University of Strathclyde Glasgow

System design

W. H. Bell

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Abstract

A realistic scenario is presented, with an initial list of non-functional user requirements, user stories and a user interface design. Exercises are described that cover initial data model design and software architecture choices.

1 Introduction

The purpose of these exercises is to create an initial data model and software architecture design to fulfil a brief and support an existing user interface design. During a software development lifecycle, it is expected that the data model design might not be fully understood at the beginning of the process of software development. However, the core data model that is needed for data storage and to support the user interface features should be documented as quickly as possible. This allows developers to discuss the nature, type and relationships of the data with the stakeholders.

Architecture design patterns are used to organise a development project. They should be chosen to fulfil non-functional user requirements and allow features to be delivered that address functional user requirements or user stories. It is more difficult to change the architecture design pattern later in the development. Therefore, initial designs should be discussed with stakeholders as quickly as possible. This can enable the capture of additional non-functional requirements. Prototypes can be used to demonstrate the viability of the architecture choice by scaling computation, memory and network requirements to estimate the performance of the final application.

2 Brief

A laboratory that provides a medical sample testing service for hospitals and associated medical staff requires a web application to be constructed to record test data and present test results to remote medical staff.

Medical staff send samples to the laboratory by a special courier service. Before sending a sample to the laboratory, the remote medical staff member accesses the laboratory website and requests one or

more tests to be performed on the sample. The process of creating a sample record with associated tests should result in a unique number being created that is associated with one specific sample. The laboratory software should allow the remote staff member to print this unique number as a barcode, such that it can be attached to the sample. Once the barcode has been attached, the medical staff member posts it to the laboratory.

The laboratory staff member who receives a sample, must update the sample status to indicate that the sample has been received. The sample is then handled by different laboratory technicians, who perform each test and update the associated test results. Each test is defined with an expected range of values, allowed upper and lower, caution upper and lower and danger upper and lower. The position of the test result within the upper and lower boundaries, should be used to set the status of the test result to “normal”, “caution” and “danger” respectively. If one or more test results that are associated with a sample have a “caution” status, then the sample should be set to “caution”. If one or more test results have a “danger” status, then the sample should be set to “danger”. A remote medical staff member should be able to access a sample and view the test results and test status.

The laboratories IT staff are very concerned that their main database should not be affected by cyber security issues. Therefore, they require that the database that is used to create the initial sample information is separate from the main test record database. They also require that the database that is used to provide information to the remote medical staff is separate from the main test record database and is not associated with the sample creation database.

3 Existing user requirements and user stories

Another company has performed the initial requirements capture and created a list of non-functional user requirements and user stories from the brief given in Section 2 and stakeholder workshops. The non-functional user requirements are given in Table 1, whereas the user stories are given in Table 2.

Table 1: Initial non-functional user requirements that have been written to fulfil the brief, which is given in Section 2.

Req. #	Description	Benefit
UR1	The medical staff member requires the ability to use a web site that is hosted by the laboratory.	Nothing is installed locally.
UR2	The medical staff member requires the ability to access the software using a graphical user interface.	Easier data entry and data review.
UR3	The medical staff member requires the ability to access the software from a remote network.	The staff member is able to access data directly.
UR4	The IT staff requires that the database that is used by the remote medical staff member to create a sample record is separate from the main testing database.	Protection from cyber security and network traffic loading issues.
UR5	The IT staff requires that the database that is used by the remote medical staff member to view test results is separate from the main testing database.	Protection from cyber security and network traffic loading issues.

Table 2: Initial user stories that have been written to fulfil the brief, which is given in Section 2.

Story #	Description
US1	As a medical user, I want to be able to create a sample record with a unique sample number, so that I can view associated data.
US2	As a medical user, I want a sample creation date to be recorded, so that I can keep track of when I requested a series of tests.
US3	As a medical user, I want to be able to view the sample number as a barcode, so that I can attach it to a sample.
US4	As a medical user, I want to be able to view a sample's status, so that I know if tests have been created.
US5	As a medical user, I want to be able to request that one or more tests are carried out on a sample, so that I can evaluate the results of the tests.
US6	As a medical user, I want to be able to view test results that are associated with a sample, so that I can understand if I need to take action.
US7	As a medical user, I want to be able to view a summary of a sample status, so that I know if I should look at the test results in more detail.
US8	As a laboratory technician, I want to be able to record a test result, so that I can save information that is associated with a sample.
US9	As a laboratory technician, I want to be able to review a test result, so that I can verify if a test has been successfully created.
US10	As a laboratory technician, I want to be able to review outstanding tests, so that I can take action to complete them.
US11	As a laboratory technician, I want to be able to record a value for each test result, so that I can save information from a test.
US12	As a laboratory manager, I want to be able to view the number of tests that have been performed as a function of time, so that I can monitor performance of the laboratory.
US13	As a laboratory manager, I want to be able to view the time taken to return test results for each sample, so that I can verify that samples are being processed within company guidelines.
US14	As a system administrator, I want to be able to define a test with test limits for "normal", "caution" and "danger" and associated units, so that another type of test result can be recorded.
US15	As a medical user, I want to authenticate to the software, so that I can view results that are associated with my samples.
US16	As a laboratory technician, I want to be able to authenticate to the software, so that I can record, view or update sample information that is associated with my account.

4 Existing user interface design

An initial user interface design that has been created to fulfil the brief discussed in Section 2 is presented in Figure 1 to 8.

- The login page is illustrated in Figure 1.
  - When a user connects to the web application, they arrive at the login page.
  - The login page provides information about the company and a “Login” button to authenticate to the web application.
  - Once a user has authenticated, they are redirected to the main menu page that is illustrated in Figure 2.
- The main menu page is illustrated in Figure 2.
  - The main menu page allows a user to select samples, tests, reports, logout and view their current user name and role.
  - If a user clicks on the “Samples” button in the menu bar, they are redirected to the samples list page that is illustrated in Figure 3.
  - If a user clicks on the “Tests” button in the menu bar, they are redirected to the test results list page that is illustrated in Figure 6.
  - If a user clicks on the “Reports” button in the menu bar, they are redirected to the reports page that is illustrated in Figure 8.
  - Clicking on the “Logout” button causes the user authentication to be forgotten. The user is then redirected to the login page that is illustrated in Figure 1.
- The samples list page is illustrated in Figure 3.
  - The samples list page displays the unique identifier, when the sample was registered by the medical staff member, when the sample was received by the laboratory staff, when the testing was completed and the testing status.
  - The date when the sample testing was completed is not shown if the sample testing has not been completed.
  - Clicking on the sample id causes the sample page to be shown, which is illustrated in Figure 4.
- The sample page and the associated summary tab is illustrated in Figure 4.
  - A user can view the status of the sample and select associated test data.
- The sample page and an associated test tab is illustrated in Figure 5.
- The test results list page is illustrated in Figure 6.

- A user can click on the test id to view or edit the test information, using the test page that is illustrated in Figure 7.
- A user can click on the sample id to view the sample information, using the sample page that is illustrated in Figure 4.

- The test result page is illustrated in Figure 7.
  - A laboratory technician uses the test result page to enter the results of a test.
  - The test name or test code can be selected from a drop-down menu or typed by hand.
  - The value of the result is checked against allowed value formats. In the example shown, the value is a dilution ratio.
  - The status value is automatically displayed by comparing the value with the allowed limits for the test.
- The reports page is illustrated in Figure 8.

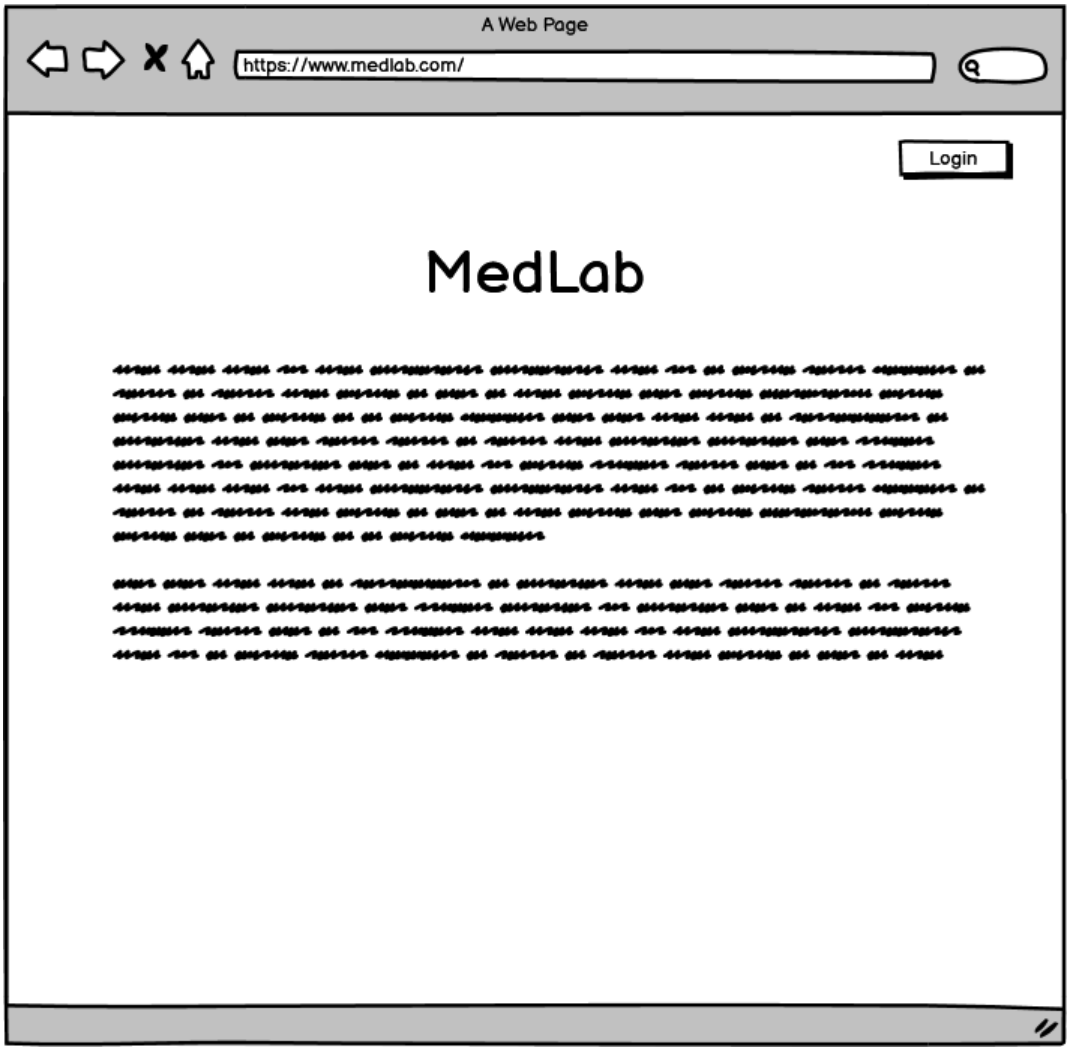

Figure 1: Application home page, before the user has logged in.

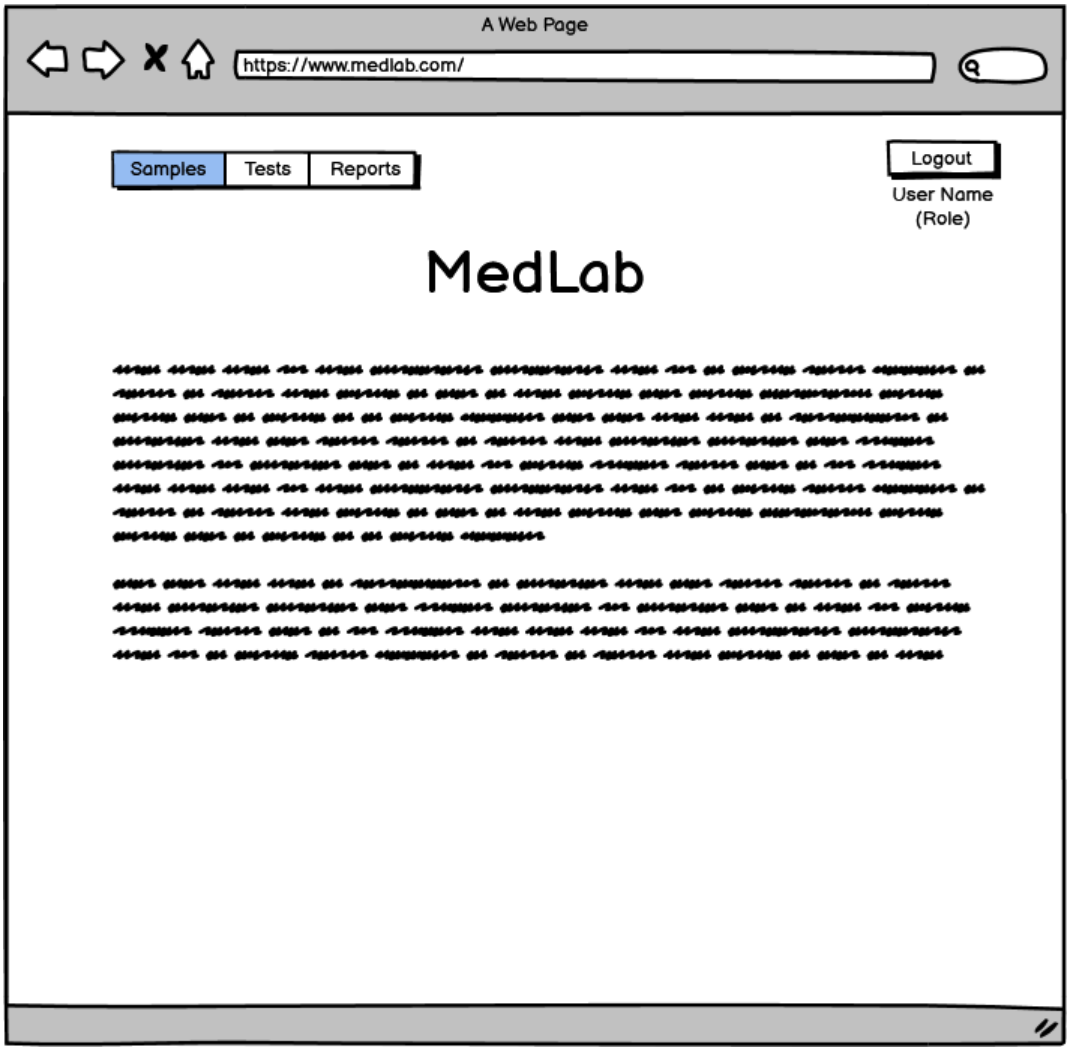

Figure 2: Application home page, after the user has logged in.

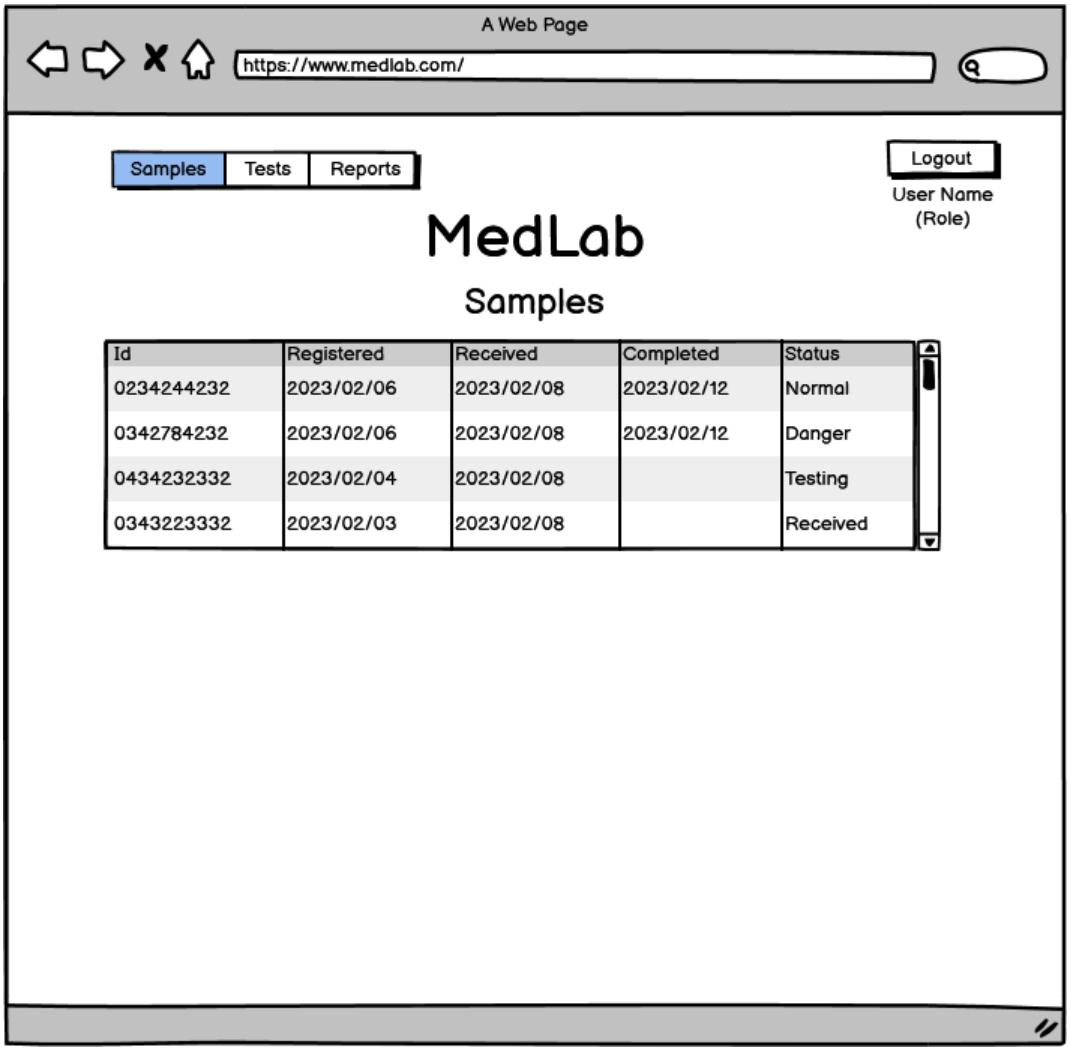

Figure 3: The samples list page, allowing a user to select a sample by clicking on the sample id.

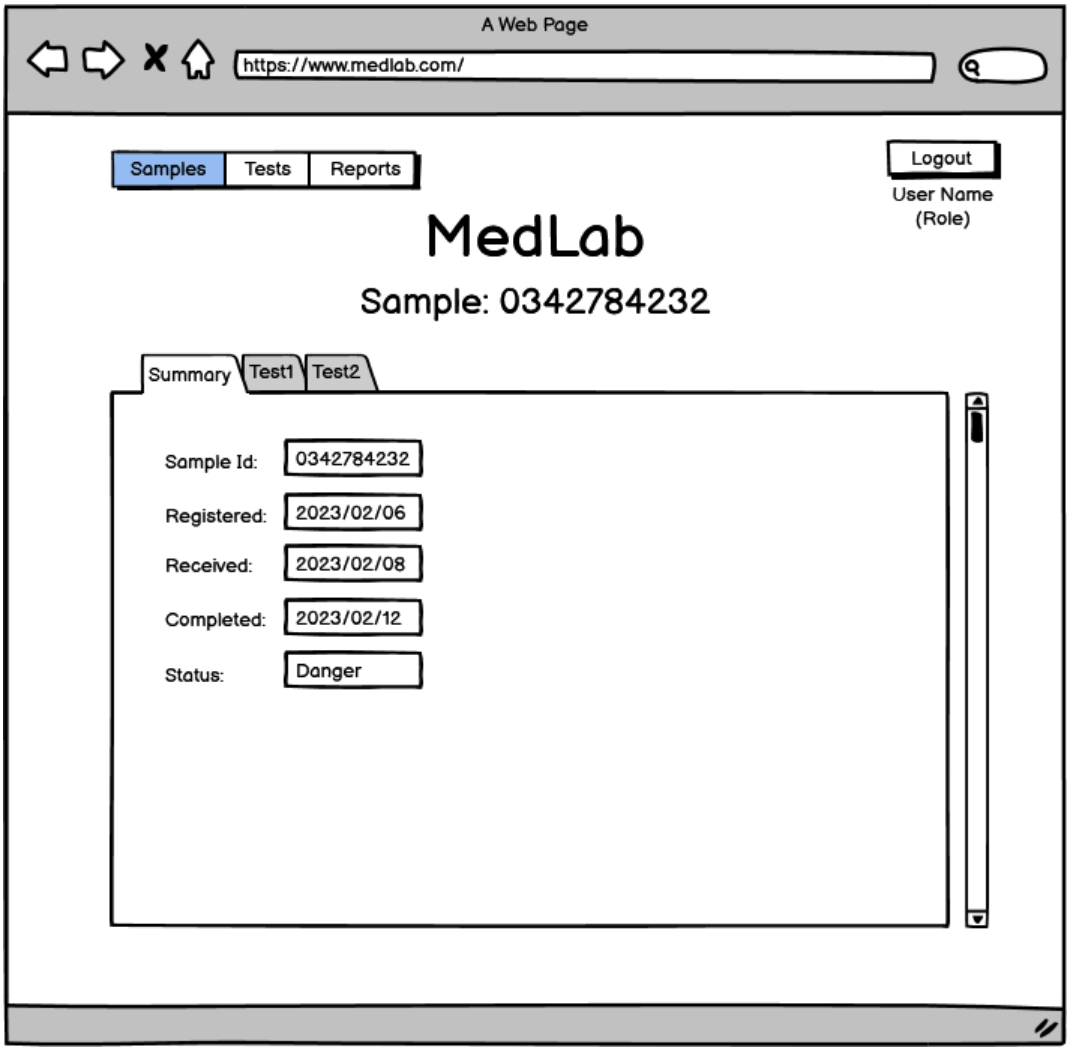

Figure 4: The sample summary page, allowing a user to view the summary information that is associated with a sample.

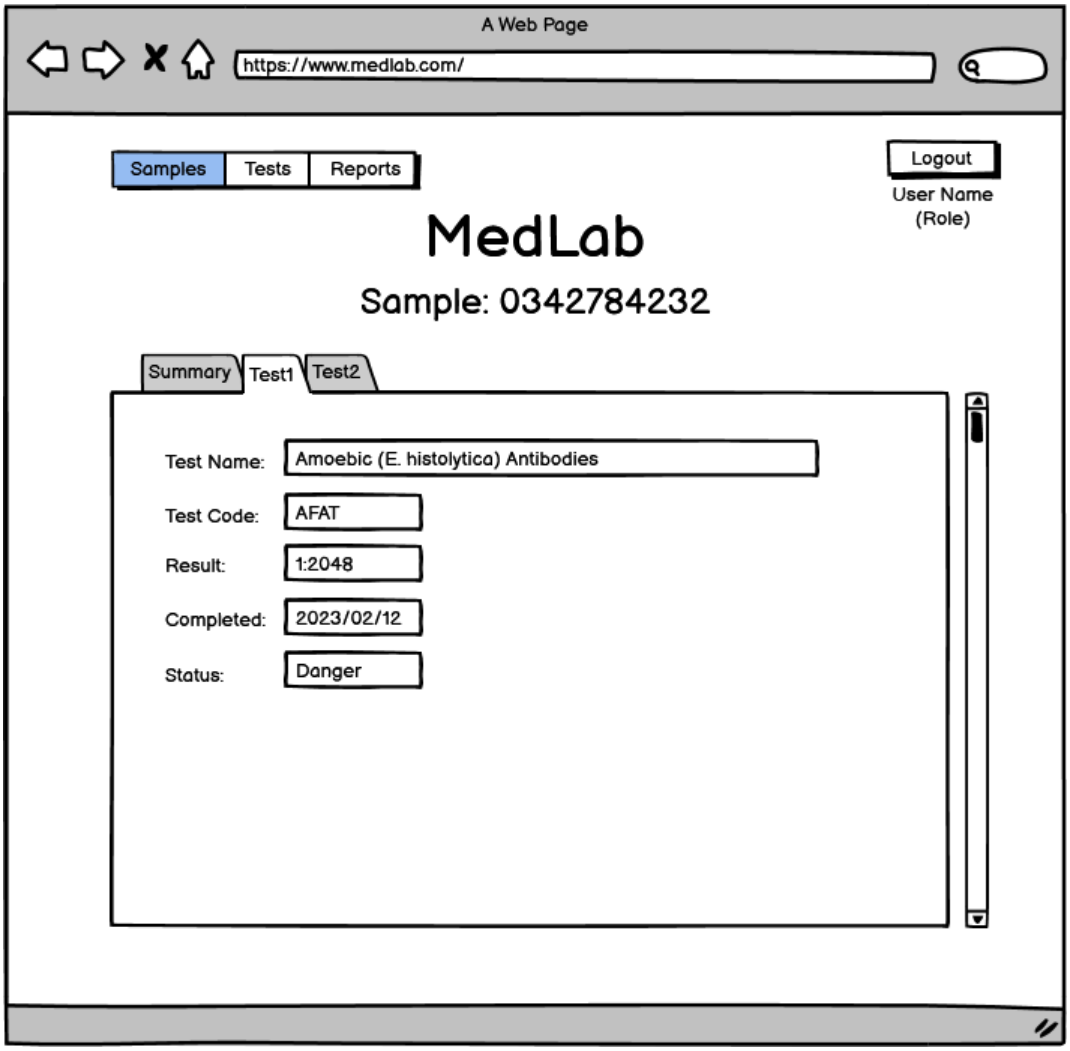

Figure 5: The sample test page, allowing a user to view test result information that is associated with a sample.

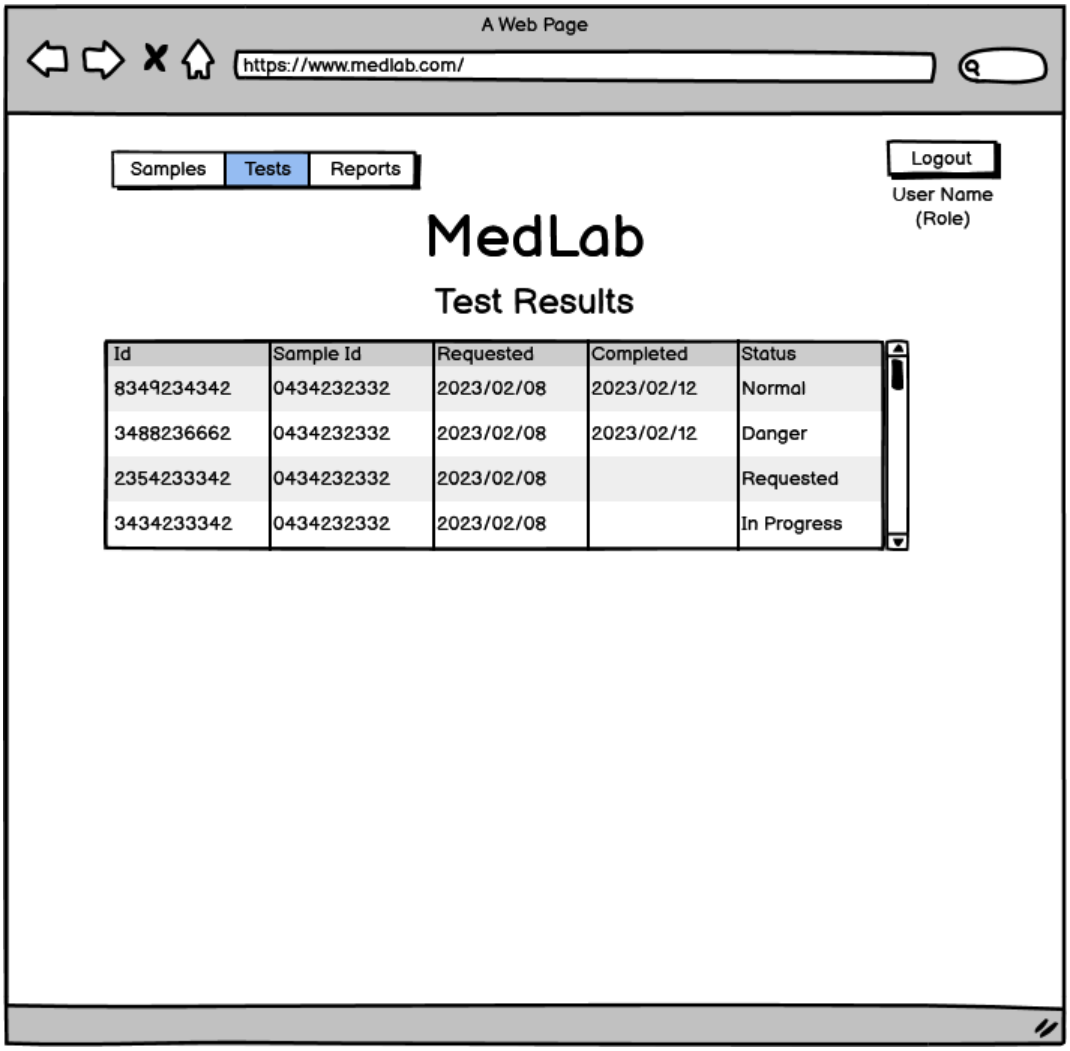

Figure 6: The test results page, allowing a user to select a test by clicking on the test id or a sample by clicking on the sample id.

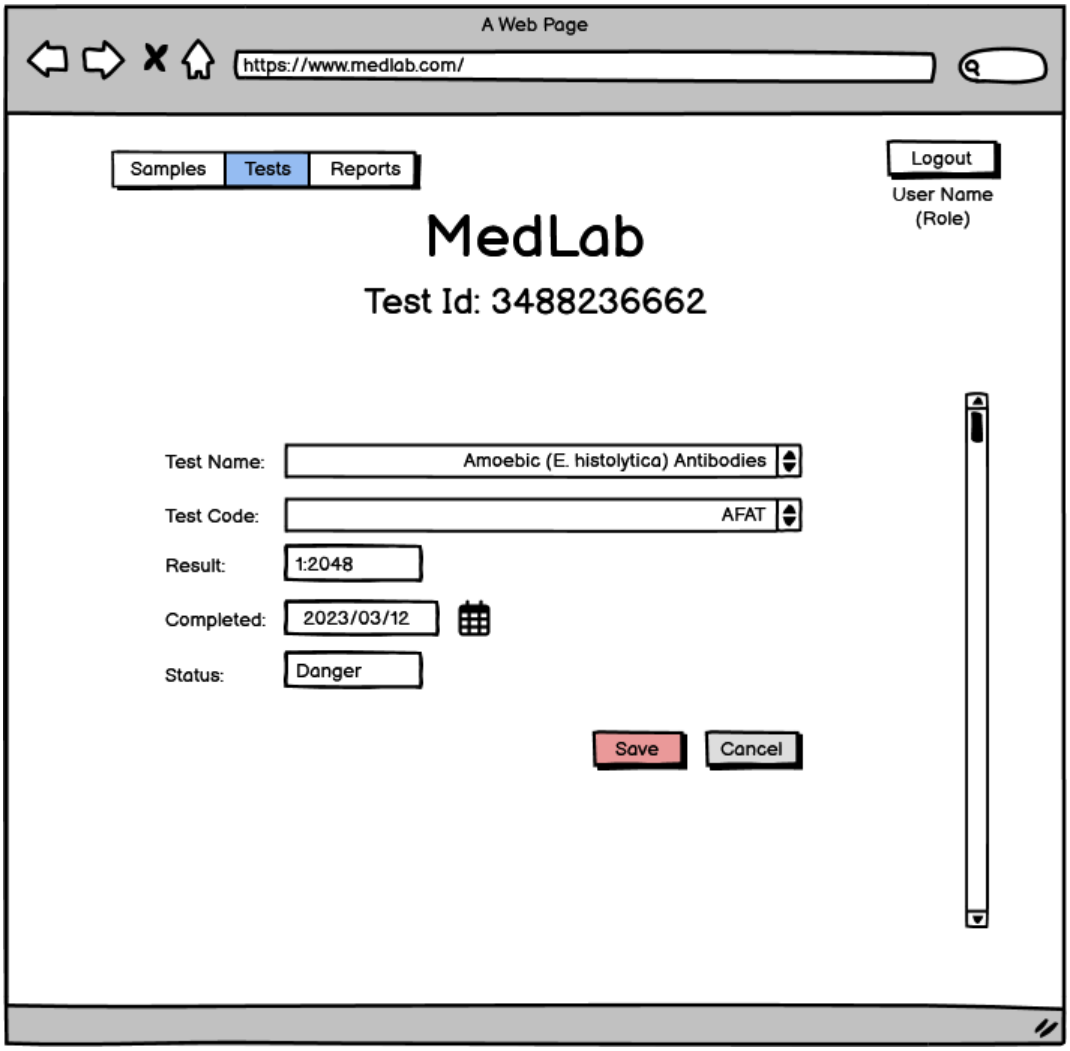

Figure 7: The test result page, allowing a laboratory technician to enter test rests.

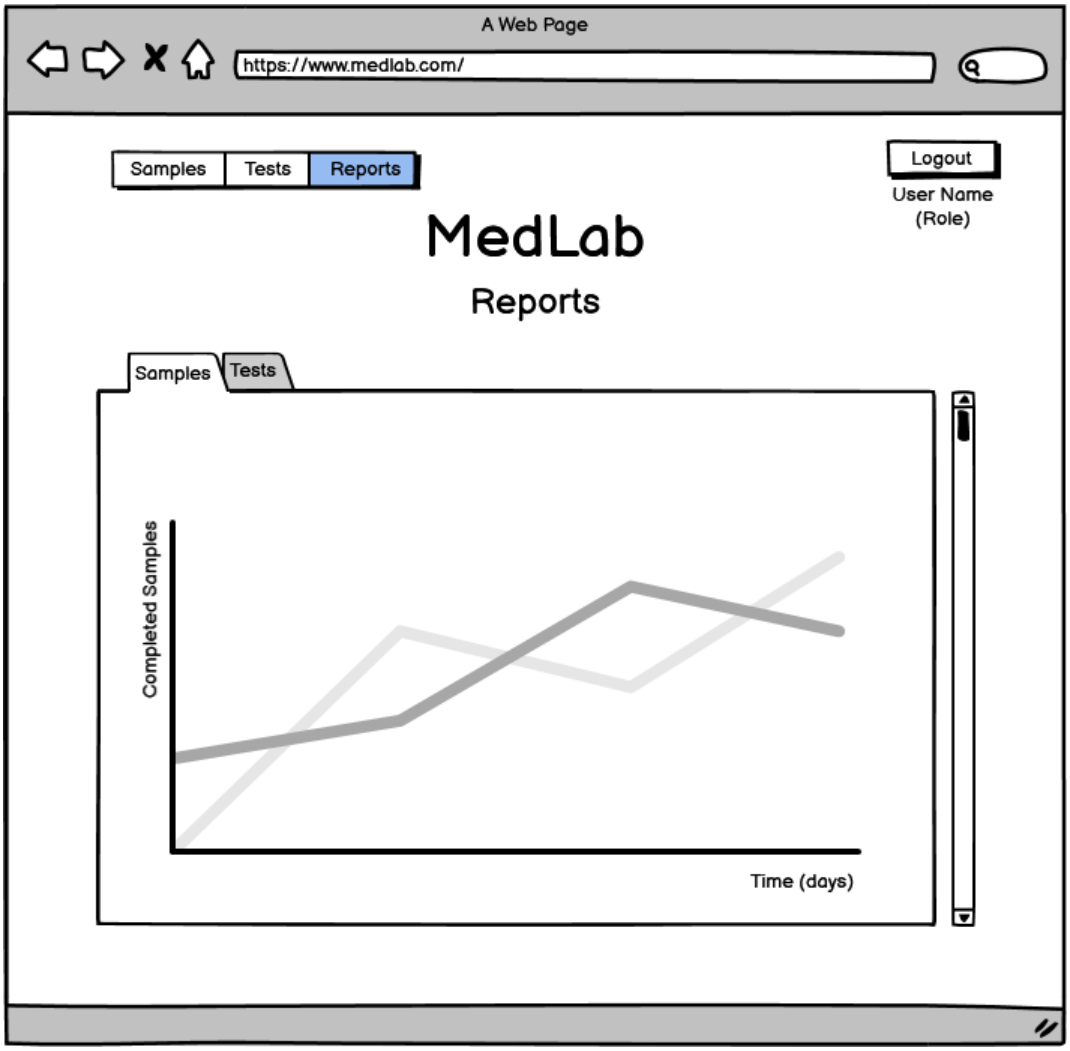

Figure 8: The reports page, allowing a manager to view the number of samples or tests that have been completed.

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5 Instructions

- Read the brief in Section 2 and examine the information that is given in Section 3 and 4.
- Discuss the brief and requirements, user stories and user interface design in a small group.
- Create an entity diagram with crows-foot notation, using https://app.diagrams.net/ or an alternative tool.
- Write a short description of the entity diagram and state how it fulfils the brief.
- Create an architecture design diagram that fulfils the brief.
- Write a short description of the architecture design diagram.