Investigating a JavaScript SPA Framework for Improving Usability/User Experience of Web Applications

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1. ABSTRACT

Due to the sophistication of modern software, manually writing software code may lead to unequal consistency and content of each part of the application and it is more difficult to maintain these existing multi-page applications (MPAs). The advantage of a single page application (SPA) architecture is easy maintenance, short page load times, high interactivity framework, and good user experience [1].

The purpose of this project is to develop a proof-of-concept SPA with the JavaScript library React, which includes a booking system using MongoDB, Express.js and Node.js and to investigate the effect on user experience and usability of an SPA compared to a traditional multi page application.

2. AIMS & OBJECTIVES

Aim:

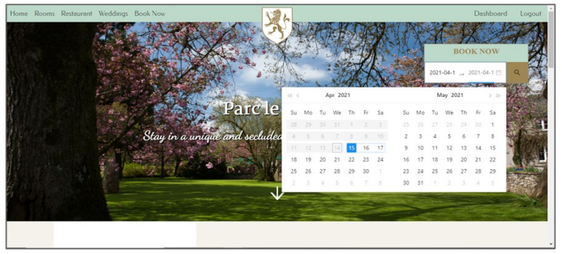
To investigate the use of a JavaScript SPA Framework for improving the usability and user experience of Web Applications.

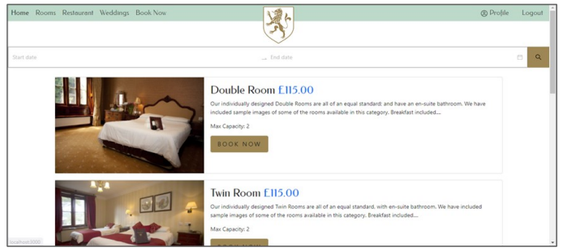
Objectives:

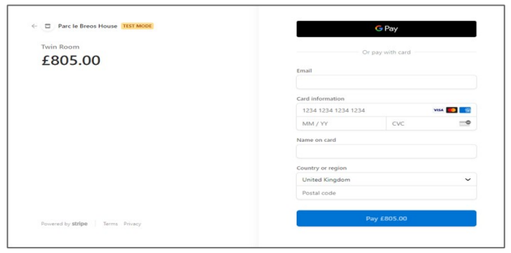
- Research performance of JavaScript SPA Frameworks for the purpose of improving usability and user experience [2].
- Investigate rigorously an existing hotel MPA and conduct pre-study tests.
- Redesign and develop a proof-of-concept hotel SPA with the aim of improving usability and user experience.
- Conduct quantitative and qualitative testing to compare both websites.
- Evaluate the performance of the SPA prototype in comparison with the MPA based on testing results.

3. DESIGN AND IMPLEMENTATION

The existing Parc le Breos [3] hotel website (an MPA) was redesigned in the form of an SPA. UI design trends of SPAs were researched and included in the implementation. A MERN (MongoDB, Express.js, React and Node.js) stack, and the use of react-redux 7.2.2 and react-router-dom 5.2.0 were used to build the hotel SPA prototype. The Stripe node.js library was used to accept credit card, Google Pay and Apple Pay payments via the Stripe payment gateway when a user books a room. Bootstrap 5 was used for flexible, responsive styling and Sass was used to create any additional CSS.

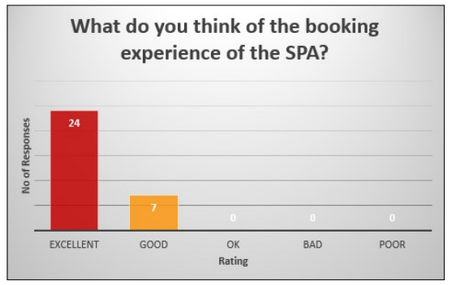


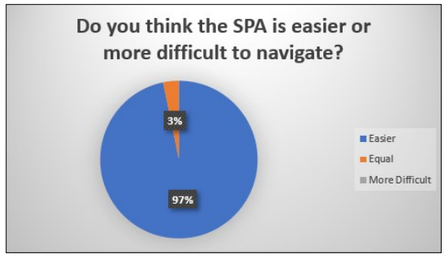


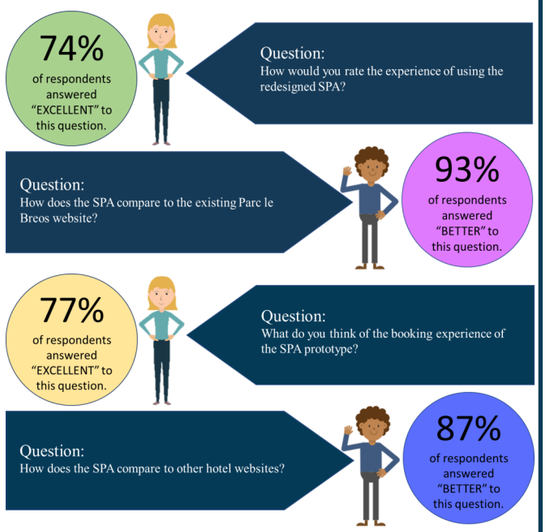


4. USABILITY STUDY RESULTS

SPAs vary from MPAs as the application fetches all the data it needs to deal with once, manages the data in one location, and then imitates multipage navigation via DOM manipulation. On the other hand, MPAs load multiple pages and make numerous fetches to retrieve data as the user navigates through the application. SPAs allow UI/UX designers to become more creative with graphics and visual effects. Since data retrieval is often the slowest aspect of any web app, SPAs are quicker and simpler to use than MPAs. However, users may be unimpressed by SPA interface strategies due to unfamiliar navigation. A focus group and a survey were conducted to establish whether users consider the SPA prototype to be an improvement on the existing Parc le Breos website which is an MPA to confirm the findings gathered in the literature review. The target audience were adults who book hotel rooms online.







5. PERFORMANCE RESULTS

Quantitative performance testing was conducted to confirm whether the SPA does load faster or whether it only appears to be. Performance testing of the existing MPA and SPA prototype was performed using Chrome DevTools [4].

Performance Comparison of MPA compared to SPA		
Initial Loading Speed (ms)	MPA	2444
	SPA	154
Overall Performance (ms)	MPA	60065
	SPA	46205

6. CONCLUSION

Development of an SPA was found to have a significant difference on usability and user experience compared to an MPA as the performance benchmarks showed the SPA was faster. In addition, the interviews and surveys produced positive feedback from the respondents.

The objectives were met, and the results showed the browsing experience with an SPA introduces a new dimension to websites in terms of reactivity, response time, and inter-page connectivity.

7. FURTHER RESEARCH

Further research could be conducted to determine which elements of the SPA are creating the positive effects.

Additionally, it would be beneficial to create a website using another SPA such as Angular or Vue due to the differences that exist between frameworks.

8. REFERENCES

[1] Emmit Scott, *SPA Design and Architecture: Understanding Single Page Web Applications*. 2015.

[2] M. Levlin, "DOM benchmark comparison of the front-end JavaScript frameworks React, Angular, Vue, and Svelte," Turku, 2020.

[3] "Bed and Breakfast in the Gower Peninsula - B&B | Parc Le Breos House." https://parc-le-breos.co.uk/ (accessed Nov. 23, 2020).

[4] "Chrome DevTools - Chrome Developers." https://developer.chrome.com/docs/devtools/ (accessed Apr. 29, 2021).