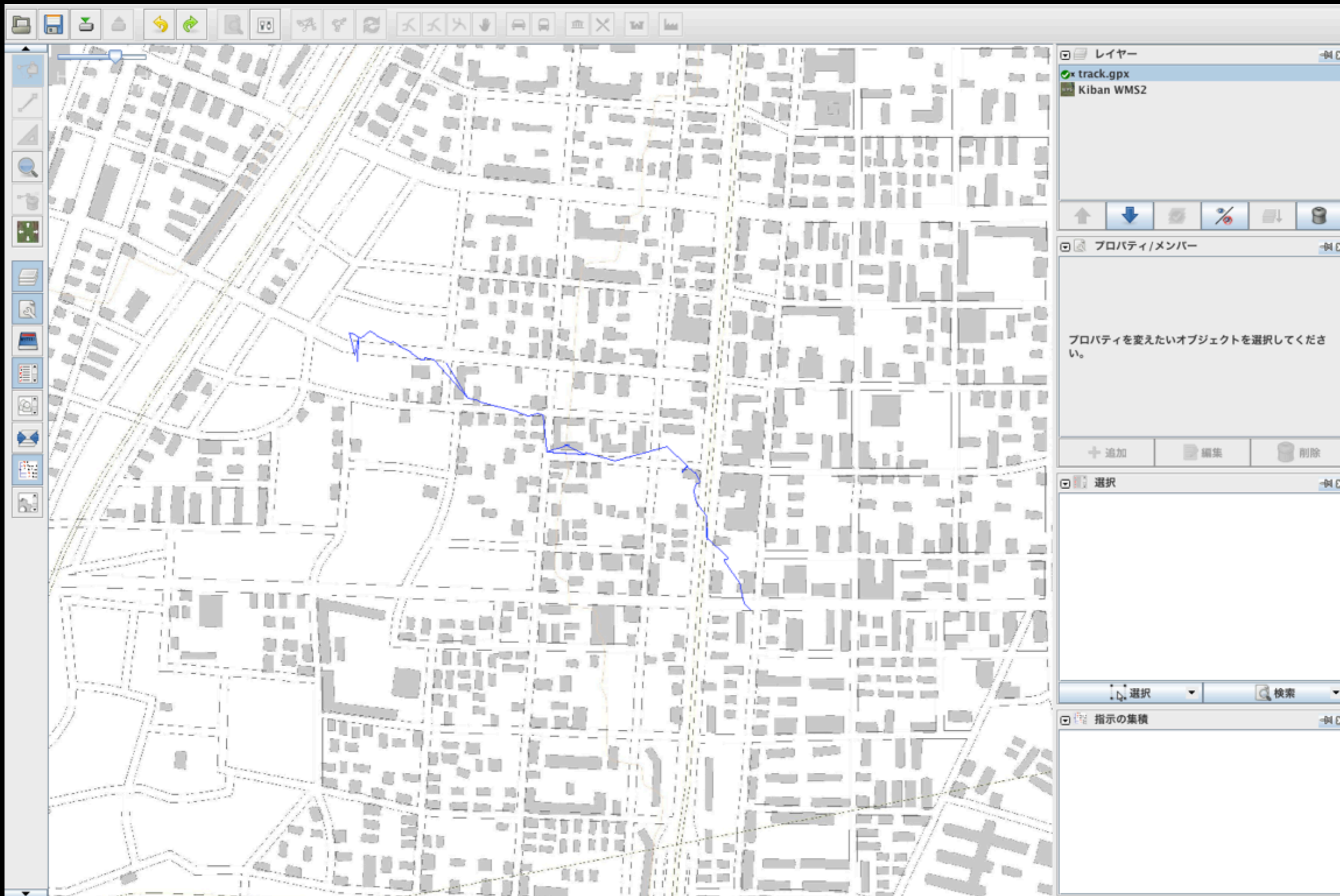
**Left Panel (Tour in 3D | Map all | Share):**

- Raw Data: Rating: ☆☆☆☆☆, Content from gisws.media.osaka-cu.ac.jp
- Raw Data 1: by Daisuke Yoshida, OCU, JAPAN, Length: 0.68 miles
- Yoshida Marry: Owner Name: Daisuke Yoshida, Date: 2008-06-09, Time: 17:47:48, Tags: marry yoshida, Photo from Flickr
- foss4g2009tokyo\_mambow\_v01: Owner Name: Daisuke Yoshida, Date: 2008-06-09, Time: 17:48:48, Tags: logo tokyo foss4g2009, Photo from Flickr
- foss4g2009osaka\_mambow\_v01: Owner Name: Daisuke Yoshida, Date: 2008-06-09, Time: 17:57:38, Tags: osaka foss4g2009, Photo from Flickr
- Yamanaka: Owner Name: Daisuke Yoshida, Date: 2008-06-09, Time: 18:00:47, Tags: beer soba, Photo from Flickr



# Exported as GPX

JOSM



# Summary

The track log management function provided an interactive interface for log management and **synchronizing POIs by Flickr API mashup**.

The GPS data enhancement has implemented **using quality filtering, line simplification and shortest path functions** and also provide these functions as **web services**.

The prototype provided **interoperable functionalities and data** between other geospatial applications through **open standards**.

The outcome contributes to various location-based data collection projects such as OpenStreetMap or other UGC services.

# Further Development

The processes in the prototype will be implemented as **OGC WPS**

Some parts are already done.

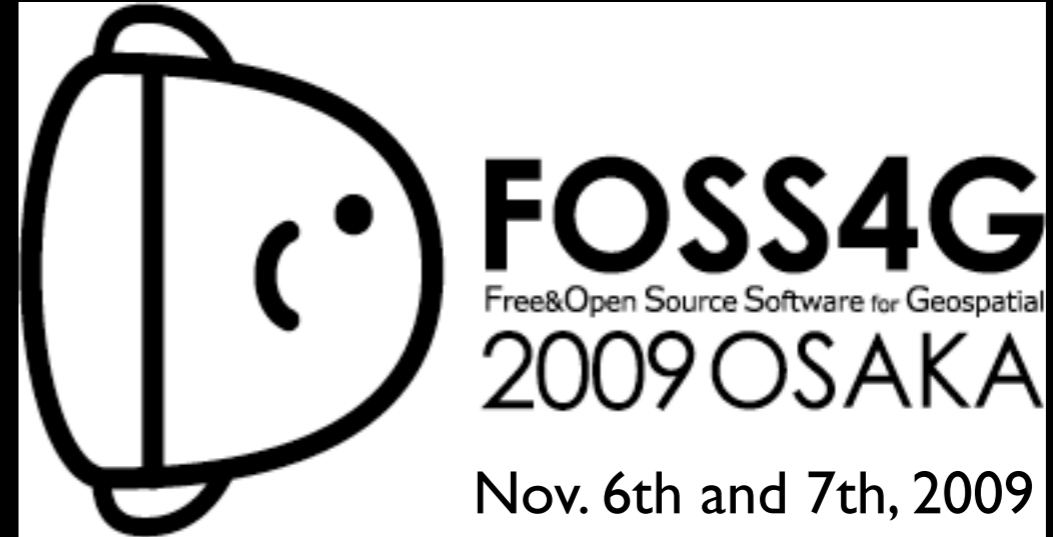
**Open web processing services for improving accuracy of GPS tracks using filtering and map-matching**

using **PyWPS**

will try with Open WPS platform **ZOO**

for **faster performance**

for **higher interoperability** with other GIS applications



**Thank you very much**

**m( \_ \_ )m**