Open Source & Open Standards drive R&D

Nottingham University's Centre for Geospatial Science spearheads a new generation of healthcare-related applications. Peter FitzGibbon reports.

Located at the heart of Nottingham University's futuristic campus is the Centre for Geospatial Science (CGS), opened in 2005 and a springboard for innovation in Open Source tools and techniques (www.nottingham.ac.uk/cgs). No less than David Schell, chair of the Open Geospatial Consortium[1], is a visiting professor, and the Centre's director, Professor Mike Jackson, is a non-executive director of the same global interoperability organisation.

Perhaps unsurprisingly, the Open Source Geospatial Lab within CGS quickly made a name for itself by masterminding OSGeo activities in Britain[2] and by hosting the OSGIS UK conference series.[3] Building on this foundation, Lab founder Dr. Suchith Anand now co-ordinates a variety of open software developments, not least in support of healthcare provision. "It's a key multidisciplinary strand of our work and one where we actively collaborate with other Faculties and external agencies to gain critical mass" says Anand, an Ordnance Survey Research Fellow with a background in cartographic and attribute generalisation.

Working alongside Anand is Dr. Didier Leibovici, a CGS Research Fellow in spatio-temporal modelling and analysis with a special interest in public healthcare applications. It is, he says, a particularly fruitful area for Open Source development, adding, "Healthcare decisions are invariably based on a variety of data – environmental, medical and crowd-sourced, for instance – and the ability to link and build those data into a coherent picture is fundamental to good decision-making."

One such development is a smartphone 'symptom checker' for members of the public who may be suffering or fearing contagious diseases such as gastroenteritis. Originally proposed in an MSc. dissertation, the Lab has been working over the past year with the University's Department of Health Science and the Health Protection Agency (HPA) in Nottingham to prototype an html 5 browser-based application of an existing HPA paper questionnaire.

This approach (Fig. 2) captures a user's response in real time, stamps it with GPS coordinates, forwards it to a central database for evaluation and epidemiological mapping, and relays self-care guidance back to the user. An important aspect of this guidance is cartographic representation of a disease outbreak as it not only informs those at-risk but also encourages them to adjust their behaviour to reduce risk.

Issues surrounding the confidentiality of personal data loom large in extending this web-based tool for widespread use in disease surveillance. Here, the Lab acknowledges concerns and recommends extending OGC's web services standards (WPS, WFS, WCS) to allow access to fine granularity data at the computational level (blind access) but for the results to be output at a coarser scale via an upscaling (generalisation) process that is governed by a GeoXACML-based access rights routine[4].

The work of the Lab is very much technical and methodological, but Leibovici believes its dynamic location-based framework can be applied to any disease anywhere in the world and implemented along the lines adopted by existing services such as www.healthmap.org. "And while mapping is at its heart, there's no reason why it can't be extended to integrate air quality, weather and other remotely-sensed data depending on the needs of epidemiologists," he suggests.

Fig. 1: Suchith Anand (left) and Didier Leibovici (right) are evolving a range of healthcare-related applications that exploit Open tools and standards

Mashups

Geospatial "mashups" are now easily assembled from various data sources and semantics and have huge potential in disease mapping/clustering, environmental risk factor analysis, exposure analysis and epidemic modelling/forecasting. However, interpreting their results and reaching valid conclusions is not always so straightforward.

To ease this problem, The Lab is currently evolving a variety of mashup workflows[5] and tools based on statistical methodologies. Disease mapping and disease clustering mashups are particularly challenging due to the heterogeneity of the overall background populations and/or populations at risk (e.g. when needing to map the incidences of a disease that afflicts, say, only children under the age of five). Using the wrong population at risk or working without 'non case' data can easily lead to misleading results.

Here, the Lab has developed a generic approach that finds spatial associations between attributes of one or more populations or spatial features.[6,7] This can be implemented within a parallel computing environment and distributed network using OGC-compliant web services (i.e., WFS and WPS). The same methodology can be applied to other disciplines such as molecular epidemiology (where spatial variability of pathogens or strains can explain epidemic history or different risk factors), and ecology or biogeography (where species interaction can explain species distribution).

Opening eyes

Few would quibble with Anand when he says the move toward open source and open standards over the past five years has opened people's eyes to the economic benefits for society at large. "Even governments are now proactively supporting the open approach and appreciating its long-term potential," he notes. Leibovici agrees. "Healthcare is not alone in receiving that support, but with ever more costly public health programmes, the efficiency and low cost licensing associated with open software development is viewed as an increasingly attractive option."

This brings its own challenges, not least the need for individuals who have the required technical skills. "One of the key gaps in the market is how we can produce really good Open Source teaching material", says Anand. Lacking this, the gulf between what the GI industry seeks to recruit and what educational programs can supply threatens to widen further.

Here, as elsewhere, the CGS is working with other educators to meet needs. As an example, it has partnered with the GIS and Remote Sensing Centre (SIGTE) of the University of Girona and the EU Open Source Observatory's SEXTANTE Project to organise this year's GIS Open Source Summer School in Girona.[8]

Fig. 2: Prototype location-based smartphone application. Any browser-enabled smartphone can benefit from existing web GIS tools such as those developed by the Open Source community as long as the interface can be adapted to mobile devices

References

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