Web services for crime deterrent design knowledge

WEB SERVICES FOR CRIME DETERRENT DESIGN KNOWLEDGE

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SUMMARY

Almost every feature of a building can contribute to improving or reducing its security. The shape, position, layout and configuration of each building component can minimise or maximise its vulnerability. However, crime also has to be considered against other impeding design issues, such as the acoustic veracity, the thermal value, the maintenance agenda, the cost, and its environmental impact for instance. Perspectives of design are usually balanced between aesthetics, ecology and economism – a three dimensional view of design that acknowledges its social, environmental and economic roles. The 3D to nD modelling project at the University of Salford aims to produce an information model that will provide an open interface for any design application using Web Services technology to try to address this. Thus, enabling true 'what-if' analysis of the various design perspectives. This paper presents an overview of the research, and discusses the structure of the information model using crime deterrent design data as an example.

INTRODUCTION

The building design process is complex, encapsulating a number and variety of factors in order to satisfy the client's requirements. In fact, it is rarely the case that there is one homogeneous 'customer,' but a number and variety of stakeholders who will be the end-users of the building. These stakeholders are increasingly demanding for the inclusion of design features such as maintainability, environmental, accessibility, crime deterrence, acoustically-sound and energy performance. Each of these design parameters that the stakeholders seek to consider will have a host of social, economic and legislative constraints that may be in conflict with one another. Furthermore, as each of these factors vary – in the amount and type of demands they make – they will have a direct impact on the time and cost of the construction project. The criteria for successful design therefore will include a measure of the extent to which all these factors can be co-ordinated and mutually satisfied to meet the expectations of all the parties involved (Lee et al, 2002a).

The volume of information required to interplay these scenarios to enable the client to visualise design changes and to assist with decision making – changing the design, planning schedules and cost estimates – can be laborious, time consuming and costly (Lee et al, 2002b). The 3D to nD research project at the University of Salford aims to develop a multi-dimensional computer model that will portray and visually project the entire design and construction process by enabling true 'what-if' analysis to be performed. This will allow users to create, share, contemplate and apply knowledge from multiple perspectives of user requirements. Conceptually, this will involve taking 3-dimensional modelling in the built environment to an *n* number of dimensions.

The research project seeks to develop the infrastructure, methodologies and technologies that will facilitate the integration of time, cost, buildability, accessibility, environmental, maintainability, acoustics, crime and energy requirements. It aims to assemble and combine the leading advances that have been made in discrete information communication technologies (ICTs) and process improvement to produce an integrated prototyping platform for the construction and engineering industries. The output will allow seamless communication, simulation and visualisation, and intelligent and dynamic interaction of emerging building design prototypes, so that their fitness for purpose for economic, environmental, building performance, and human usability will be considered in an integrated manner. It is essential to ensure that the proposed system would be durable and be compatible with new developments in IT, a far as these could be anticipated. This paper concentrates on the development of the nD knowledge service using crime deterrent design data as an example.

CRIME DETERRENT DESIGN KNOWLEDGE

Crime is increasingly becoming a growing concern for the construction industry. Recorded domestic burglary and recorded robbery rose by 6% and 27% respectively in the UK in 2001/ 02 on the previous year, bringing about the total of 430,361 break-ins (National Statistics, 2002). The unfortunate steady rise of crime in the UK through the years proved to be the impetus for the Secured by Design (SBD) scheme.

The impact that effective design can have in reducing crime (fear and incidence) is being increasingly recognised. SBD is the UK Police flagship initiative supporting the principles of designing out crime, thus encouraging the building industry to adopt crime prevention measures in development design to assist in reducing the opportunity for crime and the fear of crime, creating a safer and more secure environment (Secured by Design, 2002): -

- It is the corporate title for a family of national UK police projects involving the design for new homes, refurbished homes, commercial premises, car parks and other police crime prevention projects
- It is primarily an initiative to encourage the building industry to adopt crime prevention measures to assist in reducing the opportunity for crime and the fear of crime, creating a safer and more secure environment. It supports one of the UK Government's key planning objectives - the creation of secure, quality places where people wish to live and work
- It is supported and managed by the Association of Chief Police Officers (ACPO) and has the backing of the Home Office. It has been drawn up in consultation with the Department for Transport, Local Government & Regions (formerly DETR) as well as trade, industry and standards organisations

The scheme recognises that the built environment can be a contributory factor in incidents of crime and disorder. It recognises that more emphasis needs to be placed on the design during the planning and feasibility stage of a construction project, securing a quality, sustainable place without creating a 'fortress mentality' (Secured by Design, 2002). SBD aims to achieve a good overall standard of security for the building shell and, in order to deter criminal and anti-social behaviour within the curtilage or grounds of an estate, to introduce appropriate design features that enable natural surveillance and create a sense of ownership and responsibility for every part of the development. These features include secure vehicle parking, adequate lighting of common areas, instilling a sense of ownership of the local environment, control of access to individual and common cartilages, defensible space, and a landscaping schemed that enhances natural surveillance and safety. It does not guarantee that a particular area will be crime-proof but indicates that the site has been subject to a design process and improved level of security, which in the experience of the police service and other agencies, have been shown to significantly reduce the risks of crime and the fear of crime. Research by Huddersfield University shows that residents living on SBD developments are half as likely to be burgled, two and a half times less likely to suffer vehicle crime and suffer 25% less criminal damage (Secured by Design, 2002). SBD operates on two levels: -

- The Developers Award is a certificate given to building developments which, following consultation with local police Architectural Liaison Officers (sometimes called Crime Prevention Design Advisors), are built to conform to the ACPO guidelines and so reduce the opportunity for crime
- Licensed Products – SBD licensed company status is awarded to those companies producing security products, including doors and windows, which pass standards and tests nominated by the police service as 'Police Preferred Specification'

The 3D to nD modelling project aims to develop an information model that encapsulates crime deterrent features using partial information provided on the SBD website http://www.securedbydesign.com. Almost every feature of a building can contribute to improving or reducing its security. The shape, position, layout and configuration of each building component can minimise or maximise its vulnerability. For example, a rear window can be easily reachable or not; it can have a large or small opening; it can be a side or top opening; it can be hidden or well overlooked; it can have a standard or attack resistant glazing; it can be isolated from electronic security or be integrated. In short, it can be a burglar's friend or provide a degree of difficulty far beyond the capabilities of the average burglar. It is anticipated that this crime deterrent data, when viewed against the other nD design perspectives (time, cost, buildability, accessibility, environmental, maintainability, acoustics and energy) will assist in the client's decision-making process.

However, the data provided by SBD is often difficult to interpret in that it is not logically structured in a way that can be easily assessed against the specification of a building design, as the proposed nD modelling tool would uphold. Some of the data is indeed tangible, such as: -

> *'…The correct use of certain species of plants such as spiny or thorny types, can help prevent graffiti and loitering and create or enhance perimeter security. Landscaping should not impede the opportunity for natural surveillance and must avoid the creation of potential hiding places. As a general recommendation shrubs should have a mature growth height no higher than 1 metre, and trees should have no foliage below 2 metres, thereby allowing a 1 metre clear field of vision …'*

Whereas other data is intangible and difficult to codify, being subject to circumstance expert review, such as:

> *'…Attention should be given to …the position of trees that may become climbing aids into property or obscure lights/ CCTV cameras…'* This criterion is subjective, subject to personal review and opinion of what intervenes as a climbing aid – the position of the tree, the strength and size of the trunk and branches etc

Both sets of data type will be incorporated in the nD tool.

WEB SERVICES

The 3D to nD research project aims to create an open interface to design knowledge, which will allow the integration with any design applications using the standard protocol. To achieve this, a new technology called Web Service will be adopted in our technical implementation.Web Service is a standards-based software technology that allows programmers and integrators combine existing and new systems or applications in new ways over the Internet, within a company's boundaries, or across many companies (IDC Research, 2002). According to IDC research (2002), the primary advantage of this technology is that it permits interoperability between software written in different programming languages, developed by different vendors, or running on different operating systems or platforms. It adapts the loosely coupled Web programming model for use in applications that are not browser-based. However, it is not a new concept, but rather an evolution. Web Services' basic functional principles are similar to those of COBRA (Common Object Request Broker Architecture), DCOM (Distributed Component Object Model), although it is more loosely coupled than these traditional distributed programming models. In theory, Web Services can be used by anyone, anywhere, any time, using any computer system, as long as the services have been built using a specific set of standards, namely: -

- XML
    - XML (Extensible Markup Language) is a flexible way to create common information formats and then to share both the format and the data over an IP network. For example, computer manufacturers may agree on a standard way of describing the information about a computer product (processor speed, memory size, and so forth) and then describe the product information format with XML. Such a standard way of describing data would enable a user to send an intelligent agent (a program) to each computer manufacturer's Web site, gather data, and then make a valid comparison. XML can be used by any individual or group of individuals or companies that want to share information in a consistent way
- SOAP
    - Simple Object Access Protocol (SOAP) is a way for a program running in one kind of an operating system to communicate with a program in the same or another kind of an operating system (example: Linux Vs Windows) by using HTTP and XML as the mechanisms for information exchange. In effect SOAP is a platform-independent access protocol (W3.org, 2002)
- WSDL & UDDI
    - Web Services Description Language (WSDL) is an XML-based language used to describe the services a business offers and to provide a way for individuals and other businesses to access those services electronically (MSDN, 2002). WSDL is the cornerstone of the Universal Description, Discovery and Integration (UDDI), which is an XML based registry for businesses worldwide that enables businesses to list

themselves and their services on the Internet (MSDN, 2002) - WSDL is the language used to enable this.

nD KNOWLEDGE SERVICE

The nD knowledge service is the Web Service that stores the design knowledge. Access to this data can be made via the Internet. Its main features are as follows: -

- Specific knowledge retrieval
- Open Interface for any design application
- Building elements based knowledge access
- Store design knowledge, such as accessibility requirement, crime deterrent information, etc

Components of nD Knowledge Service

The nD knowledge service consists of the following two main components; Figure 1 illustrates its system architecture: -

- nD knowledge base
- nD data API (web methods)

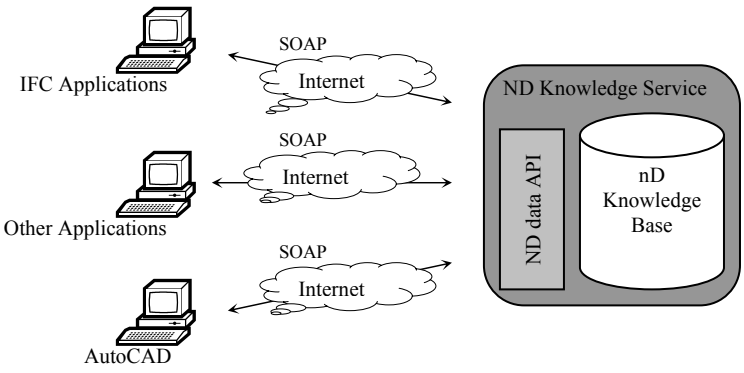

Figure 1 nD Knowledge Service

nD Knowledge Base

The nD knowledge base is the database management system that stores the design knowledge related to the various design perspective constraints of the nD knowledge service (i.e. accessibility requirements, crime deterrent measures, sustainability requirements etc). Microsoft SQL 2000 server is used as the database system to provide the data management functions of the nD knowledge service.

Information has been collated by the nD research team from various design handbooks and guidelines on the UK's legislative specifications of building component data. The data collected thus far is largely unstructured, and therefore the principal task in developing the nD knowledge base was to structure and model the information into a relational database (SQL Server). Crime deterrent information is used in this paper to illustrate that how the information has been modelled. The data collected included the following (Secured by Design, 2002): -

- Door to conform to BSI PAS24-1
- Glazed panels in and adjacent to doors must be laminated to a minimum of 6.4mm thickness
- The locking system of external doors must be equal or exceed the strength requirement of BS 3621/98. Multi point locking with three or more dead bolts may be an alternative
- Three hinges or a continuous hinge, supplemented by hinge bolts, should be incorporated on outward doors

- On outward opening doors, provision must be made to prevent access being gained from an attack on the hinge
- Letter box shall be positioned 400mm from door lock and contained, where possible, within a sealed fire resistant receptor
- Maximise natural or formal surveillance of all accessible doors
- Lighting to be provided on all external doors, operated by photo-electric cell, time switches or passive infrared detectors
- Defensible space using real or symbolic barriers i.e. change of road surface texture or colour, to encourage a feeling of territoriality
- High boundary fences and landscaping to be a balance between security and surveillance
- Public access including footpaths through the estate should be controlled
- Car parking should be located within view

In order to structure this data, it was firstly grouped based by its corresponding building element, such as door, wall, space, etc (currently, the data is only mapped to very basic building objects). In order to ensure the openness and compatibility with major design applications, the research team reviewed different building product models such as Combine II, RATAS, ATLAS and IFC (Eastman 1999), and discovered that all models have their own schema and are not very compatible with each other. Moreover, the majority of the major design applications, such as ArchiCAD and AutoCAD, are not supporting these building models. Following such, our structure was then mapped to basic building elements that are common in most of the building models (see Table 1). IFC compliance is next step of the research, however, our knowledge base will be used as external data source of the IFC building model - we are considering developing an IFC interface within our API for easy integration.

The major challenge of the information modelling is to model the qualitative information, which is subjective to individual's interpretation. For example, the differentiation of private and public space is important in deterring crime (Secured by Design, 2002), so that it is pertinent when an intruder is in private territory. Certain design features can easily be used to segregate spaces, such as a wall, planting or changes in the ground colour/ texture. Further, these features can be used in varying degrees depending on the environment, thus making it difficult to model these aspects into a database or to relate them to a specific building element.

Data	Data Type	Group
Door to conform to BSI PAS24-1	Text (String)	Internal > Door
Glazed panels in and adjacent to doors must be laminated to a minimum of 6.4mm thickness	Dimension (Long)	Internal > Door > Panel
The locking system of external doors must be equal or exceed the strength requirement of BS 3621/98. Multi point locking with three or more dead bolts may be an alternative	Text (String)	Internal > Door > Lock
Three hinges or a continuous hinge, supplemented by hinge bolts, should be incorporated on outward	Text (String)	Internal > Door > hinges
On outward opening doors, provision must be made to prevent access being gained from an attack on the hinge	Text (String)	Internal > Door
Letter box shall be positioned 400mm from door lock and contained, where possible, within a sealed fire resistant receptor	Dimension (Long)	Internal > Door > Letter Box
Maximise natural or formal surveillance of all accessible doors	Text (String)	Internal > Door
Lighting to be provided on all external doors, operated by photo-electric cell, time switches or passive infrared detectors	Text (String)	Internal > Door
Defensible space using real or symbolic barriers i.e. change of road surface texture or colour, to encourage a feeling of territoriality	Text (String)	External > pathway
High boundary fences and landscaping to be a balance between security and surveillance	Text (String)	External > fences
Public access including footpaths through the estate should be controlled	Text (String)	External > Footpath
Car parking should be located within view	Text (String)	External > Car Park

Table 1 Grouped Data

Using the grouped data, as illustrated in Table 1, a database has been built in MS SQL server. The data model of this database is shown in Figure 2.

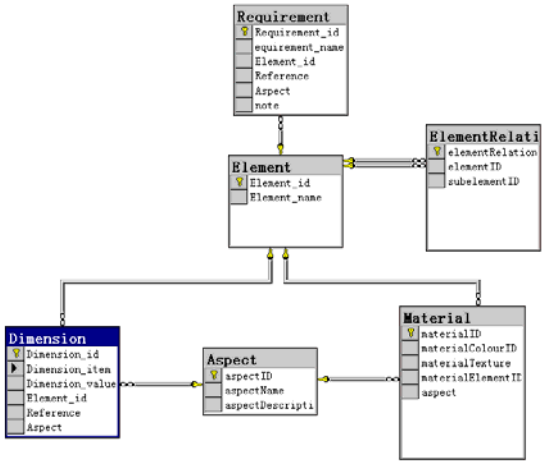

Figure 2 nD Data Model

nD Data API

nD Data API is the programming interface for the client software to access the information in the nD database. It is based on SOAP to work as Web Service via the Internet. The nD data API provides a comprehensive list of web methods that allow client applications to interact with the database. Some examples of common web methods are listed below: -

- Get_ElementCrimeRequirmentList
  - Returns a list of general requirements of crime prevention data based on building element
  - Parameter is building element
- Get_ElementCrimeDataList
  - Returns a list of physical data of crime prevention data based on building element
  - Parameter is building element
- Get_SubElementList
  - Returns a list of sub elements based on the given element
  - Parameter is building element

SUMMARY AND WAY FORWARD

To date, the Web Services model has been more rapidly and widely adopted than any other approach to building distributed applications. The technology enables the 3D to nD modelling project to build a comprehensive what-if analysis tool – to interplay the various social, economic and environmental aspects of design – and the technology also provides a generic open interface.

Currently, the nD data model is based on basic building elements to accommodate different types of building product models used in various applications. This research is still in its early stages and further work will be carried out on examining the emerging building product model, IFC (Industry Foundation Classes), to ensure that the research output is compatible with future industry standards. A series of client application samples will be developed to demonstrate the concept of the system. The research team recognises the importance of external industrial and academic contribution to design knowledge, and openly welcomes collaboration. Thus, it is anticipated that the design data of the nD knowledge service tool will be continuously revised.

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