

Design of Location Information Capturing Tools using Multiple-Sensors for Fieldwork

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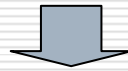
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Contents

- Introduction
 - Location information capturing tool
 - Measurement of distantly-positioned object
 - Prototype system
 - Discussion
 - Conclusion
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Introduction

- GPS devices are used widely



- Increasing location based services
(ex. navigation, tourist information etc.)

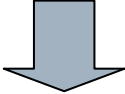


- Fieldwork by no exports use GPS
(ex. Marketing, history etc.)

[In this research]

- Development of support system for fieldwork by humanity
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Introduction

- Fieldworks by humanity researchers
 - measure the positions of objects
 - collect variable information such as photos, movies, voices, text memos and so on
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- Request of support fieldwork
 - collect and integrate the information at same time for analysis efficiently after the fieldwork
 - there are objects whose positions are not able to be measured only by GPS.
 - Objects in off-limits area
 - Objects in the house or building and so on

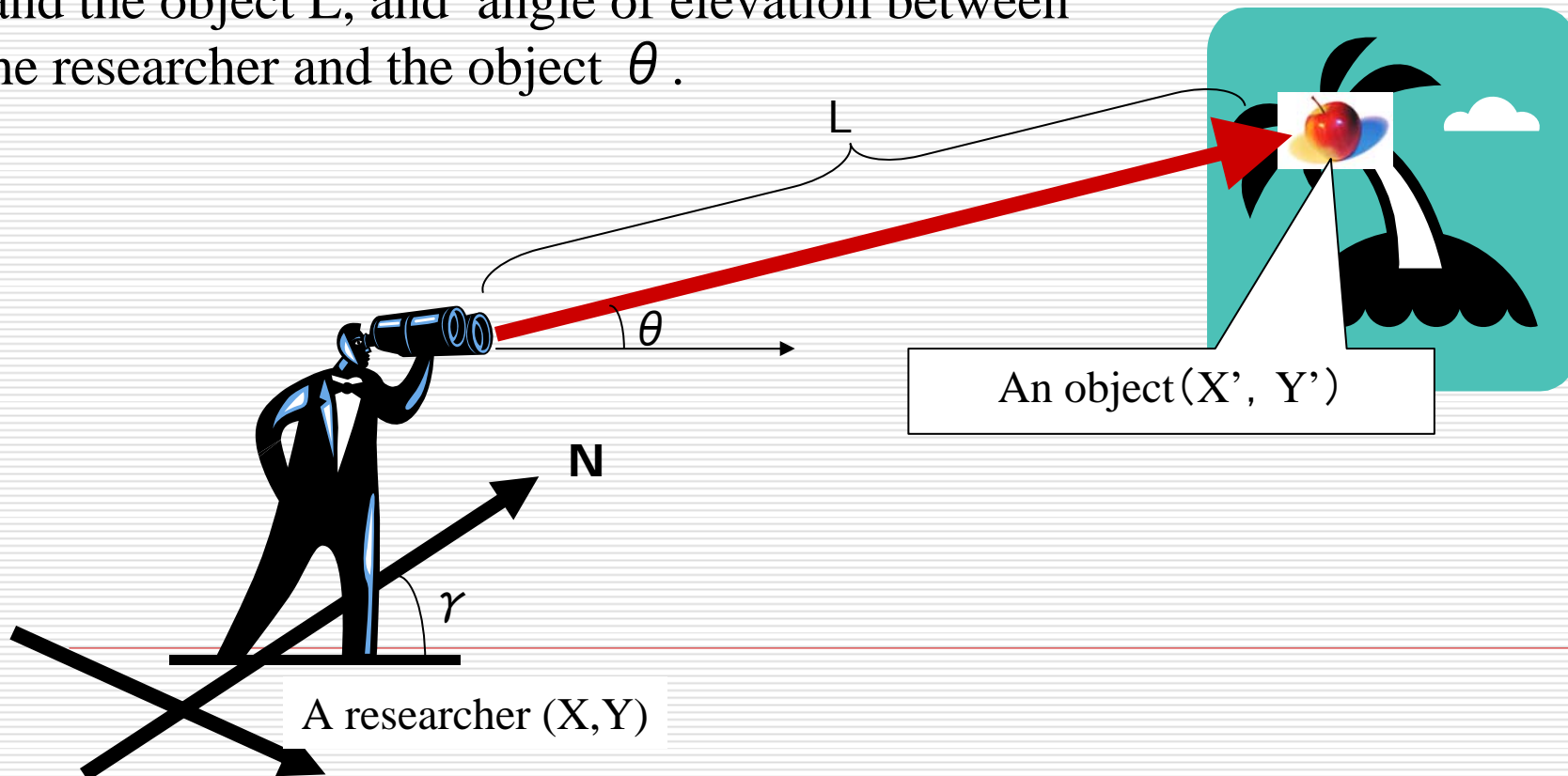
Location information capturing tool

- development of a location information capturing tool
 - integrate the data when the researcher captures it immediately
 - measure distantly-positioned objects.
 - A tablet PC is suitable device for fieldworks
 - × celler phone ··· small display, low extendibility
 - △ PDA ··· small display, middle extendibility
 - △ notebook PC ··· large display, height extendibility, low operability
 - tablet PC ··· large display, height extendibility, height operability
 - Measurement of distantly-positioned object
 - integrate data from sensors
 - a researcher can measure a object position by simple operation.
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Measurement of distantly-positioned object

[Problem]

Measurement of an object's position (X', Y') from a researcher's position (X, Y) , the researcher's direction γ , length between the researcher and the object L , and angle of elevation between the researcher and the object θ .



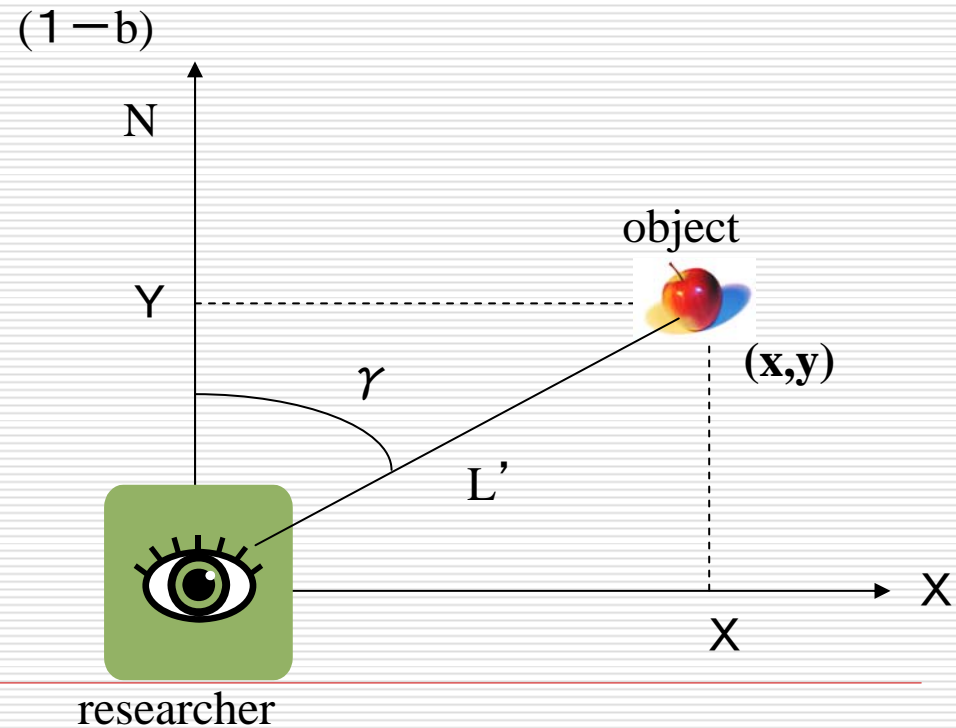
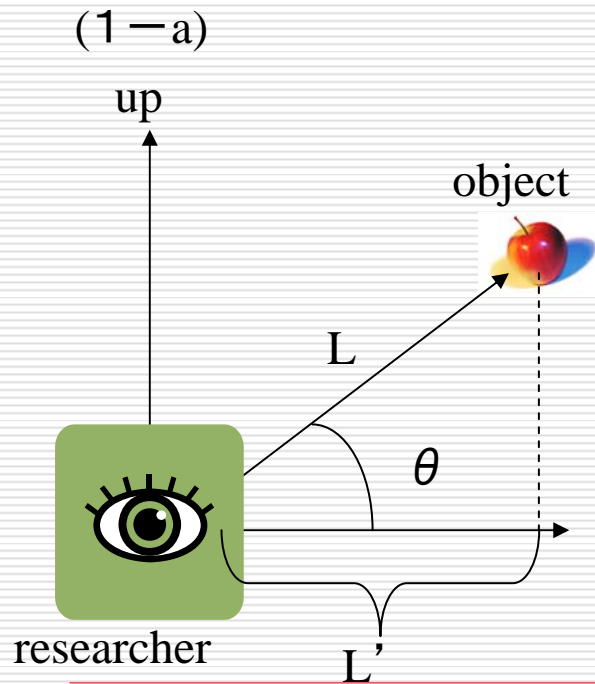
Measurement of distantly-positioned object (data capturing)

- The system uses the following sensors for computation of distantly-positioned object.
 - GPS ··· capturing a researcher's position
 - Digital compass (included in GPS) ··· capturing a researcher's direction
 - Measure ··· measurement length between a researcher and an object
 - Tilt sensor ··· an angle of elevation between a researcher and an object

Position data follows WGS-84 coordinate system

Step 1 (local position detection)

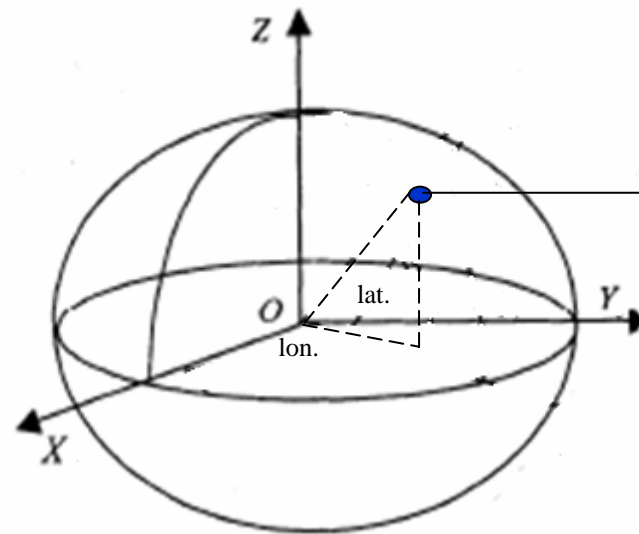
Compute an object's position on local coordinate system of which the origin is the researcher.



(local coordinate system)

Step 2 (transform from WGS-84 to ECEF)

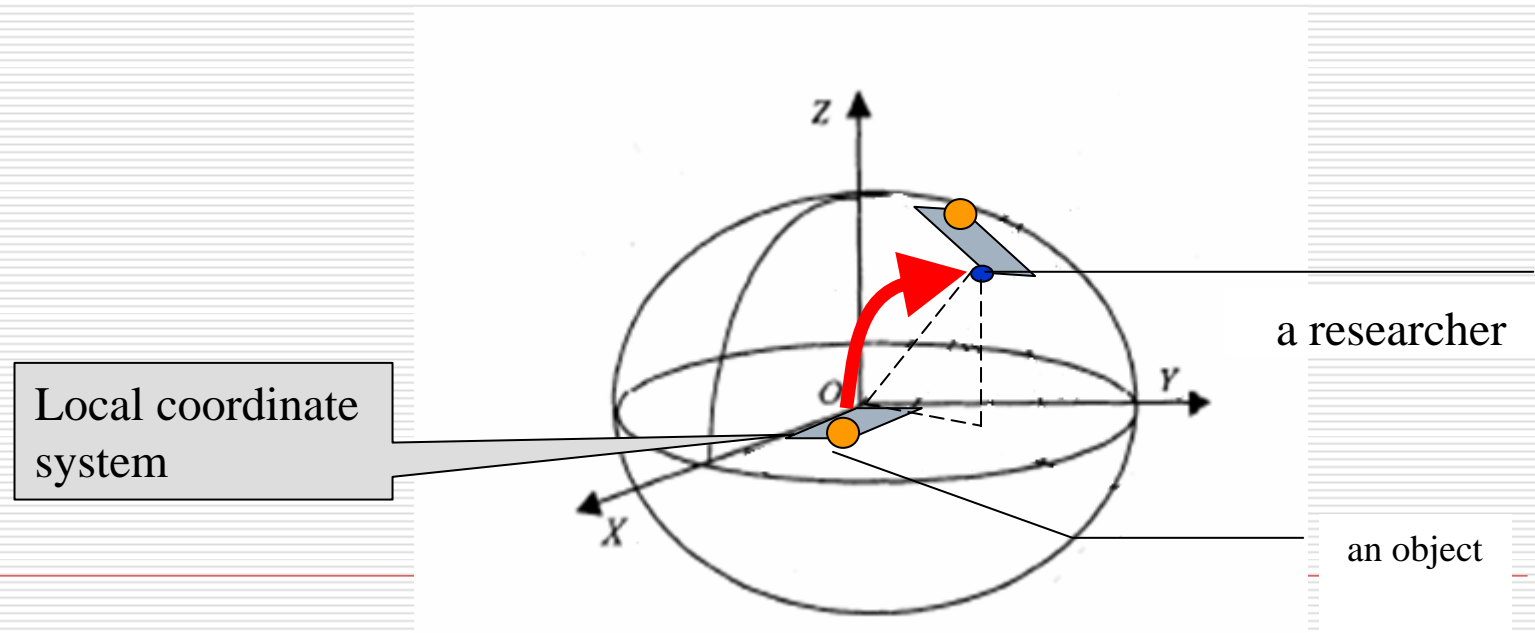
Transform a researcher's position from WGS-84 coordinate system to ECEF (Earth-Centered, Earth-Fixed) coordinate system.



a researcher
(lat., lon. \rightarrow x, y, z)

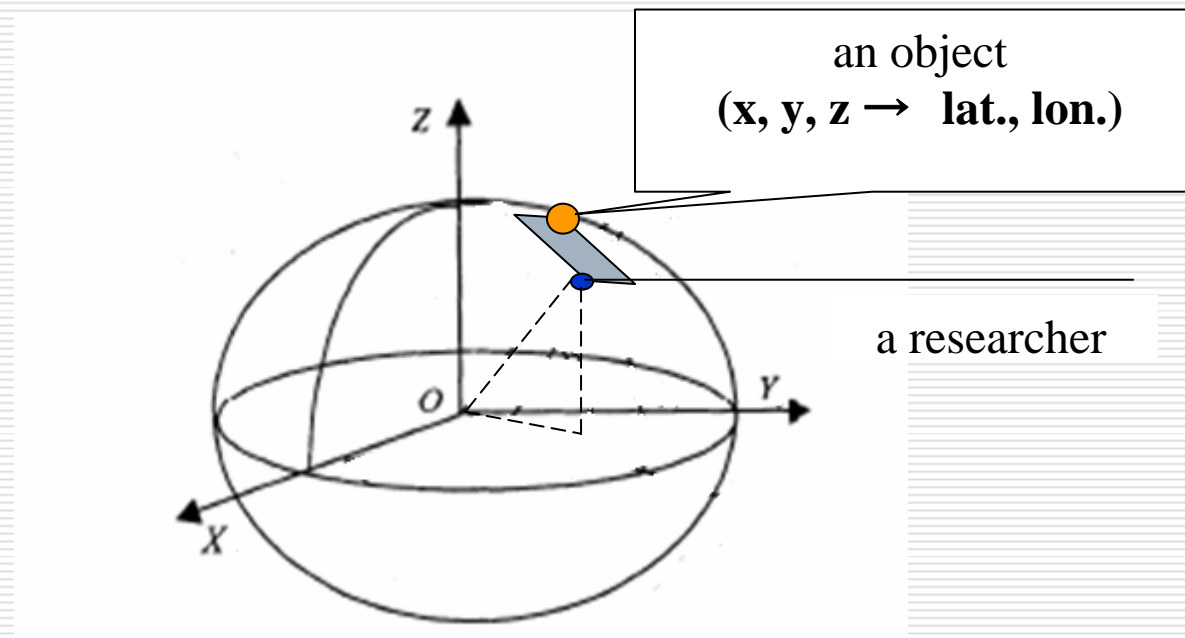
Step 3 (rotate origin of local coordinate system to researcher's position on ECEF)

- Translate the object's position from the local coordinate system to ECEF by rotation local coordinate system following the researcher's position.



Step 4 (Translate from ECEF to WGS-84)

Translate the object position from ECEF to WGS-84



Prototype System Outline (1)

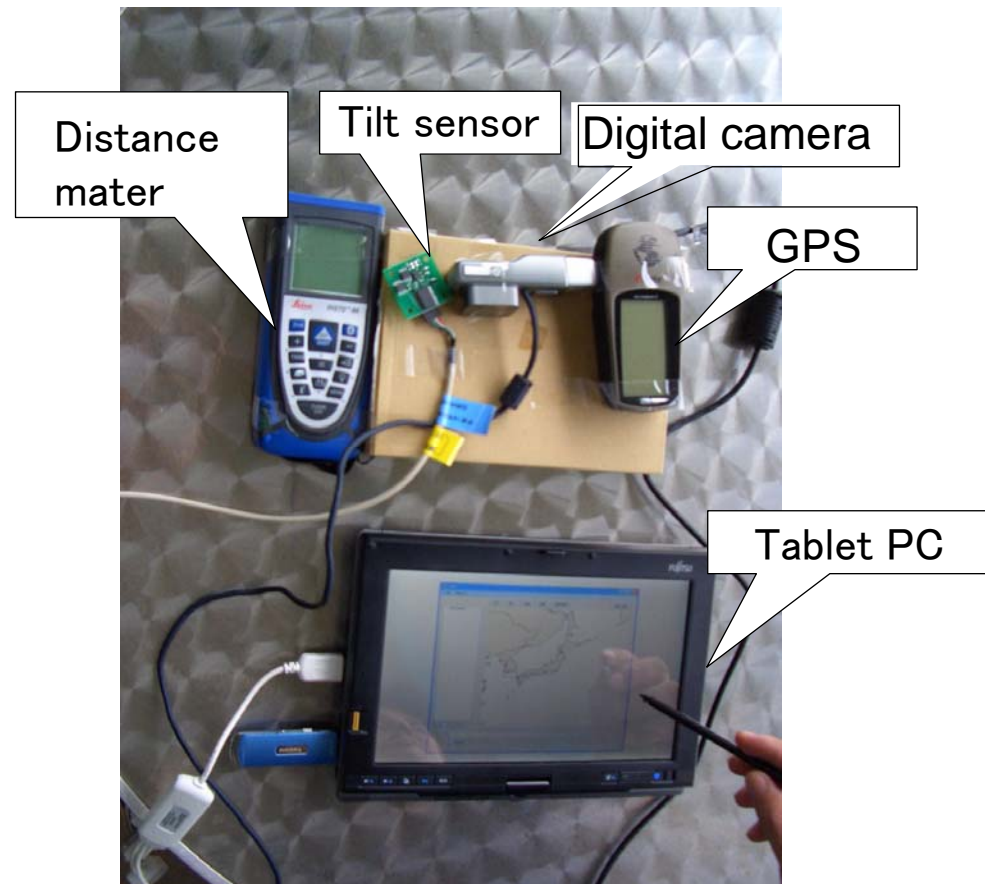
- Development Environment
 - Visual Basic.NET 2005
 - MapWindow GIS
 - WIA
 - WaveIO.dll
 - Sensor
 - GPS included digital compass ··· WGS-84, direction range ··· 1degree ~ 360 degree
 - Distance meter ··· 100m
 - Tilt sensor ··· ± 90.0 degree
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Prototype System Outline (2)

- Devices for supporting fieldwork on the proposed system
 - USB connected digital camera
 - microphone

 - A user capture information types in the system
 - image
 - comments by text or voice
 - position
 - moving logs
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Prototype system



Prototype system

- Function

- location information creation

- capturing an object's position for fieldworks

- data integration

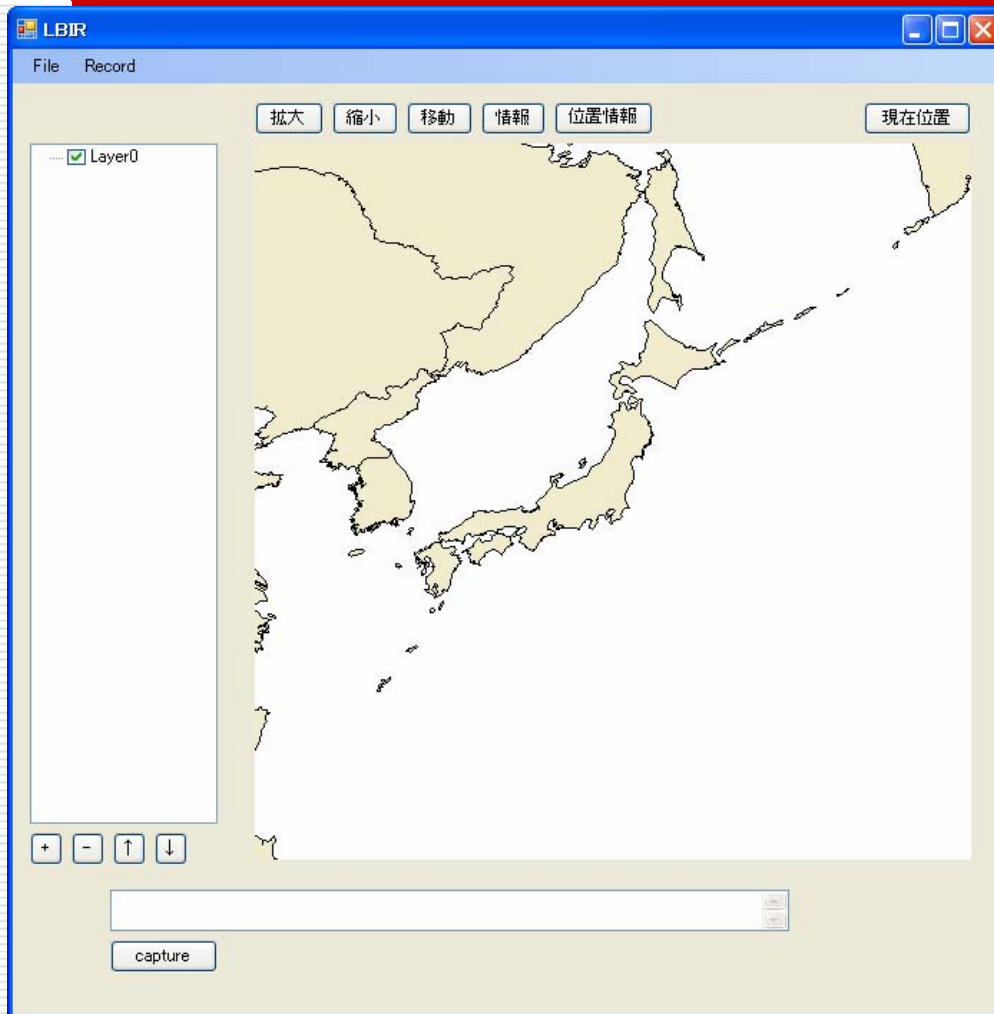
- recording moving log from GPS

- map operation

- browsing map

- browsing location information

Prototype system



Discussion

- the precision of the position measurement
 - depend on precision of the GPS
 - around 15m generally
- enough for the record of the approximate position of the building
- prototype system
 - enable location information capturing by easy operation
 - by real time plotting annotation on the map, the user can do simple analysis
- realize an effective fieldwork

Conclusion and Future works

Conclusion

- Development of prototype system for supporting fieldwork
 - Enable data integration by simple operation
 - Enable measurement of distantly-positioned object by multiple sensors

Future works

- Development of information sharing via the internet
 - Evaluate usability of this prototype
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Thank you.
