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Can GP appointment systems be improved regarding patient contact times?

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Abstract

The objective of this project is to investigate the current GP appointment system in order to see whether it can be improved. A literature review was conducted on the GP appointment system along with patient waiting times and the effect this is having on them. The related material on the subject was compiled using references from academic papers, journals, and websites. The research methodology used in this project is also acknowledged and discussed. The results from a questionnaire and interviews have been provided. Based on the preliminary research, a website application has been designed and developed.

The findings from this major project revealed a significant issue with the GPs' system failing to provide appointment times, this issue should now be resolved with the development produced for this project. However, a number of recommendations have been made to improve the website application.

Returning to the project question of 'Can GP appointment systems be improved regarding patient contact times?', the answer is yes, they can be improved by providing the patients with appointment times. Patients would be more satisfied since they would know when they would receive a call from the doctor and could arrange their day around that time. A reflection has been made on the outcome of the overall project.

Contents

Abstract.....	2
1. Introduction	5
2. Research & Review of Literature	5
2.1 Introduction	5
2.2 The GPs appointment system	5
2.3 Patient contact waiting time	6
2.4 Effects of waiting time	7
2.5 Development Environment.....	8
2.6 Summary	8
3. Methodologies	9
3.1 Research Methodology	9
3.1.1 Philosophy.....	9
3.1.2 Approach.....	9
3.1.3 Strategy	9
3.1.4 Time Horizon	9
3.1.5 Data Collection Method	9
3.1.6 Evaluation Criteria.....	10
3.2 Development Methodology.....	10
3.2.1 Software Development Methodology	10
3.2.2 Software	11
3.2.3 Hardware	12
3.2.4 Materials and Tools.....	12
4. Design & Implementation	13
4.1 Design.....	13
4.1.1 Project Requirements	13
4.1.2 System Models.....	14
4.1.3 System Interfaces.....	16
4.2 Implementation	17
4.2.1 Problems and Successes	17
4.2.2 Code Snippets	18
4.2.3 Software Testing	20
5. Evaluation	31
6. Conclusions and Recommendations	36
6.1 Conclusions	36
6.2 Recommendations	37

7. Reflection	37
8. References	39
Appendices.....	42
Appendix A.....	42
Appendix B.....	43

1. Introduction

The project's aims are to investigate the current GP appointment system in order to see whether it can be improved. It will investigate the effects contact waiting times are having on patients. Additionally, considering if phone consultations are impacting patients negatively. The project will attempt to develop a more sympathetic IT application for receptionists and patients to use.

A set of objectives must be accomplished in order to achieve these aims, these include:

- Prepare strategies on how to conduct the investigation then analysing the methods in order to justify steps taken throughout the project
- Conduct a literature review based on secondary research findings
- Design and develop an application based on preliminary research
- Reflect on the outcome of the overall research and closure of the project

The existing GPs appointment system, as well as patient waiting times and the implications, will be examined in this paper. It will also investigate the methodology to be employed, as well as the design and implementation of a new GPs appointment system. Finally, the project will be evaluated, concluded, and recommendations will be made.

2. Research & Review of Literature

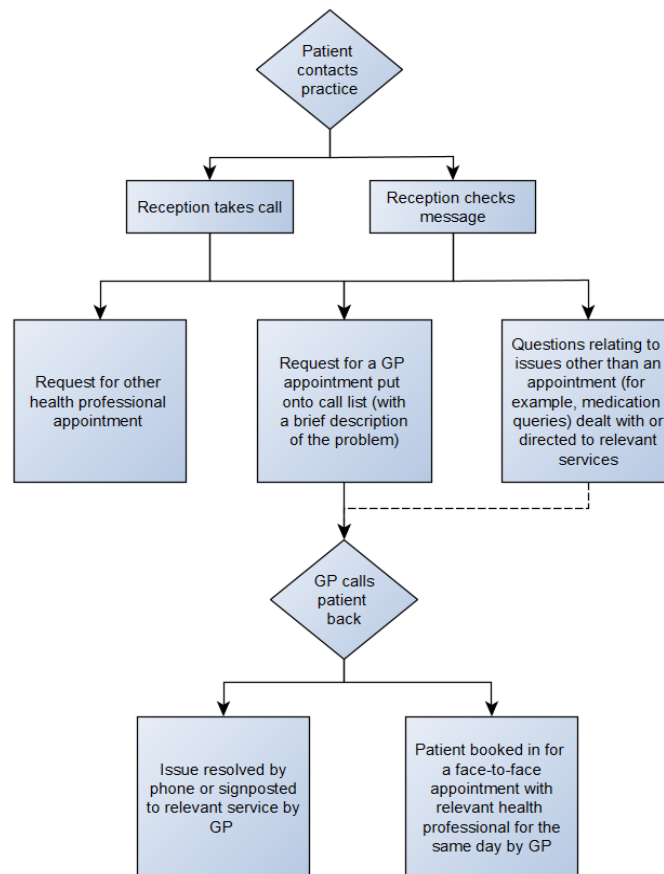
2.1 Introduction

Several areas will be considered in the course of the project. The topics that will be discussed below will revolve around the patient contact waiting times along with the implications that this might have. Also, what is the current procedure for the doctor's appointment system.

2.2 The GPs appointment system

The GPs appointment system is a website offering online consultations that allows people to send a message directly to their general practice (GP) for medical guidance and assistance.

^[1] An online form needs to be filled in with information about their symptoms, conditions or treatment as well as choosing which doctor they want to talk with and how they want to be reached, whether it's through email, phone, face-to-face, or a video consultation. This is an alternative way to avoid waiting in a long queue on the phone to talk to a receptionist, where the receptionist will fill out the online form on behalf of the patient. After that, the receptionist will go through the requests and forward them to the relevant doctor, who will review the patients online form and choose the best consultation option for them. During the consultation, a new mode may be proposed for a further consultation. ^[1 & 2]



This system was implemented in 2020, during the early stages of the COVID-19 pandemic, when social distancing was required, and non-face-to-face consultations were prioritised. Prior to this, most GP consultations were conducted face-to-face by making an appointment with the receptionist over the phone. Patients formerly received an appointment time from the receptionist right away, whereas with the new current booking system in place, patients may have to wait all day for a phone consultation with the doctor, with no idea when they will be calling because no appointment times are offered. ^[2]

2.3 Patient contact waiting time

The number of patients contacting general practices has grown since the implementation of the new method of access, resulting in a longer wait time to hear from a doctor. ^[4] Despite the fact that this new system had the ability to address patient needs more quickly, it did not appear to do so. Some patients may require a longer appointment than anticipated causing other patients a longer wait. Furthermore, because some patients may require a second consultation via a new mode to address unresolved issues, it results in the patient having two consultations, consuming more of the doctors' time and prolonging other patient's wait time. Doctors prioritise which patients to speak with first based on the severity of their ailment and the chance of recovery, which can often be influenced by how patients describe their condition, some may make it sound worse than it is, while others may be vague when describing their illness, simply writing "I have a cough" in their message to the doctor rather than listing all of their symptoms and going into detail on how they are

feeling, which may result in the patient waiting much longer for a call back from the doctor.
[2]

Brian McKinstry reports patients found the system to be problematic, with difficulty getting through or prolonged wait times for a call back. The percentage of people who would suggest their practice to friends has decreased. [7] Patient appointment scheduling is now a time-consuming and inconvenient process in the healthcare industry. Queuing and waiting to hear from a doctor have irritated many individuals. [1] Sarah Ball observes that people complained about problems with or objections to the new booking method, such as extended wait times for calls to be answered or limited phone line operating hours. They “described a delayed or unpredictable response, with no indication as to when the doctor would call back, or a lack of availability of appointments after speaking to the doctor.” The current system was found to be inconvenient for some people in one or more ways, such as not able to make appointments ahead of time, getting a call from the doctor at an inconvenient time or constrained to stay at home waiting for the doctors’ call, especially if the call is about a personal matter and uncomfortable to address in public. [8]

2.4 Effects of waiting time

Despite the fact that the original contact was conducted online, the logistical procedure of waiting around to receive a phone call from the practice could be challenging due to job responsibilities. For example, waiting by the phone for a call as a bus driver would be problematic, and support workers are not permitted to use their phones throughout their shift. [8] Some patients may have missed or not gotten the call back from the doctor, leaving them uncertain of what to do next or having to start the process all over again. Waiting round for a follow up call can be very long-winded, especially when in a rush and have numerous things to get on with. [5] With this new system in place, it also has an effect on the practitioners as the demand for appointments exceeds capacity, leaving them feeling overwhelmed and driving them to work longer hours. [6]

People stated that the concerns were challenging for them as individuals, citing reasons including a lack of time to wait on standby or trouble phoning at the correct time of day (especially for working people). Patients also expressed how unpredictability (in terms of getting a response from the practice) was particularly challenging for them due to their personal situations, for example, patients with mental health concerns have reported they feel uneasy or worried while waiting for a call back from the doctor. Many of the negative complaints focused on the scheme's operation rather than the concepts that underpin it, such as trouble getting through on the phone or not being able to arrange a call back with the doctor. [8]

According to Holly Chu's research, [9] keeping patients informed about delays and offering good interactions with doctors can help to reduce negative reactions to prolonged waits times. The patients who were fixated on what they could be getting on with rather than waiting became more conscious of the time passing by. Holly Chu stated making heartfelt apologies might help to alleviate bitter feelings. Information about delays might help

patients feel more at ease by reducing uncertainty and making the wait seem more bearable. Patients also feel more in control since they can mentally reassess the situation and change their expectations, making the wait seem more predictable. ^[9]

2.5 Development Environment

An application may be designed in a variety of ways to accommodate its target audience. The two looked at here will be a website versus a mobile app.

In comparison to a mobile app, a website can reach out to more people since it can be accessed from a computer, tablet or a phone, but a mobile app can only be accessed from a mobile phone due to it being designed for that device only. ^[10]

Also, if it were a mobile app, the number of individuals who could use it would be limited based on their operating system (OS), such as Android or iOS. A mobile app being used several times a day would be more convenient and faster to access, however, because this project is for a GPs appointment system that would not be utilised multiple times a day or even on a daily basis, using a browser just when necessary and not consuming any storage space would be more appropriate. Because an application has to be updated on a regular basis, increasing maintenance costs, using a mobile app for the GPs system would be far more expensive than using a website. ^[10, 11 & 12]

2.6 Summary

Following the implementation of a new online appointment system, the utilisation of GPs appointments increased in general practices. While there are benefits to this new system, such as patients being able to message doctors via a website rather than calling and holding in a queue, for some, not knowing when a doctor will contact them for a consultation can be frustrating and challenging especially due to certain job roles. For this to be successful, patients could be provided an appointment/consultation time so that they do not have to wait all day for a response from the doctor or be concerned about when the call will occur. To enable for more individuals to access this projects development, the chosen technology will be in the form of a website.

3. Methodologies

3.1 Research Methodology

For this project, a range of research methodologies will be used to assist with working through the objectives, starting with the outside layer working in towards the inner layer using Saunders research onion.

3.1.1 Philosophy

Pragmatism - This method was chosen since it includes both theory and practice in order to solve problems. To address the research question of whether GPs appointment systems can be improved in terms of patient contact times, research into multiple topics, including the effects of waiting times and the existing GPs appointment system, would be required. It will also require practicality since an application will be designed and developed to address the current problem. Other philosophy methodologies, such as interpretivism, positivism, and realism, are available, but pragmatism is the best fit for this project. For instance, if the interpretivism method were to be followed, it would be based on all theory, preventing any development from being able to solve the current problem. ^[13]

3.1.2 Approach

Deductive - Initially, the project focus will be theoretical research in order to formulate questions, afterwards testing the research question through a survey to determine the outcome from the data collected. Inductive approach is another option, but this involves little research whereas this project will require a significant amount of it. If the inductive approach was chosen without sufficient understanding on the topic, it would be impossible to come up with survey questions without knowing what has already been asked and whether the responses were already available from previous research. ^[13]

3.1.3 Strategy

Action Research - This is primarily intended to address a specific issue in a particular area. Setting a defined goal is the first step in the action research approach. This strategy is more appropriate for this project as it involves addressing the problems with the existing GPs appointment system and improving it. Other strategies that could be applied include grounded theory (based on a theory rather than facts) and ethnography (studying peoples' behaviour and culture), although none of these would be appropriate for this project as there is not enough time to study people due to the project's deadline. ^[13]

3.1.4 Time Horizon

Cross-Sectional - This option for time horizon was chosen since the project's completion has a short deadline of only a few months. Whereas longitudinal is another option, however it would not be suitable due to the length of time involved. ^[13]

3.1.5 Data Collection Method

Questionnaire – A questionnaire will be prepared and distributed to assist in answering the research question. Both qualitative and quantitative data will be used to have a deeper understanding of the information gathered. A statistical analysis will be used to back up the conclusions from the data obtained. ^[13]

Interview – An interview will be conducted with a receptionist working in a general practice to gain an in-depth understanding of perceptions on the research question. It will be a semi-structured interview where questions will be prepared but also allow a little freedom where some answers may need expanding or another question need answering.

Observations and focus groups are two more methods that could be utilized, however, this project would not require someone to be observed because it would not provide answers to the questions that need answering. ^[13]

3.1.6 Evaluation Criteria

For the questionnaire, the sample methods that will be used will be a mix between two, convenience and judgement sampling. Both samples are non-probability sampling methods. Convenience sampling is where the questionnaire will be distributed to those who will be available and easy to reach due to the current situation we are in with Covid-19 pandemic, with the 2-metre distance rule between people. Judgment sampling is a selective strategy that relies on judgement when deciding who to ask to participate in this project's questionnaire. The reason for choosing this method is to have participants from various counties in Wales to determine if the GPs appointment system differs in each place. ^[14]

The questionnaire will have a sample size of 20 people. This should be an adequate number to obtain the findings required to provide a range of responses and perspectives on the subject in order to move forward with the project.

When constructing the questions, bias and ethnicity will be taken into account. The convenience method considers these factors by distributing the questionnaire to those who are available, rather than forcing anyone who is unwilling or unavailable to complete it, and the judgement method considers these factors by distributing the questionnaire to people from various counties, rather than focusing on one county, which could result in the same answers, making it unfair. Other elements to show non bias and ethics will be considered in the questionnaire by letting all the participants know exactly what it is about and the reason why it is being carried out as well as ensuring them that their names or anything identifying them will not be recorded or used. All this is an important factor to receive more responses as it shows the participants their privacy will not be invaded as well as gaining their trust by giving them all the information they need to know about the questionnaire and the reason for it. ^[15]

3.2 Development Methodology

3.2.1 Software Development Methodology

The SDLC chosen for this project is the spiral methodology. This is an iterative approach which means it is flexible and adaptable to changes as the project progresses. The steps include identifying objectives, risk analysis, developing and testing and reviewing and evaluating. ^[16] One benefit of this method is that risks are detected early on, allowing a plan to be put in place to mitigate any threats to the project's overall success. However, a problem using this method is that the spiral may continue on and on, causing the project to

miss its deadline. To avoid this, a Gantt chart and work breakdown structure will be employed. ^[16]

Object oriented programming, or OOP, was also chosen for this project. It is a programming paradigm that is based on the idea of classes and objects, which will be used in the development. A standard object in this case will be an HTML structure with CSS classes added to the objects defining the object's design and flow. Laravel is also used which mostly everything works on classes and objects as it is based on PHP which PHP itself is OOP. The reusability of this approach is one advantage, and the CSS will make it easy to update portions of the site without affecting the rest. However, using this approach has the disadvantage of taking a long time to develop and being quite complicated due to object interaction. To avoid missing the deadline, this will require learning how it works and to keep at it. ^[17]

3.2.2 Software

The software that will be used is:

- Windows 10 OS as this is the operating system installed on the laptop that will be utilised
- XAMPP is the best web server to utilise since it is the easiest to set up and operate. XAMPP features extra tools and applications than WampServer, as well as being more beneficial due to its lightweight construction. Xampp also features SSL (secure sockets layer) whereas Wamp does not. ^[18 & 19] Other web servers include Node.js and Internet Information Server (IIS), although node.js would not be suitable for this project due to the consistency concerns, the API changes frequently, necessitating code updates to remain compatible, which would increase the costs. Furthermore, when dealing with large computing operations, node.js reduces performance, whereby this development may have several users all logged in at the same time trying to make an appointment, ^[20] and Internet Information Server is not appropriate for this project due to its lack of flexibility and the fact that it is only compatible with Windows products. ^[21 & 32] In addition, IIS can only be setup via the GUI, which in a production setting can be a time-consuming and difficult manual process. ^[21]
- MySQL database where the applications data will be built and stored. MySQL, in comparison to Oracle, is a quick, scalable, and user-friendly open-source database with over 26 years of industry experience. It's often used in web-based applications with PHP scripts to develop strong and dynamic server-side applications. Oracle comes in four different editions, one of which is free for students but has limitations, while the others involve payments. Oracle also distributes updates on a regular basis, which adds to the expense. ^[22 & 23] PostGres and Mongo are two other databases. PostGres consumes a lot of memory since it creates distinct services for each client, which slows down performance and speed, ^[33 & 35] and Mongo is similar in that it requires a lot of memory and has a document size restriction. ^[34 & 35]

3.2.3 Hardware

The hardware that will be used is:

- A laptop due to having access to this type of hardware
- A mobile phone (to verify that the website will be usable on a mobile)
-

3.2.4 Materials and Tools

Laravel, a web application framework that employs the PHP programming language, will be used to develop this project. Laravel offers a great database abstraction, making it simple to query and update data. It will be paired with a MySQL database in this instance. Laravel has numerous advantages, including the ability to simplify fundamental web app tasks like authentication, caching and routing. It also saves time by utilising the command-line tool Artisan, which aids in the creation of skeleton code and efficiently executes the database system. In comparison to other PHP frameworks, Laravel is the best fit for this project's development. For instance, CodeIgniter does not provide sufficient support the HTTP route and only employs a basic tool kit providing limitations and Lumen lacks web routes. ^[24]

The IDE (integrated development environment) that will be used to develop this project will be Visual Studio Code. It is a free code editor that uses the IntelliSense technique to make creating, debugging, and correcting code easier, meaning less time is spent dealing with the environment and more time implementing the idea. Cross-platform compatibility and excellent tool support for web technologies such as HTML and CSS are just a few of the benefits of Visual Studio Code. It also supports most programming languages or the language can be downloaded or utilised through an extension if the language required is not already built in. Visual studio code will play an important role in the development of software as technology improves due to its ever-evolving features, making it the ideal match for this project's development. ^[25] Other IDEs, such as sublime text, do not have GIT integration or onsite debugging capabilities like visual studio code, and Atom involves a lot more configuration to make it become an IDE, making Visual Studio Code faster and easier than Atom. ^[26]

4. Design & Implementation

The factors that go into the design and implementation of a GP appointment system for this project will be discussed in this section. The design's aims and objectives are to utilise a questionnaire to gather the project's requirements, illustrate the data using diagrams, and create a user interface design. Developing a GP appointment system, following the design generated, and executing numerous testing are among the implementation aims and objectives.

4.1 Design

4.1.1 Project Requirements

1. Login page – to identify the patient
 - Email
 - Password
2. Problem page – information about their symptoms/conditions
 - Problem heading to briefly describe their symptom
 - Problem details – allowing the patient to go into more detail about their symptoms
3. Practitioner page – allow patient to select a practitioner
 - Practitioner names
 - Day / date
 - Practitioner availability times
4. Appointment time page – allow patient to select their own appointment time
 - Times available on that day (times to be greyed out/hidden if not available)
5. Preferred contact page – allow patient to choose how they would like to be contacted by the practitioner
 - Telephone call
 - Email
 - Video consultation
 - Face to face
6. Confirmation page – shows the appointment application has been put through successfully
 - Patient confirmation
 - Delay awareness note
7. Notifications – patient to be notified if their appointment has been delayed and roughly by how long
 - Email notification
 - SMS notification

4.1.2 System Models

4.1.2.1 Data Dictionary

The data dictionary produced provides more precise details about the contents of the database in order to help explain the data and how it is used. This improves the system performance by ensuring that the wording is consistent and easy to understand. For example, the problem heading can have 50 characters and the problem details can have 300 characters giving it a clear definition for the user. This is to prevent any confusion or excessive memory or file space being used. ^[27]

Patient Data Dictionary

Field Name	Data Type	Nullable	Primary Key	Constraints	Example
Patient ID	Int	No	1		1
Patient First Name	Varchar (30)	Yes			John
Patient Last Name	Varchar (30)	Yes			Doe
Patient Address	Varchar (50)	Yes			56 New Street, Swansea
Patient Postcode	Varchar (10)	Yes			SA11 2RD
Patient Phone Number	Int	Yes			07415789248
Patient D.O.B	Date	Yes			15/11/1986

Doctor Data Dictionary

Field Name	Data Type	Nullable	Primary Key	Constraints	Example
Doctor ID	Int	No	1		1
Doctor Name	Varchar (30)	Yes			Dr Ike
Doctors Days	Date/Time	Yes			28/01/2022 or Unavailable

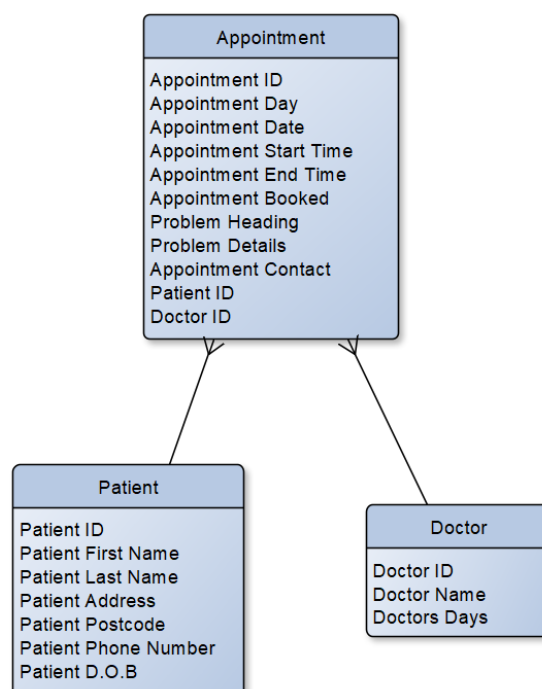
Appointment Data Dictionary

Field Name	Data Type	Nullable	Primary Key	Constraints	Example
Appointment ID	Int	No	1		1
Appointment Day	Varchar (15)	Yes			Monday

Appointment Date	Date	Yes			28/01/2022
Appointment Start Time	Time	Yes			9:30
Appointment End Time	Time	Yes			18:00
Appointment Booked	Boolean	Yes			Yes or no
Problem Heading	Varchar (50)	Yes			Bad head
Problem Details	Varchar (300)	Yes			I am getting really bad heads on a daily basis, with this, it is also giving me bad eyes and ears
Appointment Contact	Varchar (30)	Yes			Video Consultation
Patient ID	Int	No		Foreign Key	1
Doctor ID	Int	No		Foreign Key	1

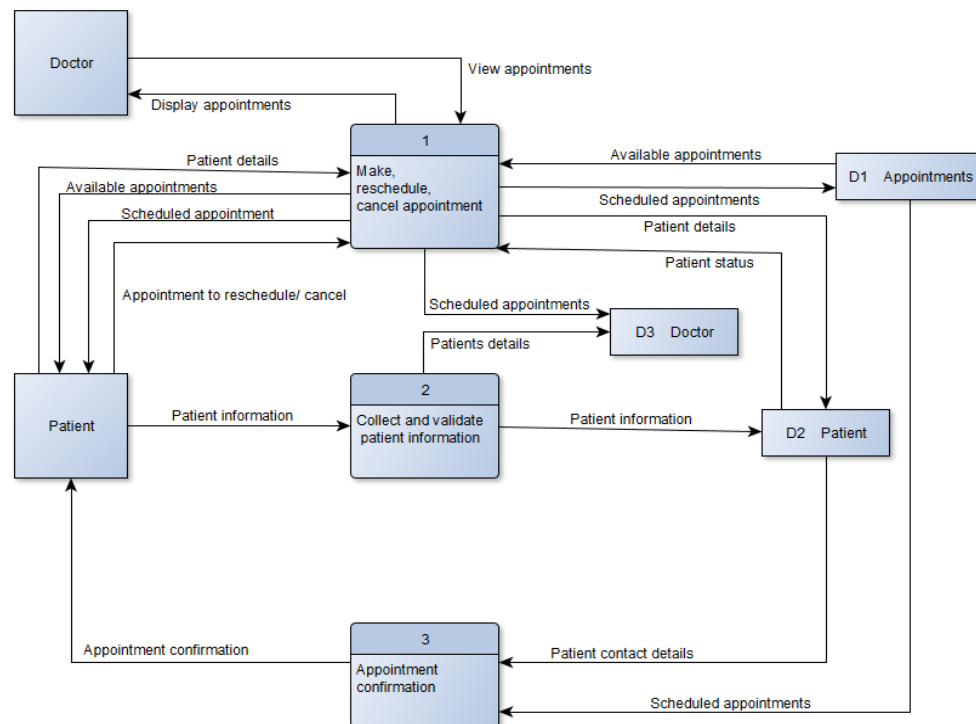
4.1.2.2 ERD

The ERD (entity relationship diagram) produced makes it easier to visualise the different sets of data used in this development, known as entities with their attributes and the relationships between them (how they connect to one another) using primary and foreign keys. For example, the appointment table has foreign keys of patient ID and doctor ID, that table gathers the foreign keys information through the links that are connected from 2 different tables. The relationships improve system performance as it speeds up and simplifies queries due to the system knowing which table to collect the data from. ^[28]



4.1.2.3 DFD

The DFD (data flow diagram) created shows the data in a graphical representation, showing the flow of the businesses activities through data movement by employing a defined set of symbols and notations. For example, the doctor output views the appointments and the scheduled appointments and patients' details goes into the doctors datastore. The DFD helps to understand the functioning and the limits of a system. [29]



The patient and doctor are classed as an external entity, boxes 1, 2 and 3 are the processes and D1, D2, D3 and the datastores showing what data gets stored where. The arrows show which direction the data flows along with a description to show what data is getting transferred.

4.1.3 System Interfaces

Vale of Neath Practice

askmyGP

Back

Hello Stephanie

Step 1 of 4

Enter your problem heading:

50 characters left. You may add more detail later.

Enter your problem details:

300 characters left.

Next

Vale of Neath Practice

askmyGP

Back

Hello Stephanie

Step 2 of 4

Select practitioner:

Practitioner	Tuesday
☐ Dr Gripper	Unavailable
☐ Dr Harrowling	Unavailable
☐ Dr Hepburn	08:00 – 18:30
☐ Dr Ike	08:00 – 18:30
☐ Dr Rinky	Unavailable
☐ Dr Adekunle	08:00 – 18:30
☐ Dr Mikhael	08:00 – 18:30
☐ Julie Kemp	08:00 – 18:30
☐ I don't mind	

Note: If in grey, practitioner is fully booked or unavailable

Next

Vale of Neath Practice

askmyGP

Back

Hello Stephanie

Step 3 of 4

December 2021

5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

Note: Date cannot be changed, appointments made on the day only

Select morning appointment time:

9:00 9:15 9:30 9:45 10:00 10:15 10:30 10:45 11:00 11:15 11:30 11:45

Note: If time is in grey, appointment has been taken

Next

Vale of Neath Practice

askmyGP

Back

Hello Stephanie

Step 3 of 4

December 2021

5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

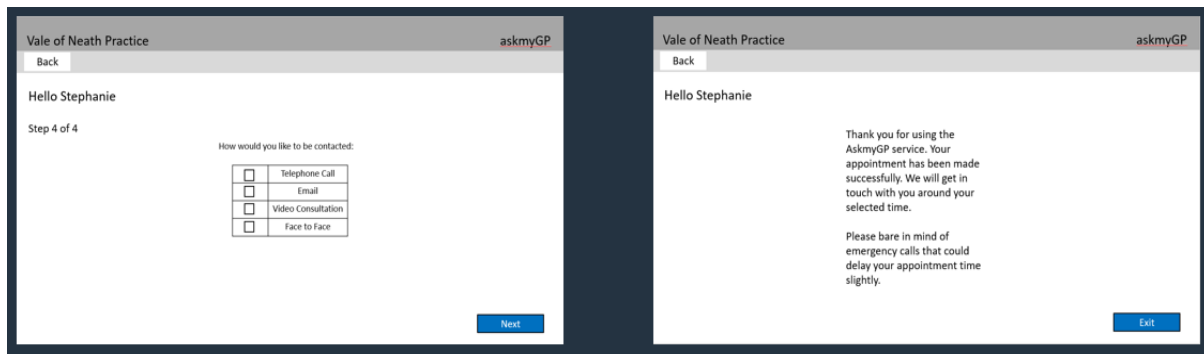
Note: Date cannot be changed, appointments made on the day only

Select afternoon appointment time:

14:30 14:45 15:00 15:15 15:30 15:45 16:00 16:15 16:30 16:45 17:00 17:15 17:30 17:45

Note: If time is in grey, appointment has been taken

Next



Above illustrates the pages that will be developed for the new GPs appointment system.

Step 1 of 4 is where the user will enter their problem heading such as a bad head and the problem details to allow the user to be more specific about their bad head. Steps 2 and 4 are checkboxes that the user would need to select one of the options available. The above images show two pages for step 3 of 4, but when the user is going through the process, only one will be shown depending on the time, if the user has signed in in the morning, the morning appointment times will be shown, if signed in in the afternoon, the afternoon appointment times will be shown. The last page will make patients aware that there could be slight delays with their chosen appointment time.

The following are some of the user interface best practices that were incorporated when designing the system interface:

Clear entry points: *“Present only a few main entry points into the interface.”* The program is self-explanatory, giving the user simple instructions as to what the website does and where they need to navigate with a back button to allow the user to go back to a previous page if they want to alter something or a next button allowing the user to go onto the next step. ^[30]

Indicators: Each page displays a step such as step 1 of 4, to show the user how many steps there are and what step they are currently on. This is an awareness of a time guidance for the user and an indicator. *“Include a “You are here” indicator.”* ^[30]

Visual framework: *“Design each page to use the same basic layout, colours, and stylistic elements.”* This website has the same basic layout on each page using the same background colouring and borders with a black font. Users won’t have to learn a new interface every time they move from one step to another. *“When the user sees a page sectioned neatly, their eye is guided along the page more comfortably.”* ^[30]

4.2 Implementation

4.2.1 Problems and Successes

The HTML and CSS were the first parts of the development to be coded in visual studio code. Both of these were a success, although the CSS part did take a bit of time to do because it required some fiddling about with to get it right. There were two items that altered from the initial design when working through the HTML and CSS. The first was

having no calendar on the appointment time page, as indicated in the design. This was due to the fact that the day and date were previously shown on the practitioner selection page, therefore there was no need to repeat it. Second, instead of having two distinct pages for appointment times depending on whether the user was logged in in the morning or afternoon, all times were combined on one page in the development so that the user may choose any time that is available for that day. This was due to a few issues with the overall development that took a long time to resolve, leaving no time to execute the changeover between morning and afternoon appointment hours.

Because of the complexity of Laravel architecture, employing it was a major problem in the project's development. This took up a lot of time with writing code and then deleting it because it was incorrect or in the wrong place, then having to relocate it to the correct location. Using Laravel entailed code in a variety of files, and determining what code was required and where it should be placed was incredibly challenging. As a result, the development took much longer than expected, almost causing the project to miss the deadline.

4.2.2 Code Snippets

HTML:

```
<h3>Step 1 of 4</h3>

<form action="/details" method="post">
  {{csrf_field()}}
  <div class="formrow">
    <label for="heading">Enter your problem heading:</label>
    <br><input type="text" id="heading" name="heading" required placeholder="Problem heading" />
    <p>50 characters. You may add more detail below.</p>
  </div>
```

CSS:

```
body {
  display: flex;
  flex-direction: column;
  justify-content: space-between;
}

footer {
  background: #D3D3D3;
}

header {
  background: #B7B7B7;
  color: black;
}
```

Laravel Controller:

```
class AppointmentController extends Controller
{
    /**
     * Create a new controller instance.
     *
     * @return void
     */
    public function __construct() {
        $this->middleware('auth');
    }

    /**
     * Display a list of all of the user's task.
     *
     * @param Request $request
     * @return Response
     */
    public function index(Request $request) {
        return view('appointments.index');
    }
}
```

Laravel Routes:

```
Auth::routes();

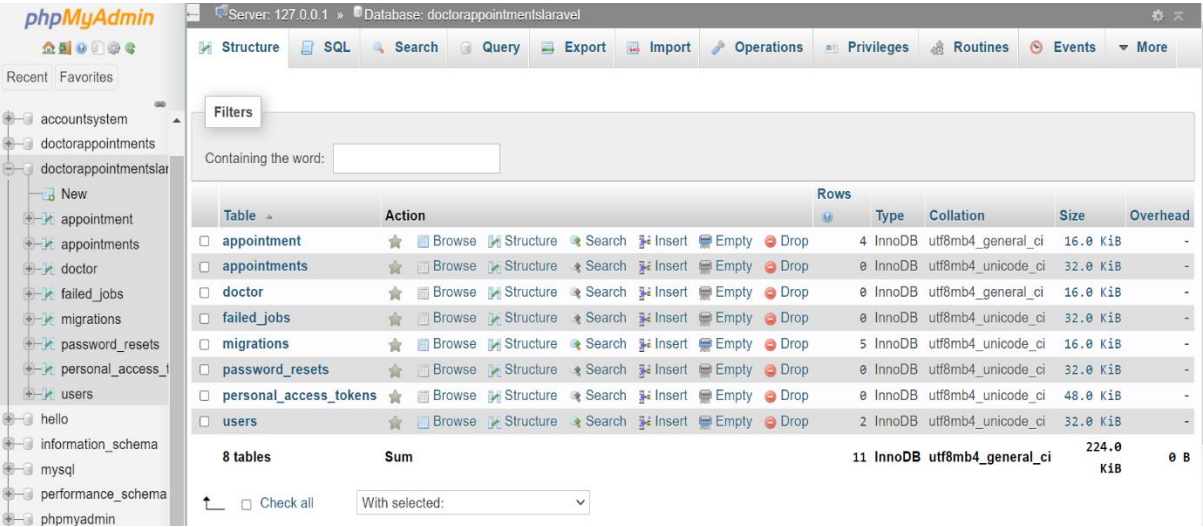
Route::get('/', [App\Http\Controllers\HomeController::class, 'index']->name('home'));
Route::get('/home', [App\Http\Controllers\HomeController::class, 'index']->name('home'));

Route::get('/appointments', [App\Http\Controllers\AppointmentController::class, 'index']);
Route::post('/appointments', [App\Http\Controllers\AppointmentController::class, 'store']);
```

Laravel Migrations:

```
class CreateAppointmentsTable extends Migration
{
    /**
     * Run the migrations.
     *
     * @return void
     */
    public function up()
    {
        Schema::create('appointments', function (Blueprint $table) {
            $table->id();
            $table->integer('user_id')->index();
            $table->string('heading');
            $table->string('details');
            $table->string('practitioner');
            $table->string('time');
            $table->string('contact');
            $table->timestamps();
            // set database headings
        });
    }
}
```

MySQL Database:

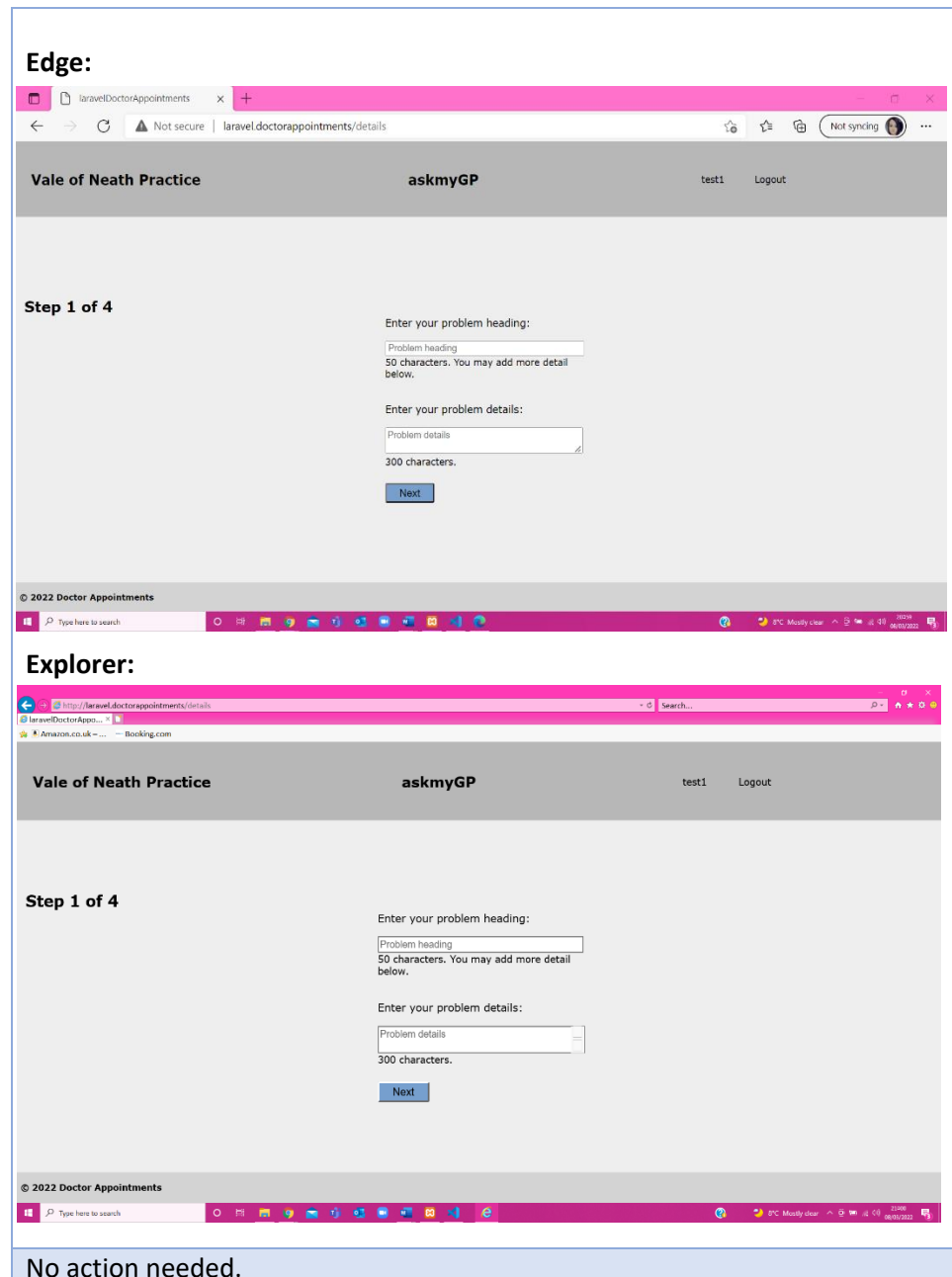


4.2.3 Software Testing

4.2.3.1 Website testing

Category	Test Case	Description
Standard automated tests	1	Browser Compatibility
	2	Mobile Friendly
	3	Accessibility
	4	Functionality

Test Case	1 – Browser Compatibility
Test Description	Website works in all web browsers
Testing Method	Use URL in different web browsers Repeat for all pages
Expected Results	Website to function similarly in all browsers
Actual Results	Chrome:



Action Needed

No action needed.

With the browser compatibility testing of the website, no actions are needed as the website works over a number of different browsers, all functioning and performing in the same way as shown in the evidence of screenshots. No improvements needed.

Test Case

Test Description

Testing Method

Expected Results

Actual Results

2 – Mobile Friendly

Checking if website is mobile friendly

Use chrome developer tool to check website in different screen views

Function on different screen sizes

Galaxy S8+:

Vale of Neath Practice

askmyGP

test1

Logout

Practitioner Availability Table

Practitioner	Monday	Tuesday	Wednesday	Thursday	Friday
Dr Grippen	08:00 - 18:30	Unavailable	08:00 - 18:30	Unavailable	08:00 - 18:30
Dr Harrowing	08:00 - 18:30	Unavailable	Unavailable	8:00 - 18:30	Unavailable
Dr Hepburn	08:00 - 18:30	8:00 - 18:30	08:00 - 18:30	Unavailable	08:00 - 18:30
Dr Ike	08:00 - 18:30	8:00 - 18:30	Unavailable	8:00 - 18:30	08:00 - 18:30
Dr Rinky	Unavailable	Unavailable	08:00 - 18:30	08:00 - 18:30	08:00 - 18:30
Dr Adejuwon	08:00 - 18:30	08:00 - 18:30	08:00 - 18:30	08:00 - 18:30	08:00 - 18:30
Dr Mikhael	08:00 - 18:30	08:00 - 18:30	08:00 - 18:30	08:00 - 18:30	08:00 - 18:30
Julie Kemp	08:00 - 18:30	08:00 - 18:30	08:00 - 18:30	Unavailable	Unavailable

[Next >](#)

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Vale of Neath Practice

askmyGP

test1

Logout

Step 1 of 4

Enter your problem heading:

Problem heading

50 characters. You may add more detail below.

Enter your problem details:

Problem details

300 characters.

Next

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Ipad Air:

Vale of Neath Practice

askmyGP

test1

Logout

Practitioner Availability Table

Practitioner	Monday	Tuesday	Wednesday	Thursday	Friday
Dr Grippen	08:00 - 18:30	Unavailable	08:00 - 18:30	Unavailable	08:00 - 18:30
Dr Harrowing	08:00 - 18:30	Unavailable	Unavailable	8:00 - 18:30	Unavailable
Dr Hepburn	08:00 - 18:30	8:00 - 18:30	08:00 - 18:30	Unavailable	08:00 - 18:30
Dr Ike	08:00 - 18:30	8:00 - 18:30	Unavailable	8:00 - 18:30	08:00 - 18:30
Dr Rinky	Unavailable	Unavailable	08:00 - 18:30	08:00 - 18:30	08:00 - 18:30
Dr Adejuwon	08:00 - 18:30	08:00 - 18:30	08:00 - 18:30	08:00 - 18:30	08:00 - 18:30
Dr Mikhael	08:00 - 18:30	08:00 - 18:30	08:00 - 18:30	08:00 - 18:30	08:00 - 18:30
Julie Kemp	08:00 - 18:30	08:00 - 18:30	08:00 - 18:30	Unavailable	Unavailable

[Next >](#)

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Vale of Neath Practice

askmyGP

test1

Logout

Step 1 of 4

Enter your problem heading:

Problem heading

50 characters. You may add more detail below.

Enter your problem details:

Problem details

300 characters.

Next

© 2022 Doctor Appointments

Action Needed

The layout will need to be adjusted for it to be responsive and mobile friendly.

The website is not mobile friendly, as shown in the test above. However, the majority of the content is still visible, and the buttons can be utilised. It has been mentioned as a recommendation that improvements need to be made to make the website mobile friendly.

Test Case

3 – Accessibility

Test Description

All pages should be accessible for all users including those who have a disability

Testing Method

Use Wave to identify accessibility warnings and errors

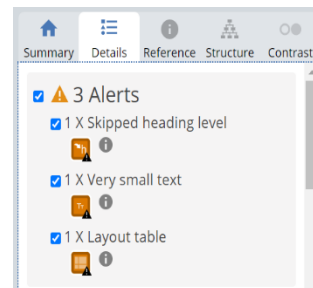
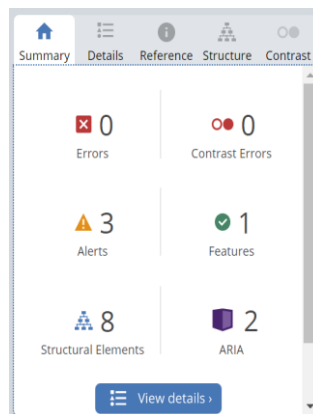
- Repeat for all pages

Expected Results

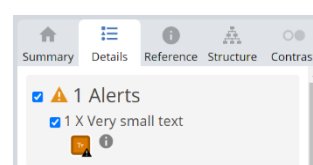
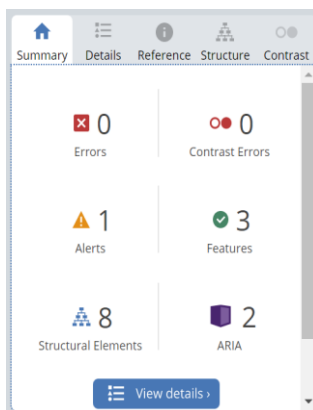
No errors

Actual Results

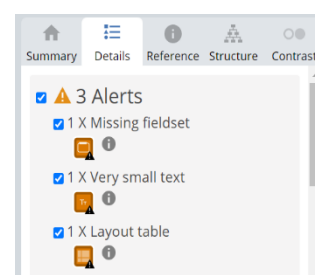
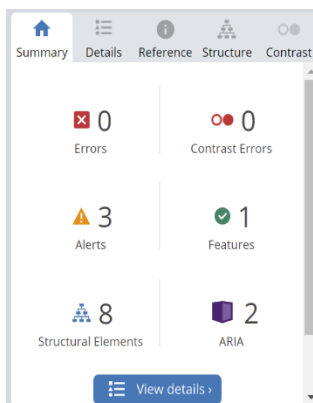
Home page:



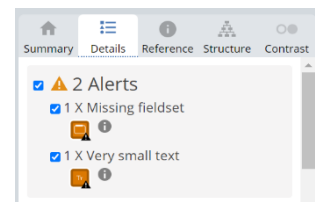
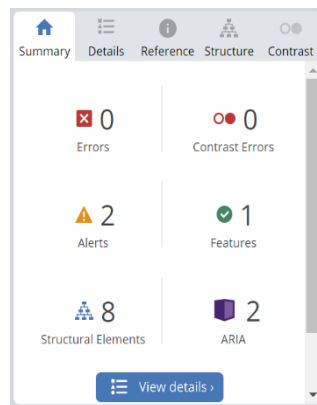
Problem page:



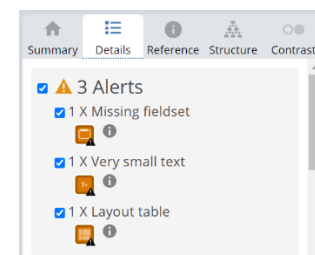
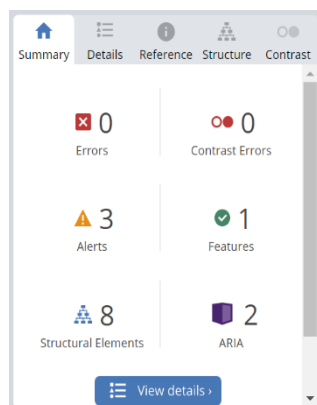
Practitioner's page:



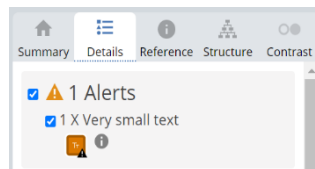
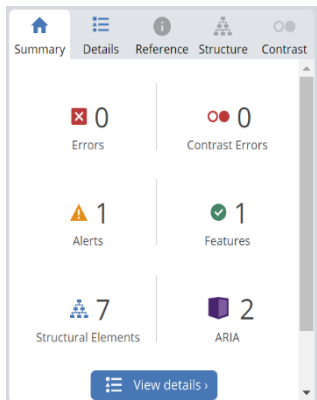
Time page:



Contact page:



End page:



Action Needed

No action needed.

There were no errors found in the accessibility testing. There were a few minor alerts found, but they were things such as 'very small text' for the copyright wrote in the bottom left-hand corner of the screen, which is meant to be small, therefore no improvements are required.

Test Case

Test Description

Testing Method

Expected Results

Actual Results

4 – Functionality

Users should be able to register and book an appointment with the data saved to a database

Go through each form and check if data was saved into the database

No errors

Register:

The screenshot shows the 'askmyGP' application interface. At the top, there's a header with 'Vale of Neath Practice' on the left, 'askmyGP' in the center, and 'Login' and 'Register' links on the right. Below the header, there's a 'Register' button on the left. The main form area contains the following fields: 'Name' (text input with 'test1'), 'Email Address' (text input with 'test1@email.com'), 'Password' (password input with 6 dots), and 'Confirm Password' (password input with 6 dots). Below these fields is a 'Register' button.

User saved to database:

id	name	email	email_verified_at	password	remember_token
1	test	test@email.com	NULL	\$2y\$10\$TLHXf22zzkugoOaVxVXe4TMu6giC6SL8dSAA2ndft...	NULL
2	tester	tester@email.com	NULL	\$2y\$10\$zjir\$JjDjnyitwzanEIZ.iucOyPG5TcUX1qLsfsfoZ...	NULL
3	test1	test1@email.com	NULL	\$2y\$10\$M2mewRna6Ewll/9jrjKpCOB.UyQV.37IPxMF54VDnOm...	NULL

Input problem heading and details:

The screenshot shows the 'askmyGP' application interface. At the top, there's a header with 'Vale of Neath Practice' on the left, 'askmyGP' in the center, and 'test1' and 'Logout' links on the right. Below the header, there's a 'Step 1 of 4' label. The main form area contains the following fields: 'Enter your problem heading:' (text input with 'Generally unwell'), '50 characters. You may add more detail below.' (text input with 'I have had bad eyes, ears and head as well as pain in the stomach and nausea for the'), and '300 characters.' (text input with 'I have had bad eyes, ears and head as well as pain in the stomach and nausea for the'). Below these fields is a 'Next' button.

Select practitioner:

Vale of Neath Practice

askmyGP

test1

Logout

Step 2 of 4

Select Practitioner:

	Practitioner	Tuesday (08-03-2022)
☐	Dr Gripper	08:00 - 18:30
☐	Dr Harrowing	Unavailable
☐	Dr Hepburn	08:00 - 18:30
☐	Dr Ike	Unavailable
☐	Dr Rinky	08:00 - 18:30
☐	Dr Adejuwon	08:00 - 18:30
☒	Dr Mikhael	08:00 - 18:30
☐	Julie Kemp	08:00 - 18:30
☐	I don't mind	

Note: If checkbox is highlighted in grey, practitioner is fully booked or unavailable

Next

Select appointment time:

Vale of Neath Practice

askmyGP

test1

Logout

Step 3 of 4

Select appointment time:

☐ 09:00 ☐ 09:15 ☐ 09:30 ☐ 09:45

☐ 10:00 ☐ 10:15 ☐ 10:30 ☐ 10:45

☐ 11:00 ☐ 11:15 ☐ 11:30 ☐ 11:45

☐ 14:30 ☐ 14:45 ☐ 15:00 ☐ 15:15

☐ 15:30 ☒ 15:45 ☐ 16:00 ☐ 16:15

☐ 16:30 ☐ 16:45 ☐ 17:00 ☐ 17:15

☐ 17:30 ☐ 17:45

Note: If time is in grey, appointment has been taken

Next

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Select contact method:

Vale of Neath Practice

askmyGP

test1

Logout

Step 4 of 4

How would you like to be contacted:

☒ Telephone call

☐ Email

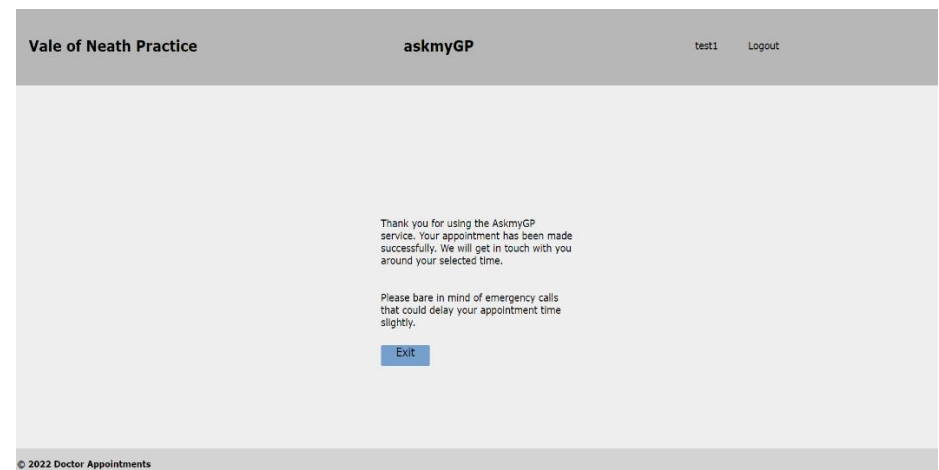
☐ Video consultation

☐ Face to face

Next

© 2022 Doctor Appointments

End page:



Appointment saved to database:

7	3	2022-03-08 13:18:16	2022-03-08 13:18:16	Generally unwell	I have bad eyes, ears and head as well as pain in ...	Dr Mikhaiei	15:45:00	Telephone call
---	---	---------------------	---------------------	------------------	---	-------------	----------	----------------

Action Needed

No action needed.

The above evidence from the functionality testing reveals that the registration of a user, booking an appointment and the data being saved in the database are all operating appropriately.

4.2.3.1 Usability Testing

Interviews were conducted to assess the website application's usability. Four users took part in testing the application to schedule a GPs appointment, after which they were asked questions on the site's usability to collect their feedback (appendix B). The questions asked were related to Nielsen's usability heuristics. These heuristics can be used to detect usability problems with specific features and how they affect the entire user experience, avoiding the need for redesign and reconstruction, which would take a lot more time. ^[31] The judgement sample method was used for the interviews as the goal was to have a mix of people of varied ages and computer skills ranging from beginner to advanced. ^[14]

Each usability heuristic that was applied to the online application is listed below, along with screenshots to demonstrate evidence and the key responses from the participants (participants responses in more detail under evaluation section).

Visibility of system status

Feedback given to inform user what is going on

The screenshot shows the 'askmyGP' interface for 'Vale of Neath Practice'. The header includes the practice name, the 'askmyGP' logo, and links for 'Steph' and 'Logout'. The main content area contains a confirmation message: 'Thank you for using the AskmyGP service. Your appointment has been made successfully. We will get in touch with you around your selected time.' Below this, a note states: 'Please bare in mind of emergency calls that could delay your appointment time slightly.' There is a blue 'Exit' button. The footer shows '© 2022 Doctor Appointments'.

Match between system and the real world

No unfamiliar or confusing words or phrases have been used

User control and freedom

The back button on the browser allows the user to go back to the previous step

Consistency and standards

Each step has the same layout and structure to keep it consistent.

Does not contain anything unique that forces users to learn something new.

The screenshot shows 'Step 1 of 4' of the 'askmyGP' interface. The header is identical to the previous screenshot. The main content area has the title 'Step 1 of 4'. It contains two input sections: 'Enter your problem heading:' with a text box and a character count '50 characters. You may add more detail below.', and 'Enter your problem details:' with a larger text box and a character count '300 characters.'. A blue 'Next' button is at the bottom. The footer shows '© 2022 Doctor Appointments'.

The screenshot shows 'Step 2 of 4' of the 'askmyGP' interface. The header is identical. The main content area has the title 'Step 2 of 4' and a section 'Select Practitioner:'. It features a table with two columns: 'Practitioner' and 'Tuesday (08-03-2022)'. The table lists several practitioners with their availability status. A blue 'Next' button is at the bottom. The footer shows '© 2022 Doctor Appointments'.

Practitioner	Tuesday (08-03-2022)
☐ Dr Gripper	08:00 - 18:30
☐ Dr Harrowing	Unavailable
☐ Dr Hepburn	08:00 - 18:30
☐ Dr Ike	Unavailable
☐ Dr Rinky	08:00 - 18:30
☐ Dr Adejuwon	08:00 - 18:30
☐ Dr Mikhael	08:00 - 18:30
☐ Julie Kemp	08:00 - 18:30
☐ I don't mind	

	Vale of Neath PracticeaskmyGPStephLogout Step 3 of 4 Select appointment time: 09:00 09:15 09:30 09:45 10:00 10:15 10:30 10:45 11:00 11:15 11:30 11:45 14:30 14:45 15:00 15:15 15:30 15:45 16:00 16:15 16:30 16:45 17:00 17:15 17:30 17:45 Note: If time is in grey, appointment has been taken Next © 2022 Doctor Appointments Vale of Neath PracticeaskmyGPStephLogout Step 4 of 4 How would you like to be contacted: Telephone call Email Video consultation Face to face Next © 2022 Doctor Appointments Vale of Neath PracticeaskmyGPStephLogout Thank you for using the AskmyGP service. Your appointment has been made successfully. We will get in touch with you around your selected time. Please bare in mind of emergency calls that could delay your appointment time slightly. Exit © 2022 Doctor Appointments
Error prevention	Not able to move to next step if one of the fields required has been missed out Vale of Neath PracticeaskmyGPStephLogout Step 1 of 4 Enter your problem heading: bad back 50 characters. You may add more detail below. Enter your problem details: Problem details 300 of 300 characters. You may add more detail below. Please fill out this field. Next © 2022 Doctor Appointments

Recognition rather than recall

Each step tells the user exactly what to do with a next button to show the user where to go next

Practitioner	Tuesday (08-03-2022)
☐ Dr Gripper	08:00 - 18:30
☐ Dr Harrowing	Unavailable
☐ Dr Hepburn	08:00 - 18:30
☐ Dr Ite	Unavailable
☐ Dr Rinky	08:00 - 18:30
☐ Dr Adejuwon	08:00 - 18:30
☐ Dr Mishalel	08:00 - 18:30
☐ Julie Kemp	08:00 - 18:30
☐ I don't mind	

Note: If checkbox is highlighted in grey, practitioner is fully booked or unavailable

Next

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Aesthetic and minimalist design

Kept simple with no unnecessary or distracting features

Enter your problem heading:

Problem heading

50 characters. You may add more detail below.

Enter your problem details:

Problem details

300 characters.

Next

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Help users recognize, diagnose, and recover from errors

It tells the user what is wrong and offers a solution.

Password

Confirm Password

The password must be at least 8 characters.

Register

Enter your problem heading:

bad back

50 characters. You may add more detail below.

Enter your problem details:

Problem details

300 characters.

Please fill out this field.

Next

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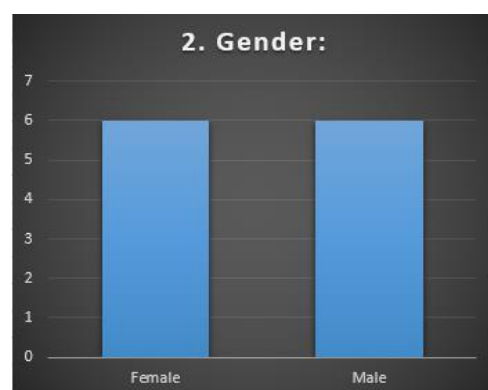
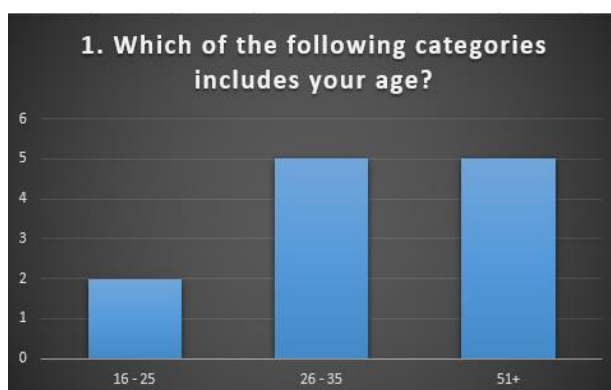
Two usability heuristics were not used because they were not applicable to this website. The first was 'flexibility and efficiency of use,' which allows for shortcuts, personalisation and customisation, whereas the GPs appointment system requires each step to be completed to be able to move onto the next step and to complete the application successfully. The second was 'help and documentation,' because the website application was simple and straightforward with no complications, even for computer beginners, therefore did not require any help or documentation.

5. Evaluation

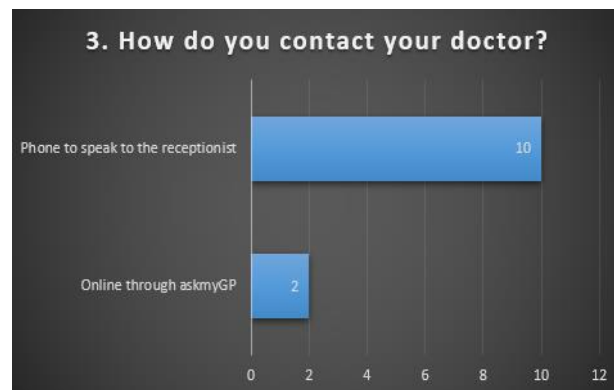
A lot of research was conducted for the review of literature to learn more about the topic question of 'Can GP appointment systems be improved regarding patient contact times?' It entailed going through a variety of websites and scholarly articles to see if they were reliable and had the relevant information. The articles and websites found underwent CRAAP evaluations to guarantee that they were reliable and accurate enough to be included in the project. Many references were looked at but could not be utilised due to failing the CRAAP evaluation. If this had not been conducted, outdated or inaccurate information could have been used, potentially jeopardising the entire project.

Twenty questionnaires were distributed with 12 responses. The questionnaire was created through Microsoft Forms which consisted of 12 questions regarding the project question of 'Can GP appointment systems be improved regarding patient contact times?' The reason for choosing Microsoft Forms to develop the questionnaire was mostly due to cost, since it was a free resource available at the college, resulting in no project costs, whereas using Survey Monkey would have resulted in a fee. Another reason for choosing Microsoft Forms was down to the simplicity with which the questionnaire could be created, distributed and responses received. This was done online, making it a quick and simple process overall. The questionnaire included an equal number of quantitative and qualitative questions, to provide a broader and deeper knowledge of the topic question. The quantitative questions provided for a more generalised and controlled outcome when evaluating the project's theory, while the qualitative questions provided important information for a more detailed response as well as an understanding of how the individual perceives and interprets their quantitative response.^[36] Although some of the qualitative responses were time-consuming to analyse due to the wide range of responses, some of which were rather lengthy.

From the questionnaire results, a lot of useful information was gathered and found.



From the results shown above, there were 2 people between the age of 16 – 25, 5 between the age of 26 – 35 and 5 people of the age 51 and plus with 6 of those who were female and 6 were male.



In question 3 above, there were a lot more people who opted to phone to speak to the receptionist as their preferred way to contact their doctor with only 2 choosing the online option through AskmyGP.

4. In relation to your answer to question 3, why do you prefer that method? (Qualitative question, answer summarised)

Phone: Some of the participants don't have the online option so have to go through the phone while the others preferred to speak to someone to get their voice heard

Online: Save waiting in a long queue on the phone to speak to the receptionist



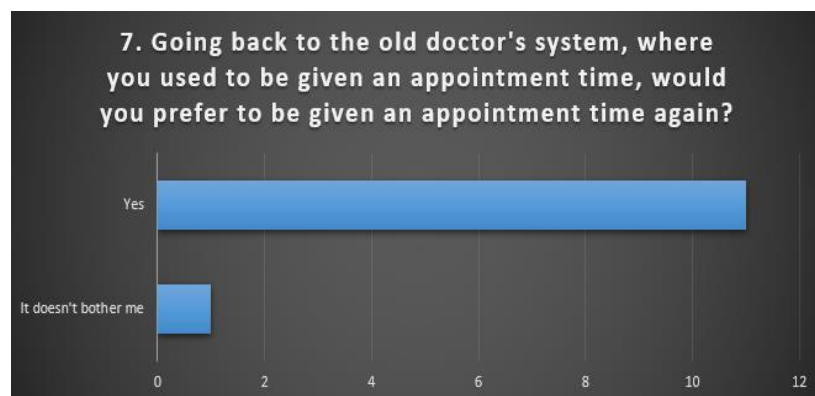
Question 5 above, 1 participant said they wait less than an hour to speak to a doctor, 2 participants answered 1 – 2 hours, 6 answered 3 – 4 hours waiting time, 1 answered 5 – 6 hours and 2 participants said they wait more than 7 hours to speak to a doctor.

6. How do you feel about the wait time to speak to a doctor and why? (Qualitative question, answer summarised)

Participants words used were 'terrible', 'annoying' and 'frustrating'. The reasons given were that they may have other appointments to attend to or work which can then be difficult to take a call in privacy.

One participant stated they think 'it is fair as they prioritise calls depending on patient symptoms/query.'

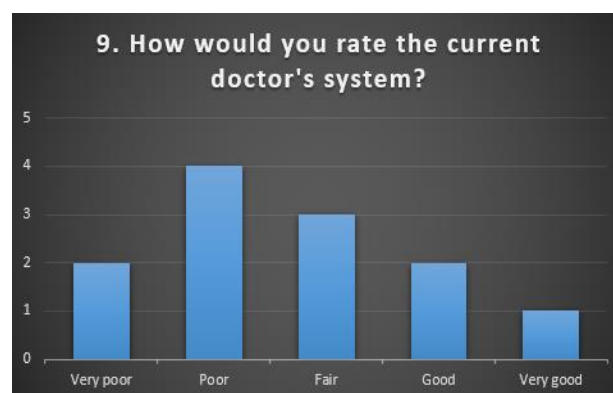
While another participant replied, 'the waiting time is quite quick at my GP so have no issues with the service.'



As shown above in question 7, the majority answered yes, they would prefer to be given an appointment time while 1 answered 'it doesn't bother me'. No participants answered 'no'.

8. Can you explain why you have chosen your answer in relation to question 7? (Qualitative question, answer summarised)

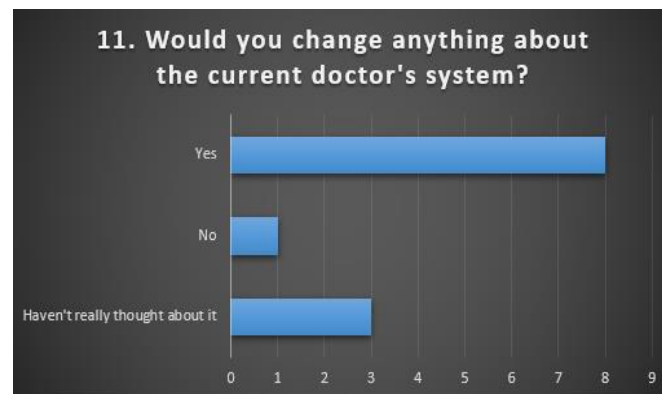
Participants felt that appointment times would save the hanging around and make it easier to arrange their day and ensure that they are available around the allocated time.



For rating the current doctor's system for question 9 above, 6 participants choose the poor rating while 3 rated it fair and 3 gave a good rating.

10. Please explain your answer to question 9? (Qualitative question, answer summarised)

The participants who rated the system as poor all stated the reason was down to not having appointment times and having to wait around all day. The ones who gave a good rating haven't experienced a long waiting time to speak to their doctor.



67% of the participants would change the current doctor's system as shown above in question 11. 8% would not change anything while 25% of the participants haven't really thought about it.

12. If answered yes to the above question, what would you change and why? (Qualitative question, answer summarised)

All participants want appointment times back so they know where they are.

One participant also mentioned having the phone service improved for those who cannot use a web service.

The main goal was to find out how people felt about the current doctor's system and how it could be improved. The main issue, according to the data in the questionnaire, was not having appointment times and waiting around not knowing when they would receive the phone call.

An interview with a receptionist that worked in the general practice was specified to take place in the project proposal and further up in this report under the research methodology section, however due to the receptionists' extremely busy schedules, they were unable to conduct an interview. This could have helped the project further on their views around appointment times and given recommendations on what may be needed.

Instead, interviews were conducted with four users who tested the website application to obtain feedback. Bias and ethnicity were taken into account when creating the questions.

^[15] The interview questions were semi-structured where questions were prepared but also gave the freedom to ask participants to expand on some of their answers to provide more

detail and explain their reasons to some of their answers. The following shows the interview responses from the participants:

	Participant 1	Participant 2	Participant 3	Participant 4
1. Age:	32	29	26	55
2. Computer skills:	Advanced	Advanced	Intermediate	Beginner

3. **After completion, it notifies you if your application was successful and makes you aware that there may be a delay. Do you think this kind of feedback is useful for keeping you informed about what is going on?**

All participants answered yes because they know it went through and know they may not get the call on the specific time they chose due to a delay.

4. **Was there anything you found unfamiliar or confusing?**

All participants answered no and that it was easy and straightforward to fill in and complete

5. **Was it easy to undo or change something?**

One participant experimented by going back and changing one of the details, claiming it was simple, the others did not attempt to change anything but were notified on how to do so after completion if they wanted to.

6. **Did you find each step was consistent with the content and the buttons?**

All of the participants agreed that each step was consistent throughout the process.

7. **Was there anything unique about using this website application over other websites that required you to learn how to use it?**

Participants 1, 2 and 3 all replied no, noting that they didn't need to learn anything new and that the website's functions were comparable to those of other websites.

Participant 4 responded that they don't have much experience with computers and websites hence would not know, but thought it was straightforward to use.

8. **Would you be able to go to the next step if one of the steps had been missed out?**

Participants 1 and 2 both said no, stating that they had to complete each step before moving on to the next.

Participants 3 and 4 did not miss anything, therefore did not have this experience, although they were notified and shown a screenshot of what would happen if something were to be missed.

9. **Were there any errors that prevented you from making an appointment?**

All participants responded with 'none that they came across'.

10. **Did you find each step clear on what you had to do and what you needed to do next?**

All stated yes that it was easy to use and clear on what needed to be done.

Participant 3 mentioned that they have dyslexia and find some tasks challenging but did not require help when filling out this website's application due to its simplicity and clearness.

11. Do you believe there was anything on the pages that was unnecessary or distracting at any point during the process?

There was nothing unnecessary or distracting for any of the participants.

12. If you came across any errors, did it notify you on what went wrong and offer a solution?

Participants 1, 2 and 4 came across an error when registering, they were all informed that their password was too short and that it needed to be 8 characters long, a simple fix.

Participant 3 did not come across any errors.

All usability heuristics have been fulfilled based on the interview results.

The development part using HTML and CSS to make it look like the design was straightforward. The design was kept simple with no unnecessary elements to allow ease of use for the users. The use of Laravel allowed the website to connect to a database to save the necessary details inputted by the user. Overall, the project's development was successful since it accomplishes the basic objectives, such as allowing the user to enter data, provides an appointment time and saves the data to a database. However, there is still more work to be done in terms of development, as detailed in the report's recommendations section.

6. Conclusions and Recommendations

6.1 Conclusions

The findings from the questionnaire supported the project's research and review of literature. Based on these findings, the biggest issue with the GPs system was no appointment times were being provided, a lot of people were dissatisfied by not knowing when they would receive a call from the doctor. This problem should be resolved as part of the project's development.

Some of the findings were quite surprising such as the majority of those who completed the questionnaires chose to phone and speak to a receptionist rather than use the AskmyGP online service, as common belief would suggest that the younger generation would have chosen the online option. However, a few who chose the phone option stated that they did not have access to the online service where they live. If this were to be rolled out across the country, more people may choose this option, making this development beneficial.

Referring back to the project question of 'Can GPs appointment systems be improved regarding patient contact times?', the answer is yes, they certainly can be improved by providing the patients with appointment times, as they did in the past. Patients would be

more satisfied as they would know an approximate time when they would receive the doctors' phone call and could arrange their day around that time.

6.2 Recommendations

There are numerous recommendations that can be added to improve the project's development. A few of the implementations were left out due to not having enough time and the development taking far longer than anticipated.

One of the features that could be implemented is to send patients delay notifications or emails if the doctor is running late, informing them that there will be a delay in their allocated time and providing an estimate of how long the wait will be.

Another feature is to provide the ability for patients to return to a previous page before submitting their information if they decide to modify their options, such as the appointment time or the practitioner.

The character count for the problem heading and details were planned to be set at 50 and 300 characters, however due to a lack of time, they were not implemented and would need to be included as a future development. Additionally, when selecting a practitioner, the times displayed should be automated to show if that practitioner is available, whether they are in on that day or have the day off, which was also not implemented due to time constraints. Also, slight adjustments would need to be made as well as more code added to the CSS part to make the website mobile friendly.

Lastly, the most important feature that should have been added but was unfortunately not was the capability of greying out or hiding the practitioners and times if they had already been claimed by another patient. If there were more time, this would be the first feature to be implemented.

7. Reflection

When this project originally began, it was difficult to locate material related to the project's primary question. This was due to a lack of knowledge about what to look for and just looking for certain terms rather than broadening the scope of the topic. Once the horizons were widened, the review of literature became simple and a lot of useful material was discovered. If this were to happen again, this error would be avoided and a larger vocabulary would be employed.

For this project, it appears that the appropriate research methodologies were used. Such as pragmatism because a lot of research was done and a development was implemented, deductive approach because of the amount of research that was needed, and action research strategy because it involved addressing the appointment times problem with the existing GPs appointment system and improving it by developing it into a website that

included the appointment times. The same methodologies would be chosen if this project were to be done again.

The design appeared to be a success as it was kept simple and not overly cluttered. To avoid confusing current users of the service, the interface was similar to the current GPs online system. There were no negative feelings regarding the design, it was all positive and nothing would be changed if it were to be done again, with the exception of the two features previously mentioned under the problems and successes section, which were altered during implementation for the better.

Last of all is the project's development. Using Laravel was extremely complex that caused a great deal of frustration and stress. The good thing about Laravel is what it can accomplish in terms of security, authentication and the database connection, the negative thing is that it was simply too complicated to understand in such a short amount of time. However, the development was up and running as it should have been, but there is still a lot more to be done as features had to be left out due to time constraints. If this were to be done again, an alternative framework would be looked at and used.

This project topic was chosen due to personal frustrations with the local GPs appointment system, as well as knowing others (family, friends, college lecturers) who felt the same way about not being given an appointment time and having to wait hours for a doctor to call without knowing when they would. It was interesting to find out that similar research had been done on this topic with a lot of other opinions being made and feeling the same way. This goes to show that appointment times should be brought back.

This research project and the development, providing the recommendations listed above were implemented, could help general practices as it would provide better patient satisfaction.

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Appendices

Appendix A

Questionnaire questions:

1. Which of the following categories includes your age?
 - a. 16 – 25
 - b. 26 – 35
 - c. 36 – 50
 - d. 51+
2. Gender:
 - a. Male
 - b. Female
3. How do you contact your doctor?
 - a. Phone to speak to the receptionist
 - b. Online through AskmyGP
4. In relation to your answer for question 3, why do you prefer that method?
5. How long do you usually have to wait to speak to a doctor?
 - a. Less than an hour
 - b. 1 – 2 hours
 - c. 3 – 4 hours
 - d. 5 – 6 hours
 - e. More than 7 hours
6. How do you feel about the wait time to speak to a doctor and why?
7. Going back to the old doctor's system, where you used to be given an appointment time, would you prefer to be given an appointment time again?
 - a. Yes
 - b. It doesn't bother me
 - c. No
8. Can you explain why you have chosen your answer in relation to question 7?
9. How would you rate the current doctor's system?
 - a. Very poor
 - b. Poor
 - c. Fair
 - d. Good
 - e. Very good
10. Please explain your answer to question 9?
11. Would you change anything about the current doctor's system?
 - a. Yes
 - b. Haven't really thought about it
 - c. No
12. If answered yes to the above question, what would you change and why?

Appendix B

Usability heuristics interview questions:

Age:

Computer skills: Beginner, Intermediate, Advanced

1. Visibility of system status –
 - a. After completion, it notifies you if your application was successful and makes you aware that there may be a delay. Do you think this kind of feedback is useful for keeping you informed about what is going on?
2. Match between system and the real world –
 - a. Was there anything you found unfamiliar or confusing?
3. User control and freedom –
 - a. Was it easy to undo or change something?
4. Consistency and standards –
 - a. Did you find each step was consistent with the content and the buttons?
 - b. Was there anything unique about using this website application over other websites that required you to learn how to use it?
5. Error prevention –
 - a. Would you be able to go to the next step if one of the steps had been missed out?
 - b. Were there any errors that prevented you from making an appointment?
6. Recognition rather than recall –
 - a. Did you find each step clear on what you had to do and what you needed to do next?
7. Aesthetic and minimalist design –
 - a. Do you believe there was anything on the pages that was unnecessary or distracting at any point during the process?
8. Help users recognize, diagnose, and recover from errors –
 - a. If you came across any errors, did it notify you on what went wrong and offer a solution?