CS-M14 Industrial Project
Narrative and Reflective Account

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1 Introduction

The aim of this Narrative and Reflective Account is to provide a detailed description of the development process while producing both the customer and administration web applications.

To begin with, the document contains narrative of the stages of the development process from the requirements formulation through to the final acceptance testing. The document then moves onto discussing a number of challenges faced during the development of the project, their effects on the process and how I overcame them. To conclude, this document contains a discussion of any mistakes that I made during the development and what lessons were learnt from the mistakes together with an evaluation of the project as a whole.

2 Development Process

2.1 Requirements Formulation

The underlying aim of the project was to redevelop the existing system using current web technologies and provide a new, modern look-and-feel. By closely inspecting the previous system together with discussions with the centre about new features and functionality, I was able to identify a number of functional and non-functional requirements for each section of the system. Then, for each of the requirements, a number of specifications were produced detailing how each requirement would be met.

2.2 Design Process

The design of the system began with inspecting the existing system together with attempting to gain an understanding of the processes performed at the centre.

Having to use the existing database structure, I designed the various Data Access Objects that would sit on top of the database and provide a layer of abstraction to the application code.

Working with the existing system, I then moved onto designing what each page of the system would be responsible for and what functions it would perform as part of the application.

Finally, I produced a number of user interface prototypes in order to design how the user would interact with the applications. These prototypes involved looking at the existing system and discovering any good design elements together with identifying any problems with the existing design that could be improved upon.

2.3 Development Methodology

While developing the project I chose to use the iterative development model for the development methodology. The primary reason for choosing this model was because it allowed me to work closely with the staff at the centre by gradually producing partial prototypes versions of the applications which would be reviewed by myself and the staff of the centre. After each of the prototypes were produced and reviewed and everything was accepted I then progressed onto developing the next set of features/functionality for the next prototype version. This process repeated until all functionality had been introduced and reviewed successfully. This approach of producing prototypes and evaluating each one ultimately resulted in an application which is as close to the requirements

as possible and it also allowed myself to produce the application without constant supervision by the centre.

2.4 Development Tools & Techniques

While developing the system I also chose to follow an existing software architecture with which I have had extensive experience with. By choosing to follow this architecture it allowed me to produce simple, clean and high-quality code which, in the long run, will prove beneficial for any future maintenance or extensions to the application.

To aid with the development of the application I decided to use the Netbeans Integrated Development Environment (IDE) as it provided the ability to easily debug and perform tests on the source code that I produced and has resulted in higher quality and consistent code.

2.5 Implementation Process

As outlined in the initial planning of the project I decided to divide the project into 6 prototypes, each one adding additional functionality until the project was completed and all requirements were met. The details of each prototype are outlined below.

Prototype 1 The first prototype concentrated on designing and producing a new modern layout that the application will use.

Prototype 2 This prototype was used to introduce the authentication and session functionality. It was also used to add the 'submitters' functionality.

Prototype 3 The next prototype contained two major sections of the application. First it added the ability for customers to submit new samples and then it also introduced the sample lists allowing the customers to view all of their samples.

Prototype 4 The fourth prototype added all the management functionality required by the staff at the centre to move the samples through each stage of processing.

Prototype 5 The fifth prototype was used to introduce the ability to attach result files to a sample allowing the customer to download or view them.

Prototype 6 The final prototype added the drawing tool to the sample submission page.

In this section I will discuss the development stage of each prototype detailing any difficulties that were experienced.

2.5.1 Prototype 1

The first prototype involved producing a new modern layout to replace the out-dated existing layout currently used in the existing system. This involved designing a new universal HTML & CSS layout to be used on each of the pages on both the customer web application and the administration web application. I first decided upon a light grey and blue colour scheme for the site before moving onto designing the HTML structure of the pages.

A major concern when developing this first prototype was to ensure that the new layout was compatible with all major browsers so that the system displayed identically in each one.

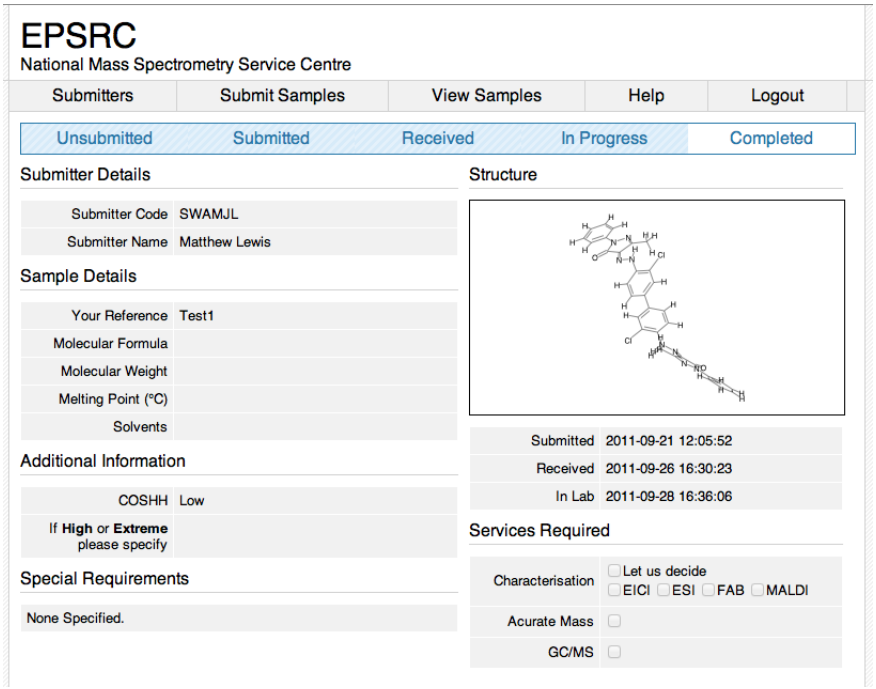

Figure 1: New HTML/CSS Layout

Overall, I feel that the new design for the system is in-line with todays standards but still keeps a simple and clean look and feel.

2.5.2 Prototype 2

The next prototype was used to introduce the authentication of the centre's customers onto the new system. This involved producing a new login screen for the system together with the logic for authenticating user's credentials against those stored in the database.

This prototype was also used to implement the 'submitters' functionality allowing users to add, edit and delete submitter accounts. The submitter accounts are used to identify individuals within an organisation so that they can identify who submitted each sample to the centre. During prototype 3 the ability to choose what submitter to submit a sample under was added.

While adding the submitters functionality I found the existing database structure for storing submitters to be problematic and, with permission from the centre, I modified the structure.

2.5.3 Prototype 3

This prototype had required the most amount of time during the development of the project as a whole. It contained two major parts of the system; the ability to submit new samples and the lists of all samples already submitted.

I began with creating a simple and functional form for the customers to complete when submitting a new sample. This form requires that the user enters all required data about their sample while also allowing them to decide which services they require from the centre. This form can be seen in Figure 3.

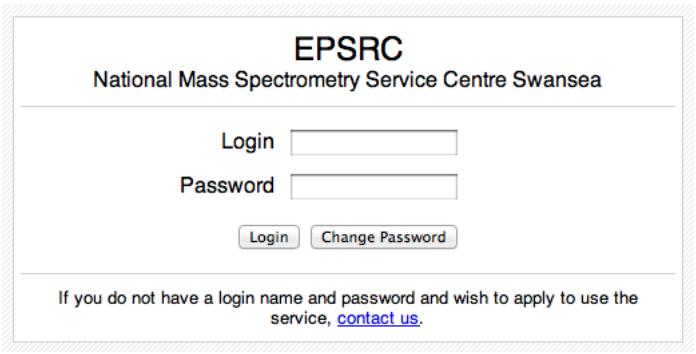

Figure 2: Customer Login Screen

Along with entering basic data about their sample the customers can also provide a sample structure file (.mol). Once uploaded, the sample structure is displayed graphically in the form. An example of the system displaying a chemical structure file can be seen in Figure 1.

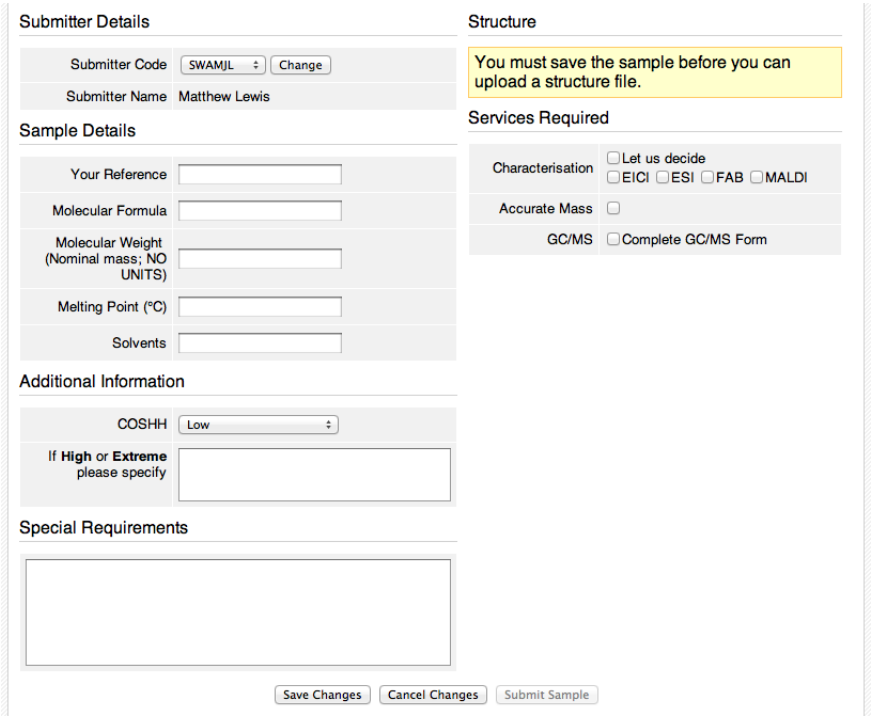

Figure 3: New Sample Form

The next major part of the system I introduced in this prototype was the ability to view the lists of samples and to be able to filter them by certain criteria. Each sample can be in one on five stages; unsubmitted, submitted, received, in lab and complete. For each one of these categories there will be a list of samples that are currently at this stage. In order to organise the 5 sample lists I introduced a tab bar with 5 tabs, one for each stage.

Clicking on each of the tabs displays the list of samples that are currently at that stage in the

Figure 4: Tab bar displaying five sample categories

lab. However, as it is possible for there to be hundreds of samples in each list I added the ability to filter the samples to within a specified date range.

Figure 5: Filter bar allowing for filtering samples

Along with the ability to filter samples I also added basic pagination to the sample lists. This allows the user to choose how many samples they wish to view per page with the rest being accessible by selecting a page number. If desired, it is also possible to view all the samples in one list.

2.5.4 Prototype 4

The fourth prototype was designed to add all the management functionality required by the staff at the centre in order for them to move the samples through each stage of processing. For example, moving a sample from the 'In Progress' stage to the Completed Stage.

When moving a sample from 'Submitted' to 'Received' the user assigns the sample a sample code that is used internally by the centre to uniquely identify samples. This code is also attached to the physical sample received via post and essentially ties the online data to the sample vial so that it can be tracked while at the lab.

To move a sample from 'Received' to 'In Progress' involves finding the record on the web application and setting it as 'In Progress' by clicking a button. This then moves the sample into the 'In Progress' list and will allow the staff at the centre to attach analysis results to the sample record. However this functionality is currently being completed in prototype 5. While 'In Progress' the staff can also record data about what analysis techniques have been performed on the sample. This can be seen in Figure 6.

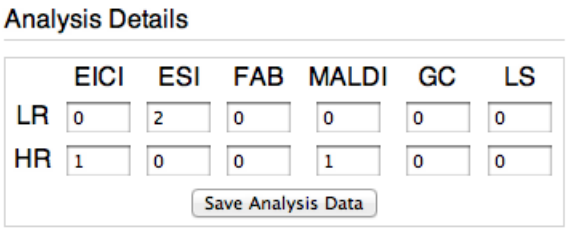

Figure 6: Recording analysis techniques used

At each stage I have also allowed for a sample to be moved back a stage in case any errors were made. It is also possible to unsubmit a sample if the submitter has missed any information that may be needed during the analysis.

2.5.5 Prototype 5

The fifth prototype was used to add the functionality for attaching results to samples after they have been analysed by the lab.

Currently, during analysis of the sample, many different result files are generated by the various machines in the lab and are stored in a directory. I designed this prototype to list the various result files to the user and allow them to choose which files to attach to the sample so that they could be downloaded by the customer.

The process of attaching files consisted of creating a zip archive into which the selected files are put. This zip archive is then moved into a directory from where it can be downloaded by the customer. The prototype was also used to archive the sample files into a hierarchy used by the centre.

2.5.6 Prototype 6

The sixth prototype involved implementing the chemical structure drawing tool into the system so that customers could draw their own structures which would be saved and associated with a certain sample.

To complete this prototype I used a third party chemical sketching tool which is provided as part of the ChemDoodle Web Components Javascript library. The library was incredibly simple to understand and I managed to implement all the required functionality in a small amount of time.

2.6 Testing Process

While developing the applications I made sure that they were continually tested at all times to ensure that all functionality worked correctly and as required. During the development I performed numerous unit tests on the code and if any test failed, it was corrected and retested immediately before moving on.

After completing the development of the whole system it was important to make sure that all the requirements set out before starting were satisfied. This involved undertaking acceptance testing on the system.

- A test suite was designed to ensure that the applications satisfy each of the requirements originally set out.
- Each test case was given a description explaining what the test is actually testing, the requirement ID that the test refers to, the acceptance criterion and the outcome of the test.

3 Challenges

3.1 Existing Database

While developing the system the major challenge I faced was due to the fact that the current system used at the NMSSC was to remain compatible with all the data produced by the new system. Ultimately, this meant that the database structure employed by the old system had to remain the same and that the new system would have to work with the existing tables and fields.

Once of the problems that arose due to the existing database structure was that it was not normalised and there was a risk of data redundancy. For example, when samples are in the 'Unsubmitted' stage they are stored in one table named 'Samples_pending'. When they are submitted by the user the whole sample record is moved from the 'Samples_pending' table to and identical table named 'Samples_in'. Both tables were required to contain the same fields and data types. By employing this structure it made a number of tasks, such as finding unique sample references, significantly more complicated than if the database was fully normalised.

To overcome this challenge, I decided to separate the database manipulation logic from the rest of the code for the system. This provided an abstract layer to the application code allowing it to use the database without worrying about the specific SQL queries. This approach also helped when any modifications needed to be made to the tables and resultant queries. Instead of the query being replicated multiple times throughout the system it could be found in a single function. Any change to the query would have no impact on the code that uses that database function.

Although I was unable to make any significant changes to any of the table structures, I was able to add additional fields to certain tables. This allowed me to add additional functionality or simplify processes that would have been significantly more complicated otherwise. For example, the current system utilised the five date fields (DateReceived, DateInLab etc.) to calculate which stage a sample is at. However, due to the data type of those fields, it was not always reliable. I changed this process by adding a field 'SampleStage' with incrementing values for each stage.

3.2 Browser Compatibility

Another major challenge I faced so to produce a web application that was compatible across the range of different browsers that might be potentially used by the users. Each browser's engine works differently and can mean that one layout that works in Firefox, for example, may not work in Microsoft's Internet Explorer. This risk was avoided by thoroughly testing all page layouts on a multitude of browsers to ensure that the page is displayed the same in each one and all functionality works the same.

The only issue remaining with the project and cross-compatibility is that the structure viewer and drawing tool required HTML5 and Javascript. However, it is still possible for users to upload a structure without being able to view it so it is only a minor issue. Most modern web browsers provide HTML5 and Javascript functionality so only those on older non-compatible browsers would be affected.

4 Technology Choices

4.1 PHP & MySQL

The centre's existing system was built using ASP, an outdated web technology. From the beginning of the project, the aim was to rebuild the system using a more current technology. It was also required that there were no restrictions on the type of web server hosting the system. As a result of these requirements PHP was chosen as the language to develop the system in. The existing system also already interacted with a MySQL database so PHP, known for its popularity with MySQL, was again the obvious choice.

Instead of using PHP the only other option would have been ASP.NET with C#. However as this is a proprietary system that runs on Windows web servers it would have restricted the centre

to only using Windows-based web server.

Both PHP and MySQL have extensive support bases and documentation available on the Internet. Another advantage was that I have also had a large amount of experience developing web applications using both technologies and resulted in a minimal amount of issues during development.

4.2 ChemDoodle Web Components

One of the new features which I added to the system was the ability to view the chemical structure files that have been uploaded and also provide the ability for users to draw their own using a web-based tool. To achieve this functionality I used an external Javascript library called 'ChemDoodle Web Components'. The library utilises HTML5 and Javascript to provide many different canvases to the user such as the structure sketcher/viewer. It provides the ability to manipulate structures in both 2D and 3D and calculating the number of atoms and bonds.

5 Reflection

5.1 Mistakes

Overall the development process went extremely well and I believe that if I was to do the project from the beginning again I would do it exactly the same way. All the initial goals of the project were achieved successfully and I believe this is due to the careful identification of the requirements and the specifications of each. Also, being able to constantly communicate with the lab about any piece of functionality meant that there was no part of the system that had to be changed significantly after it was developed.

5.2 Evaluation

Although the technology choices available for developing the project were limited, I feel that my previous experience using PHP and MySQL meant that this did not become an issue. It allowed me to concentrate on developing the system straight away rather than having to learn a new programming language or development process before or during development. This has meant that the focus had been on producing a high-quality project which might not have been the case if alternative, unfamiliar technologies were being used.

The project faced a number challenges right from the beginning with regards to use the existing database structure. However, I was able to successfully overcome each challenge without any significant setback during the development phase. Overcoming the challenges has improved by ability as a developer and has given me greater confidence for any challenges I may face in the future.

I believe that throughout the development of the project I have worked efficiently and have produced a project to a very high standard which has met all of the requirements set out before beginning. I feel after completing a major project while interacting with the client about features and functionality to include has given me valuable experience under the pressure of developing for a client in the future.