# Development of a server to manage a customised local version of OpenStreetMap in Ireland

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## 1. Introduction

In this paper we describe the software architecture of a prototype web-based GIS system for the deliver environmental research data in Ireland.  The central component in this system is OpenStreetMap which provides the base layers of geographical data. An OpenStreetMap data collection campaign for our university town was carried out earlier this year yieldeding a spatially rich OpenStreetMap representation of Maynooth. Our server (OpenStreetMap database, supporting software, and specially generated map tiles) has been used by several GIS and location-based services projects in our department. One such example is a mobile device-based pedestrian navigation system is described in this paper. We describe some of the components of our server system. This includes a description of the management of the local copy of the OpenStreetMap database and the generation of sets of customised map tiles.

## 2. Choosing OpenStreetMap for this project.

One of the initial specifications of this research project was the development of a GIS data server. All software on the server must be free and open source software. A key function of the GIS server will be the provision of Web Map Services (WMS) and Location-based Services (LBS) for environmental research data in Ireland. The server must be capable of delivering different types of maps for different types of environmental data and information. This free and open source specification provided this project with the opportunity to with OpenStreetMap. At the beginning of this project we decided to become fully immersed in the 'world' of OpenStreetMap and volunteered geographic information (Haklay and Weber, 2008). We undertook an extensive OpenStreetMap mapping campaign of Maynooth. This involved mapping almost every geospatial feature in the locality: from university buildings, to housing estates, to public services, to traffic lights, to cemeteries. As data collection was underway other projects in our department began using the data. This showed us that the application of OpenStreetMap in our university would extend beyond our project. All data from this mapping campaign is now part of the OpenStreetMap dataset available to the whole world. Minor edits and additions are performed regularly, often on a weekly basis, from our research team. A new quality checked version of the entire OpenStreetMap database for Ireland is downloaded automatically every week and our local OpenStreetMap database is subsequently updated.  In the next sections we describe the generation of sets of location specific map tiles for presenting environmental research data and information. As updates occur to our local OpenStreetMap database the sets of map tiles are regenerated as necessary.

## 3. Server Setup and Configuration
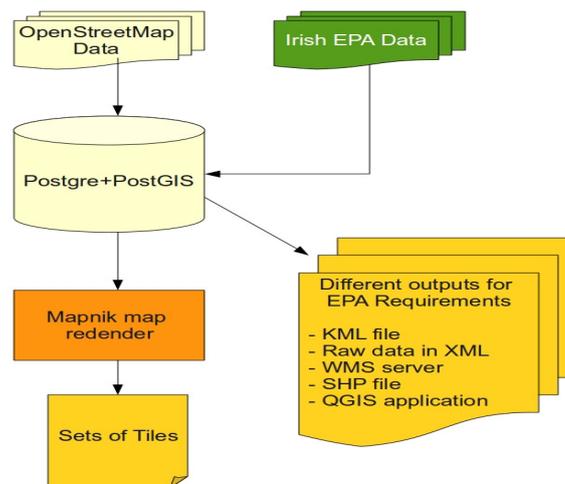


*Figure 1. Flowchart showing all software components of our server system*

Figure 1 shows a flow chart of the principal software components of our server system. Environmental data and information from the Environmental Protection Agency research is mostly in spreadsheets and database formats. Several PHP converter scripts have developed to import these data into the PostGIS database holding the OpenStreetMap data. Point based data was inserted into the OpenStreetMap point feature table while polygon data was inserted into the OpenStreetMap polygon tables. Mapnik software is used to generate sets of map tiles from the OpenStreetMap data. Using the GDAL ogr2ogr tool we can generate KML files and ESRI Shapefiles easily from the PostGIS database. Spatial output can be generated from entire tables within the database or as output from specific spatial queries specified in PostGIS SQL. From our local network we could provide access to members of our research team to access the local OpenStreetMap PostGIS database using QGIS. TileCache software is used to provide a Web Map Service (WMS) for access to the sets of map tiles.

## 4. Generation of customised map tiles

In web-based GIS multiple layers of spatial information is usually presented by providing the user with a mapping base layer and a set of layers which can be "switched on and off" over the base map layer (Ciepłuch et al, 2009). This works well for many applications but can become unwieldy when there are a very large number of optional layers. This can also be awkward for users of web-based GIS applications on mobile devices. To present the results of environmental research in Ireland it was decided to generate sets of map tiles which embedded the environmental information and data into the map tiles to combine several layers into a single layer. For each set of map tiles certain map features were omitted, included, or had their cartographic representation customised depending on the environmental datasets. For example: for water related projects water features are emphasised on the maps while features such as roads, railways, etc. are removed or customised. The Mapnik (2009) application is used to generate sets of map tiles from PostGIS databases holding OpenStreetMap data. A key component of Mapnik is the XML file called the Mapnik stylesheet. In this configuration file are the rules for generation of tiles – what types of icon should represent point features, through what range of map scale should a certain feature be rendered, etc Rules are expressed in XML for any feature that is rendered on the tile and is represented in the database. Figure 2 shows an example of a rule from the Mapnik stylesheet where any polygons representing 'places of worship' are rendered in different colours depending on the zoom level the tile is requested at.

```
<Rule>
  <Filter>[amenity] = 'place_of_worship'</Filter>
  &maxscale_zoom10;
  &minscale_zoom14;
  <PolygonSymbolizer>
     <CssParameter name="fill">#777</CssParameter>
     <CssParameter name="fill-opacity">0.5</CssParameter>
  </PolygonSymbolizer>
</Rule>
<Rule>
  <Filter>[amenity] = 'place_of_worship'</Filter>
  &maxscale_zoom15;
  <PolygonSymbolizer>
     <CssParameter name="fill">#777</CssParameter>
     <CssParameter name="fill-opacity">0.5</CssParameter>
  </PolygonSymbolizer>
  <LineSymbolizer>
    <CssParameter name="stroke">#111</CssParameter>
    <CssParameter name="stroke-width">0.3</CssParameter>
  </LineSymbolizer>
</Rule>
```

*Figure 2. A Mapnik style file rule controlling the rendering of places of worship at different zoom levels*

Figure 3 provides an example of where the customisation of the local version of the OpenStreetMap database and generation of customised map tiles. This set of map tiles show all map features in the Irish language. Irish is an official working language in Ireland and distribution of some information must be provided in both English and Irish. During the data collection campaign the Irish names of streets, buildings, etc were collected and assigned to their corresponding features in the OpenStreetMap database. The Mapnik stylefile is adapted to include a rule to ensure that only the "name:ga" attribute was used to render the text names of buildings, streets, areas, etc. To our knowledge this is one of the first examples of a fully Irish only web-based map.
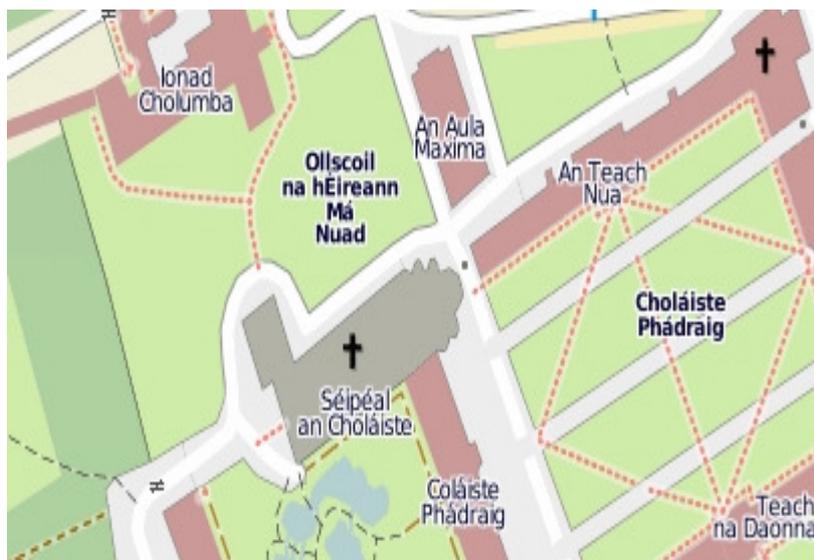


*Figure 3 OpenStreetMap for Maynooth showing Irish names for place names*

## 4. Accessing the customised map tiles

The sets of tiles generated by Mapnik are stored in different folders on the server hardisk. Tilecache is used to serve out these tiles to users who request them. To demonstrate the end-to-end functionality of the server: from input data, to customised tiles, to user interface we have built a web interface to the server. This is shown in Figure 4. Using the JavaScript library Open Layers the client can use the local tiles from our server but also access Web Map Services (WMS) from other remote locations. Two OpenStreetMap databases are available: our local version and the globally accessible OpenStreetMap database for Ireland. In Figure 4 the interface is shown where the user can click on the web-based map. All features matching their search criteria are returned and highlighted on the map. In the case of this example all places of worship are rendered red on the map if they lie within 200 meters of the map click location. The interface allows users to explore the spatial data in OpenStreetMap by providing a clickable map. Users can click on a location and explore the Point and Polygon features in the neighbourhood of the mouse click.
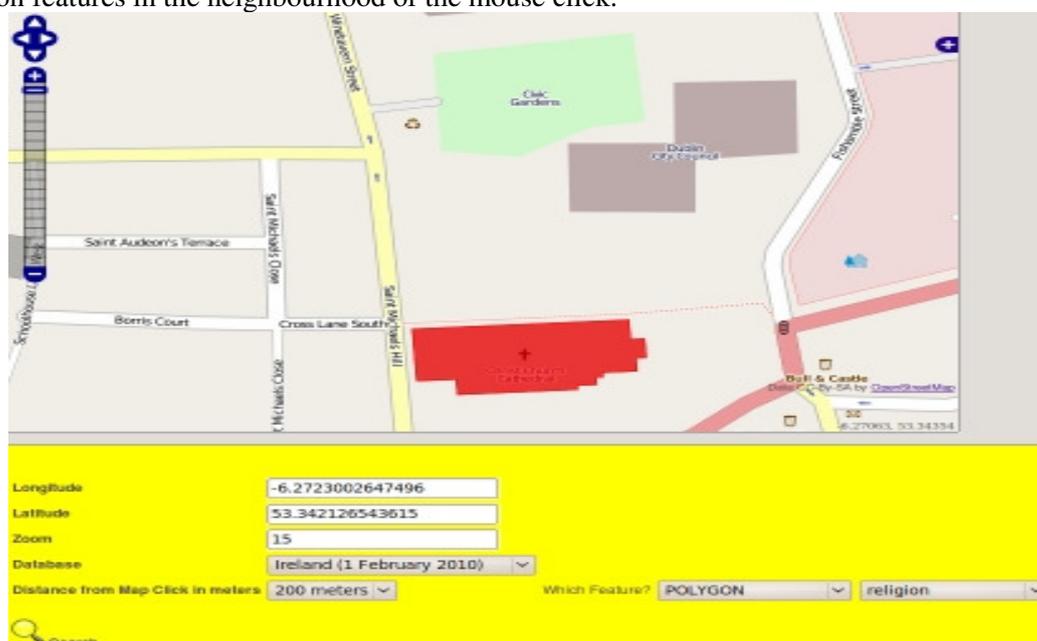


*Figure 4 A screenshot of the user interface to the server with customised tiles*

## 5. Applications using the local OpenStreetMap server

As mentioned above other projects in our department have begun to access the OpenStreetMap database and map tiles from our local server. Access to the PostGIS database and map tiles from applications residing on the same server or in the same network provides quicker query response time, better slippy map performance, and less overall network latency. One of the application using the server described in this paper is a Location-Based Service (LBS) for pedestrian navigation in the Maynooth university campus and Maynooth town. A special set of map tiles are generated which use darker colours for feature rendering which makes it easier for most mobile phone users to read when they are in bright environments. The local OpenStreetMap database is queried for spatial attribute information to supplement shortest paths generated specifically for pedestrians. Spatial attribute information include: Irish language placenames, historical information, and postal address details. Figure 5 shows a screenshot of a mobile device accessing the local server with OpenStreetMap database access and customised local tiles.

*Figure 5. Mobile client using both the local tiles and OpenStreetMap database*

## 5. Conclusion

The paper describes work that is very much in progress. There is an incorrect perception that the setup and configuration of a customised OpenStreetMap data and tile server is a very difficult task. Any perceived difficulties in setup and configuration are offset by the advantages of having a very spatially rich database of geographical information for our locality available on a GIS server system. The next milestone is to prepare sets of tiles based on the likely profiles of potential users of environmental research data and information. This will involve generating tiles holding a common environmental theme but are different for urban and rural areas due to different perceptions of the environment from citizens living in these areas. We are commencing research into inclusion of vernacular geographies into our local version of OpenStreetMap to include the local names of streets, buildings, and other geographical features different to those appearing in official gazetteers.

## Acknowledgements

## References

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## Biography

*Błażej Ciepłuch is a 2nd year PhD student in Computer Science. He obtained an MSc in Computer Science from Poznań Technical University in Poland in 2006. Dr. Jianghua Zheng is researcher in pedestrian navigation project. Dr. Peter Mooney is Błażej's PhD supervisor and is an environmental research data manager with the Irish EPA. Dr. Adam Winstanley is head of the Computer Science Department at NUIM and is a CO-PI of the LBS Strand of the STRAT-AG project.*