# Appendix C - Detailed Project Proposal

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## Defining your Project

**1.1 Detailed research question/problem**

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| What is the potential for WebVR as a tool for delivering e-learning experiences, and how does it compare to existing VR platforms being used for this purpose? |

**1.2 Keywords**

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| Virtual Reality; WebVR; e-learning; A-frame; 3D |

**1.3 Project title**

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| Developing immersive virtual reality e-learning experiences for the web. |

**1.4 Client, Audience and Motivation:**

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| WebVR is a relatively new arrival within web development. With the growing adoption of VR amongst the general public, it has become an ever more exciting and interesting field in which to study. Having a low barrier to entry, both for developers and end-users, WebVR could potentially further democratise Virtual Reality technology and learning.  An important aspect of this project involves determining whether virtual reality for the web, is suited to delivering an effective e-learning experience. One of the attractions of WebVR is its inherent accessibility. WebVR content can potentially be accessed through any device with an appropriate web-browser. At the more primitive end of the scale, this could take the form of a smartphone equipped with a relatively cheap cardboard viewing device, or at the other end, a piece of VR hardware such as the Oculus Rift or HTC Vive. It is important therefore to consider the scalability of any VR software developed for the web. One of the goals of this project is to determine if an application delivered at the lower end of the scale, is as engaging and effective as it is when experienced on more powerful, dedicated VR platforms.  The project also has the potential to contribute to the understanding of how the internet and WebVR can be used to lower the barriers of entry to virtual reality experiences and technologies. By providing users with content not only for dedicated VR devices like the Oculus Rift; but also a device as ubiquitous as smartphones have become, the initial cost to access an entry-level VR experience is reduced to the price of a simple cardboard holder. Accessing immersive, virtual reality content can be as straightforward as clicking a button on a web page, or receiving a link from a friend. The device agnostic nature of WebVR and its inherent accessibility; in financial terms and additionally with its delivery through the web, may have implications for pedagogy, both in the classroom and the wider public sphere. |

**1.5 Project Plan**

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| **Aims and Objectives**  I have developed a set of aims and objectives to help describe what I hope to achieve during this process. The aims I have set out relate to what I wish for the project as a whole, while the objectives are more directly related to what must be achieved within the project itself.  **Aims**   * To meet the requirements of the BSc (Hons) Digital Media: Design, Production and Development degree course.      * To further expand my knowledge and competency within the fields of front-end web development, WebVR, User Experience design and e-learning.      * To better understand the potential for WebVR as a platform and a tool for e-learning.      * To demonstrate skill and understanding to potential employers.   **Objectives**   * Research and bring together the key concepts and best practices for presenting e-learning material to end-users. * Research and develop an appropriate and optimised development method for combining web-based, virtual reality experiences, with educational material. * Develop a prototype WebVR-based e-learning application that delivers educational material via the internet. * Test and measure the effectiveness of a variety of pedagogical techniques applied through WebVR.   **Research**  The research undertaken within this project will inform the development of a design specification for the WebVR application I intend to produce. A large part of the research within this project will take the form of an in-depth literature review. The literature review will seek to establish:   * The challenges relating to WebVR as a whole, the optimal development methods and approaches to working with WebVR. * The best practices associated with developing e-learning material for the web, and more specifically, developing e-learning materials for immersive 3D environments. * How these best practices can inform the design process for a WebVR application.   It would also be sensible to examine the current offerings from other developers working with WebVR, to see what can be learned. In addition to the in-depth literature review, I will produce a critical review of existing WebVR applications: what they do well; how they can be improved; and how they may relate to the focus of this project.    **Development**  To ensure that the scope of the project remains within an achievable range, the application I intend to develop is not expected to become a fully-featured, completed piece of educational software. Rather, I intend to develop a prototype that will be used to test and compare a number of different approaches to, and applications of, e-learning techniques and best practices within VR. Development of the prototype will begin after I have conducted my initial research into the subject area.  In order to implement the prototype, I intend to use the WebVR API in conjunction with A-frame. A-frame is a JavaScript framework, created by the team at Mozilla, for WebVR developers. It makes use of the three.js library and WebGL, and is based on the “entity-component model” - similar to the approach used in game development environments such as Unity.  **Testing and Evaluation**  A number of testing methodologies will be applied throughout the course of the project.  **Acceptance Testing**  To determine if development of the prototype software has been successful, it will be tested against a list of functional requirements. The functional requirements will be created during the research and development stage of the project and will relate to the operation, and quality of, content delivery through the WebVR application.  **Code Review**  All code written shall conform to the accepted best practices of the relevant language. Where possible, code should be validated against W3C standards.  **Usability Testing**  A set of testing criteria, based around the findings of my research, will be created. An appropriate number of participants will be recruited to take part in the study.  **Evaluation**  Once the prototype has been completed and undergone various acceptance and usability tests, the next step is to evaluate the results. Analysis of the data and information created by test participants will hopefully allow me to determine whether WebVR, in its current state, has potential as a tool for learning. A section of the report will be devoted to interpreting and evaluating the results from the various testing that has taken place.  **Phases, Dates and Deliverables**  Below is a table showing the major phases of the project, beginning and end dates, and the associated deliverables.   |  |  |  |  | | --- | --- | --- | --- | | **Project Phase** | **Starting Date** | **End Date** | **Deliverables** | | Initial planning and concept creation | 30/09/2016 | 21/10/2016 | - Project plan.  - Initial literature review. | | Research | 22/10/2016 | 19/12/2016 | - In-depth literature review.  - Critical analysis of existing applications and techniques. - Design specification. | | Development | 20/12/2016 | 17/03/2017 | -Prototype WebVR application. | | User Testing | 18/03/2017 | 31/03/2017 | - Relevant testing results and documentation. | | Analysis and Evaluation | 01/04/2017 | 27/04/2017 | - A review and evaluation of the data and information generated during the testing phase. | | Presentation | 28/04/2017 | 28/04/2017 | - A demonstration of the WebVR application and the findings of the report. | | Final touches | 29/04/2017 | 03/05/2017 | - Completed project report. | |

## Section Two: abstract and initial literature review

**2.1 Abstract**

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| In this work, research was undertaken to help to determine what the best practices are for incorporating e-learning material into immersive WebVR applications. The implications for this new, highly scalable and device agnostic method of delivering content were beginning to become evident as this research began.  Part of this investigation involved discovering how educational material is currently being incorporated into established virtual reality technologies and frameworks. It was then necessary to take this knowledge, and to see if, and if so how, it is currently being applied to current WebVR development, and to determine if there were any new or improved ways in which it could be utilised during the design and development process.  Informed by the findings of the research, a prototype WebVR application was created. The intention was to experiment with a variety of teaching and learning techniques through the WebVR medium. Data and feedback from these experiments were generated and recorded through usability testing with a group of participants. The results were then analysed and evaluated, in order to try and determine the feasibility of WebVR as a tool for learning. |

**2.2 Initial/Mini Literature Review**

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| **Introduction**  The purpose of this initial, condensed version of a literature review, is to explore some of the key concepts surrounding the honours project, and to provide a basis from which to continue further research into the subject area.  **VR and WebVR**  To begin, it is useful to describe what exactly is meant when we talk about Virtual Reality(VR). It is also important to define what WebVR is, and how it relates to VR as a whole. Pimentel and Teixeira (1993), defined VR as “an immersive, interactive experience generated by a computer”. VR, as we know it today, works according to the principles of Stereopsis, which describe the human ability to perceive the world in three dimensions (Howard & Rogers 1995). The idea of VR sounds very modern, yet since the early days of computing, and with the advent of computer graphics in the 1960s, early pioneers were theorising about stereographic headsets and virtual worlds (Earnshaw 2014). Today, VR is well established as a consumer-level digital medium. We have recently seen the first generations of competing VR hardware, enter the market.  The next important question to address is: what exactly is WebVR? WebVR is an experimental JavaScript API that allows web-browsers to access VR hardware such as the Oculus Rift, Samsung Galaxy VR or Google Cardboard. Data on positioning and movement from these head-mounted displays can be translated from the device to be reflected in a 3d environment within the web-browser (Mozilla 2016). Although still in its infancy, WebVR is currently receiving interest from many of the big players in the technological world. Mozilla currently leads the way in terms of support and development for WebVR, and there is also strong support from Google, Microsoft and Samsung (Mozilla 2016, Microsoft 2016). The declaration of interest in WebVR from industry-leaders suggests that there is a future for the technology. As the uptake of WebVR and support for its features becomes more widespread, the potential applications for this technology will become clearer.  **E-Learning and VR**  A succinct definition of e-learning would be “instruction delivered on a digital device that is intended to support learning” (Mayer & Clark 2016). The field of e-learning is well established, and a large amount of research has taken place on how to incorporate educational material into virtual environments. Game-based learning is one approach that has proven to be effective (Ke, Xie & Xie 2015). Another successful teaching method within VR is the “virtual tour”, which gives students the opportunity to visit and experience remote environments and locations (Abdelaziz et al. 2014). The effectiveness of a number of different methods suggests that there are a variety of ways in which the development of VR e-learning environments can be approached. It would also appear that combining a particular method of engagement with the appropriate subject material is a key factor in determining the teaching efficacy of the learning environment. |

**2.3 Relevant professional, social, ethical, security and legal issues to the project**

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| I shall ensure that any copyrighted or third-party material used in the development of the application has been done so with permission, and that references have been provided where necessary.  All test participants will be made aware of the guidelines for proper use of any VR hardware. They will also be given information on the nature and purpose of the study. Data and information generated during the testing phase will be presented anonymously in the final report. Participants will be required to sign a consent form agreeing to the terms of the study.  This degree course is accredited by the British Computer Society. I will therefore ensure that throughout the duration of this project I adhere to the society’s Code of Conduct. |

**2.4 Bibliography**

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