

Hitch a Ride - Online Carpooling Application

Final Report for CS39440 Major Project

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Abstract

Include an abstract for your project. This should be no more than 300 words.

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Chapter 1

Background & Objectives

This section should discuss your preparation for the project, including background reading, your analysis of the problem and the process or method you have followed to help structure your work. It is likely that you will reuse part of your outline project specification, but at this point in the project you should have more to talk about.

Note:

- All of the sections and text in this example are for illustration purposes. The main Chapters are a good starting point, but the content and actual sections that you include are likely to be different.
- Look at the document on the Structure of the Final Report for additional guidance.

1.1 Background

1.1.1 Overview

As a student studying in a university away from home, I have often needed to travel back home during the holidays or on weekends. My motivation for this project comes from the requirement that many people have to travel frequently from one place to another.

I have always driven to Cardiff from Aberystwyth and back during the holidays in a car with 4 spare seats. If there was some way I could offer those spare seats to other students or people travelling in the same or similar direction the cost of fuel could be split, meaning a cheaper mode of transport.

1.1.2 Example Use Case

Upon opening the home page, the user will be confronted with the option of either registering, or logging in using existing details. Either action done successfully will log the user in.

Once logged in, the user is taken to their home page, which displays predicted journeys that the site thinks the user might be interested in using their preferences. From this page, they can access all features within the site, which include:

- 'My Activity' - Information about upcoming rides and hitches related to the user. The ability to accept or decline hitch requests for their journeys.
- 'Messages' - Messages to and from other users.
- 'My Profile' - Personal details about the user, available for editing.
- 'Find a Journey' - A search page used to search for journeys from one location to another.
- 'Post Journey' - The page used to post new journeys that the user will be partaking in.

When a user posts a journey from location A to location B using the 'Post Journey' page, it will display a map route which needs to be accepted by the user. Once this is accepted, the journey will be entered into the database, where it will be returned in other users searches if the parameters match the details of the journey.

If another user requests to hitch a ride on the journey, the driver will be prompted in the 'My Activity' page, and will have the option of accepting or declining the hitch request.

The hitch request could be from location A to location B, but it could also be from location A to a new location C. Similarly it could be from location C to location B, or even location C to location D. It is up to the driver to accept or decline the hitch request, depending on how it changes the route that the driver takes.

If the driver accepts this new hitcher, the route will be altered if necessary to include the new pickup / drop off points and saved into the database with one of the spare spaces now filled.

1.1.3 Existing Services

There are existing websites that offer the same sort of carpooling service. The leading services are Carpooling.com [2] and BlaBlaCar [?]. These sites provide a platform for people to offer rides to other people needing to travel in similar directions.

1.2 Analysis

Taking into account the problem and what you learned from the background work, what was your analysis of the problem? How did your analysis help to decompose the problem into the main tasks that you would undertake? Were there alternative approaches? Why did you choose one approach compared to the alternatives?

There should be a clear statement of the objectives of the work, which you will evaluate at the end of the work.

In most cases, the agreed objectives or requirements will be the result of a compromise between what would ideally have been produced and what was felt to be possible in the time available. A discussion of the process of arriving at the final list is usually appropriate.

1.2.1 Original Goals

The original goals of the project were to produce an online service that enables people to share journeys with people who are looking to travel to and from similar locations or locations along the route of the driver.

This would enable the users to reduce the cost of the journeys by sharing the cost of fuel.

1.2.2 Requirements

Enable users to:

- FR1 - Register to the site
- FR2 - Log in if an existing member
- FR3 - Post new journeys to the site, offering spare spaces
- FR4 - Search for a journey between two locations
- FR5 - Request to join a journey offered by another user
- FR6 - Accept a hitcher requesting to join a journey
- FR7 - Decline a hitcher requesting to join a journey
- FR8 - Suggest journeys depending on preferences
- FR9 - Cancel a journey
- FR10 - Send messages to other users

1.3 Process

You need to describe briefly the life cycle model or research method that you used. You do not need to write about all of the different process models that you are aware of. Focus on the process model that you have used. It is possible that you needed to adapt an existing process model to suit your project; clearly identify what you used and how you adapted it for your needs.

1.3.1 Overview

1.3.2 Methodology

I have chosen to use the Waterfall Model as the methodology for this project. The reason for this is that this project was of my own design, meaning that the requirements of it were known from the very beginning and were very unlikely to change.

1.3.3 Planning

1.3.4 Research

The vast majority of this service depends on its ability to recognise, locate and route directions from an origin to a destination. The APIs that were looked into were the Google Directions API [4] and the Google Geocoding API.

Chapter 2

Design

You should concentrate on the more important aspects of the design. It is essential that an overview is presented before going into detail. As well as describing the design adopted it must also explain what other designs were considered and why they were rejected.

The design should describe what you expected to do, and might also explain areas that you had to revise after some investigation.

Typically, for an object-oriented design, the discussion will focus on the choice of objects and classes and the allocation of methods to classes. The use made of reusable components should be described and their source referenced. Particularly important decisions concerning data structures usually affect the architecture of a system and so should be described here.

You should also identify any support tools that you used. You should discuss your choice of implementation tools - programming language, compilers, database management system, program development environment, etc.

2.1 Overview

2.2 Technologies

2.2.1 PHP

PHP is used as the main language for the object oriented controlling of the data flow to and from the database. It is also used as the language to dynamically display produce the website output that the user sees.

2.2.2 JQuery

JQuery is featured on the website as a means of displaying certain features. Graphical maps generated by Google Directions [4] service are retrieved and displayed using JQuery. It is also used on the messages page of the site.

2.2.3 PostgreSQL Database

Using an Object Relational database management system is the most efficient method of storing dynamic for websites. The PSQL database is handled by the object oriented PHP application that is used by the website.

2.2.4 Github

Github [?] version control web hosting was chosen as the desired.

2.2.5 Programming Environment

Developing an object oriented application in PHP meant that an suitable IDE was required for the development process. Netbeans IDE 7.3.1 was the selected tool for this job.

2.3 Overall Architecture

2.3.1 Overview

The data storage system the website uses is a PostgreSQL database which contains the following tables:

- Person - Personal details of each user.
- Journey - Details of Journeys that users have posted.
- Journey_Step - Each journey has many journey steps. This table holds the geographical location, the related journey and the order of the step.
- Journey_Step_Temp - A temporary table used when the journey steps for a particular journey change. This may occur is a hitch request is accepted which alters the route of the journey.
- Hitch_Request - Details about a hitch request made from a person to a particular journey.
- Message - Messages sent from user to user.

All actions performed on the database are done via a connection from the PHP database controller classes. Each table has a representative PHP model class mirroring the table. Controller classes control these classes to insert, update and delete records from each of the tables.

The website instantiates the database controller classes to enable the site to produce dynamic output and allow the user to access all of the site's features once logged in.

2.3.2 Other Considered API Structures

The final structure of the database controller that is present in the final system was not originally the first choice for it. Investigative prototypes were developed that completely separated the website from an API that interacted with the database.

The prospect of a procedural API was considered, prompting a basic prototype to be built. It worked well to an extent but because of its procedural nature did not follow any sort of design pattern as it was not object oriented. The method of data transferral between API and website was that of JSON data, which was sent via HTTP POST to a single API URL. This JSON data would contain a 'request_type' field, which would indicate to the API what kind of operation needed to be called on the rest of the JSON data. A data encoder method would parse this data, call a specific procedure which would perform some kind of action of the JSON data and query the database, then echo JSON data back to the website with the result of the request. This structure worked fairly well, but the development over time slowly became more of a hassle as the entropy of it outgrew the benefits. Any slight change in database structure or table meant changing every function that queried the database, which made the code almost impossible to refactor or update. It was deemed that Object Oriented was the right path to follow.

If the API was going to separate from the website it should probably be in the form of a Representation State Transfer architecture, or REST. RESTful web services explicitly use HTTP methods to perform all queries on the database. They are usually used for high performance services with many queries being passed to the server from many sources. Implementing a RESTful API was considered in detail but deemed not right for the project because of the scale of it. If there were other methods of access that would be made available, for example mobile applications and other third party websites, REST would be a perfect solution. But because only service accessing the API is this website, there is no need to separate the website from the API. This is how the current structure of database controller classes and website files came to be. The website files are not object oriented and simply maintain a session whilst the user is browsing. The database controller files are object oriented and control data flow to and from the database. The website gives the user an interface to take advantage of the database controller classes and use their methods to perform actions of the database.

2.3.3 Method

The waterfall software development methodology was used as the development methodology for this project. A detailed project specification document was produced to outline the key functional requirements of the final release.

A design specification document was produced to outline the key design aspects of the site, including the database and database controller classes in PHP. It also outlined how the website would communicate with these controller classes.

As well as the design specification document, UML design diagrams describing the database structure and database controller structure were produced. Use case diagrams describe how users interact with the website.

Agile methodologies were considered also. Feature Driven Development in particular was considered as a potential method of development, in conjunction with Test Driven Development as a coding method. However, the project specifications were so finely outlined and set in stone from the beginning, there seemed no need to choose a method which puts so much effort into dealing with changes in requirements.

2.3.4 Structure of Database Controller

The Database Controller is the name given to the object oriented structure of PHP classes used to control data flow to and from the database. For each of the main tables in the database, there is a corresponding PHP class with the same name: Hitch_Request, Journey, Journey_Step, Message and Person. These classes that model the tables have attributes matching those of the table attributes and contain the 4 methods: Create, Load, Update, Delete; following the CRUD persistent storage technique [?]. The Create method in each of the classes uses the class attribute values to create a new entry in the corresponding database table. The Update methods update the related entry already in the corresponding table using the attributes in the class object by the primary key that will have been retrieved from the database upon executing the Create method and stored as once of the class attributes. The Load method loads the attributes to the class object from the corresponding table in the database using the primary key as a parameter. The Delete method simply deletes the related entry from the corresponding table in the database using its primary key stored in the class object's attributes. The Delete method also resets all of the attribute values in the object just in case the object is used again for a different entry in the database. All of these methods use dynamically constructed SQL queries within the method call to query the database depending on the current state of the object itself. the return value from the method depends on the success of the query to the database.

Upon instantiating each of the model class objects, a non-compulsory parameter may be parsed to the constructor as the primary key to that table. If something is parsed in this parameter, the constructor will call the Load method, which attempts to populate the class object's attributes with values from the corresponding table using the parameter as the primary key.

Each of the table model classes are utilized by controller classes. These classes instantiate their model classes to manipulate the entries in the database. Each of the controllers are unique to the tasks that need to be performed on each of the tables and often involve interaction between the controllers. For example, when a new Journey gets posted by a user, the Journey_Controller class would be instantiated. This object would then instantiate a Journey class object, populate its attributes with values and use its Create method to insert the data into the database. It would then instantiate a Journey_Step_Controller class which in turn would instantiate and populate a series of Journey_Step classes depending on the number of steps in that journey. Each of the entries would then be inserted into the database by the controller calling the Create method in each of the Journey_Step objects.

A UML class diagram of the controller and model classes can be found in Appendix

2.4 Website Design

2.4.1 Overview

The website is produced by the collection of 25 PHP files which dynamically output HTML depending on the data that is received from the database controller classes. They also provide a platform for users to access all of the features available to them that the site offers. Other technologies and libraries are also used in the productions of the dynamic website, including Bootstrap CSS library [?] and JQuery Library [?].

2.4.2 PHP

The PHP files responsible for dynamically outputting the website maintain a session throughout the user's time on the site. This session allows the site to maintain a user logged on as they navigate through the site. The only data that is stored continuously as a session variable is the user's email address, which is used when they log in or register to the site. If there is no session present, or the session variable containing the email is empty, any page that is accessed redirects the browser to the index page.

Once logged on, there are 6 main pages accessible via the menu bar spanning the top of the web page. These pages are:

Home Clicking this redirects the browser to 'home.php'. This page is basically a splash page which makes 3 journey suggestions that the site thinks the user may be interested in considering to hitch a ride with. It calculates this by instantiating a 'Person' object from the database controller classes, parsing the email address stored in session to the 'Load()' method, and retrieving the details stored in the 'Person' object's attributes. If their profile has not yet been fully completed to enable predictions, the user will be prompted. Otherwise, these details are parsed into a 'Journey_Controller' object which searches for any journeys that may be relevant to them. Each suggested journey has two buttons: 'View Journey Details' and 'Request to Hitch'. The first takes the user to a new page, 'journey_view.php' where more details about the journey are displayed, including a map of the route. The second redirects the browser to 'request_hitch.php' which attempts to make a request on the user's behalf and redirects the user back to 'activity.php', the Activity page.

Activity Clicking the 'Activity' button redirects the browser to 'activity.php'. This page displays all of the current user's shared journeys on the left hand side and hitch requests on the right. If there has been any change in the status of a journey, it will be highlighted red with a prompt message also in red inside it. This will occur if someone has made a hitch request to it. Journeys are retrieved from the database by the page instantiating a 'Journey_Controller' object and parsing the email address in the session variable into the 'GetMyJourneys()' method, which returns an array of journeys posted via that email address. The hitch requests are obtained in much the same way but instead of using the 'Journey_Controller.php' class, it instantiates a 'Hitch_Request' object and parses the email address into the 'GetMyHitchRequests()' method.

Each journey and each hitch request are click-able if the user wishes to view them in more detail. Clicking on a journey will redirect the browser to 'journey_view.php' which displays more details and a map relating to the route of the journey. If a hitch request is clicked it redirects the user to 'hitch_view.php' which displays more details about the journey and driver, details of the other accepted hitches, whether the request has been accepted or not and a map of the route including the way points that hitches will be picked up / dropped off at.

Messages Clicking the 'Messages' menu button will redirect the user's browser to 'messages.php'. This page allows the user to see messages sent from other users, messages sent to other user and allow them to send more. It does this by instantiating a 'Message_Controller' object from the database controller classes and parses the email from the session variables into the 'LoadMyMessages()' method to load the messages to the object. It then calls 'GetMessages()' to retrieve them as an Array. Similarly, the same process is repeated to retrieve sent

messages except instead of parse the email into the 'GetMyMessages()' method, it parsed it into the 'GetSentMessages()' method. When a new message is compiled and submitted by the site, it parses the new data fields into the 'SendMessage()' method inside the 'Message_Controller'. This page uses JQuery 'Hide()' and 'Show()' methods to display each div. These divs include 'New Message', 'Inbox' and 'Sent Messages'. Clicking on the buttons on the left shows the corresponding div relating to the button and hides the others.

Profile Clicking on the 'Profile' button redirects the browser to 'profile.php'. This page retrieves the user's data by instantiating a Person object from the database controller classes, then parsing the email address in the session variable into its 'Load()' method and retrieving the attribute values. It then displays all user data on the page. The page provides a button at the bottom of the page captioned 'Edit Profile'. This button redirects the browser to the 'edit_profile.php' page which displays all of the same information as the 'profile.php' but instead of just text, the data is displayed in editable data fields. A submit option is present at the bottom of the page which when clicked submits the form data to 'perform_edit_profile.php'. This page uses the 'Person' object in the database controller classes to load the person data using the email address in session, update its attributes with the posted form data and call 'Update()' in its functions to update the entry in the database. The browser is then redirected back to 'profile.php' to view the new person details.

Find a Journey Clicking 'Find a Journey' on the menu bar will redirect the browser to 'search_journey.php'. This page is simple a form which asks the user to input the parameters of their search. Once filled in and submitted, the input is posted to the 'perform_journey_search.php' page. This page instantiates a 'journey_controller' object and sets the controller's search attributes to the search parameters posted from the form. The controller's 'SearchJourney()' method is called which returns an array of search results. These results are displayed on the page with two buttons each giving the option of immediately request to hitch, or to view more information about the journey. Clicking the 'Request Hitch' button will redirect the browser to 'request_hitch.php' which attempts to request a hitch for that journey using a 'Hitch_Request_Controller' object, and parsing the email stored in the session and data relating to the journey in question into the 'CreateHitchRequest()' method. the browser is then redirected to the 'activity.php' page. if the user clicks the 'View Journey Details' button, they are redirected to 'hitch_view.php', which uses database controller object 'Hitch_Request_Controller' to retrieve all data relating to the journey in question. There are two button present on the page for the user to click at this point: 'Request Hitch' and 'Find Another'. The 'Find Another' button simply redirects the browser back to the previous search results on the 'perform_journey_search.php' page. The 'Request Hitch' button redirects the browser to 'request_hitch.php' which uses the database controller class 'Hitch_Request_Controller.php' to store the hitch request in the database and then redirects the browser back the 'activity.php' page.

Post a Journey Clicking on the 'Post a Journey' button on the menu bar redirects the browser to 'post_journey.php'. This page is a form, requiring the user to fill in the fields and submit the data using the button at the bottom of the form. This button posts the form data to the 'post_journey_preview.php' page, which using the Google Directions API [4] and JavaScript displays a preview map outlining the route so that the user may check the correct place names have been used. If the place names were not found, the user is redirected back to the form on the 'post_journey.php' page. if the user confirms the route, the submit redirects the browser to 'perform_journey_post.php', which using the database controller object

'Journey_Controller' adds the new journey to the database.

2.4.3 Bootstrap

Bootstrap [?] is a standard open source CSS library which makes the development of structures web pages easy. Bootstrap uses a mathematical based system for measuring divs across a page. It considers that every div on the page, including the base container of the whole page, is made up of 12 identically sized segments covering the width of the div. If a div inside the container is given the class 'col-lg-12', it will cover the entire width of the container. If it is given the class 'col-lg-6' it will cover half the width of the page. If inside a div given the class 'col-lg-6' is another div given the class 'col-lg-6', it will fill half of the div it lies within; where if it was given class 'col-lg-12' it would fill the whole width of the div it lies within, which could be of class 'col-lg-6' so it would only fill half of the page. Using this method enables easy segmentation and management of divs around the website.

It contains a standard CSS file with the central classes with a large online repository of additional CSS files available for download for additional effects. The styles used in this project and where they are as following:

'Jumbotron' Jumbotron style was used on 'index.php'. The header across the top from this style is also maintained throughout the website on all pages.

'Dashboard' Dashboard is used as a side menu system. It was used on the 'messages.php' page along with JQuery to separate the Inbox, Sent items and New Message.

'Signin' Signin is used for form control. It is used on every page where data is entered in the style of forms: 'search_journey.php', 'post_journey.php' and 'index.php'.

2.4.4 JavaScript and JQuery Library

Google maps embedding

Chapter 3

Implementation

The implementation should look at any issues you encountered as you tried to implement your design. During the work, you might have found that elements of your design were unnecessary or overly complex; perhaps third party libraries were available that simplified some of the functions that you intended to implement. If things were easier in some areas, then how did you adapt your project to take account of your findings?

It is more likely that things were more complex than you first thought. In particular, were there any problems or difficulties that you found during implementation that you had to address? Did such problems simply delay you or were they more significant?

You can conclude this section by reviewing the end of the implementation stage against the planned requirements.

3.1 Overview

3.2 PHP

A few languages were considered for this project, these include Ruby, Python and Perl. Perl was the first to be discarded. This was mainly due to its performance and usability when used in an Object Oriented fashion. Ruby with Ruby on Rails provides a very stable platform to develop upon, but does not quite have the flexibility that I intended to yield in the development. The final decision came between Python and PHP. Python is a clean language with very good performance and is easy to use. However, the flexibility that PHP provides when developing web pages and its good Object Oriented capabilities meant that I sided with it even though its performance may not be as good as Python.

3.3 Google Directions API

-talk about long motorway journeys and how steps can be very far apart

3.4 Database

3.5 Database API

-procedural v OO

3.6 Website

-communication with API.

Chapter 4

Testing

Detailed descriptions of every test case are definitely not what is required here. What is important is to show that you adopted a sensible strategy that was, in principle, capable of testing the system adequately even if you did not have the time to test the system fully.

Have you tested your system on real users? For example, if your system is supposed to solve a problem for a business, then it would be appropriate to present your approach to involve the users in the testing process and to record the results that you obtained. Depending on the level of detail, it is likely that you would put any detailed results in an appendix.

The following sections indicate some areas you might include. Other sections may be more appropriate to your project.

4.1 Overview

4.2 Database API Testing

4.2.1 Overview?

4.2.2 Unit Tests

4.2.3 Functional Tests

4.3 Website Testing

4.3.1 Overview

4.3.2 Functional Tests

Chapter 5

Evaluation

Examiners expect to find in your dissertation a section addressing such questions as:

- Were the requirements correctly identified?
- Were the design decisions correct?
- Could a more suitable set of tools have been chosen?
- How well did the software meet the needs of those who were expecting to use it?
- How well were any other project aims achieved?
- If you were starting again, what would you do differently?

Such material is regarded as an important part of the dissertation; it should demonstrate that you are capable not only of carrying out a piece of work but also of thinking critically about how you did it and how you might have done it better. This is seen as an important part of an honours degree.

There will be good things and room for improvement with any project. As you write this section, identify and discuss the parts of the work that went well and also consider ways in which the work could be improved.

Review the discussion on the Evaluation section from the lectures. A recording is available on Blackboard.

5.1 Original Goals

5.2 Accomplishments

5.3 Future Improvements

5.4 Future Development

5.5 Design Choices

5.6 Approach

Appendices

Appendix A

Third-Party Code and Libraries

If you have made use of any third party code or software libraries, i.e. any code that you have not designed and written yourself, then you must include this appendix.

As has been said in lectures, it is acceptable and likely that you will make use of third-party code and software libraries. The key requirement is that we understand what is your original work and what work is based on that of other people.

Therefore, you need to clearly state what you have used and where the original material can be found. Also, if you have made any changes to the original versions, you must explain what you have changed.

As an example, you might include a definition such as:

Apache POI library The project has been used to read and write Microsoft Excel files (XLS) as part of the interaction with the clients existing system for processing data. Version 3.10-FINAL was used. The library is open source and it is available from the Apache Software Foundation [1]. The library is released using the Apache License [?]. This library was used without modification.

Appendix B

Code samples

Appendix C

Definitions

Appendix D

Design Diagrams

Annotated Bibliography

- [1] Apache Software Foundation, “Apache POI - the Java API for Microsoft Documents,” <http://poi.apache.org>, 2014.

This is my annotation. I should add in a description here.

- [2] Carpooling.com, “Carpooling.com - existing online carpooling service,” <http://www.carpooling.co.uk/>, 2001.

Existing carpooling website

- [3] H. M. Dee and D. C. Hogg, “Navigational strategies in behaviour modelling,” *Artificial Intelligence*, vol. 173(2), pp. 329–342, 2009.

This is my annotation. I should add in a description here.

- [4] developers.google.com, “Google directions api,” <https://developers.google.com/maps/documentation/directions/>, 2014.

API used to retrieve routing data

- [5] S. Duckworth, “A picture of a kitten at Hellifield Peel,” <http://www.geograph.org.uk/photo/640959>, 2007, copyright Sylvia Duckworth and licensed for reuse under a Creative Commons Attribution-Share Alike 2.0 Generic Licence. Accessed August 2011.

This is my annotation. I should add in a description here.

- [6] M. Neal, J. Feyereisl, R. Rascunà, and X. Wang, “Don’t touch me, I’m fine: Robot autonomy using an artificial innate immune system,” in *Proceedings of the 5th International Conference on Artificial Immune Systems*. Springer, 2006, pp. 349–361.

This paper...

- [7] Various, “Fail blog,” <http://www.failblog.org/>, Aug. 2011, accessed August 2011.

This is my annotation. I should add in a description here.