# **Introduction**

Healthcare is an integral part of every society, with hospitals being the centre of such activity. Thus, it is imperative that the healthcare process of a hospital is as nice an experience as possible for everyone involved. As a result, our team was tasked with enhancing the healthcare experience for patients attending the hospital by improving how they familiarise themselves with the department and/or ward which they are being seen or are staying in. This solution took the form of software through an interactive website which provides all the information a patient moving from the accident and emergency department to a ward in the hospital would need.

Our team used the rapid application development model in order to develop this application in order to provide for measurable progress of development and easy modification through compartmentalisation of system components. We created a user-friendly interface by keeping the end user in mind every step of the way. As far as the content of the site, it contains general information about the department/ward to anyone after they login with a guest ID and password. On the administrative side, administrative personnel can long on through entering their admin ID and password which must be approved before they can view the system. While logged in, they can manipulate certain information that is contained on the site such as updating the frequently asked question page by asking new questions.

One of the main areas our team focussed on was the quality of the application, and thus thorough testing played a large role in the development process. We utilised unit, integration and alpha testing to test the application as thoroughly as possible in order to detect faults which were rectified in the next software build.

In summation, given the importance of healthcare and its requirement for excellence we were tasked with this project and have done everything in our power to ensure it functions as it is supposed to and meets the needs of the patients.

# **Discussion**

# **Test Cases**

# **Unit Testing**

(See Appendix A for test case tables)

# **Test Scenario 1**

This series of test cases was used to test the unit function that stored the Guest and Child Name of the Guest User. For this we used both Equivalence Class Partitioning and Boundary Value Analysis to test varying data lengths entered into the input boxes, which would eventually be sent to another function that stores the data into the system database. In our first two test cases, we used Equivalence Class Partitioning to verify what would occur if the Guest Name and the Child Name were less than one character and if they were one or more characters. Using the formulae below, we were able to derive two test cases that would satisfy the goals intended.

The goal for Test Scenario 1-1 was to confirm that the unit function would store both Guest Name and Child Name fields as long as they are one character or more. After entering a three character Guest Name and a four character Child Name, the function was allowed to execute successfully. As a result, our goals were met in this instance. The goal for Test Scenario 1-2 was to confirm that the unit function would not allow either Guest Name or Child Name to be stored as empty fields. After refusing to enter values for Guest Name and Child Name, the function prompts the user to enter a value for each field. Since the function never stores the Guest Name and Child Name unless values are written, then our goal was satisfied. Since these two test cases satisfied four conditions, less test cases needed to be executed, thus saving valuable testing time and allowing an increase in productivity.

*Let Guest Name = G and Child Name = C*

# Equivalence Class Partitioning (Test Scenario 1-1 to 1-2)

G = 0, C = 0 satisfies G < 1 and C < 1

G = 3, C = 3 satisfies G >= 1 and C >= 1

Afterwards, we used the formulas below that were derived using Boundary Value Analysis, to create five more test cases. Unlike Equivalence Class Partitioning, these test cases were able to test the range of valid amounts of entered data. In this scenario, the lowest valid value amount allowed is 1 and the highest allowed value amount is 20. The goal of Test Scenario 1-3 was to confirm that 10 characters is a valid amount for both Guest Name and Child Name. After using the test data from the table, the function executed successfully. Therefore, our goal was achieved. The goal of Test Scenario 1-4 was to confirm that 1 character is a valid amount for both Guest Name and Child Name. After using the test data from the table, the function executed successfully. Therefore, our goal was achieved. The goal of Test Scenario 1-5 was to confirm that two characters is a valid amount for both Guest Name and Child Name. After using the test data from the table, the function executed successfully. Therefore, our goal was achieved. The goal of Test Scenario 1-6 was to confirm that 20 characters is a valid amount for both Guest Name and Child Name. After using the test data from the table, the function executed successfully. Therefore, our goal was achieved. The goal of Test Scenario 1-7 was to confirm that 19 characters is a valid amount for both Guest Name and Child Name. After using the test data from the table, the function executed successfully. Therefore, our goal was achieved. These five test cases had high adequacy since they were able to satisfy ten Boundary Value Analysis conditions in just five test cases. This saved valuable testing time and allowing an increase in productivity.

# Boundary Value Analysis (Test Scenario 1-3 to 1-7)

G = 10, C = 10 satisfies nominal values for G and C

G = 1, C =1 satisfies minimum for G and C

G = 2, C = 2 satisfies just above minimum for G and C

G = 20, C = 20 satisfies maximum for G and C

G = 19, C = 19 satisfies just below maximum for G and C

# **Test Scenario 2**

This series of test cases was used to confirm that the unit function would only allow a successful login when receiving a valid Admin Name and Password. In these scenarios, Boundary Value Analysis would not be usable since we are dealing with Boolean expressions. Therefore, we used the Equivalence Class Partitioning formulae below to derive two test cases. The goal of Test Scenario 1-1 was to confirm that the unit function would allow successful access after receiving a valid Admin Name and Password from the Access Control List. After the test data was entered, the function successfully executed to completion, allowing us to navigate to the Admin homepage. Therefore, our goal was achieved. The goal of Test Scenario 1-2 was to confirm that the unit function would not allow successful access after receiving an invalid Admin Name and Password from the Access Control List. After the test data was entered, the function prompted for us to enter valid Login data. Since we were unable to enter the website without valid Login data, our goal was achieved. These test cases proved very adequate since they allowed us to achieve 4 conditional goals in just two test cases. This allowed us to reduce testing time, thus improving productivity.

*Let A = Admin Name and P = Password*

# Equivalence Class Partitioning

A = Valid, P = Valid satisfies A = Valid and P = Valid

A = Invalid, P = Invalid satisfies A = Invalid and P = Invalid

# **Test Scenario 3**

This series of test cases was used to confirm that the unit function would only allow a successful login when receiving a valid Guest ID and Password. In these scenarios, Boundary Value Analysis would not be usable since we are dealing with Boolean expressions. Therefore, we used the Equivalence Class Partitioning formulae below to derive two test cases. The goal of Test Scenario 1-1 was to confirm that the unit function would allow successful access after receiving a valid Guest ID and Password from the Access Control List. After the test data was entered, the function successfully executed to completion, allowing us to navigate to the next page, where the user would enter their Guest Name and Child Name. Therefore, our goal was achieved. The goal of Test Scenario 1-2 was to confirm that the unit function would not allow successful access after receiving an invalid Guest ID and Password from the Access Control List. After the test data was entered, the function prompted for us to enter valid Login data. Since we were unable to navigate to the next page without valid Login data, our goal was achieved. These test cases proved very adequate since they allowed us to achieve 4 conditional goals in just two test cases. This allowed us to reduce testing time, thus improving productivity.

*Let G = Guess ID and P = Password*

# Equivalence Class Partitioning

G = Valid, P = Valid satisfies G = Valid and P = Valid

G = Invalid, P = Invalid satisfies G = Invalid and P = Invalid

# **Test Scenario 4**

This series of test cases was used to confirm that the unit function is able to accurate determine whether a MySQL database was created or not. In the case where a database was not created, the function would create one. In these scenarios, Boundary Value Analysis would not be usable since we are dealing with Boolean expressions. Therefore, we used the Equivalence Class Partitioning formulae below to derive two test cases. The goal of Test Scenario 1-1 was to confirm that the unit function would recognize that a database was already created. Since the function executed without displaying a message, then a database was already created. Therefore, our goal was achieved. The goal of Test Scenario 1-2 was to confirm that the unit function would recognize that a database was not created and therefore create one. Since the function notified us that a database was created, then a database was successfully created. Therefore, our goal was achieved. These test cases proved very adequate since they allowed us to have simple and accurate tests that can be executed in reasonable time. This allowed us to reduce testing time, thus improving productivity.

*Let D = Database*

# Equivalence Class Partitioning

D = Created

D = Not Created

# **Test Scenario 5**

This series of test cases was used to confirm that the unit function is able to accurate determine whether an Access Control List table and User Log table were created. In the case where neither table was created, the function would create one. In these scenarios, Boundary Value Analysis would not be usable since we are dealing with Boolean expressions. Therefore, we used the Equivalence Class Partitioning formulae below to derive two test cases. The goal of Test Scenario 1-1 was to confirm that the unit function would recognize that an Access Control List table and a User Logs table were created. Since the function executed without displaying a message, then both tables were already created. Therefore, our goal was achieved. The goal of Test Scenario 1-2 was to confirm that the unit function would recognize that neither table was created and therefore create both tables. Since the function notified us that both tables were created, then our goal was achieved. These test cases proved very adequate since they allowed us to have simple and accurate tests that can be executed in reasonable time. This allowed us to reduce testing time, thus improving productivity. What makes these tests so special is that once an Access Control List table is created, a User Logs table is automatically created as well. Therefore, the test cases only needed to check for the availability of an Access Control List table. Once that was available, so was a User Logs table as well.

*Let A = Access Control List and L = User Logs Table*

# Equivalence Class Partitioning

A = Created, L = Created satisfies A = Created and L = Created

G = Not Created, L=Not Created satisfies A = Not Created and L = Not Created

# **Test Scenario 6**

This series of test cases was used to confirm that the unit function is able to accurate determine whether a Frequently Asked Questions (FAQ) table was created or not. In the case where a FAQ table was not created, the function would create one. In these scenarios, Boundary Value Analysis would not be usable since we are dealing with Boolean expressions. Therefore, we used the Equivalence Class Partitioning formulae below to derive two test cases. The goal of Test Scenario 1-1 was to confirm that the unit function would recognize that a FAQ table was already created. Since the function executed without displaying a message, then a FAQ table was already created. Therefore, our goal was achieved. The goal of Test Scenario 1-2 was to confirm that the unit function would recognize that a FAQ was not created and therefore create one. Since the function notified us that a FAQ table was created, then a FAQ table was successfully created. Therefore, our goal was achieved. These test cases proved very adequate since they allowed us to have simple and accurate tests that can be executed in reasonable time. This allowed us to reduce testing time, thus improving productivity.

*Let F = FAQ Table*

# Equivalence Class Partitioning

F = Created

F = Not Created

# **Integration Testing**

(See Appendix B for tables)

These series of test cases were used to analyse each main functionality of our web application. The three main functionalities are Login process for a Guest, the Login process for an Admin staff member and updating the FAQ table. Test 1-1 and Test 1-2 test the integration between the Database Check Unit function and the User Access List/User Log unit function during both a successful and unsuccessful Admin login. The goals were to successfully login using both valid and invalid Login credentials. If a user was on the Access Control List, they would be allowed passage to the Admin homepage. Otherwise, the user would be prompted to enter a valid Admin Name and Password, therefore never gaining access to the homepage. Since each test executed successfully, our goals were achieved.

Test 2-1 and Test 2-2 test the integration between the Database Check Unit function and the User Access List/User Log unit function during both a successful and unsuccessful Guest login. The goals were to successfully login using valid Login credentials and being unsuccessful using invalid Login credentials. After a successful reference to the Access Control List table, they should be able to navigate to the Guest homepage successfully after entering a valid Guest Name and Child Name. In this situation, a user would be prompted to enter a valid name of at least one character, otherwise they would be at an impasse. Since each test executed successfully, our goals were achieved.

Test 3-1 and Test 3-2 test the integration of functions used when the FAQ table is checked, updated and data is displayed on the page. The goals were to successfully enter a new Question and Answer and be submitted to both the FAQ table and the FAQ simultaneously. This distinguishing tests show that this would be possible whether an FAQ table existed before or not. Since both tests executed successfully, our goals were achieved.

These test cases were highly adequate since they involved using all relevant combination of functions that would be needed to achieve each requirement outlined in the assignment. These tests cases allowed for a better understanding of how exactly each necessary function interacted with one another. For instance, an FAQ or User Log table cannot be updated if one does not exist. A user’s credentials cannot be verified if there is no Access Control List table to refer to. If a guest user is allowed to navigate to an Admin privileged page, then they would have access to update the FAQ table. Upon successful execution and completion of these separated functionality tests, we had high assurance that the Alpha tests would execute just as smoothly and easily.

# **Alpha Testing**

(See Appendix C for tables)

This test case was used to verify that the system could execute uninterrupted successfully to achieve all the goals outlined. Using the Decision table below, we were able to get an adequate perspective of how to arrange these goals within our test case. Our goals were to present a User-friendly interface that would allow us to successfully enter ten FAQ Questions and Answers for ten 10 different employees. In order for these staff members to that, they needed to log into the web application using a valid Admin Name and Password which would be referenced with the Access Control List. This entire process was then to be simulated for six months, with each result being printed to a file storing this information. Throughout this test case we were able to successfully achieve each goal. Our confirmation for the achievement of these goals came when the information was displayed on the file as requested. This test case had high adequacy because it provided a simple and detailed step by step process that sought to achieve each goal consecutively in reasonable time. Within the test case, steps were taken to verify successful execution of each goal.

# Decision Table

|  |  |  |  |
| --- | --- | --- | --- |
| Admin Name Entered | Y | - | N |
| Password Entered | Y | N | - |
| User Log Updated | X |  |  |
| Can Update FAQ Table | X |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| Guest Name Entered | Y | Y | - |
| Password Entered | Y | Y | N |
| Guest/Child Name Entered | Y | N | N |
| User Log Updated | X | X |  |

# **3. Rapid Application Development (RAD)**

Our team chose to use the Rapid Application Development model to tackle the requirements of this Assignment. This model was ideal since it allows for rapid development of a smaller project like ours, whereas the Spiral Process Model would have been more ideal for a larger project which involved continuous enhancements. RAD allowed us to have more flexibility during our web application design and implementation. For example, we were able to build a rapid prototype of the web application, however quick changes were needed consistently, to allow the application to continuously adapt to the requirements of the assignment. Since our team was made up of a mix of developers of varying experience, this agile method was perfect to allow each other to compliment the lacking experience in each area, whether that being during design and implementation of the website, or during the testing and documentation phase.

Since we needed to have this project completed in a short period of time, RAD was the perfect choice. Without the restrictive spiral model, we were able to have a working prototype of the web application completed within a few days. Since the requirements allowed for flexibility in the design and look of the application, we were able to continually implement more user friendliness to our web application with each update. It was very important for us to have an application that was adaptable to changes. The RAD model usually has less risk associated with it than the Spiral Model, and considering that this is an application to be used in the Health industry, low risk web application development was a must.

One of the other reasons we chose to use RAD, was because it allowed us to quickly have a visual aspect of the requirements needed. This visual representation allowed us to identify the flaws easier, resulting in less flaws that needed to be addressed with each porotype cycle.

# **4. Rapid Application Development Phases**

# **Requirements Planning (Definition Stage)**

First we analysed the requirements and was able to development a business model for this project. We identified what was the most vital and necessary information needed and made sure that a heavy focus was made. For instance, in an Accident & Emergency, the most important information to a patient would be how and when they would be cared for. We realized that it had to be made easily apparent to any guest using the website, and also for any authorized staff that needed to update that information.

We also continued to analyse the other requirements, making sure that they were clearly defined and understood amongst our team. It was vitally important that the goals were clearly evaluated, in order to have the most correct build of the first stage prototype. Although a prototype can be altered later, with Rapid Application Development, speed and accuracy are the defining attributes. The less errors that are apparent in the first stage of the prototype, the less time would be needed to have to fix them before addressing the actual, correct requirements.

# **User Design (Design Stage)**

During this stage is when we got the opportunity to take the defined requirements, and turn them into a visual display. Since realistically we were not able to meet with clients for this project, we all at some stage took on the roll as a client by sharing ideas with one idea and continuing to consistently improve the design. Our main focus was usability, mobile responsiveness and accuracy to requirements. It was at this stage that we continually tested and tweaked each design until we were able to settle on a design that best fit the requirements of the assignment. At the end, we believe that we came to the more satisfying design for this project.

# **Rapid Construction (Development Stage)**

During this stage we took the web application prototype and transformed it into a working model. Although at this stage changes could still be made, due to the iterative design phase, we were able to quickly and smoothly finalize the development of this application. It was during this phase that we were able to conduct unit testing of each function, then integration testing of each functionality. Finally, we were able to conduct alpha testing of the entire web application.

# **Implementation (Deployment Stage)**

At this stage the final tests were done to confirm full functionality before finally launching the web application fully. Upon completion, we had a functioning application that could be used with node.js to satisfy the requirements outlined in the assignment.

# **5. Maintenance**

One of the main concerns of the development team after the application is fully launched is the subject of maintaining the application. Maintenance, as it applies to this specific instance, would be modifications and updates applied to the application to keep it up-to-date and tuned to the ever-changing world of technology and the environment it is operating in, this case being a web environment. In other words, we mainly concerning ourselves with Adaptive Maintenance.

The development team had multiple discussions as to why an adaptive approach would be best and our reasoning as to the importance of Adaptive Maintenance is as follows: The software ecosystem, especially those concerning web applications is in a constant state of flux. Regular maintenance is required to adapt to these never-ending changes. Whether it changes in work patterns of staff, software platforms, compilers, updating the hardware (servers, desktop machines, etc.), they all affect the functionality of the application. To ensure that the maintenance goes as smoothly as possible, we intend to do the following:

1. Study the current landscape in which the application operations for any sign of changes.
2. Analyse any changes to obtain a thorough understanding of their direction and timeline.
3. Deduce how our customer base will be affected at predictable points in the future or if they are being affected now.

The most likely cause of maintenance would be updates to the web browser the application operates in. For example, say that our team discovers that the latest version of Google Chrome, Firefox or Safari released in developer-only beta is/will be incompatible with the current build of the application. Looking at the trend of releases in the past, we will know that within the span of a few months since the beta's release, our application will be incompatible with the latest versions of these web browsers when they go live. Thus we can work on updating our website to work with these new versions instead of waiting until they are released, customers run into issues, they complain and we have to spend extra time and resources performing Corrective Maintenance to develop a patch to solve these issues.

# **6. Recommendations**

Software quality is an extremely important principle whose processes must be applied at many stages in the software development life cycle, and the maintenance stage is no different. Software quality can be defined as “the degree to which a set of inherent characteristics fulfils requirements” [1]. Thus, software maintenance, which involves the changing or evolution of the software product after delivery and the surfacing of new user requirements, must also meet these quality standards to ensure these new requirements are met fully. An existing organisation can improve their software quality approach by improving quality management processes and encouraging a software engineering culture devoted to culture.

The software quality management (SQM) process defines ‘processes, process owners, and requirements for those processes, measurements of the process and its outputs, and feedback channels.’ [2]. The SQM processes consist of many different processes, some which will directly find defects and some which will show where further evaluation may be needed. The SQM processes include the quality assurance process, verification process, validation process, review process and audit process. While these processes may be implemented to some extent by the organisation currently, there is always room for improvement.

The first SQM process which would need to be implemented or improved would be the software quality assurance (SQA) process. This process includes the creation of a plan which details the quality requirements and the specific techniques that will used to achieve these. This document must contain great detail about the costs and resources required, the schedule the measures will operate on, and the overall management objectives. In regards to the organisations maintenance situation, they must create a detailed quality requirements list for future updates to the site as well as the processes they will implement to meet these requirements. This must be done in order to ensure the product satisfies the user’s requirements and is the pinnacle of quality possible within the given constraints.

Secondly, the verification and validation (V&V) process would need to be improved. These include activities which addresses the software product quality directly and uses testing techniques which can locate defects so that they can be addressed. They are methods to ensure the software product meets the requirements created (verification) and checks to see whether the product built to match these requirements actually fulfils its intended purpose (validation). The V&V document that the organisation must produce should be created in the early stages of the build of the next website update. It must contain the specific activities needed to carry out the verification and validation as well as the techniques and tools used to do so.

Reviews and audits are also another area which when improved would also improve the software quality approach of the organisation. The tasks concerned with reviews and audits can be broken down into five parts in order to be implemented: management reviews, technical reviews, inspections, walk-throughs and audits. Management reviews which determine the adequacy of plans and keep track of their progress will serve to ensure the development of the updates or adaptation to the site are moving in the right direction toward the goal. Technical reviews will allow for the team to identify if the build for the update or adaption to the site is in line with the approved specifications set out at the start of development. In addition, inspection which is a type of review to ascertain anomalies in the software product will be employed to improve the quality of the product. Walk-throughs, similar to inspections provide an evaluation of the product, only now in a less formal setting than inspections. Lastly, audits carried out by independent bodies can be used to give an unbiased look at the new builds to check non-conformance levels and produce a report detailing how to take corrective action. Whether all or some of these methods are employed the quality approach of the organisation will definitely be improved as many different aspects of the product are checked for defects which can then be resolved to ensure quality.

Lastly, the organisation can improve their approach to software quality by developing a healthy software engineering culture which encourages a commitment to quality [3]. If engineers developing the software have a focus on quality as they develop, the end product will meet a greater standard. Therefore, the engineers should follow the code of ethics and professional practice created by the IEEE Computer Society and the ACM and the eight principles they outline in order to help build or reinforce the attitudes required to generate updates and alterations to the website in a quality fashion consistently.

In conclusion, by improving the software quality management processes and the culture of their developers the organisation would be able to substantially improve their quality approach which ensures the quality of the updates and adaptation built in the maintenance phase of their website development are of top quality.

# **Conclusions**

Upon completion of this project, our team was able to provide a functioning web application that could be used by Accident & Emergency attendees. Our flexible design would allow any attendee to use our application with any type device sufficiently. Our rigorous testing of each unit, functionality and the complete system can give our future users confidence that they will be using a simple, user-friendly, robust web application. No longer will attendees entering the Accident & Emergency department be left in the dark. Now there is simple program that can guide them from the moment of entry up to their temporary stay at ServeYou Hospital.

Having used the Rapid Application Development Model, we were able to design and build a functioning application in reasonable time with minimum faults. It is because of the repetitive upgrade to the prototype in each stage that our program increased closer and closer towards perfection, allowing for easier testing with each cycle. Our focus was more on functionality than imagery & style. Ofcourse it is great to have a fancy program that would attract users, however if that program doesn’t function, then it would all be for not. Since our program would be extension of the hospital resources, it was not vital to have many fancy styles and animations since the priority of the user that is using the application, is to gather as much information as needed. Therefore, user-friendliness, error-free functionality and adherence to the requirements stated were the primary motivation.

Maintenance is just as important as Design and Implementation. We offered our perspective on the best path and importance of adaptive maintenance. It would be pivotal to be able to continual update and maintain a program of this importance. The medical industry is always updating and improving, which requires that doctors and nurses continue to educate and keep themselves update. Shouldn’t this also apply to our application?

We also looked at the perspective of another organization and used our research and experience to better advise them on their software quality approaches. Learning from experience is key, but it is also just as important to learn from others’ experience so as not to follow along the same incorrect path. This kind of questioning allowed us to view our own product from a third person perspective which allowed us to not only see our program as a potential user but a potential investor. If we were investors, how would we want our clients to maintain their product?

This third person perspective also came in handy when doing the three types of testing. Although Unit testing was the most numerous, it was arguably the most important. If the unit fails then the function fails. If the function fails then the system fail. If the system fails then we fail. We took the most important unit functions and rigorously tested them with a fine toothed comb until they were working flawlessly. From here, we were able to integrate the associative units together to result in a working function. Integration testing was important since working random functions can only take us so far. We needed to be sure that these units would work well with each other and provide the functionality that was requested. Ofcourse after our rigorous integration tests, we were able to provide that. Now for our last stage, we needed to know that the entire system would function. Our guided Alpha testing allowed us to observe how the entire program would function while implementing the instructions outlined in the Alpha testing directions in the assignment. Fortunately, our web application succeeded in doing just that.

In conclusion, this experience this experience has allowed us to see software development from a better perspective. Having been involved in the design, implementation, testing and observing maintenance of our program, we were able to see the importance of each stage. One thing that stands out to us mostly is that without proper testing, no development stage will ever function properly. There is testing at every stage, whether it be in design, implementation or even maintenance.

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# **Appendix A: Unit Test Cases**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Test Scenario | Test Case | Preconditions | Test Step | Test Data | Expected Results | Actual Results |
| 1-1 | Check if Guest Name and Child Name >= one character | User must have successfully entered their Guest ID and password | 1. Enter test data for Guest Name 2. Enter test data for Child Name 3. Await results | Guest Name = “Sam”  Child Name = “Gary” | User would successfully enter Guest homepage | User successfully entered Guest homepage |
| 1-2 | Check if Guest Name and Child Name < one character | User must have successfully entered their Guest ID and password | 1. Enter test data for Guest Name 2. Enter test data for Child Name 3. Await results | Guest Name = “ ”  Child Name = “ ” | User would never leave the current security page as the input boxes prompt for at least one character to be entered in each input field box | The input boxes await for at least one character to be entered in each input field box |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Test Scenario | Test Case | Preconditions | Test Step | Test Data | Expected Results | Actual Results |
| 1-3 | Check if Guest Name and Child Name = ten characters | User must have successfully entered their Guest ID and password | 1. Enter test data for Guest Name 2. Enter test data for Child Name 3. Await results | Guest Name = “Clementine”  Child Name = “Joan White” | User would successfully enter Guest homepage | User successfully entered Guest homepage |
| 1-4 | Check if Guest Name and Child Name = one character | User must have successfully entered their Guest ID and password | 1. Enter test data for Guest Name 2. Enter test data for Child Name 3. Await results | Guest Name = “S”  Child Name = “G” | User would successfully enter Guest homepage | User successfully entered Guest homepage |
| 1-5 | Check if Guest Name and Child Name = 2 characters | User must have successfully entered their Guest ID and password | 1. Enter test data for Guest Name 2. Enter test data for Child Name 3. Await results | Guest Name = “Sa”  Child Name = “Ga” | User would successfully enter Guest homepage | User successfully entered Guest homepage |
| 1-6 | Check if Guest Name and Child Name = 20 characters | User must have successfully entered their Guest ID and password | 1. Enter test data for Guest Name 2. Enter test data for Child Name 3. Await results | Guest Name = “Samantha Eve Jackson”  Child Name = “Chrissio Eve Jackson” | User would successfully enter Guest homepage | User successfully entered Guest homepage |
| 1-7 | Check if Guest Name and Child Name = 19 characters | User must have successfully entered their Guest ID and password | 1. Enter test data for Guest Name 2. Enter test data for Child Name 3. Await results | Guest Name = “Sam Annette Jackson”  Child Name = “Chrissy Eve Jackson” | User would successfully enter Guest homepage | User successfully entered Guest homepage |

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| Test Scenario | Test Case | Preconditions | Test Step | Test Data | Expected Results | Actual Results |
| 2-1 | Test when Admin Name and Password are both valid | The user must have Node.js running and have selected to login as an admin | 1. Enter Admin Name 2. Enter Password 3. Await Response | Admin Name = “Jake”  Password = “entering” | Admin User should have a successful login | Admin User had a successful login |
| 2-2 | Test when Admin Name and Password are both invalid | The user must have Node.js running and have selected to login as an admin | 1. Enter Admin Name 2. Enter Password 3. Await Response | Admin Name = “Karl”  Password = “lake” | Admin User would be notified of a username or password error | Admin User would be notified of a username or password error |

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| --- | --- | --- | --- | --- | --- | --- |
| Test Scenario | Test Case | Preconditions | Test Step | Test Data | Expected Results | Actual Results |
| 3-1 | Test when Guest ID and Password are both valid | The user must have Node.js running and have selected to login as a guest | 1. Enter Guest ID 2. Enter Password 3. Await Response | Guest ID = “Jake”  Password = “entering” | Guest User should be directed to security page where they would enter their Guest Name and Child Name | Guest User was directed to security page where they would enter their Guest Name and Child Name |
| 3-2 | Test when Guest ID and Password are both invalid valid | The user must have Node.js running and have selected to login as a guest | 1. Enter Guest ID 2. Enter Password 3. Await Response | Guest ID = “Ruth”  Password = “klare” | Admin User would be notified of a username or password error | Admin User would be notified of a username or password error |

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| --- | --- | --- | --- | --- | --- | --- |
| Test Scenario | Test Case | Preconditions | Test Step | Test Data | Expected Results | Actual Results |
| 4-1 | Test when Database exists | The user must have Node.js running | 1. Attempt to access Database 2. Await response | A select query to the Database | The Database is now available for use | The Database is now available for use |
| 4-2 | Test when Database does not exist | The user must have Node.js running | 1. Attempt to access Database 2. Await response | A select query to the Database | The database is created | The database is created |

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| --- | --- | --- | --- | --- | --- | --- |
| Test Scenario | Test Case | Preconditions | Test Step | Test Data | Expected Results | Actual Results |
| 5-1 | Test when Access Control List and User Log Tables exist | The user must have Node.js running | 1. Attempt to access Control List 2. Await response | A select query to the Access Control List table | The Access Control List table is displayed. Once the Access Control List exists, then the User Logs Table also exists | The Access Control List table is displayed. Once the Access Control List exists, then the User Logs Table also exists |
| 5-2 | Test when Access Control List and User Log Tables do not exist | The user must have Node.js running | 1. Attempt to access Control List 2. Await response | A select query to the Access Control List table | Tables are created for the Access Control List and the User Logs | Tables are created for the Access Control List and the User Logs |

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| --- | --- | --- | --- | --- | --- | --- |
| Test Scenario | Test Case | Preconditions | Test Step | Test Data | Expected Results | Actual Results |
| 6-1 | Test when FAQ table exists | The user must have Node.js running | 1. Attempt to access FAQ table 2. Await response | A select query to the FAQ table | The FAQ table is available for updating | The FAQ table is available for updating |
| 6-2 | Test when FAQ tables does not exist | The user must have Node.js running | 1. Attempt to access FAQ table 2. Await response | A select query to the FAQ table | The FAQ table is created | The FAQ table is created |

# **Appendix B: Integration Test Cases**

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| --- | --- | --- | --- | --- | --- | --- |
| Test Scenario | Test Case | Preconditions | Test Step | Test Data | Expected Results | Actual Results |
| 1-1 | Testing the integration between the Database Check Unit and the User Access List/User Log Unit during a successful Admin login. | The user must have Node.js running and have selected to log in as an Admin | 1. Enter Admin Name 2. Enter Password 3. Click “Log In” 4. Await confirmation for the correct comparison of log in details to the valid log in data stored in the Access Control List table | Admin Name = “Jake”  Password =”entering” | The Admin User should successfully be taken to the Admin homepage and the User Logs Table updated with the Admin Name and timestamp. | The Admin User should successfully be taken to the Admin homepage and the User Logs updated with the Admin Name and timestamp. |
| 1-2 | Testing the integration between the Database Check Unit and the User Access List/User Log Unit during an unsuccessful Admin login. | The user must have Node.js running and have selected to log in as an Admin | 1. Enter Admin Name 2. Enter Password 3. Click “Log In” 4. Await confirmation for the correct comparison of log in details to the valid log in data stored in the Access Control List table | Admin Name = “Jan”  Password =”kong” | The Admin User would receive an error that they have entered incorrect log in details. | The Admin User received an error that they have entered incorrect log in details. |

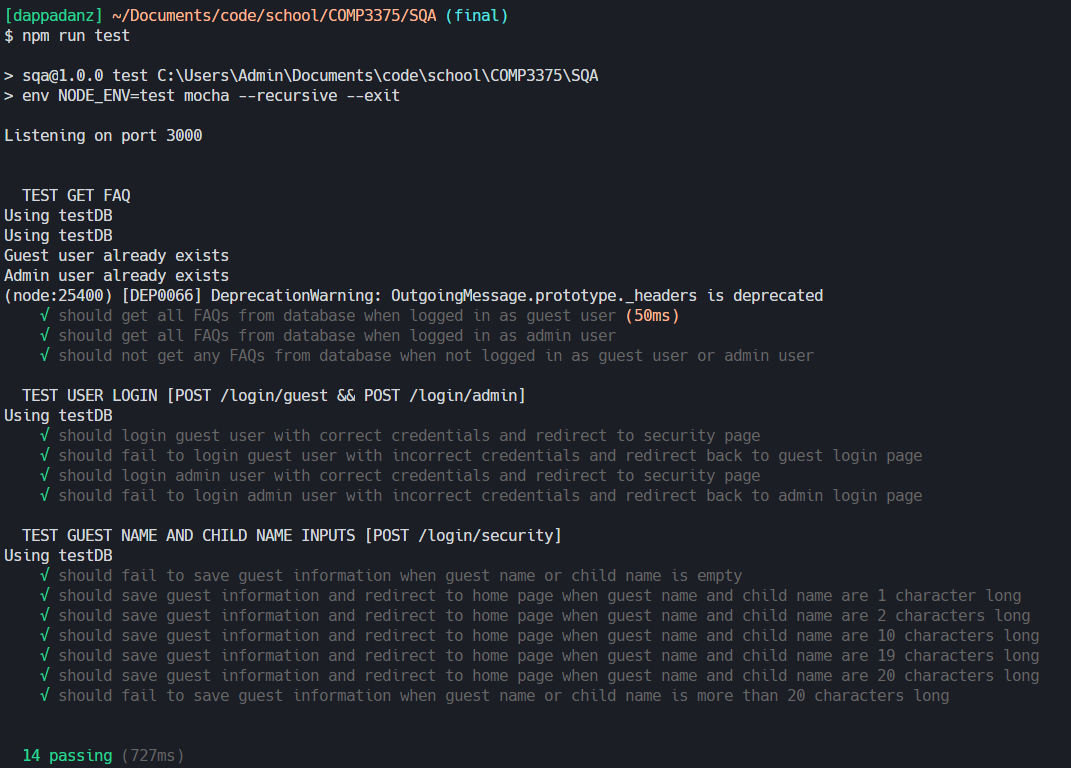
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| --- | --- | --- | --- | --- | --- | --- |
| Test Scenario | Test Case | Preconditions | Test Step | Test Data | Expected Results | Actual Results |
| 2-1 | Testing the integration between the Database Check Unit, the Guest/Child Name storing Unit and the User Access List/User Log Unit during a successful Guest login. | The user must have Node.js running and have selected to log in as a Guest | 1. Enter Guest ID 2. Enter Password 3. Click “Log In” 4. Await confirmation for the correct comparison of log in details to the valid log in data stored in the Access Control List table 5. Upon successful comparison, then enter both the Guest Name and Child Name 6. Click “Submit” and await response | Guest ID = “Jake”  Password =”entering” | The Guest User should successfully be taken to the next page after entering Guest ID and password. Upon successful log in, their ID and timestamp will be sent to the User Logs Table. On the next page, the user will be taken to the Guest homepage after successfully entering a valid Guest Name and Child Name. The Guest Name will also be sent to the User Logs Table | The Guest User was successfully taken to the next page after entering Guest ID and password. Upon successful log in, their ID and timestamp were sent to the User Logs Table. On the next page, the user was eventually taken to the Guest homepage after successfully entering a valid Guest Name and Child Name. The Guest Name was also sent to the User Logs Table |
| 2-2 | Testing the integration between the Database Check Unit, the Guest/Child Name storing Unit and the User Access List/User Log Unit during an unsuccessful Guest login. | The user must have Node.js running and have selected to log in as a Guest | 1. Enter Admin Name 2. Enter Password 3. Click “Log In” 4. Await confirmation for the correct comparison of log in details to the valid log in data stored in the Access Control List table | Admin Name = “Jan”  Password =”kong” | The Guest User would receive an error that they have entered incorrect log in details. | The Guest User received an error that they have entered incorrect log in details. |

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| --- | --- | --- | --- | --- | --- | --- |
| Test Scenario | Test Case | Preconditions | Test Step | Test Data | Expected Results | Actual Results |
| 3-1 | Testing the integration of functions used when the FAQ table is checked, updated and data is displayed on the page. | The user must have Node.js running and have selected to log in as an Admin. They must currently be on the Admin FAQ page | 1. Enter FAQ Question 2. Enter FAQ Answer 3. Click “Submit” 4. Await response | FAQ Question = “How many doctors does ServeYou have?”  FAQ Answer=”Enough to satisfy everyone” | The function should check for the availability of the FAQ table. After verification, the FAQ Question and Answer are added to the FAQ table. The new FAQ information is then displayed on both the Admin and Guest FAQ page | The function should checked for the availability of the FAQ table. Upon verification, the FAQ Question and Answer were added to the FAQ table. The new FAQ information was then displayed on both the Admin and Guest FAQ page |
| 3-2 | Testing the integration of functions used when the FAQ table needs to be created before being updated and data is displayed on the page. | The user must have Node.js running and have selected to log in as an Admin. They must currently be on the Admin FAQ page | 1. Enter FAQ Question 2. Enter FAQ Answer 3. Click “Submit”   Await response | FAQ Question = “How many doctors does ServeYou have?”  FAQ Answer=”Enough to satisfy everyone” | The function should check for the availability of the FAQ table. Since there will be none, one will be created. The FAQ Question and Answer are added to the FAQ table. The new FAQ information is then displayed on both the Admin and Guest FAQ page | The function should checked for the availability of the FAQ table. Upon creation, the FAQ Question and Answer were added to the FAQ table. The new FAQ information was then displayed on both the Admin and Guest FAQ page |

# **Appendix C: Alpha Test Cases**

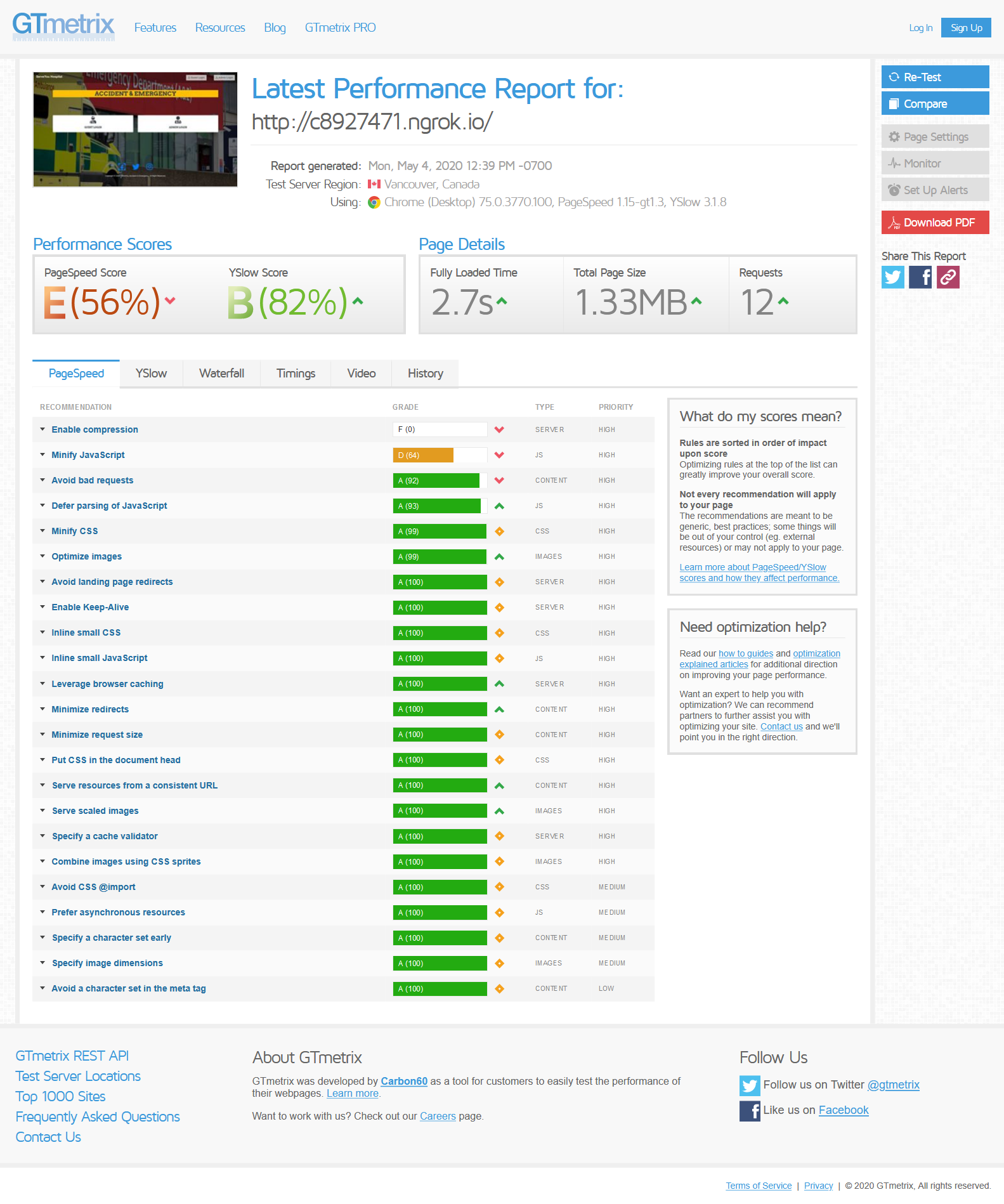
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| --- | --- | --- | --- | --- | --- | --- |
| Test Scenario | Test Case | Preconditions | Test Step | Test Data | Expected Results | Actual Results |
| 1 | Check that the program executes to completion successfully | The user must have Node.js and apache running | 1. Login as a Guest using a valid Guest ID, password, Guest Name and Child Name 2. Ensure that the User Logs table was created and updated correctly 3. Ensure correct navigation to each page on the web application 4. When currently on the FAQ page, ensure that it is not possible to update the page using guest privileges 5. Logout 6. Repeat Steps 1-5 nine times 7. Check that the User Logs table has all 10 guests represented 8. Login as an using a valid Admin Name and password 9. Ensure that the User Logs table was created and updated correctly 10. Ensure correct navigation to each page on the web application 11. When currently on the FAQ page, ensure that it is possible to update the page using admin privileges 12. Enter an appropriate Question and Answer 13. Click ”Submit” 14. Ensure that the FAQ table was created and updated correctly 15. Ensure that the Question and Answer can be seen on the FAQ page 16. Logout 17. Repeated steps 8-16 nine more times 18. Check that the User Logs table has all 10 staff members (admins) represented 19. Check that the FAQ table has all Questions and Answers represented 20. Simulate process for 6 months and store data to a file 21. Ensure that the file has the correct information | GUEST DATA   1. Guest ID: 789; Password: password; Guest Name: Carl; Child Name: Kim   ADMIN DATA   1. Admin Name: Jake, Password: password | The User Logs table should have all 20 (10 Guest and 10 Admin) Login information stored with timestamps  The FAQ database table should have all 10 Questions and Answers stored  The FAQ page should have all 10 Questions and Answers shown | The User Logs table had all 20 (10 Guest and 10 Admin) Login information stored with timestamps  The FAQ database table had all 10 Questions and Answers stored  The FAQ page had all 10 Questions and Answers shown |

# **Appendix D: Screenshot from Automated Unit Tests**



# **Appendix E: Screenshot from GTmetrix Performance Alpha Test**

Link for the generated report: <https://gtmetrix.com/reports/c8927471.ngrok.io/bG8xejtM>



# **Appendix F: Web Application Documentation**

This web application can be used by visitors to allow themselves to become more familiar with the Accident and Emergency Department. This application can also be used by authorized staff to update specific sections like the Frequently Asked Questions area. This web application was created using HTML, CSS, Bootstrap and JavaScript/Node.js. Various features from Font Awesome and Google Fonts were also used. Bootstrap was the front-end framework of choice, since it design for responsiveness to varying screen sizes like mobiles, tablets and Desktops/Laptops. Node.js was the ideal choice used to enable back-end functionality like Login Authorization using the Access Control List and storing the record of each log in. This application was designed to be user friendly and functional for the requirements.

When a visitor starts the application, they are given the option to log in using a guest ID and password. In the case of an incorrect log in information being entered, the visitor will be notified and inferred to enter the correct log in details. Upon successful log in, they would be prompted to enter their name and the name of their child. The visitor will not be allowed to leave these fields blank. Upon successful submission of this information, a record of their name of time of logging on would be sent to a file on a server and the visitor is then taken to the homepage. Depending on what device they are currently using, the web application will have a different appearance. At this point they can view the information displayed on the homepage or navigate to another section. At any point, the user will be allowed to log out using the navigation bar.

Upon view of the Wards page, they will be shown varying procedures and rules of the department and information about the ward they would be staying in, if admitted to the hospital. Upon view of the Frequently Asked Questions page, the visitor can view all questions and answers pertaining to the department.

When an authorized staff member starts the application, they will be given the option to log in using the administrative page. They would also be notified of any incorrect details entered. Upon successful log in, a record of their name and time of logging in would be sent to a file on the server. The authorized staff member would be able to view the same responsive pages as the visitor, along with having similar features. The one difference would be the view of the Frequently Asked Questions page. On this page, the staff member would be allowed to update the page by entering new Questions and Answers. Upon successful submission of this information, the page would be updated for both authorized and guest users.