

# DB-SWINGS: DataBase - Secure Web Interface Generation System

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## ABSTRACT

*To support teleworkers, off-site staff, and to allow clients up-to-date order status information, web-sites providing access to organisational databases are becoming increasingly important. However, the development of secure web-sites is a complicated and expensive task, where an error can expose data to unauthorised personnel. There are problems of cost, time, the need for web-developer expertise, and the dangers of security weaknesses. Due to costs and risks organisations can only develop web-based interfaces for a few "core" databases, and are likely to only update systems occasionally. Therefore many small organisational databases, used by individuals or small teams (e.g. question/answer database created for an ongoing project) are unlikely to benefit from web-based interfaces.*

*Simple systems to automatically generate web-site interfaces based solely on the database structure and contents have been developed. The promise of such systems is that if a database changes, the web site can be regenerated, and since automatic there is no cost to create web-based interfaces to any database, including small databases.*

**Index Terms** — *Automatic Interface Generation, Databases, Organizational databases, Web Interfaces*

## I. INTRODUCTION

**W**EB based information systems can provide secure access of information to staff both at and away from their desks. However, the development of secure web based computer systems is a complicated and

expensive task where just one error can expose data to unauthorised personnel. There are problems of cost, time, the need for web-developer expertise, and the dangers of security weaknesses live database data.

The majority of organisations now have some sort of website for their employees, customers or clients to access organisational information. However some companies have tried to maximise the benefits of new web technologies and adopted a three tier software application architecture [5]

- Tier one the database
- Tier two Business logic components communicating with database
- Tier three comprised of user interface components providing access to business logic web applications

The third tier is web based and comprised of a set of web pages. An advantage of the three tier architecture is that it allows for the creation of web applications with dynamic web pages based on live database data.

Database Driven Web Applications are an important achievement in internet technology. DDWAs allow web pages to be created dynamically which reduces development time and cost and also means the most up to date information can be assessed. They have meant that organisations have been able to create new information structures that are more central and user accessible, thus improving business process with less cast and risk that was previously possible.

## II. DATABASE DRIVEN WEB APPLICATIONS

Dynamically generated web pages have reduced the development time and maintenance time of web sites. There is no need for developers to create hundreds of web pages for each record or manually update these pages with dynamic web pages the database content is used to populate these pages so as a result only a small number of templates need to be created. If data in the database changes the web pages are automatically updated.

DataBase Driven Web Applications (DDWAs) have presented companies and organisations with a new way to communicate with their employees, customers and clients that is advantageous to all. DDWAs allow web pages to be created dynamically which reduces development time and cost and also means the most up to date information can be assessed. Secondly it has meant that organisations have been able to create new information structures that are central and user accessible thus improving their business process with less cost and risk than was previously possible.

## III. PROBLEMS WITH DDWAs

Although DDWAs have a positive affect on how people communicate and how the internet is used the implementation of the system can be problematic. One of the problems with implementing DDWAs is development time. Another major problem is in the development of user interfaces.

When creating such applications there is a need for expertise. So although DDWAs offer benefits to organisations their development is problematic with respect to the risks of time and cost and expertise required to develop and implement such systems.

## IV. WHAT THE PROJECT PURPOSES TO DO

This research project proposes to develop a solution involving the automatic generation of a secure web-based application, driven by the structure and contents of data in a standard SQL-compliant database (such as MYSQL) and some user specified security and look-and-feel preferences. It is a follow on project to [1]. DB-WINGS automatically generates a usable web application entirely driven from the database structure and contents. Thus, if

the database structure is changed at all, the web-based system can be regenerated in seconds.

In addition to the above, organisations will have other factors influencing the acceptance of web-based information systems, relating to issues such as:

- whether the data is to be available on an intranet, extra-net, or full internet
- the sensitivity or corporate importance of the data
- the size, duration and corporate importance/sensitivity of the work undertaken by the team using the database
- whether the web-based system is to provide dynamic access to a “live” database, or to static web pages (which can also be generated by such system from the contents of the database at the time of web-site generation)

The project will develop and evaluate a “Corporate Acceptance Model” to investigate these issues. Building a model, and gaining industry partner feedback about the types of database contents and types of access and level of page dynamism they would be willing to deploy at different levels (and why) in their organisation

## V. CRITICAL REVIEW OF EXISTING WORK

Modern web-based systems allow users to view and edit “live” data in a database. It is possible to develop highly usable web-based systems around live database data. However, such systems as “ITB-SIP” (Smith 2003, an ITB staff intranet systems for live database of staff contact data and event information) require custom design and development, and carry the costs for re-development when requirements change, even by a small amount. The DB-SWINGS industry-relevant research project proposes to develop a solution involving the automatic generation of a secure web-based application, driven by the structure and contents of data in a standard SQL-compliant database (such as SQL-server, MS Access or mysql), and some user specified security and look-and-feel preferences.

During the development of “ITB-SIP” it was found that much of the development work was routine, and determined by the table relationships, number and data types of different parts of the database. DB-WINGS

automatically generates a usable web application entirely driven from the database structure and contents. Thus, if the database structure is changed at all, the web-based system can be regenerated in seconds. However, DB-WINGS is an academic “proof of concept” and does not meet two key requirements for corporate acceptance of such as system:

- (1) Security (security is the “S” added to DB-WINGS to become DB-“S”WINGS)
- (2) Corporate image and standard “Look-and-feel” while conforming to HCI principles  
– standardized screen layouts etc. are important so that staff already trained on one corporate system require little if any retraining on other systems conforming to the same look and feel)

Existing research publications on automatic generation of web interfaces for databases includes:

Elbibas A, Ridley MJ (2003) [6],  
Engelson V, Fritzon D, Fritzon P (1996) [7],  
Milosavljević B, Vidaković M, Konjović Z (2002) [8],  
Pukari A, Shirita Y, Atsushi I (1993) [9] and Zoller P, Sommer U (1998) [10].

However, there are various limitations to the body of existing work. Many existing systems to automatically generate web interfaces rely on human-authored meta schemas. This raises issue of time, cost and expertise each time the structure of a database needs to be changed. Other researchers have had limited success with the variety / flexibility of user interface operations – relying on choices between a small number of user interface templates or “typical” business uses of DDWAs. We intend to address both categories of limitation of existing work in this DB-SWINGS project, while being informed by the problems they have solved.

This project will build upon the two projects described above and the following sources:

- existing HCI web interface design and evaluation research including: Zhu X, Gauch S (2000)[11], Ohnemus K (1997)[12], Nielsen J (1990)[13], Lok S, Feiner S (2001)[14]
- information sources for the development and evaluation of the Corporate Acceptance Model will be based on interviews with the industry project partners, existing case studies.

## **VI. WHAT THE PROJECT PROPOSES TO DO**

This project proposes to investigate the feasibility of automatically generating web-sites that allow authorised staff to access data in organisational databases, while maintaining corporate style requirements and conforming to effective interface design principles. Research questions to be asked are:

- How can a system effectively enable database owners to specify access privileges to different parts of a database based on a dynamic analysis of the database itself?
- How can a system effectively enable database owners to make interface design and “look-and-feel” decisions that meet corporate style specifications while conforming to research-based interface design principles?
- What are the requirements for commercial organisations to trust and implement such automated web-site generation systems and how can they be met for the type of systems resulting from this project?

## **VII. HOW IT WILL WORK**

This DB-SWINGS project involves 3 stages:

- Development of user login and level of database access security features
- Development of interface look-and-feel rules, allowing an organisation to easily control layout, colour schemes and corporate look and feel
- The development and evaluation of the “Corporate Acceptance Model”

The basic approach is as follows:

- Development of a working web application
- Identifying the parts of the application that are constant (the template) and those that are determined from either the database structure content, or user specified settings
- Developing XSLT file generation rule-sets to generate the dynamic elements and add them to the “template” elements to form the system components

Before the web application is generated a Java program using metadata about all database tables will be used to help the user create security access rules. For example

security settings may be expressed as user-edited properties of an EAR (Entity-Attribute-Relationship) diagram.

A second program will allow users to make presentation choices about how different tables and fields are presented (e.g. image file name to display image), rules for their location on a page (e.g. corporate logo in frame on **left** of page) and presentation style features such as colours, fonts etc. while not violating a set of HCI derived style constraints. This second program will require use of an interactive multimedia interface, such as that offered by Macromedia Flash 2004. Existing source code and prototype multimedia tool (a dynamic UML state-chart diagram editor to code generator) is available [3] on which both the security and user interface preference rule editors could be based.

At generation time a core XML data will be generated, where meta-data is extracted about each table in the database and foreign key representation of relationships and user rules add to presentational and security meta-data about each field of each table. The meta-data file is the data source for XSLT transformations that generate the run-time components of JSP pages, Java beans and CSS and XSL stylesheets. This is illustrated below:

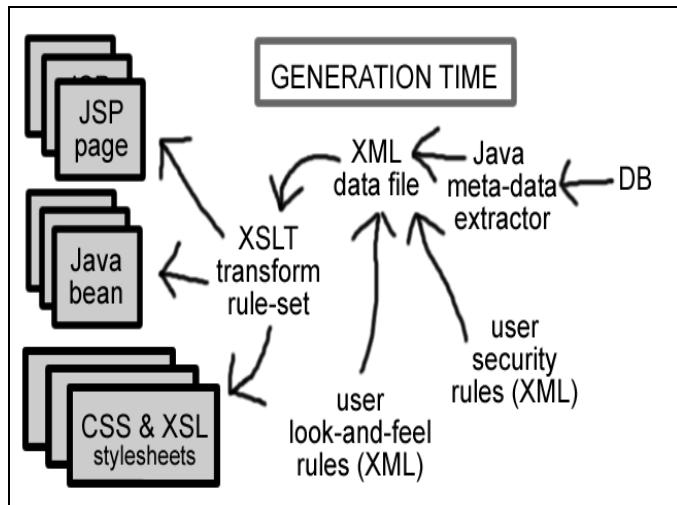


Figure 1 – Generation Time

The XMLtoJSP [2] and DB-WINGS [1] systems are proof-of-concepts demonstrating JSP and Java database bean generation.

At run time a JSP retrieves data from the database via a Java Bean. The JSP outputs an XML file referencing an appropriate XSL stylesheet. The browser receives the XML data and XSL style sheet, generates an XHTML

page that is styled with a CSS stylesheet. This is illustrated below:

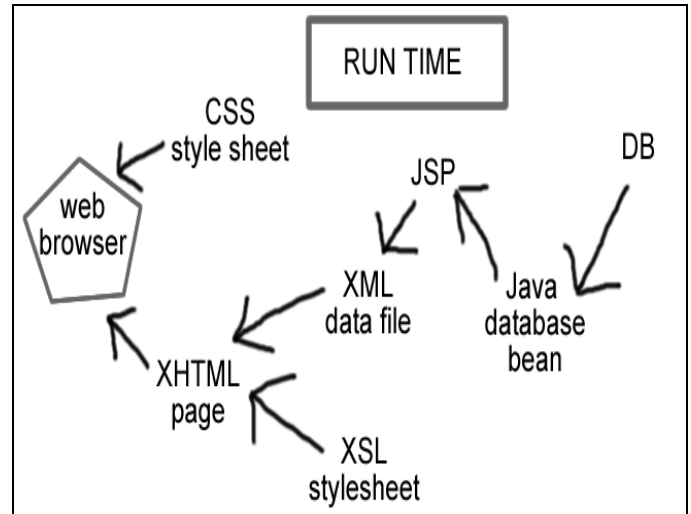


Figure 2 – Run Time

To investigate instances where for security reasons a company only wishes to publish static pages, the XHTML page generated from the above could be stored as files rather than generated dynamically in response to HTTP requests from the browser. However, the system would then be a collection of static web pages meaning that data could not be edited by users, and run-time sort-search features could no longer be available from the SQL engine.

## CONCLUSION

The benefits of DDWAs have been presented, and we propose a solution to issues of cost, time and the need for web-technical staff that currently prevent many small organizations / teams from benefiting from DDWAs. We have critically reviewed existing work in the field, and highlighted problems to be solved. Our proposed DB-SWINGS project addresses these issues, and current informal feedback from industrial project partners is encouraging.

Towards the end of this project we will be deploying and demonstrating progressive prototype systems for the industrial project partners. We will provide basic staff training and then will evaluate the industrial project partners' confidence regarding the use of the system for different organizational databases.

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