

# FINAL REPORT - ONLINE APPLICATION SYSTEM

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The Online Application System is designed to allow potential PhD and Post Doctoral students to submit applications for research vacancies online. The system is fully integrated online so that staff from the University can create the vacancies online, and view potential applications. Nottingham University is being used as a pilot study to test the system.

The system was designed to fit in with the overall colour scheme and motif of the Nottingham University website; this was accomplished by using similar shades of blue and the Nottingham University logo. As the site is laid out entirely with CSS, it is only a matter of altering of the style sheets for it to be adapted for use at another university or for another use; this illustrates the importance of separating content from style. In addition, the header and the quick links box are merely functions included into each page; therefore, it is a simple matter of change one function file to alter the menu layout and the links included in the quick links box. The site was designed to be as flexible as possible.

## **Technologies and Testing:**

The site is implemented entirely in PHP and MySQL; apart from the statistics and report pages in the staff section, these are implemented in Perl and the graphical representations in Java (as an applet). It would have been better if the Perl statistics had been written in PHP for consistency, and also because those pages are not as secure as the rest of the site as it was not possible to pass the sessions from the PHP to the Perl pages.

During the construction of this site, I learnt a great deal about web programming languages and databases, and found it very useful.

This system has been tested in a variety of browsers on a variety of systems and has been found to display fairly consistently on all. The only differences are due to the browsers' different interpretations of CSS. All the pages on the site are valid XHTML Strict 1.0 and valid CSS.

**Problems encountered:**

There were some problems experienced during the creation of the site, mainly due to a few kinks in the programming, but these were sorted out fairly quickly. There was also some difficulty getting the Perl programs to connect to the database initially, but these were also fixed.

In addition, there were some compatibility issues with the java applet. Mainly these were because the program was initially written on a later version of the Java Developer's Kit (1.5.1) and had to be slightly altered and recompiled to work on the version that is available on the university servers (1.4.2).

**Amendments to the Specification:**

The database has been redesigned since the original initial specification. The main reason was because having separate tables for the different users was impractical. The current design is much more normalised, and interfaces better with the website. In addition, tables were created to hold file details, normalising the database further. The Reference table has been used merely to link a referee's user details to the application and store when they uploaded their reference (which is an entry in the Files table). The Reference table contains a fileID so that when an application is displayed, the correct reference is associated with each referee.

The Perl scripts output a printer friendly formatted HTML page. I decided to redesign the report, as the one outlined in the specification was not optimal. The report now prints:

- Information about the vacancy
- Statistics from the vacancy (age, gender, country breakdowns)
- For each applicant:
  - o All their details and the details of the references.
  - o Links to the files uploaded which can be clicked on and opened (then printed).

This redesign preserves formatting of the uploaded files, and means that there are no problems with reading in from files (i.e: .pdfs). A "Print Report" link is also provided so that reports can be printed out. A "View Graphical Statistics" link is provided so graphical representations of the statistics can be displayed in a Java applet.

## **Features of the System:**

### *All Users*

- The system will generate and email out a new password if the user forgets theirs.
- Passwords are encrypted and stored in the database for greater security.
- New passwords are generated using a substring of an encrypted time stamp multiplied by a random number. This produces a random seven-character alphanumeric string. The random number part means that if passwords are generated at the same time (as they are for the referees) they are not going to be the same due to the same time stamp.
- The system provides a mechanism for changing the user's password.
- The users have the option to contact the help desk if they have a question or a problem.
- In addition, they could also view the FAQs or the site map.
- The system will not let you view pages when you are not logged in, or if you do not have the correct permissions.
- On login, the users will be redirected to their appropriate home page.
- Only passwords are case sensitive because they are encrypted. Usernames are not.

### *New Applicants*

- The system checks that the email address is valid and errors if it is not.
- The system checks that the username and password conform to specifications (using regular expressions), i.e: that they are the right length, contain the right characters.
- The system encrypts the password.
- The system validates user input, strips tags, trims spaces, adds slashes and adds the data to database.
- The system will inform the user if the username is in use, or if the email has already been registered.
- The system will not let you create an account if the required information is not supplied.
- The system will email you to let you know the registration was successful and to remind you of your username.

## *Applications*

- The system will not let you apply for a vacancy for which you already have an application. In addition, will not let you apply for a closed or deleted vacancy.
- The system will let you edit "In Progress" applications.
- The system will let you edit your personal details without starting a new application.
- The system will not let you continue past page 2 of the application process if you have not selected the vacancy for which you are applying.
- The system will not let you view any applications other than your own.
- The system will NOT let you submit an application if you have not supplied all required information or files, or if you have already submitted it. (The system will only count "other" files in this check for Post Doctoral positions)
- The system will let you know if a vacancy's status changes.
- The system will not let you submit an application to a closed or deleted vacancy, even if it has been partially completed.
- The system will let you know when your references have all been added.
- The system will validate all the information before saving it to the database.
- The system will let you delete references and some files.
- The system will email you to let you know your application has been submitted successfully.
- On submission of an application the system will generate your references a password (having already generated them a username previously), and email them this information.
- The system provides a link to your uploaded file and, as it has set the correct permissions, it will let you download and view the file.
- The system summarises your application before letting you send it so that you can check all of your details are correct.
- The system also restricts which file types can be uploaded.
- File permissions are automatically set to 755 on upload, so files are accessible by the users.

## *References*

- Are emailed a password and username by the system on submission of a completed application.
- On login the system will let them know whether a vacancy has been deleted.
- The system will let them know the date they uploaded their reference.
- They can alter their details.

- They can upload their letter of reference (.doc or .rtf).
- They can view the file they uploaded.
- They can delete the file they uploaded
- They can review their reference before submitting it to check that all their details are correct.
- They cannot alter their reference after submission, and can only submit it the once.

### *Vacancies*

- Users can view all vacancies that are open for applications, or they can view all PHD/Post Doc vacancies that are open.
- The system will let you know if there are no current vacancies available.
- Users can also search by vacancy code.
- Users can view the details and status of an individual vacancy, through the browse or the search page.
- If a vacancy is closed/ deleted then its status will be display on the individual vacancy page, and the 'apply for link' is not displayed.
- Users can apply for a vacancy; this will add the vacancy code to the session information and redirect the user to the Application home page. This will also automatically complete the vacancy code field on a new application.

### *Staff*

- Add vacancies to the system.
- View all vacancies that they manage, and cannot alter any vacancies they do not manage.
- View or edit vacancy details.
- Delete, close or reopen vacancies – and view the status of the vacancy at that time.
- View statistics or reports for each vacancy.
- View a graphical representation of the statistics for each vacancy as a pie chart.
- Print out those reports.
- View all individual completed applications made to a vacancy, and print them out. The references are listed with each referee.
- See how many partially completed and completed applications there are for each vacancy.
- Edit their own details.

## *Administrators*

In addition to all the permissions of a normal staff member, administrators can also:

- Add staff members.
- Delete staff members, and re-assign the vacancies they manage to another staff member.
- View all staff members and their current permissions.
- Give staff members administrator permissions, and also take them away.
- View all vacancies and who manages them.
- Re-assign a particular vacancy to another staff member.

## **Results of the User Testing:**

On the whole the users that tested the system had very few problems, and the general feeling was that this was a well-implemented and aesthetically pleasing system. Some features have already been implemented since the user trials, such as providing an option for users to edit their personal details without having to create a new application, and showing the status of a vacancy before it is changed. There were a few comments made that could perhaps be taken into account in future implementations of the system.

- Some users felt that there should be some type of alert message reminding them to save their details before clicking on 'Next Page'. However, this was mainly commented on where people had not taken the time to read the instructions before completing the page.
- It could be made clear, on the Preview Application page, which required details were missing, and therefore preventing them from submitting their application.
- Provide an option to delete the 'Other Files'. This was not added because there was no limit to the number of files that could be uploaded, yet sometimes a file may be added erroneously, so this feature could be useful.
- The search facility could be extended to search for particular words in the names or descriptions of the vacancies, and perhaps for a particular salary or starting date.
- The site could be made more accessibility friendly by implementing a large text style sheet (etc) which can be selected in a user preference section and then the correct style sheet would be loaded each time the user logged in.

- A feature could be implemented so that staff members can offer interviews to applicants, and select them for the job; or send emails to particular applicants.
- In addition, more types of statistics could be added – such as the number of applications per month/ per year, or the average number of applications for each vacancy – or more representations of the statistics, i.e: bar charts or histograms.

### **Security concerns:**

I have tried to design the site to be secure, by implementing the following security measures:

- Checking that the user has permission before they can access a certain area of the site, or view a particular application or vacancy - by having different user types.
- Encrypting passwords in the database.
- Using sessions to pass data from one page to the other instead of cookies, as they are more secure. In addition, once the browser is closed the session will automatically end, even if the user forgets to log out.
- Allowing the administrator to delete a staff's account if they were to leave the university, assigning their vacancies to another staff member, ensures that staff accounts are limited to current staff members.
- All text fields are stripped of any code (that could possibly be malicious) and slashes are added so that the text cannot possibly affect the site adversely. This type of error checking is particularly important to prevent users gaining access to unauthorised information, or damaging the system.
- Checking that emails addresses are correct, and that all details have been entered before an application (etc) can be submitted. This is an important concern to limit the amount of time that is wasted by blank applications etc, and it also limits the possibility of abuse of the system.

However, despite these measures there are possibly some ways in which the security of the site could be compromised. It is important to take into account these considerations in future implementations of the site.

- It is possible that someone could create a fake session and fool the site into thinking that they are someone that they are not. This is because sessions are written into plain text files in the /temp/ directory; therefore, someone who knew what they were doing could potentially fake the sessions and pretend that they were an administrator. A way to make this less likely to happen would be to restrict administrator access to the site to University campus only.
- Through a technique called 'mySQL injector' it is possibly that someone could trick the database into letting them log in with actually having a valid username and password, or into revealing information about the database. This could be achieved by inserting a fake apostrophe ('), signalling the end of the SQL query content, and adding something like 'OR 1=1', which of course is always true, and would therefore let them log in. However, as many of the queries are based around userID and usertype, it is unlikely that using this technique would actually give that person any access to important areas of the site, as these variables would not be set correctly.
- The Perl pages are not as secure as the rest of the site because it was not possible to pass the sessions from the PHP to the Perl pages. Therefore, it would be advisable to implement some kind of token passing in future implementations that would provide a way of passing userID, usertype and permissions from the PHP to the Perl pages to prevent unauthorised access.
- Emails with randomly generated passwords are sent as plain text, to make this more secure an IMAP protocol could be implemented so that the emails could be sent more securely.
- There could be some type of restriction on incorrect password attempts. For example, if the user enters their password wrongly three times then it will not let them log in for an hour or so. Alternatively, as extra security you could get the administrator to confirm their password before performing any action.

### **Future Recommendations:**

Further user trials would also be advisable before the system is released, as it would give a better idea of the overall usability of the system if a selection of the proposed demographic were to try it. This is recommended because user trials generally bring up problems that may not have been noticed during testing by the site designer. In addition, it would also

test whether the system can actually hold up to multiple users accessing at the same time, and the delays measured to see what server upgrades may need to be applied.

In the future, I believe that this system could be used in other Universities, or possibly even in businesses, for posting vacancies online and gathering applications. The system has been designed with flexibility, in order that it can be adapted to any use or any situation. In future implementations of the system, it would be desirable to add as many of the changes mentioned in this report, as are possible; and provide a mechanism for gaining feedback from new users of the system so that further features could be added depending on their specific needs.