Delivering location-based services using GIS, WAP, and the Web: two applications

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Contents

• Introduction
• Mobile positioning
• Architecture of the system
• Application programming
• Applications 1 & 2
• Summary and future work
Introduction

- The Web has changed the way we work
- One of the main advantages of the Web: “universal access”
- Global System for Mobile Communications (GSM) → Mobile digital communications
- The GSM network can be used to establish the position of the user
Delivering location-based services using GIS, WAP, and the Web: two applications

Introduction

• Two WAP applications for mobile phones
• Provide location-based information to the user
• Geographical Information System (GIS)
  ➔ Geographical information to the user

Application 1: resource searcher and locator
  ➔ User can obtain information from the GIS

Application 2: data acquisition system
  ➔ User can obtain information or can also introduce information into the GIS.
Delivering location-based services using GIS, WAP, and the Web: two applications

Contents

• Introduction
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  • Application programming
  • Applications 1 & 2
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Mobile positioning

• The position of a mobile phone can be located using information from the GSM network
• When a call is established, the phone is connected to a base station
• The distance from the base station can be approximately calculated (Timing Advance)
Mobile positioning

- A cell is the basic unit of a mobile system → The area where the radio coverage is given by one base station
- A cell is represented simplified by a hexagon

Mobile phone
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Mobile positioning

• Timing Advance is a server-based solution that allows positioning services to be used with current mobile phones
• It is not possible to give a specific value for the accuracy, since it depends on several factors: the size of the cell, the kind of the cell, the distance to the base station, the topology, etc.
• Tens of meters … Hundreds of meters
Mobile positioning

• European Telecommunications Standard Institute (ETSI):
  – Time of Arrival (TOA)
  – Enhanced Observed Time Difference (E-OTD)
  – Assisted GPS (A-GPS)

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• Introduction
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Architecture of the system

• Ericsson’s Mobile Positioning System 3.0 (MPS 3.0): Timing Advance
• It can be used with current mobile phones with no further change

• The WAP Device (mobile client or mobile station)
• Connects to the wireless network by means of the Wireless Session Protocol (WSP)
Delivering location-based services using GIS, WAP, and the Web: two applications

- The WAP Proxy (Gateway) translates WAP requests to Web requests and vice versa.

Delivering location-based services using GIS, WAP, and the Web: two applications

- The WAP Proxy converts the WSP requests into HTTP requests and forwards them to Internet.
The WAP Proxy allows the WAP Device to submit requests to the Web server that hosts the Positioning Application.

• The Positioning Application requests the position of the WAP Device to the Mobile Positioning Centre by means of Mobile Positioning Protocol (MPP).
The Positioning Application uses the position of the WAP Device to query the GIS database and provide localized services.
Application programming

• Client/server model
• Server:
  – ASP → Personal Web Server or Internet Information Server
  – Visual Basic Script
  – Access database

Application programming

• Client:
  – Application → WAP device:
    • Wireless Markup Language (WML)
    • The correct operation of the application has been proven with different mobile phones: Nokia, Ericsson, Phone.com WAP browser, etc.
  – Administrative tool → Web browser:
    • HyperText Markup Language (HTML)
    • JavaScript
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Application programming

• Narrow bandwidth → Transmission of GIS files is time-consuming
• Limited display → Geographical images can be hardly showed
• Applications provide geographical information based on text

Application programming

• Ericsson Mobile Positioning System Software Development Kit 3.0 (MPS SDK 3.0):
  – MPC Emulator: positioning server that accepts MPP requests and emulates positioning answer
  – MPC Map Tool: mobile network building tool
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- The PA sends a POST request to the MPC
- The message body of the request includes an XML formatted request

Application programming

```xml
<?xml version="1.0" encoding="ISO-8859-1" standalone="yes"?>
<REQ ver="3.00">
  <CLIENT><ID>TheUser</ID><PWD>ThePassword</PWD></CLIENT>
  <LIR>
    <GEO_INFO>
      <COORD_SYS>LL</COORD_SYS>
      <DATUM>WGS-84</DATUM>
      <FORMAT>IDMS0</FORMAT>
    </GEO_INFO>
    <MSIDS><MSID>461011334411</MSID></MSIDS>
  </LIR></REQ>
```

Latitude and longitude

Geodetic datum

Mobile Station

Direction indicator, degrees, minutes, seconds, and precision
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- The MPC responds with either an error message or with the position of the WAP Device
- The PA uses the answer to query a GIS database

Application programming

```xml
<?xml version="1.0" encoding="ISO-8859-1" standalone="yes"?>
<ANS ver="3.00">
  <LIA><GMT_OFF>+0100</GMT_OFF>
  <POS msid="461011334411">
    <PD><TIME>20020128090000</TIME><ARC>
      <LL_POINT>
        <LAT>N391628.3</LAT>
        <LONG>E010001.5</LONG>
      </LL_POINT>
      <IN_RAD>1200</IN_RAD>
      <OUT_RAD>1500</OUT_RAD>
      <START_ANGLE>120</START_ANGLE>
      <STOP_ANGLE>180</STOP_ANGLE>
    </ARC></PD></POS></LIA></ANS>
```
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Application 1

• Resource searcher and locator
• The user can locate the nearest resource (gas station, theatre, etc.) to his/her position
• It is not necessary to know the exact position (latitude and longitude coordinates)
Delivering location-based services using GIS, WAP, and the Web: two applications

Application 1

Where is...?

[Products]
[Search product]
[Categories]
[Search category]

Select the product you want to search:
1 CD (2)
2 CD-ROM (2)
3 Computer (2)
4 CPU (3)

OK Menu

[Search by name]
[Select city]
[Select street]
[Help]

Where is...?

[Order by distance]
Select the company:
1 Big Mall
2 Kump Computers

OK Menu

Application 1

[Order by name]
Select the company:
1 Big Mall (0)
2 Kump Computers (2)

By name

contact@bigmall.com
[wap.bigmall.com]
[Description]
[Products]
[Categories]
[How to get]

Big Mall
Address: Oak Road 2
03001 Alicante
Telephone: 999112233
Fax: 999223344
Email:

Call Menu

Big Mall is about 570 meters
Go along the following streets:
* Sabina
* Oak Road

Main Menu
Delivering location-based services using GIS, WAP, and the Web: two applications

Application 2

- Data acquisition system → The user can introduce information into the GIS
- The application is oriented to gather data about agriculture: terrain quality, plants that grow, etc.
Delivering location-based services using GIS, WAP, and the Web: two applications

Application 2

A.D.A.

View position

View position: [C]

W40°30'10" (Lat)
W80°01'12" (Lon)

Position

Nearest Menu

Current values

Owner: John Doe
Terrain: Rich soil
Plant: Wheat
Height of plant: 0.3
Size of grain: 0.001

OK Menu

Select plant:
1 Barley
2 Corn
3 Rice
4 Sunflower
5 Wheat

OK

New inputs - Microsoft Internet Explorer

Main menu New inputs Back

<table>
<thead>
<tr>
<th>D&amp;T</th>
<th>Position</th>
<th>Owner</th>
<th>Terrain</th>
<th>Plant</th>
<th>H&amp;S</th>
<th>Notes</th>
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</thead>
<tbody>
<tr>
<td>15/08/2001 11:23</td>
<td>Flat valley</td>
<td>R. Smith</td>
<td>Soil</td>
<td>Corn</td>
<td>0.02</td>
<td>Contaminated</td>
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<tr>
<td>15/08/2001 17:35</td>
<td>C 14890472</td>
<td>John Doe</td>
<td>Rich soil</td>
<td>Wheat</td>
<td>0.3</td>
<td>Frozen soil</td>
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<td>C 14890472</td>
<td>Bill Doors</td>
<td>Rocky</td>
<td>-</td>
<td>-</td>
<td>Bunt</td>
</tr>
</tbody>
</table>
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Summary

• WAP → The de facto standard for wireless applications
• Two WAP applications → Mobile positioning system → Location-based services
• Information can flow two ways:
  – GIS database → User
  – User → GIS database
• Standard technology
Future work

- New applications: news, weather and traffic reports, recommendation systems, etc.
- Generate dynamic images that represent maps from GIS database