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Methods

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Introduction

A survey conducted by Statista shows that 52.2% of all website traffic in 2018 was accessed via a mobile device [1]. Mobile usage of websites is a growing phenomenon and with both mobile and web technology advancing, the statistics will only grow higher and higher and this is where progressive web apps arrive. The goal of this research document is to understand how progressive web apps can be used for e-commerce, why they should be developed in contrast to other web applications and how 52.2% of website traffic can be harnessed through a progressive web application to benefit the company. E-commerce will be looked into and how e-commerce applications are designed in order to get an idea of what an e-commerce styled progressive web application would look like.

1 Background Research & Literature Review

Title: Investigation into progressive web applications for the purpose of e-commerce.

1.1 Project Aim & Objectives

1.1.1 Project Aim

- Investigation and development into progressive web applications for the purpose of e-commerce.

1.1.2 Objectives:

- Analyse progressive web applications used for e-commerce.
- Systematically assess current guidelines and best practices for e-commerce.
- Develop a proof of concept e-commerce progressive web application for evaluation against current guidelines.
- Evaluate the progressive web application using Googles lighthouse tool.

1.2 Progressive web applications

A progressive web application is developed using standard web technologies, such as JavaScript, and frameworks which can be ported as an application for mobile devices. This brings them to have majorly decreased file sizes by locally downloading the front end [2] [3] [4].

Google are credited with the discovery of progressive web applications in which they displayed via a conference in 2015. Google have set out on their website the progressive web app checklist. The checklist contains the requirements for developing a progressive web application. The requirements from Google state that a progressive web application should contain core features such as good performance, should work in any browser and be responsive which are standard features that should be applied when developing a website. The two core functionalities that don't necessarily apply to standard websites viewed on browser however do apply to progressive web application development is providing an offline experience and being installable [5]. These core features can be accomplished through service workers and a web manifest file.

It is a common assumption that the cost of developing would be cheaper than developing a native or hybrid web application due to the multi-platform capabilities of progressive web applications and the application only need to be developed once and maintained by one team as opposed to more teams for each different platform.

1.2.1 Service Workers

Service workers are written in JavaScript and is an event driven script which runs in the background so that when the event is met, the script will run and the action is carried out, an example of this is push notifications [6]. Service workers can only run over HTTPS protocol to avoid attacks between device and requests to the server [7]. Although, given the name, a progressive web application implies a connection to the internet is required to access all features and content. While this is true for browser dependent access when used on a mobile device the application works alongside the native browser and is not dependant on an internet connection to work, this is through using service workers and caching the data when the user is online, so it can then be loaded offline [8] [9].

1.2.2 Web Manifest File

A web manifest is a JSON file and is used to display the name, icon for the app, orientation to display and source address when the app is opened. This makes it possible for the app to be installed on mobile devices like a normal native application [10].

What are the advantages to developing a progressive web application?

- Cost of development is cheap.
- Service workers allow for offline use and caching of data.
- Similar to website, user experience.
- Secure through HTTPS.
- Performance for cost.
- Smaller file size.

What are the disadvantages to developing a progressive web application?

- New technology, won't be supported on older devices.

1.3 Adversaries to a progressive web application

As well as progressive web apps there are other types of applications that can be developed and use different methods. It is important to understand the difference between the different types and the benefits to each type of web application.

1.3.1 Native web applications

A native web application is developed for a specific device platform, for example IOS or Android, allows for specific platform API's to be used allowing for a better performance and advanced graphics. Alternative platforms will use different code dialect therefore being native to that platform. Native web applications are typically faster than other types of web applications due to the native code being compiled compared to other interpreted languages such as JavaScript [11] [12]. Developing a native web application can be costly as development for more than one platform will require additional teams of personal with experience on that platform.

Native application advantages

- Performance due to native coding.
- App features due to specific platform development access.

Native application disadvantages

- The cost of development.
- The specificity for users.
- The support for each individual platform.
- Duplication of programs.

1.3.2 Hybrid web applications

A hybrid web application is developed using a mixture of standard web technologies such as JavaScript, CSS, HTML and also using native API's to the platform the web application is being developed on. Hybrid web applications also have limited access to native API's provided by the platform the application is being developed on. This is due to mirroring by a cross platform JavaScript API [13].

Hybrid application advantages

- Takes less time to develop.
- Reduced cost of development.
- One application across all platforms.

Hybrid application disadvantages

- Slower performance due to middleman JavaScript API.
- Not getting full access to the native platform API.
- More generic web-view interface.

1.4 E-commerce

In 2019 e-commerce streams brought in \$3.53 billion in sales which shows the scale in which users use the internet to purchase goods and this is expected to rise to \$6.542 billion by 2023 [14]. E-commerce developed applications focus in on the usability and user friendliness to convert the user engagement and experience into sales for the company to benefit [15].

Popular features of e-commerce sites are to digitally nudge items to the user's screen based off their previous buying behaviour, this works in the backend and displayed on the frontend of the website for the user to get personal recommendations [16]. E-commerce websites use web atmospherics which uses design layouts and features to create an atmosphere for users to create positive consumer responses from uses. This includes features such as reviews from other customers so that customers can feel the social presence of online shopping aswell as get a rating on the product from like-minded people. The layout of a store is generically in a grid layout like you'd get in a supermarket, where products are laid out in sections, this is what is tried to be recreated online by categorising products for usability and familiarity [17].

1.5 Comparison

Developing a progressive web app is a logical venture for a company that wants to save on development costs and deliver a product that can meet user expectations without sacrificing any of the necessity's an adversary application provide.

In terms of storage progressive web applications have the advantage with a much smaller file size compared to the adversary options, a study into the comparison between the file sizes of native, hybrid and progressive web applications found that a progressive web app stands about 157 times smaller than a native web app and 43 times smaller than a hybrid web app [4]. Additional phone storage can be costly therefore by having a smaller app size and developing a progressive web app, users are more likely to keep it installed and continue using it.

As discussed above, performance of a progressive web application is mediocre. However, considering the lack of access to the native API's available on native platforms, using generic cross-platform code which is deemed slower and still getting better performance results than hybrid applications is something that should not go unnoticed. A study into the comparison of the response speed of native android applications against progressive web applications found that native applications are generally faster at accessing hardware features which is backed up by a further study at the 2017 WEBSIT conference that native applications have a faster response time in general, the test included was from tapping the icon to page load [18] [4].

Progressive web applications are assumed to be the most cost effective to develop, alongside hybrid web applications. This is due to having one development team developing one application which gets ported to all the different platforms, whereas there would need to be different development teams for each individual platform for a native web app.

Progressive web applications can offer most of the same major hardware features such as GPS, Camera and Bluetooth providing the user has granted permission [2]. However, where progressive differs to native and hybrid is the, current, inability to access certain hardware features such as fingerprint scanners or face identification features, these features aren't necessarily going to be useful within an e-commerce situation however for mobile banking applications it may make more sense to use native web apps for the security provided by these features.

1.6 Rationale

Progressive web applications fall under the field of web development are the future of modern world web development with every company needing a website and online branding to succeed, it is important that they have an easy to use website that has as big a reach as possible across all platforms for a cost effective price and the best way to do this is through progressive web applications. There have been many similar studies to the one proposed however not including e-commerce. The rationale for the study is that the demand for progressive web applications in the future will be unprecedented due to cost effectiveness of them being developed over the adversary applications such as native or hybrid with majority of major features included aswell as being able to develop new innovative ways to access new features it will be a very popular way of developing applications in the future. There are also techniques that could be developed using service workers to alert user of price drops of wish listed items in order to get a positive consumer response as talked about above. This could be interesting to investigate into how progressive web applications can use service workers to feed users the information of products such as push notifications therefore getting additional app time and transferring that into sales which would benefit many e-commerce companies.

1.7 Deliverables

The overall deliverable expected to be achieved at the end of this study is to have developed a progressive web application for the purpose of e-commerce where the application meets all of the testing criteria required to be an efficient, accessible and useable web application. The production of the deliverable will come through producing a literature review that demonstrates research and understanding into the development and theory behind progressive web applications as well as deep research into the frameworks design aspects that make a good progressive web application. The research will take advantage of both primary and secondary research. The primary research will take the form of a questionnaire which will ask users what they look for specifically in web applications such as design implementation, usability, functionality and performance. The final result will focus on delivering an attractive and engaging design that will be both responsive, accessible and easy to follow for users. Evaluating each of the key elements such as search engine optimisation, (SEO), performance and accessibility against the relevant testing tools to ensure the progressive web application is produced to a high standard and meets the criteria set out.

2 Research & Development Methods

2.1 Research Methodology

The research that will be conducted for this project will be a mixture of primary and secondary research. The primary research will take the form of a questionnaire that will be sent out to users for their opinions design features, usability and performance preferences specifically throughout a range of different web applications. The secondary research will consist of thorough investigation into current e-commerce progressive web applications, the design they take, features they contain and the overall usability of the application from browser to mobile app. Furthermore, research will be conducted to assess general guidelines and best practices for progressive web applications and how it differs when the application takes the form of an e-commerce style.

2.1.1 Philosophy

The research philosophy chosen for this is positivist. This is the approach that involves hard data that is gained through experimenting and testing and analysed through the data gained [19]. This will be applied when choosing frameworks to use by analysing performance through other programmer's experiments and experiences in them frameworks. Design idea's may also be adapted and analysed in this way by basing choices off of video and reading material.

2.1.2 Approaches

The approach taken for this project will be deductive. The deductive approach begins with a "General statements (premises) and, through logical argument, comes to a specific conclusion" [19]. The project will implement the deductive approach as there will always be a theory of the outcome, therefore by applying a 'logical argument', a conclusion can be assessed and therefore compared against the hypothesis.

2.1.3 Strategy

The strategy for the project will be a document review of client-side and server-side development of progressive web applications. This approach will be used to gain understanding through the positivist philosophy and then make a conclusion on which client-side and server-side development tools are the best to be used to ensure that the objectives are met and confirming the hypothesis.

2.1.4 Risks & Limitations

R1 Hardware Failure - There is possible risk of hardware failure throughout the project which could cause major harm to the development of the project. This can be avoided by sticking to the 3-2-1 backup rule, which is to avoid data failure in almost any scenario [20]. By doing this, the impact of hardware failure to the project would be lessened incredibly as any data lost can be restored.

R2 Gold Plating – Gold plating is the term for developers going overboard and adding unnecessary features that are not included within the scope of the project. Therefore, this adds a risk of the main scope not being completed due to time restrictions. To avoid this risk, possible new idea can be documented for the end of development if there is time to show additional skills [21].

R3 Design Compromising – When developing anything it is important to have a design report that documents what is needed to be included within the application. This is a risk as compromising the design will cause issues further down the line such as using time that is not available to re-design. This can be avoided by having an in-depth design documentation before development starts [21].

R4 Time Constraints – Keeping to time schedules when developing software is hard to do with un-expected things that may go wrong within development or certain features taking longer to implement [22]. Time issues cannot be avoided however the impact can be reduced by creating a Gantt Chart that allows for extra time polishing development so that unfinished features or issues can be finished. Another way of doing this is by amending the Gantt chart to incorporate the new schedule in which the developer has gone over.

L1 Hardware Limitations – Hardware limitations may slow development down and limiting how much can be achieved. This can only be avoided by using a computer that is capable of running the programs needed to complete the project efficiently.

L2 Software Support/ Understanding Limitations – Software support/ understanding limitations such as explanations of what certain tags, classes and so on. The way to combat this limitation is to search online for forums. Forums can be a great way to gain an understanding of coding languages and different ways to achieve the same result, possibly in a more efficient way.

2.1.5 Ethical & Legal Issues

One of the ethical and legal issues attached to the project is the copyright protection law. As this project is primarily a research project the majority of ideas will be influenced by reading material or visual material this should all be referenced and not claimed as their own work by the developer [23]. To mitigate this law, it is important to ensure permission for all information or images used.

Another ethical and legal issue that may threaten the project is the general data protection regulation (GDPR). This regulation is all about how data is managed from users, being a web development project it is naturally assumed that user's data will be kept and held via at minimum an email and password. It is important that the data is stored correctly “to protect the fundamental rights and freedoms of natural persons and in particular their right to the protection of personal data” [24]. To avoid this issue, it is important to have a secure way of storing the data or use external login API platforms, such as Facebook or Microsoft, so that the developer is not directly liable if there is a breach through their security systems.

2.1.6 Validity, Reliability & Generalisability

Validity

The approach chosen for the project is a valid approach for a development style project. The supported philosophy allows for data to be gained via experiment with different ideas and drawing conclusions through analysis on whether what has been read or implemented is a good way of doing something. The deductive approach also supports a development project as well as when developing there will always be a theory of the outcome which can be compared to actual outcome.

Reliability

If the research was carried out by others the result would be assumed to be different each time as the research is broad therefore there are many ways of developing an e-commerce progressive web application and therefore the result would more than likely be different each time.

Generalisability

The result of this project can be applied to the business sector as e-commerce is a massive part of the business sector as talked about in the research section, by selling over \$3 billion in goods, which is a massive contribution to the business sector. The result of the project could be used to help grow small businesses with how much they sell down to the engagement statistics of mobile applications.

2.1.7 Data Evaluation Methods

Data Collection

The research conducted will be quantitative research. This is the gathering of data in numerical form. This is ideal for the project as a likeness questionnaire can be created where users can rate the answer to a question from 1, strongly disagree, to 5, strongly agree. This type of data is very easy to graph and also easy to draw conclusions from. The questionnaires are likely to be sent out to students through the university email, this is to gain a general conception of what users look for in web applications and mobile applications. If not enough data is gained it would affect the design and can be averted through researching more generic design ideas for applications.

Data Evaluation

The progressive web application as a whole will be evaluated using googles evaluation tool, google lighthouse. This scores the progressive web application on its performance, search engine optimisation, best practices and accessibility. Data will be displayed in bar graphs as this is an easy way to read and understand data. The statistical analysis technique used will be inferential statistics, this is because an inference will be made from the data collected from the questionnaire such as preferred designed ideas.

2.1.8 Development Methodology

The research methodology used for this project feature-driven development. Feature driven development is an agile methodology which uses five steps. This is a good method for the project as each feature can be evaluated in this way before being compiled together into the overall model. Each stage is encouraged to track progress, results and errors [25].

3 Resources & Planning

3.1 Hardware Resources

- Normal Networked Pc

3.1.2 Software Resources

- Visual Studio Code
- Photoshop
- Google Chrome

3.2 Gantt Chart

The following Gantt Chart will show an estimated schedule for the project. The Gantt chart is schedule to change.

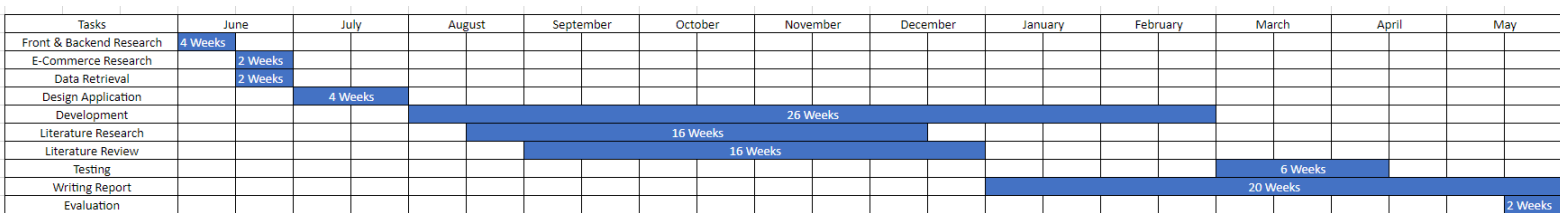


Figure 1, Gantt Chart showing estimated schedule for project.

4 Conclusion

In conclusion the research carried out to understand the basics of the subject at hand and support what a progressive web application is and the competitors to a progressive web application including a mini comparison which drew simple conclusions from the performance, cost effectiveness and file size. E-commerce was also briefly glanced over where the term 'web atmospherics' was mentioned and talked about and how it can positively impact the customers response, which led onto the question in the rationale about how service workers could possibly be used to also get this reaction. The research and development section looked over the philosophy and approaches that will be used for the project in the best interest for software development as well as thinking about the possible risks that could affect the project and how the data will be collected and evaluated. A development methodology was chosen and briefly explained as to why. The final section, resources and planning, displayed the hardware and software resources needed for the project followed by an early estimated schedule for the project to run. Overall, the report has been a success and many new findings were learnt about progressive web applications and e-commerce especially.

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