GIality – Geospatial Data for Augmented Reality

Crispin Hoult, Director, Linknode Ltd

Introduction

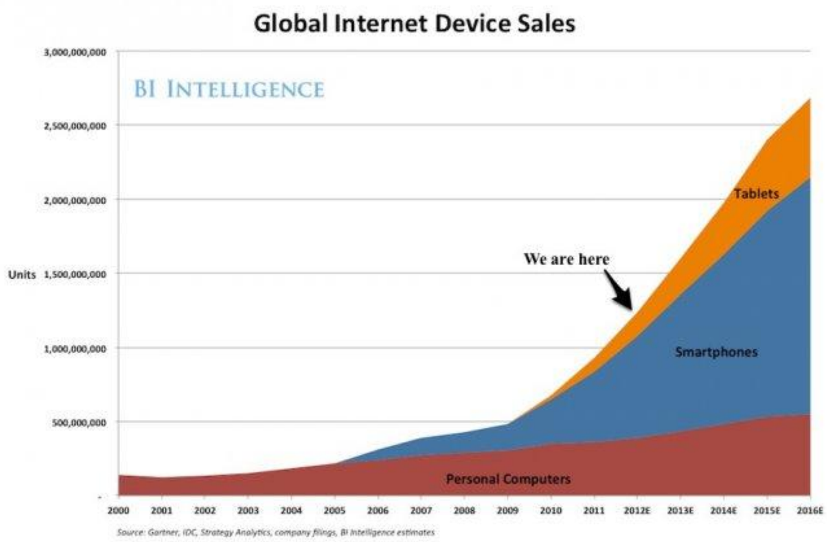
GIality is the convergence of geospatial data and augmented reality.
Augmented reality (AR) is the integration of real-world sensors (ie camera, location and orientation) with an overlay of imagery and data models, especially on a mobile device (usually used as a specific application).
This paper will discuss how, using the modern technology drivers of mobile phones and tablet computers, GIality can bring a new dimension to visualisation of geospatial data. Specifically, the sensor capabilities of such devices are discussed with examples of the requirements and processes to achieve levels of integration.
With the prevalence of mobile devices we will discuss how the opportunity for democratisation and personalisation of data is further empowering the citizen. A case-study will be presented of a theoretical planning application comparing a conventional "fixed" visualisation assessment with the new AR-based dynamic representation of place for unambiguous visual impact assessment.

The Power of Place

The Power of Place is defined by personalising and customising knowledge at a user's location. Location is not only "where am I" defined as a geospatial coordinate and "when you are" in time, but also "what am I looking at" as orientation and attitude.

The Growth of the Mobile Platform

Whilst the figures and statistics in this paper will be superseded in a short period of time there is no doubt that the mobile platform is the disruptive revolution in IT: smartphones replace feature phones, tablets replace netbooks, apps compete with applications, major industry players and start-ups trade values and hardware and ecosystems become a factor again in software design and development (although still with standards). The one certainty is that the change is not to be ignored but embraced – that the users of data, including maps and spatial derivatives, will predominantly be via mobile devices in the near future.



Source: Gartner, IDC, Strategy Analytics, company filings, BI Intelligence estimates

Figure 1: Global Internet Device Sales (1)

Mobile Device Characteristics

Mobile devices have broadly evolved into smartphones and tablets. These now include high resolution screens, modern browsers, efficient processors and of course network capabilities. Marketplaces open to developers allow for high degrees of customisation defining the characteristics of the mobile device:

- Powerful
- Personal
- Located

The location capabilities of mobiles are just one of the sensor dimensions required to support advanced applications. Other sensors include:

- Magnetometer (compass)
- Accelerometer (attitude / orientation)
- Gyroscope (rotation and motion stability)

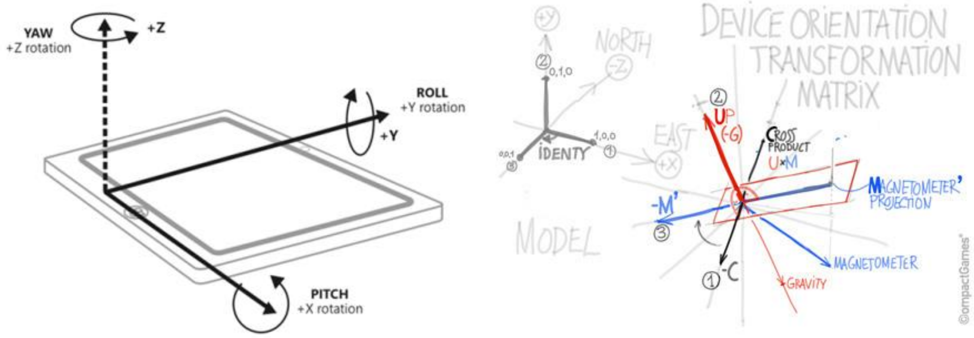


Figure 2: Sensor and Device Relationships

By accessing this information on a mobile device we can begin to answer questions like "what am I looking at" and into that field of view add, or augment, additional information.

Augmented Reality

Augmented Reality (AR) is the supplementation of additional information on an image, usually a live camera image. Along with other similar technologies such as virtual reality (VR) and mediated reality, AR is commonly used in gaming, entertainments, TV sports coverage, heads-up displays and visualisation.

Hardware Development

As most AR solutions were initially developed as desktop applications the first image source was a webcam and this is still common today. However, the popularity of mobile devices, along with ease of application deployment to mass markets (online marketplaces), built-in camera sensors and accessible programming interfaces for sensors has meant this platform now has many applications available.
The next generation of wearable computing under development by all the major hardware and mobile OS manufacturers will further deliver new mediums for heads-up access to information.

Mobile Applications

There are several classifications of AR applications – each building on the sensor requirements of the other to enhance the application experience.

- Marker-Based – Camera: Uses image recognition to allow overlay of different data or models
- Non-Marker-Based – Camera + Accelerometer: Predefined model using gravity sensor for orientation

- Heads-Up Compass – Camera + Magnetometer: Compass Overlay with optional model
- POI Guide – Camera + Magnetometer + Location: Display objects based on geographic location
- GIality AR – Camera + Magnetometer + Location + Accelerometer and Gyro

Figure 3: Samples of Augmented Reality Applications

GIality – Geospatial Augmented Reality

The differentiator in geospatial AR is that the relative position of the target objects can be calculated and visualised with respect to the absolute position of the observer. Geospatial data has inherent location (and hence position, size and orientation) so the viewing of that data in device context can be achieved through integration and interpretation of mobile sensor feedback.

The model to be displayed may still be point, line or area but also 3D and be stored within the app or more likely delivered as a web service or download through standards or proprietary formats.

Finding a Place for Augmented Reality

Augmented reality is in the transition between innovation and compelling value, from science to business defined by the move to being customer centric rather than technology centric (5).

Example applications include visualisation of underground utilities, local area development zone polygons, historic, heritage and built-environment architectural 3D model visualisation and rural wind farm planning. The latter has been shown to be ripe for digital innovation with public and expert enthusiasm for digital communication technologies that enhance existing methodologies (6). Alongside limitations associated with current dynamic visualisation in terms of navigation and position, there is a case for a greater exploration of the topic through technology in the field of visual impact analysis or VIA.

Visual Impact Analysis

Visual Impact Analysis (VIA) is a component part of Environmental Impact Assessment (EIA) – an examination and investigation into the possible impacts resulting from proposed development. The VIA is defined as a change in the appearance of the landscape as a result of potential development (2).

Types of VIA

There are three broad components in VIA (3):

- Viewshed / ZTV: Map-based zones of theoretical visibility of the new development
- Cross-Section: A-B line-of-sight assessment in profile
- Viewpoint: As photomontage, wireline diagram or artistic impression

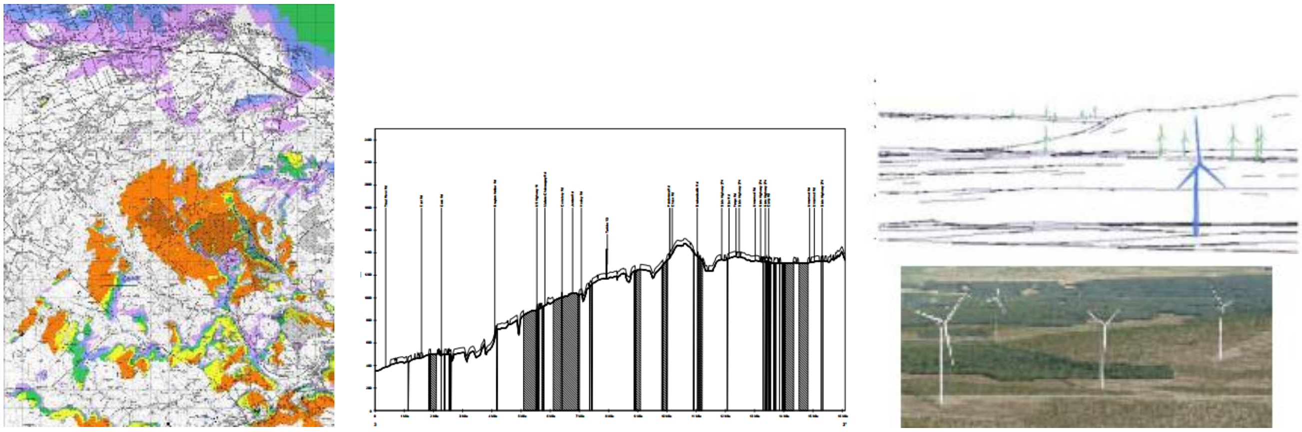


Figure 4: Classic Images of Visual Impact Analysis (3, 4)

Issues with Viewpoint Assessment

Viewpoint assessment requires personal involvement by experts in location selection, site visits and post-processing to create augmented imagery. This is time consuming and expensive, open to question and interpretation under appeal. The process must be limited to a small, fixed number of sites due to resource limitations and the sample will never represent the needs of all interested parties.
However, importantly, photomontages are considered the most effective visual representation in terms of impact of development from specific locations but with drawbacks listed as including; lack of realism, static viewpoints, weather dependant and inflexible and expensive to manage for dynamic design options.

Augmented reality, GIality, offers a technical and practical solution to these issues for real benefit.

Mobile VIA – Ventus AR

To address these issues in democratising the viewpoint visualisation, the solution presented is to put the VIA tool into the locations and hands of those potentially affected. Currently, widespread public access to such tools is not possible because of software expense, expertise and requirements for desktop based analysis. However, now new mobile app economics make mobile VIA a reality.
Ventus AR is a system for mobile VIA developed by Linknode Ltd. Initially designed to support the uptake of renewable microgeneration for SMEs in support of Scotland’s 2020 carbon targets, the system was designed for location-based wind assessment and turbine visualisation. Uniquely incorporating 3D model visualisation across the mobile platforms the solution is scalable, international and suitable to all geospatial and 3D visualisation.

Figure 5: Mobile VIA

Issues and Further Development

As with all large-scale real-world visualisation solutions, the management of obscuring features is a major issue in augmented reality. Terrain modelling is useful in rural environments but accommodation must also be made for natural topography of trees, especially on obscuring ridges. In closer proximity, the natural and built-environment become factors where buildings are the prominent topography.

3D visualisation also requires appropriate lighting to be realistic. However, because of the 3D power, position and time inherent in apps a solution is to use the location and relative sun angle (in combination with light sensors and online weather forecast feeds) to provide a local lighting model.

Summary

Through a summary of the current state of mobile technology, with specific reference to the sensors available in smartphones and tablets it has been shown how the modern device is a personal, location aware tool capable of running augmented reality applications.

With the combination of geospatial data the augmentation of camera, model, orientation attitude and position gives a new level of visualisation capability previously limited to expert-driven desktop solutions and post processing – this integration of geospatial data and mobile augmented reality has been termed GIality.

An assessment of the issues around visual impact demonstrated how empowering the citizen with viewpoint visualisation on their own device solves many traditional issues, increases awareness and goes beyond sharing the Power of Place into emboldening and democratising people through new ways to access geospatial information.

Ultimately, the augmentation of as-planned models with geospatial data and mobile location, orientation and attitude allows individual and personal places or residence, work and play to be equally fairly and rigorously assessed for visual impact of development.

References

- (1) Cocotas A, Blodget H [Business Insider] (2012) “*The Future of Mobile*” www.businessinsider.com/the-future-of-mobile-deck-2012-3?op=1
- (2) [The Macaulay Land Use Research Institute] (2010) “*Visual Impact Assessment*” www.macaulay.ac.uk/ccw/task-three/via.html
- (3) horner + maclennan, envision [Scottish Natural Heritage, The Scottish Renewables Forum, Scottish Society of Directors of Planning] (2006) “*Visual Representation of Windfarms Good Practice Guide*” www.snh.gov.uk/docs/A305436.pdf
- (4) horner + maclennan [Scottish Natural Heritage, Stirling Council, Loch Lomond and The Trossachs National Park Authority] (1997) “*Stirling landscape sensitivity and capacity study for wind energy development*” http://www.stirling.gov.uk/__documents/planning/future-development/development-advice/study-part-1.pdf
- (5) Kozick Z, Gettliffe (2010) “*Why Augmented Reality Needs a Reality Check*” http://www.perey.com/MobileARSummit/Omniar-Augmented-Reality-Reality-Check.pdf
- (6) Berry R, Higgs G, Langford M, Fry R (2011) “*An Evaluation of Online GIS-Based Landscape and Visual Impact Analysis Tools and Their Potential for Enhancing Public Participation in the UK*” http://www.isprs.org/proceedings/xxxviii/4-w13/id_46.pdf