Use of Open Source Programs to Create a Foundation for Developing Serious GIS Application on Mobile Device

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Underlying Concepts and Technology

- OpenGIS simple features specifications for SQL
- SQL geometry type hierarchy proposed by OGC
- Spatial data representation formats: WKT and WKB
- Spatial metadata (2 spatial DB tables)
  - SPATIAL_REF_SYS
  - GEOMETRY_COLUMNS
- Open source DBMS supporting geospatial data
  - PostgreSQL + PostGIS
  - MySQL Spatial Extension
  - SQLite + SpatiaLite

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Building a Mobile GIS Software Foundation

- Target device: Windows Mobile 5 or above
- Compiling environment: Microsoft Visual Studio 2008
- Open source projects involved: SpatiaLite, SQLite, PROJ4, GEOS, libiconv, and WCELIBCEX
- Compilation output: 6 binary DLLs (WMcharset-1.2.dll, WMgeos_c-3.1.0.dll, WMiconv-1.9.2.dll, WMproj-4.6.1.dll, WMspatialte-2.3.0.dll, and WMsqlite-3.6.13.dll)

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Building a Mobile GIS Software Foundation (cont'd)

- Problems encountered
  - Original source of open source projects are targeted for Linux and Microsoft Windows OS
  - Diversified programming languages, such as C, C++, Java
  - Adaptation of original source programs to Windows Mobile environment
  - Working out the project dependency order

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Mobile Device HW and SW Configurations

Figure 1 – CPU type and memory size

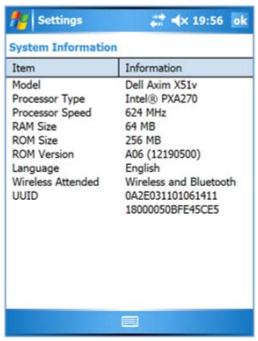

Figure 2 – Mobile device system information

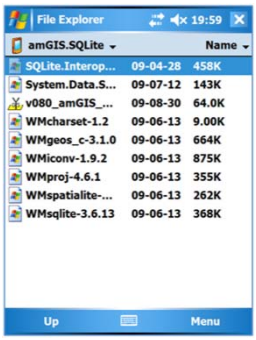

Figure 3 – Show the executable file and its dependencies

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Geospatial Operations Test

- Test Part A
  - Common geospatial operation capability test
  - Altogether 24 spatial operations have been tested, such as IsValid, IsSimple, IsRing, PointOnSurface, Contains, etc.
- Test Part B
  - Common geospatial analysis functions test
  - For example, simple spatial searches such as select record by clicking on graphic screen or on data grid
- Test Part C
  - Advanced geospatial analysis functions test
  - Complex geospatial analysis functions such as point-in-polygon test, polygon-in-polygon test, point/polygon overlay, and polygon/polygon overlay

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General Spatial Relationship Operators Test – Part A

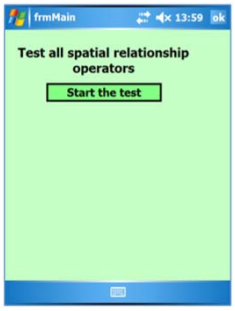

Figure 4 – Click "Start the test" button to run all pre-defined spatial operations

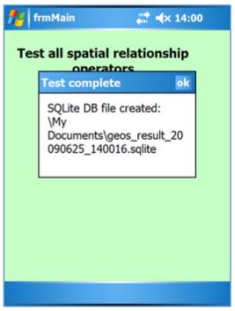

Figure 5 – Test results are stored in a spatial database file as shown

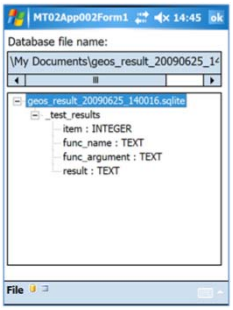

Figure 6 – Database information of the newly created DB file

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Common Geospatial Analysis Functions Test – Part B

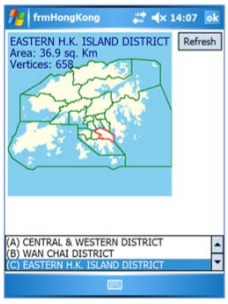

Figure 7 – District boundary is highlighted in red color when tapping anywhere within Eastern HK Island

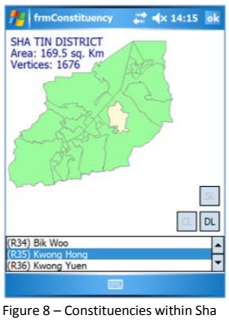

Figure 8 – Constituencies within Sha Tin District are shown

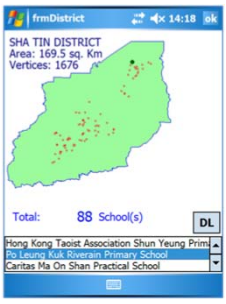

Figure 9 – The selected school is highlighted in green color in the map

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Advanced Geospatial Analysis Functions Test – Part C

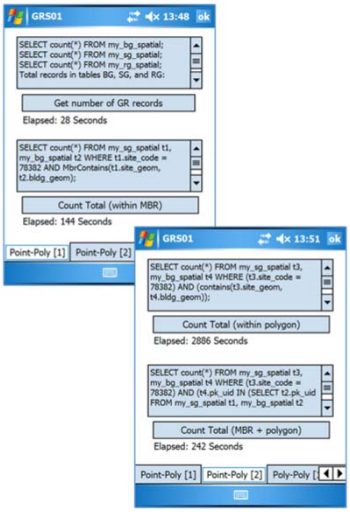

Figure 10 – Time spent to perform set of point-in-polygon search

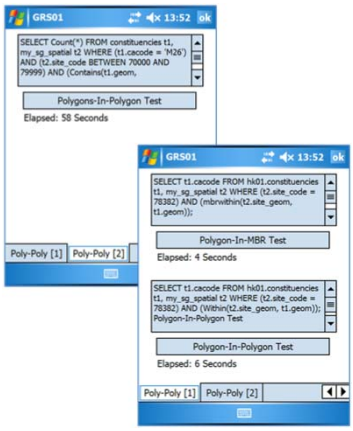

Figure 11 – Time spent to perform set of polygon-in-polygon search

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Analysis of Test Results

- Test Part A
  - 24 basic spatial operations have been conducted and finished successfully
- Test Part B
  - Part B test result illustrated no problem to retrieve attributes of geospatial data from a standard RDBMS via different means of interaction
- Test Part C
  - Part C test result reflected complex geospatial analysis operations can be handled and performed in mobile devices

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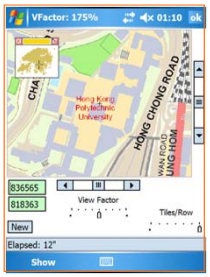
Example Mobile Application Using libMobileGIS Components – amGIS.Viewer.SA

- Aimed to serve seamless base map data and geometry from the underlying local RDBMS on mobile devices
- Provided with functions such as pan/zoom for viewing both descriptive and graphic output of geometry on top of base map data



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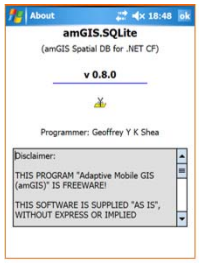
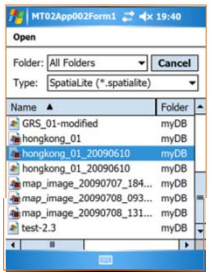
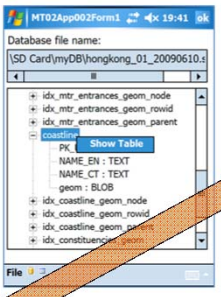
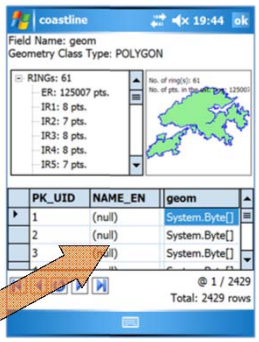
Example Mobile Application Using libMobileGIS Components – amGIS.SQLite









Attributes of the selected polygon feature are shown (more than 120,000 points)

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Example Mobile Application Using libMobileGIS Components – amGIS.SQLite

- Aimed to serve as generic geospatial data editor on mobile devices
- Provided with functions for viewing table definition and geometry record in descriptive and graphic output
- Able to navigate record-by-record, page-by-page, go to the beginning/end of database

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Conclusions

- A mobile GIS software foundation, *libMobileGIS*, is produced and functioned as design
- Complex geospatial analysis functions and operations are available on mobile devices via *libMobileGIS*
- Handling of geospatial data on mobile device with open source RDBMS is functioning comparable with its desktop counterparts

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Acknowledgements

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Thank you!

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References

OGC, 2006. OpenGIS Implementation Specification for Geographic information – Simple feature access – Part 2: SQL option.

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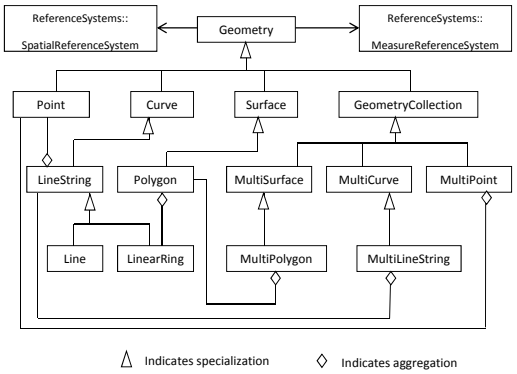
SQL Geometry Type Hierarchy



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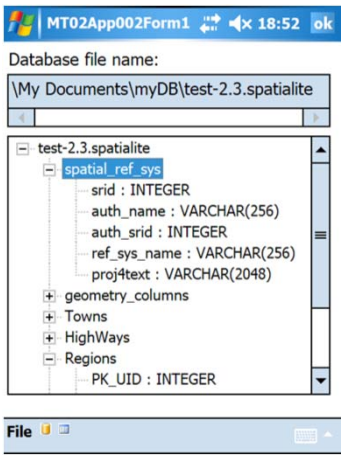
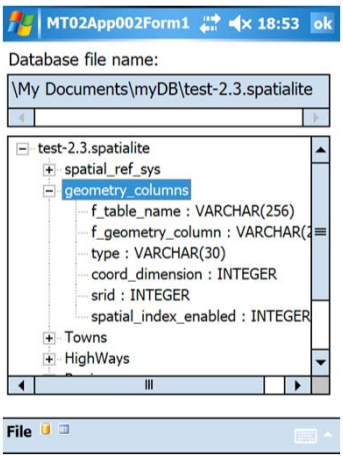
Spatial Matadata





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