Trinity Impulse – Event Aggregation to Increase Students' Awareness of College Events and Supports

by

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Declaration

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A student's engagement with college is a factor which affects the student's likelihood of persisting to attain their full college degree. 'Student engagement' is a broad term which encompasses an array of sub-categories – all in which contribute to the student's success. In this dissertation, I aim to target a stem of student engagement which involves itself with social interaction and co-curricular activities. The goal of the research is to determine if there is an approach which would be likely to increase the attendance to co-curricular activities, and in-turn, increase social interaction. The underpinning philosophy of the dissertation, states that an increased awareness of ongoing events, scheduled within the campus, will lead to higher rates of attendance.

As a proof of concept, a widely-accessible, mobile web application was developed, which aims to expand the students' awareness of ongoing events. The novel web application allowed for an exploration of the design space, to acquire initial stakeholder and user feedback. It serves as an event aggregation system, which is a single, central resource, for students to view events. The primary sources of events were the college's own web

noticeboard, and any Facebook 'Page'. The latter allows for an unlimited, expandable model for event retrieval. The interface of the application was created using an iterative pattern, making use of low-fidelity prototypes and user-centered design. A usability test, user task analysis, and questionnaire evaluation proved to show that the web application was usable, it had increased students' awareness of events, and it could potentially increase attendance to events. In essence, the application is likely to increase student engagement with their college environment.

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Chapter 1

Introduction

1.1 Background

Academic institutions world-wide are concerned with their students' level of progression toward successfully completing their course. It is in the best interest of the institutions to preserve high rates of student retention. Based on statistics released in 2006, Harvard Graduate School of Education (HGSE) report that in America, "only 56 percent of those enrolling in a four-year college attain a bachelor's degree after six years" [Symonds *et al.*, 2011]. The low percentage representing the lack of student completion, provides sufficient reason to conduct analyses, in search for a solution. In order to find a solution, it is imperative to identify the problems which lead to low student retention. The HGSE report summarises the main problems to be: the lack of readiness of the student to endure the academic work; and the failure of the student to efficiently balance different lifestyle demands such as family, friends, study, and employment. Whilst some of the demands cannot be controlled by an institution, solutions to the other demands have been researched. Tinto, a researcher in the field of student retention, lists five solutions to improve retention [Tinto, 2000]. Amongst them, he suggests that institutions must increase the number of available academic and social supports, and also increase the degree of the students' involvement. Put into perspective, Tinto infers that an increase in student engagement, results in an increase in student retention. It is now obvious to see why investing time and resources into the field of student engagement, is generally beneficial to the interests of the students, and of the institution.

Before the 1970s, failure to complete a college course was seen as a fault of only the individual. Afterward, there was an emergence of theories which hypothesised that the environment that was subjected upon the students, had a role to play in a student's decision of whether to stay or leave [Tinto, 2007]. To lead the research, Tinto developed

a model, which made important the idea of successfully integrating students into their university. He reinforces the idea of peer and faculty interaction as a means of increasing one's engagement with the college. Not only should this be done within the college classroom, but also outside of scheduled class hours. This coincides with Kuh et al.'s assurance that student perseverance is positively impacted by their involvement in co-curricular activities [Kuh *et al.*, 2006].

1.2 Motivation

Annually, the National Survey of Student Engagement (NSSE) is distributed to hundreds of college students in order to gain statistics on the number of students interacting with peers, and participating in co-curricular activities. The most recent results (2011) reveal that "59% of students spent no time participating in co-curricular activities"[NSSEville State University, 2011]. Since we know that participation in co-curricular activities positively affects the rate of student progression, we can discern that a potential 59 percent of students can increase their likelihood of successfully completing their course.

This dissertation is motivated by the opportunity to help students to engage with their college environment. An increase in engagement has been seen to affect persistence, and also influence student satisfaction with their college [Kuh *et al.*, 2006]

1.3 Aims

Currently within Trinity College Dublin, co-curricular events are dispersed amongst several different resources. Each individual department, society, club, etc., advertise their own events, in their own way. Some organisations employ dedicated web pages for their events, some advertise events through their Facebook 'Page', and some simply email their event details. There is a sense of separation between each organisation. A web noticeboard is present, allowing organisations, students, and faculty to publicly post their events; a weekly email is sent to students, containing the newly added and currently ongoing events. There is a lack of participation by organisations in posting events to the web noticeboard. For students to truly gain knowledge of all ongoing events within Trinity College Dublin, they are required to visit multiple websites. However, it may be the case that some students are not aware of the events that they would be likely to attend – especially if they do not know which websites to visit in order to browse events.

The primary aim of the dissertation is to raise awareness of ongoing events and supports that are scheduled within the campus. A hypothesis is made that, event aggrega-

tion, with ease of access, will increase students' awareness of events and supports. Raising awareness of events, may lead to increased participation. As mentioned previously, increased participation has been proven to contribute to student retention.

Other aims of the application are to:

- engage students with their college environment via more frequent event attendance;
- create a usable application which evokes user satisfaction;
- determine if the application will be used on a frequent basis.

1.4 Research Approach

An Irish report on smartphone usage, discovered that one in three mobile phone owners, are owners of smartphones [Amárach Research, 2011]. The report forecasts that the population of smartphone owners in Ireland will continue to grow.

This dissertation aims to take advantage of the high population of smartphone users, by developing a mobile-accessible web application to collate events, to display to students. The application is titled Trinity Impulse, and is operating system independent, allowing for maximum penetration of the student body. It acts as a central resource for event information, allowing students to browse, search, and save events; as a result, the research approach aspires to lower barriers of entry to event information, and in the process, increase the students' awareness of ongoing events and supports.

In order to analyse the effects of the application, volunteers were acquired to complete a list of tasks on the application. Volunteers were then asked to answer a questionnaire. The questionnaire served to attain data about the usability of the application, and to determine whether the application answered the questions of the dissertation – primarily, if the application raised the user's awareness of events, and if they would be more likely to attend events after using the application.

1.5 Outline

The remainder of this dissertation is structured as follows:

Chapter 2: State of the Art provides an in-depth analysis of the state of the art in the fields of student engagement, student retention, interface usability, semantic mapping, context-based systems, and interactive engagement.

Chapter 3: Design details the processes involved in designing the application, and explores the rationale behind the design. This chapter also explains the: gathering of user requirements; scenarios; use cases; and interface design using low-fidelity prototypes.

Chapter 4: Implementation presents the Trinity Impulse mobile web application. This chapter delves into the inner-workings and technical aspects of the application, including the: choice of programming languages, interface design decisions, technical architecture, system functionality, and database schema design.

Chapter 5: Test and Evaluation explains the approach to testing and evaluating the application with a number of participants. In this chapter, several forms of testing are accomplished in order to acquire quantitative ad qualitative data, which are analysed to provide a final verdict. The questionnaire-styled evaluation gives an insight into the use of the application, and determines if it reaches the requirement of the research.

Finally, *Chapter 6: Conclusion and Future Work* summarises the information obtained from the research, and puts forth a final conclusion on the affects of the application on college students. The chapter also proposes additional features and ideas for implementation, which intend to allow for a more useful and attractive application. Effective ideas, withdrawn from the test participants are considered and elaborated on.

Chapter 2

State of the Art

2.1 Introduction

The issue surrounding this project brings attention to the fact that many events are scheduled within the campus but many of them are unseen by the students. Whilst there are a multitude of events available for participation, there is a low level of event awareness inside the student population. Information about events is dispersed amongst several different resources, therefore making it difficult for students to locate events of interest. This is particularly true for new entrants of the college, whom I hypothesise, will incur the greatest benefit from the application. A focus is put on first-year students; although the category of "new entrants" can include other students such as transfer students and postgraduates, for example. The research presented in this chapter largely targets first-year students, however, the application as a whole benefits all student demographics.

The goal is to facilitate improved integration with the college environment. I hypothesise that the increase in awareness of events may lead to a higher rate of attendance to these events. This, in-turn, may increase the social integration of the students, which more broadly may increase retention. Increased awareness of support services, both academic and emotional, may accommodate struggling students and result in higher retention.

In order to enable better access and visibility to event information, it is not only important to reconstruct the way in which the information is collaborated and presented, it is imperative to analyse the methods which are effective in engaging students. A goal is to not only provide a single resource to easily access the event information, but also to encourage students to view events of interest continually, rather than infrequently.

Presented in this chapter, is the literature review which describes the aforementioned issues, and the state of the art approaches implemented to overcome those issues. Section 2.2 provides an empirical analysis of the first-year student experience and modern

techniques used to engage users. Section 2.3 talks about the results of engagement – namely, retention – and the best approaches for higher rates of retention. It includes an analysis of retention within Trinity College Dublin. Section 2.4 explores the usability aspects of a mobile device when retrieving location-based information. Furthermore, a comparative study is done between the effects of presenting information in list views, interactive maps, and augmented reality (AR). Section 2.5 talks about the context-based systems and provides an analysis on the accuracy of these systems, and examples of such systems. Section 2.6 investigates the use of semantic information and mapping. Finally, Section 2.7 provides a study of the interactive aspects of engagement. This includes an analysis of two social networking sites, a public display, and explores the domain of gamification.

2.2 Student Engagement

A core component and result that will be returned from the project is the ability to engage students with the college. Numerous pieces of the literature cover the area of engagement within the first-year experience – this is the core topic of the dissertation. But what exactly is "engagement" and why do we become engaged? The author of 'The Anatomy of Engagement' [Turner, 2010] sought to find a more succinct definition for engagement. Moreover, he describes various avenues of engagement. Amongst these are psychological engagement - where a person directs their attention to another person and reacts based on their state of emotion; behavioural engagement – where a person believes that their actions are as a result of another's; aesthetic engagement – the attraction of a person to a "thing", such as art; and finally, social engagement – the involvement of a person within the social context, such as Facebook. The author goes on to explain the state of "flow" which is a positive form of engagement [Csikszentmihalyi, 1990]. I will later elaborate on the state of flow, as it becomes more appropriate to the content described. The author summarises that the "ontological core of engagement (and user experience) is our involvement in the world, of being-in-the-world".

A set of criteria are presented in which a person must fulfill, to be seen as experiencing engagement; the first of which is "disclosive space". Disclosive space is the context in which engagement occurs, whereby each person has their own interpretation of their disclosive space.

The second criteria identified for engagement is "affect". This is the affect of a task on one's emotions, in a positive way. It is one of the aspects of flow. It is based on positive reinforcement whereby a person's involvement or completion of a task produces a sense of pleasure. It is explained that our emotional state influences our actions in scenarios

where there is a lack of complete knowledge.

Third, and finally, is the criteria of "identity and purpose". It denotes the practice of engagement to lead to an ultimate goal; so as to engage in a task to achieve a certain characteristic or regularity. It is not dissimilar to being aware of how peers perceive one's self.

Furthering the explanation of engagement, [Peters *et al.*, 2009] describe engagement at a higher-level, and as a process, or set of phases. The core phases involve the initial interaction, the maintenance of the interaction, and the disconnection from that interaction. A more systematic description of engagement comes from what they call the "action-cognition-perception" loop.

Perception refers to the interpretation of the interactor's actions. It is the understanding of cues, and deriving the meaning of hints from that interactor. It is similar to disclosed space, mentioned in [Turner, 2010].

Cognition refers to the perceiver's degree of interest in the interactor. It is concerned with the maintenance of the interaction cycle. This, in turn, is the degree of engagement.

Despite the initial declaration of the action-cognition-perception loop, the authors of [Peters *et al.*, 2009] believed it to be important to include another process. This process is called "experience". Experience is strongly linked, if not the same as flow mentioned by [Turner, 2010]. It is the state of immersion with the interaction.

Finally, action refers to the outcome or result of one's perception. In the paper [Peters *et al.*, 2009], the authors use the example of a face-to-face interaction – the person who is listening, provides a frequent utterance to communicate that they are listening and are interested.

Collectively, papers [Turner, 2010] and [Peters *et al.*, 2009] provide an in-depth exploration of the attributes that envelop the term engagement. Although the author of [Turner, 2010] defines the paper as a "brief sketch of engagement", it is more than sufficient as an introduction for this section, and as a foundation for this dissertation.

The following paper investigates engagement with respect to first-year students. The authors of [Hayek & Kuh, 2004] explain that the key to success, within the student's first year, is their activeness, rather than the resources available at the college. Those who wish to assess student success must review the amount of time in which students engage in activities, and effectively detail this information so as to improve the college. In the paper, five principles are outlined which lead the assessors in gaining a better first-year experience.

The first is to become aware of student engagement within the college. One such way of increasing this knowledge is to create an effective survey for students to complete, and examine the results. The authors use the National Survey of Student Engagement

(NSSE) which is a practical survey that has been created for this purpose. The 2011 NSSE survey [NSSEville State University, 2011] was taken by a random sample of 3272 students from NSSEville State University. The results were collated and displayed to show the percentages for each question. There are two distinct question-and-answer sets which have been taken away from this survey that directly relate to the context of student engagement for this project. These are as follows:

1. "**To what extent does the school help students deal with their academic and social needs?** 82% of FY students felt that this institution had a substantial commitment to their academic success. 50% felt well-supported by the institution regarding their social needs."
2. "**How much time do students devote to co-curricular activities?** 6% of FY students spent more than 15 hours a week participating in co-curricular activities. 59% spent no time participating in co-curricular activities."

In question 1, it is evident that half of the students surveyed, believe that they are not being provided with enough of their social needs. Question 2 shows that fifty-nine percent of the students do not participate in co-curricular activities. The question remains as to whether the increase of awareness of ongoing social activities, could lead to higher percentages in this survey.

The second principle is to obtain apt sampling information for the domain under investigation. An unbiased result-set produces best results.

The third principle asks assessors to review other NSSE results from other universities and make the comparison in result-sets. Other universities' results may be relevant to the assessor's own college. It was found in Indiana University Bloomington that "less engaged students were from 7 to 13 percent less likely to return for their sophomore year".

The fourth principle asks to frequently announce the first-year experience. The idea is to spread the information openly and often to show and gain interest for engagement.

Lastly, the fifth principle explains that various approaches should be used when calculating the performance of the first-year students. One of these approaches would be to compare them against first-year students from other universities. Another approach is to set benchmark values that must be reached. An example mentioned in the paper is to ensure that at least fifty percent of a first-year group frequently socialise with students of different backgrounds.

The paper presents good guidelines to follow when attempting to tackle issues during the first-year experience. The overall message is to get students to engage with their campus and the facilities it has to offer. A belief is formed that the more a student engages, the better their first-year experience will be. Statistics show that students who

engage more show higher expectations of returning to continue to their next year of their degree. The five principles outlined by the authors, provide a model for people who wish to improve the first-year experience of students.

A later study in [Kuh *et al.*, 2008] delves into the "effects of student engagement on first-year college grades and persistence". The paper provides an in-depth analysis of several metrics related to student engagement. The data were drawn from years of NSSE results, and filtered to ensure that they were relevant to the study of first-year engagement, in particular. The purpose of the paper was to determine the correlation between student behaviours and conditions, which affect the success of the student. A second dimension of the study explored the differences of engaging in educational activities for students of different ethnic and racial backgrounds. The grade point average (GPA) of students were compared to determine if engagement had a role to play in increasing their GPA. Other conditional factors were included in the analysis such as the students' "background, pre-college experiences, prior academic achievements, and other first-year experiences". Student engagement was measured by the time a student spent studying, their time spent in co-curricular activities, and the level of engagement in educational practices.

The results extracted from the data, showed multiple conclusions within different areas. The following, are conclusions which relate to this dissertation. An increase of 0.4 in GPA, was seen when a student engaged in educational activities. There was an increase of 0.6 in GPA for students who began college with lower levels of academic achievement. Conversely, students with prior high levels of academic achievement saw an increase of 0.2 in GPA. With regard to the difference between race and ethnicity, the results showed that Hispanic students' GPA increased by 0.11 on average, whilst White students' GPA only increased by 0.03, when engaged more in educational activities. These were the only races seen to show a difference. Persistence for students was positively impacted by the increased level of engagement with educational activities. The results showed that African American students were less likely to persist than White students, with low levels of engagement. As the rate of engagement increased within the African American students, the level of persistence gradually outgrew the rate of persistence in White students.

Despite the detailed analysis of the data, there were some mentioned limitations to the analysis. The results extracted from the NSSE, spanned across different years in order to gain more data from different institutions. Although there are a large amount of colleges and universities included in the data, the results cannot relate to every college and university. Another limitation explains that not all aspects of engagement are measured and the inclusion of different metrics, would possibly provide different results. Finally, the authors mention that the rate of persistence is high, at about eighty-five percent, because it is possible that some first-year students had left the college prior to doing the NSSE,

so they would not have been accounted for.

The overall outcome from the paper [Kuh *et al.*, 2008] shows that students' participation in education purposeful activities leads to greater chances of persistence, and an improvement of grades. These effects resonate more in students with lower abilities and students of colour.

To this point, I have explained engagement in a general sense, and with respect to first-year students. A plethora of information has been provided about the academic approach to engaging students. However, it may be worthwhile to explore the more interactive side of user engagement, which encompasses human-computer interaction (HCI). The paper [Sundar *et al.*, 2011] analyses the affects of different interaction modalities on user engagement. Those investigated were mouseover, drag, click, zoom, coverflow, and slide. The authors speak of "perceptual bandwidth", which they describe as the amount of cognitive load a user can extract from the interface content. They suggest that different interaction modalities incur different amounts of perceptual bandwidth. As a result, different levels of engagement occur from these different interaction modalities.

They categorise users into either power users or regular users, whereby power users are those that make full use of functionality to efficiently complete a task, and regular users make less use of the full functionalities available.

The experiment was set up so that there were six different interfaces; each exhibiting a different modality. The content on a web page was to be accessed via these modalities. For example, one must click, slide to, zoom, etc, the interface in order to view the content.

The results from the experiments showed that the slide modality had the highest amount of recall. Coverflow was not as effective for pictorial recognition as slide or click interactions. The authors believe that coverflow induced overload of perceptual bandwidth. Coverflow and mouseover showed a greater amount of actions executed by the users. Power users showed more positive feelings towards the website content when using modalities click, mouseover, and zoom. The authors' rationale to this explains that power users prefer to use less decorated techniques to complete the task, with maximum efficiency. In contrast, regular users enjoyed the coverflow, slide, and drag interactions, which they allowed for the hindrance to efficiency, to engage with the fun element.

It is apparent that the way in which a user interacts with their interface, and the way that they retrieve information from the content, directly affects their overview of the content. The content presented in each interface was the same and the only difference was the method of access to the content. Thus, it is of key concern for a designer to consider the interaction technique and content presentation when developing for user experience.

User experience and a user's degree of engagement allows them to persist in their tasks [Turner, 2010]. This is also true for first-year students [Kuh *et al.*, 2008]. Generally, the

greater the amount of engagement, the more likely the chances of persistence. With this evidence in mind, I hypothesise that my dissertation project, if successful in increasing levels of engagement, will also lead to the increase rates of retention. Section 2.3 explores the literature that analyses student retention.

2.3 Student Retention

The issue of student retention is one which is of concern to all educational universities. During the first year of college, many students are unprepared for the intensity of the workload that they must endure. This workload generally differs from that of a second-level school. The transition often incurs a shock effect on the new entrant. Moreover, there are many factors that may lead to a bad first-year experience for a student, and consequently lead to student drop-outs. Such factors include: the first time a student has lived away from home; ambiguity when choosing their college course; financial issues; etc. Whilst there is only a limited amount of help a university may provide, a university must attempt to ease the entrant's transition into the college life, and as a result, improve retention rates. A common practice implemented by universities is to have students attend a seminar for first-year students. This seminar aims to gently ease the student into the college by providing a hospitable environment, and also providing information about the college and where a student can go for educational assistance. Thus, retention is the continued engagement of a student with their studies.

In the paper 'Taking Student Retention Seriously: Rethinking the First Year of College' [Tinto, 2000], the author mentions that these seminars are generally used as a quick solution or as an "add a course" strategy, and have limited affect. Tinto claims that institutions are not taking retention seriously and are viewing the problem just as they view any other problems within the institution. He goes on to mention that there are several conditions that must be considered in order for students to succeed. Presented, are Tinto's five conditions for success.

The first condition mentions that the universities should define "high and clear expectations" so that the student can rise to the challenge. Clarity is required so that students know what they must do to succeed, and an approach to achieve the end-goal must be defined.

The second condition asks that universities provide adequate support for students in times of need. For example, a student must have available to them, services to assist them if they require extra educational tutoring, or services such as counselling, for social support. If these support services are not available, it is likely for students to fall behind in their course work and spiral into an unhappy state.

The third condition is for academics to provide frequent feedback about the performance of their students. Good feedback can reassure students who doubt their abilities, and conversely, bad feedback can motivate students to strive towards improvement.

The fourth condition for student success explains that integration in to the college is important. Students who are academically and socially engaged in college activities, show less of a chance of prematurely terminating their studies. This involves interaction with academics, staff, peers, etc.

The fifth, and final condition states that learning should be relevant. Information that is taught in the student's modules should be of value to the student, as Tinto explains that they will become more involved in the learning experience, if they are interested in the material. The paper goes on to explain the ways in which a university can ensure the five conditions are met. Such methods include planning mixed classes for different courses, so that students can engage with a more diverse set of students. Furthermore, scheduling students into many of the same classes allows them to build friendships. The way in which the module is taught affects students. Tinto suggests planning more interactive classes where students must collaborate and share knowledge to provide a result. This helps students to interact with one another and collectively work towards a solution.

Tinto provides five conditions for universities to adhere to in order to produce successful students and increase retention amongst first-year students. His conditions are practical and produce successful results.

An excerpt of the report 'What Matters to Student Success: A Review of the Literature' [Kuh *et al.*, 2006] also discusses the area of retention. We have seen work from Kuh in Section 2.2 where he talks about engagement, and there was brief mention of retention; however, further information is now provided regarding his discussions on retention.

The paper delves into different areas which relate to retaining students and their ultimate success in their college years. Excerpts of the report have been selected, which show relevance to this dissertation. Many of the areas covered in the extract, synchronise with the ideologies expressed by Tinto, above. These include the emphasis on the importance of student interaction with faculty members and peers, inside and outside of the class environment. The authors also confirm that the more one interacts with these bodies, the more likely one is to persist to degree completion. "Cognitive, affective, psychological, and behavioural" development is increased by peer interactions. One difference, which is not detailed in Tinto's paper, is the mention of co-curricular activities. This section is significant to this research, as it explores engagement with co-curricular activities, and their benefits. In the ideal scenario, the developed application will increase the amount of participation in co-curricular activities for students. The report mentions that involvement in these types of activities relates to the persistence of students. One reason for this

is that students get engaged with and become members of different societies and groups, where they feel a sense of unity, and generally these groups have a positive mentality to graduate. Another reason why co-curricular activities can guide towards graduation is that students gain interpersonal skills by involving themselves in their chosen group.

2.3.1 Student Retention in Trinity College Dublin

In June of 2009, Callaghan of Trinity College Dublin published a report on retention [Callaghan, 2009]. The report presented the statistics for the retention rate of students within the college. An aggregate of retention statistics from 2001 to 2005 showed that an overall approximation of 15.4 percent of new entrants did not complete their undergraduate studies. Moreover, 10.5 percent of students did not complete their first year of studies. This shows that roughly 68.18 percent of students who dropped-out were first-year students. Callaghan points to another report conducted at Trinity College Dublin in 2002 [Baird, 2002] which provided further information as to why students had withdrawn from the college. The main issues identified, which were particularly true for first-year students, were with their choice of course and their level of commitment. Baird provided several recommendations for improving retention:

- create a system to collate data on student progression;
- create a system to identify students at risk;
- provide available access to second-level students of the requirements, course prospectus, pre-requisites, etc, so that the students are aware of what is expected of them from the course;
- a review of the college's liaison activities;
- "the provision of accessible information and support for students";
- "a clearly defined exit procedure".

Baird also did a comprehensive review of the literature which led to many key findings. The relevant findings noted "the importance of student and social integration to course completion" [Tinto, 1987] and "social integration into college is crucial at the outset of the year, academic integration is a more important determinant of persistence later in the year" [Tinto *et al.*, 1994].

There are numerous student supports available within Trinity College Dublin such as "the Tutor System, Student Counselling Service, Student Disability Service, Trinity Access Programme, the Learning Support Programme, and the Students' Unions". Services provided include "library training, personal development planning, peer assisted learning, maths support, study skills and personal development workshop programme, study skills

material, generic skills integration project, study skills seminar, and the peer support programme" [Callaghan, 2009]. Despite the numerous supports and services available, there are no statistics to show the level of awareness of these supports and services amongst the student population.

2.4 Usability for Location-Based Information

In this section, we explore the affects of mobile interfaces on the usability aspect, when retrieving location-based information. The purpose of this investigation is to discover the different options for using location-based information. This relates to the dissertation project because a navigation system may be provided to the students in order for them to find the venue of their events. This facility to provide navigation is a means of reducing the friction of going to campus events.

The human vision system is frequently used to search for a location on a map. Real geographical information can be scaled down and well displayed on a physical map. However, with the emergence of powerful and intelligent mobile devices, people are viewing these maps in their virtual representation. Furthermore, the use of mobile maps is becoming more attractive to the average person for several reasons: location-based technologies are improving; location-based technologies are being implemented into less costly phones; there are a multitude of mobile apps available on handheld devices; network providers are accommodating Internet usage in their pricing plans; and relative mobile maps are useful in certain situations (such as finding the nearest public restroom, finding the nearest restaurants, etc). However, once the visual aspect of these maps is withdrawn, they can be deemed effectively useless.

2.4.1 Audio Interface

The paper titled 'Exploring Future Challenges for Haptic, Audio and Visual Interfaces for Mobile Maps and Location Based Services' [Magnusson *et al.*, 2009] brings this issue to attention, and provides alternative methods to guide a user to a location. The motivation for the paper's investigation is to address the problem of navigating a map where the visual parameter is inaccessible. This may be the case when the user is visually impaired, the screen estate is too small for useful displays, the user is on the move, or the user is in a position where he/she cannot physically interact with the device. In the latter scenario, an example would be if the user was driving or cycling, where it may be illegal to use the device, or simply does not have a free hand to control the device. The paper suggests making use of the other human senses (in particular, touch and sound) to help

the user to navigate the map. Whilst accompanying visual displays with other sensory information has an impact on usability, the authors state that it is important for the other sensory channels to be sufficiently informative when designing systems to be used without relying on the visual quality. This means that a user should be able to make effective decisions without the need to view the screen. This also means that the information provided should be succinct to the task, and not overbearing. The authors are engaged with a European project called 'HaptiMap'. The aim of HaptiMap is to make it easier for developers to include sensory information (other than visual) in their apps, by providing a toolkit. The other goal of the project is to provide guidelines to help developers include the issue of accessibility within their design process. The authors provide examples of scenarios where a HaptiMap enabled device would become useful. One example is if a visually impaired person wished to hike in a national park, they could use a pen on the device's touch screen to gain an audio insight into the landscape of the park. The user can then re-evaluate their position and surroundings at any time by interacting with the device.

This paper emphasises the problem where users may be unable to view the visual display of a map, whether it is because of the quality of their vision or the context with which they are using their device. It brings forward the notion of relying solely on other sensory channels to navigate a terrain using the device. In the extreme case, they target a minority who are so visually impaired that they can not see the screen in any scenario, but they also mention those who are unable to view the device because of the context of use. Furthermore, the paper introduces the novel guidelines and toolkit that is HaptiMap. The paper aims to spread awareness of the requirement for different angles of accessibility and to encourage developers to consider this in their design. I believe that a shortcoming of this paper is that they did not investigate or even address the effectiveness of the audio in the respective environment. For example, if a user is reliant on audio, it may not be very effective in a loud national park. This problem can be worsened when coupled with the limited volume produced from mobile devices. If equipment such as earphones are introduced to enhance the ability to hear the device, it may take away from the natural awareness of the user's surroundings.

2.4.2 Visual Interface

The most prominent and frequently used interface for maps is naturally the visual interface. Before the technology was available, navigation was done using physical maps on a paper (or similar) material. The only useful interactive aspect of a paper-drawn map is with the human vision system. Therefore, with a minimal learning curve, a virtual

visual map can be easily interpreted on mobile device. The paper entitled 'Pedestrian Navigation System Implications on Visualization' [Mahler *et al.*, 2007] talks about the visual element of the user interface. The aim of investigating the graphical user interface is to best design a means of interaction between the user and the device. The goal is to guide the user in achieving their objective with the least amount of resistance possible. With regard to mobile maps, these goals involve making the map easy to learn, fast to use, informative, and essentially to make them a useful tool rather than a hindrance. There are many different aspects which collectively can produce an interface with those characteristics. The features used in the paper include: colours to distinguish between different objects (white for a building, blue for a river, red for points of interest, etc); functionality to zoom, pan, and roll; automatic panning and rolling so the user doesn't have to manually manage the map's positioning; default functionality for button presses (which they felt 'zoom' would be the most beneficial in order to change the granularity of the map data); and Halo circles (which were circles around the destination point of interest) – the advantage of this approach was when the point of interest was off-screen, the user would see an arc portion of the circle, and therefore know the location of the point even though it is off-screen. The user study was carried-out on twenty four participants with a computing background. However, their backgrounds were not related to human-computer interaction or mobile technology. Three tasks were set out to be completed, which were to navigate to a location, go to a location (out of two) which seems to be easiest to reach, and navigate to a known location. The Halo support was switched on periodically to evaluate the users' performance with and without its help. The authors found that the Halo support increased performance and the majority of users liked this feature. Recorded metrics also reinforced the benefits of using the Halo support.

The automatic panning and rolling feature used on the map is practical because it reduces the requirement for the user to interact with the map, and also reduces the likelihood of the user losing their location on the map. The zoom feature is necessary for the user to have control over the amount of information they wish to have displayed on the map. The Halo support system showed advantages when implemented. It worked effectively to direct users to their intended point of interest, when it was not actually on the screen. Based on the shape of the arc, the user could make an intelligent guess as to how far away the centre of the circle was from their current position.

2.4.3 Tactile Interface

Another type of interface used for navigation is tactile feedback. Tactile feedback, in this scenario, is concerned with making use of the human sense of touch to help navigate

to a destination. The authors of [Pielot *et al.*, 2010] present an Android app named 'PocketNavigator' which uses a phone's vibration for tactile feedback. They discuss the motivation for building a tactile-based system; in particular, explain the disadvantages when using visual and audio based systems. They mention that mobile devices are used "in short bursts which results in fragmented attention", which they originally source from [Oulasvirta *et al.*, 2005]. In addition to this, they state that the use of earphones, for audio, can remove the user from their surroundings, whilst the use of an amplifier to project the audio, can cause user embarrassment and is obtrusive. The PocketNavigator guides the user in a similar way to a compass. The user chooses their destination on a map and the PocketNavigator points them in that direction without the need for the user to view the phone display. It uses a vibration mechanism to direct the user – two short vibrations to indicate that the destination is straight ahead; the first vibration is long with the second vibration short, for left; the first vibration short with the second vibration long, for right; and three quick vibrations to explain that the destination is behind the user. The distance to the destination is announced based on the duration between a vibration set. The app uses a GPS system to retrieve the user's location and orientation. Their orientation is determined by tracking the current and previous co-ordinates. A disadvantage to this, as mentioned in the paper, is that the user must be moving for this to be calculated. Furthermore, the authors mention that the tactile compass is suppressed if the user has stopped. The PocketNavigator also has a pointer feature. When positioned parallel to the ground, the device vibrates more frequently for a faster output of information.

The results of a field test showed that the PocketNavigator was effective for users attempting to reach a destination. The use of the Tactile Compass showed that less physical interaction was required with the phone, meaning more attention could be assigned to the primary task. The authors found no disadvantages when using the PocketNavigator when compared with traditional visual maps. There are many shortcomings or details missing from the paper. One major concern is the expenditure of battery life. Using hardware such as vibration motors always introduces the question of whether much energy is being consumed. This would be a key area to explore, as extended use of the app would most likely lead to a quick depletion of battery power. The advantages of using a tactile mechanism should be weighed against its probable energy consumption.

2.4.4 Comparative Evaluation of Interfaces for Location Information

To this point, knowledge has been gained of visual, audio, and haptic interfaces for retrieval of location-based information and navigation. A comparative study was conducted

by Goh et al. in the paper 'Comparative Evaluation of Interfaces for Presenting Location-Based Information on Mobile Devices' [Goh *et al.*, 2011]. It focused on the "ease of use, learnability, efficiency, effectiveness, and satisfaction" of using interface styles: list, map, or augmented reality (AR). The list interface provided a list of the results ordered by distance from the user – the nearest result item positioned at the top of the list. Each list item was an annotation – with a title, tags, a description summary, image, date of contribution, and the distance.

The map's interface displayed each item as a marker on a map. To see the full annotation details, the user was required to tap on a single marker.

The AR interface required users to point the built-in camera in a direction, to present markers as a screen overlay. Each marker was an annotation, similar to the map interface, where the user was required to tap the marker to view the full annotation details.

Three groups of thirty participants were randomly divided, and each group was assigned a different interface to use. The same set of tasks were assigned to each group where they were required to search and browse. Each participant was asked to complete a questionnaire after completion of the tasks, and to provide comments.

The results for the search related tasks showed that the map took the longest time with a mean time of 63.12 seconds. The list had a mean time of 33.13 seconds, and AR had a mean time of 53.38 seconds. Participants commented that "the list enabled them to locate the point of interest within a short span of time". Users of the AR interface said that it was difficult to find the location. Participants commented that all three interfaces were easy to learn, efficient, effective, and satisfying.

With respect to the browsing tasks, again the map interface took the longest time with a mean time of 76.89 seconds. The list held a mean time of 32.87 seconds, while the AR mean time was 49.52 seconds. Results showed that the list was the easiest to use. Again, participants said that all three interfaces were easy to learn, effective, and satisfying.

It is clear from this comparative that the list interface, although simplistic, is the most effective interface for fast interaction. The authors makes suggestions to enhance the application. These include: designing a combined interface; allowing the user to choose their preferred interface; and allowing the user to switch between interfaces on-the-fly.

2.5 Context-Based Systems

Many people can benefit from apps which utilise location information. Available apps can assist users with driving directions, locating nearby facilities, receiving discounts, etc. This information is only relevant if the apps have information pertaining to the user's area. These systems are "context-aware".

The paper entitled 'Towards QoC-Aware Location-Based Services' [Chabridon *et al.*, 2011] is concerned with the quality of context (QoC) information, in particular, location information. The authors observe three of today's well known location gathering technologies – GSM, Wi-Fi, and GPS. The QoC is determined by reviewing three criteria – accuracy, freshness, and trustworthiness. Accuracy is the correctness of the provided location information when compared to the actual location in the real-world. Freshness is the measure of how up-to-date the information is with respect to the current time, and the time since the information was received. Trustworthiness is the amount of belief that the provided information is correct. The location data are sorted by their class of trustworthiness, freshness, and accuracy, and whichever location is seen as the top class, is used as the most correct location. The experiment consisted of two phases. In the first phase, the authors went to different locations and measured the GSM, Wi-Fi, and GPS metrics. Each of these locations were identified by names which the authors had given them. In the second phase, the authors went to those documented locations and used the location detection application to record the current location. The metrics returned were compared against real location data recorded from the first phase, and the accuracy was examined. The results showed that the correct location was found seventy-two percent of the time.

The paper examines the correctness and accuracy of the location data provided. The authors use an aggregation of data from different technologies in order to retrieve the most accurate information available. This is of key concern as it is worth investigating what information each technology provides. It relieves the stress on a single technology to provide the correct information, and instead allows for a judgement to be made, based on all received data. This is a good approach as it is in the user's best interest to have accurate information on their location, and they need not worry about a single faulty recording. The authors explain that extra parameters could be used to gain more accurate readings. These parameters would accommodate their use of trustworthiness, accuracy, and freshness. They also mention that it may be useful to display how much belief there is that the location is where it is displayed on the device. For example, if the algorithm calculates that there is a seventy-two percent likelihood of correctness, the user may benefit from knowing this.

The following paper [Anhalt *et al.*, 2001] demonstrates context-aware applications in terms of spatial and temporal awareness. Spatial awareness is concerned with the real-world geographic location of the user. Temporal awareness examines the user with respect to time. The experiment was implemented within the Carnegie Mellon campus, using four-hundred wireless access points. The first application, titled 'Portable Help Desk (PHD)', provided a way for users to locate other users that were within their team. This exhibits an

example of a spatial awareness application. The intention for this application was to allow students to view their team members' location if they were late to a meeting. Moreover, if a student was unsure as to where their meeting was located, they could view the collective location of their peers, to find the meeting. Visual and audio interfaces were available for the PHD. The visual interface provided detailed information about team members where the user could browse information and view a map. This was intended to be used in an environment or situation where the user had sufficient time to focus on the application without disturbance (i.e. in a stationary position, as opposed to walking and viewing the screen). The audio interface allowed the user to query and retrieve information without the need for touch-based interaction with the device. The interaction with the speech-PHD was done by asking it natural-language questions. An example mentioned in the paper explains that the user could ask the device "what is Bryan's phone number?" to which the device would reply with Bryan's phone number. Another function of the PHD describes that if a user has began a print job, and the print queue is long, the printer will look for nearby printers with a smaller print queue, and will suggest that the user prints from the printer with the smaller queue.

The second application detailed in the paper is called 'Matchmaker'. Matchmaker helps users who are searching for an answer to a question. It allows them to query a database, in order to find an expert, in the question domain. The user describes the question to the application, and the application looks for an available expert user within that question domain, who is also geo-spatially nearby, and forwards the question to them. The expert is then asked to acknowledge that they are suitable to help with that question. The response from the expert, updates the database, so that future questions can be directed more accurately. This application includes spatial context (the location of the current user and expert user), and temporal context (the availability of the expert user). The authors were concerned with the privacy aspect of the applications. As a result, they built 'Privacy Guard'. Privacy Guard allowed users to hide their location from specific users, groups, and at specific times. When the user's location was queried, the server read the privacy policy of that user, and either allowed, or blocked the location from the requester.

Other context-aware agents were used on the devices which aimed to make easier the life of the user. A 'Notification Agent' alerted the user if they were within geographic proximity to a task on their to-do list. A 'Meeting Reminder Agent' alerts the user if they may miss a meeting, by viewing the user's location and considering the time that is required to travel to the meeting location. An 'Activity Recommendation Agent' suggests activities or meetings that the user may be interested in attending. The user predefines their interests, and the agent alerts the user if they are near to an activity or meeting of

interest. Since the users may be indoors, Wi-Fi signal strengths are used to determine location. Firstly, training information is gathered by retrieving the strength of a group of access points, at a location, and repeating this process at multiple locations. The user's position is measured by retrieving the surrounding access points' signal strength and calculating the difference between that, and those documented a priori. The smallest difference returned is the user's position.

The approaches used in this paper provide insight into handling location detection for the indoor environment. Nowadays, location detection outdoors is more cost effective and available (GPS).

2.6 Semantic Mapping

Machines are increasingly used for jobs where humans would previously have been employed. Some of the reasons for this, are that machines are generally predictable, reliable, less expensive, computationally faster, etc. For tedious jobs, machines can be a good replacement for human workers. However, there is a field of human intelligence which machines still arguably struggle to render efficiently. This field is known as 'semantics'– the interpretation of meaning.

The following paper [Liu *et al.*, 2006] aims to gather more meaningful information about the location of the user. Rather than just retrieving the current co-ordinates and time of the user, the authors assign the user a semantic location. In the paper, a semantic location is one which provides real-world information about the location of the user, for example, a clothing store. A semantic location is defined by its attributes: location name; street address; and semantic location. The location name is a store name. The street address can be found by reverse engineering the geo-spatial co-ordinates. Semantic category is similar to a grouping or description, for example, 'café'. The approach is automatic when assigning the location, but requires user feedback to learn and operate more efficiently. The application estimates the user's semantic location by analysing multiple sources. These sources are: the mobile calendar; the mobile address book; the phone call log; web history; list of destinations searched for; and the user's feedback. Each of these sources bears a weighting, whereby some sources are seen as more reliable. The semantic location is then calculated. A look-up is done to the online Yellow Pages, in order to gather as much information about the business at the street address. A location is estimated when it is seen as a 'stay' period – a period where the user has not changed their co-ordinates within a specified time. After a semantic location is determined, the user is asked to provide feedback, as to whether the prediction correctly estimated the semantic location. The semantic location is entered into a log file and the user's feedback

affects future predictions. The predictions were approximately ninety-six percent correct.

The authors state that for their experiment, they chose a student to use a GPS enabled device for a four month period. The GPS location was retrieved every one second. For the estimation process to work, the application largely relies on user interaction, in a passive and active manner. Passive: if the user does not use their mobile device frequently, the application will have less data to base calculations on. Active: the user must tell the application if the semantic location was correct or incorrect. Since this process may be postponed to a later date, cognitive load is demanded by the user to remember if they were truly at the estimated location, at the time.

Another paper regarding semantic mappings [Plumbaum *et al.*, 2011] looks to aggregate and share user information across different social applications. The motivation for the application is to create a rich dataset of user preferences to provide relevant information and recommendations to users. A few examples of the social applications examined for the analysis are Facebook, LinkedIn, Flickr, Yahoo, and Vimeo. The authors evaluated common fields from the different websites and generated a template for use with the social web. These fields included name, gender, birthday, country, email address, etc. Social applications incorporated most of the fields that were used in the template, but an issue arose with the fields, where different words were used by different applications, to refer to the same meaning. To combat this problem, the authors created a User Model Word Net (UMWN) which calculated the relatedness between a pair of comparison values. For example, Facebook may contain the field 'last name', whereas Vimeo would have the same field, but it would be written as 'surname'. WordNet, the lexical database, was used and optimised to calculate the relatedness value. When compared, 'last name' and 'surname' would have a higher relatedness value than 'last name' and 'age'. If the relatedness value was above a defined threshold value, the match was accepted.

The use of WordNet for calculating a relatedness value allowed for ease of interoperability between different applications. This is an example of an application where privacy concerns would arise. Users may be hesitant to use an application, knowing that their information is being manipulated or documented in any fashion.

2.7 Interactive Engagement

In October 2011, social networking was the top activity on the Internet [Aquino, 2012]. "Nearly 1 in every 5 minutes spent online around the world is now spent on social networking sites, making Social Networking the most popular content category in engagement worldwide." [Aquino, 2012]. With social networks possessing such a high level of engagement, a belief is formed, that the research application would benefit from the integration

of a well-known social networking site (SNS) - namely, Facebook.

A study was done by Barkhuus and Tashiro in their paper 'Student Socialization in the Age of Facebook' [Barkhuus & Tashiro, 2010] about the effects of Facebook on real-life socialisation. It explores the use of Facebook as a communication tool within the students' lives.

They retrieved their data by interviewing eighteen participants, using self-report diaries, and asking the participants to complete a questionnaire. The students were divided into three categories: 'mobile' – meaning they had full access to Facebook via their mobile phone; 'semi-mobile' – meaning they had access to Facebook via a laptop; and 'non-mobile' – meaning they only had access to Facebook via a desktop computer. Their findings indicated that Facebook was used in a similar manner to other everyday communication tools; more precisely, it was seen as similar to emailing and text messaging.

An interesting finding was, participants enjoyed the distant relationships which they could have on Facebook. They felt that they would not feel comfortable phone calling their Facebook "friends" but would be fine with contacting them via Facebook. This lowers the social barriers of engagement for users.

In the research, an emphasis was put on the organisation of events and meetings. Four categories of events were documented; these were: 'scheduled events' – sorority meetings, volunteer events, etc.; 'semi-scheduled events' – lunch dates, for example; 'ad-hoc events' – impulsive meet-ups; and 'special events' – events which occurred on rare occasions, such as birthday parties. Events were generally advertised through the person's status updates, 'wall' postings, or more formally by using the 'event' function.

The use of Facebook served as a reminder tool for events. In the paper, one participant explains how he had forgotten about an event until he had seen a friend's message, which reminded him to attend. Another participant describes how she promoted an event, which led to her friends seeing the event, and asking to be put on the guest list.

An important comment made by a participant explains how she may have interest in a seminar or lecture, but will be hesitant to go alone; however, if her friend says that she is attending the event, it will persuade her to attend. This holds special interest to the dissertation because it is likely that it encompasses the thought process of many students, and is a possible solution to providing a student with that extra "push" to attend an event. For this reason, the authors say that Facebook is useful for "shy and less extroverted students".

From the paper, one can see that the use of Facebook, as a tool for engagement, can show great success. It is especially useful for people who are not "close friends" to interact, since it is a less intimate form of communication [Barkhuus & Tashiro, 2010].

A further example of using a social networking site to interconnect people on a social

level, is IBM's Beehive intranet. The research by Farzan et al. [Farzan *et al.*, 2009] highlighted an issue with the Beehive social network. The problem was with content discovery. They had a growing amount of users on the social network, and consequently, a growing amount of content being uploaded to the site. There was a 'most-viewed' listing for the three content types: photos; lists; and events. Over time, the 'most-viewed' listing became quite static, where the top twenty-five photos, for example, remained in that list, with less and less chance of new images entering the listing. It was understood that the reason behind the stagnant state of the listing, was that the listing brought forward the content for the users to easily view, therefore encouraging users to increase the photos' view count. The designers set out three goals which they aimed to achieve:

> "Goal 1: Increase the breadth of the content viewed on the site;"
> "Goal 2: Deploy a rating system that encourages a diverse set of users to promote a diverse set of content;"
> "Goal 3: Promote content in such a way that encourages new social interaction between users."

Goal 1 sought to get more content viewed on the website that was not just in the top twenty-five listing. Goal 2 aimed to create a novel rating system for the content, which would encourage users to view content that was not in the top twenty-five listing. Goal 3 wished to increase the amount of social engagement between employees, who would not normally have interacted.

The system that they designed chose fifty users each week, which were crowned as 'promoters'. The promoters chosen must have had a minimum threshold of activity in the week prior to the election, and must not have been a promoter in the past four weeks. Each promoter was given one week to promote one piece of content from each of the lists of photos, lists, and events. The chosen content must not have been promoted previously within the past four week period. After the one week period, all promoted content was displayed in a designated section on the home page of the website, and in email digests. Promoters who participated in the promotion of content received a "thank you" email, were highlighted on a special page, and were gifted with a star next to their profile picture.

The results showed that 25.9 percent of users viewed promoted photos, compared with 1.9 percent viewing 'most viewed', and 15 percent viewing recently added photos. This satisfied goal 1. One of the ninety-three promoted pieces of content made it to the top twenty-five list. However, the promoted content gained more views and comments than any other method of content highlighting - goal 2 was achieved. 70 percent of the promoters left comments on the content that they promoted. Out of that 70 percent, 65.71 percent of the comments were to owners who they had never previously communicated

with. This concluded that goal 3 was accomplished. There had also been no signs of users "gaming" the system in any way. Gaming a system is finding a way to gain points quickly, in a manner that was unintended by the developer. In this case, an example of gaming would be to get a high amount of view counts by exploiting a weakness in the system's design.

The paper [Farzan *et al.*, 2009] provides a novel approach to fair content visibility, and encourages users to view a more diverse set of content within the social networking site.

Furthering the interactive engagement topic, a public display styled engagement approach was developed by Day et al. in their research "Breaking the Campus Bubble: Informed, Engaged, Connected" [Day *et al.*, 2007]. It describes a voting system with the aim to encourage user engagement. The university campus, in which the project was set, was located away from the town, which led to students' feeling of isolation. The voting system, UniVote, was developed to attempt to get students more engaged, and to keep them connected to the outside world. Its functionality was to display poll questions that were mostly news related, on public displays across the campus. Students were able to anonymously cast a vote on the news articles by connecting to the display via Bluetooth. Staff at the university could create questions through the web administration site, with three multiple choice votes. They could also view statistics about the voting polls. A news feed was parsed from the BBC in XML format, along with a two-minute RealVideo feed.

For the evaluation, twenty-three students were asked to perform two tasks. The first task asked students to log into the web administration site and create a question. The second tasks required students to download and install the UniVote mobile application which was built using J2ME. Then they were asked to cast a vote on the question.

Eighty-seven percent of the students reported that they would use this system if it was implemented across the campus. More than two-thirds of the participants agreed that it was a suitable system to be deployed across campus. The first task was easily completed by students. The second task was less successful because of technical issues with installing the application, however, students overall attitude towards the system was positive.

From this study, we learn that students would engage with such a system, should it be integrated into the campus environment. It also shows that students are quite positive and optimistic about engaging with new systems via their mobile devices. The encouragement for first-year students to be more proactive, can result in their success in college [Hayek & Kuh, 2004].

That study was conducted in 2007. Mobile Internet has advanced quite substantially since then. In their study, they used WAP and Bluetooth, however, today there are many easier ways to obtain connectivity to the Internet – 3G, for example.

2.7.1 Gamification

Social networking sites (SNS) are engaging in their social nature, however, there is also a large amount of attraction to SNS' game applications. Facebook contains a vast array of games, which users may play by simply allowing the game to access their profile. The game with the highest number of daily active users, 'Words With Friends', had 7.4 million daily active users on the 4th of May 2012 [Socialbakers, 2012]. This astonishing number of gamers indicates that there is a desire to play games, and that games include an engagement factor. Researchers have taken this engagement factor in gaming, and have integrated it into non-game contexts. This idea is called 'gamification'.

Fitz-Walter et al. gamified an orientation event and wrote about it in their paper 'Orientation Passport: Using Gamification to Engage University Students' [Fitz-Walter *et al.*, 2011]. An application was constructed for a first-year orientation event whereby students received virtual achievements for completing tasks. The authors state that during orientation, new students face issues of feeling lost, with making new friends, and locating the services and events on campus. This was their motivation to create this application. They designed a framework with the 'game layer' on top, the 'context layer' below it, and the 'utility layer' below that.

The utility layer was an interface which displayed a list of events, an interactive campus map, a friend page, a service information page, and a personal profile page.

The context layer handled and recorded all interactions from the interface, and passed them to the game layer. The interactions were: "answering a question using the touch screen; finding a university location or object and scanning it using a barcode or Quick Response (QR) code; checking in to an event using GPS and time; or adding a friend by bumping phones together using the third party Bump API (http://bu.mp)".

Twenty achievements were created so that when a student successfully completed a task, she would be rewarded with one of the achievements. Each achievement requires a specific task to be completed, in order to claim the reward. Examples of tasks to gain an achievement are: answering how many storeys a certain building has; checking in to an event; adding one friend; adding two friends; finding the bookshop; etc.

Data for the results were retrieved from twenty-two students who were asked to use the application. The evaluation based on questionnaire feedback. The findings showed that all participants thought that the interactive map was useful – with some saying it was the most useful feature. Twenty-one students said that the event list and information was useful. Nineteen students said the 'check-in' feature was useful. Twenty students said the 'friend' feature was useful. Students preferred the location-based games, such as finding the library, when compared to answering questions. Eleven students said the QR

scanning was their favourite feature. Some students gamed the system by guessing the answer to the questions with numerical answers. This is because they had no limitation on the amount of attempts, and they simply used the trial-and-error approach. Twenty-one students said that "the achievement system added value to their orientation experience and that the achievement system was fun to use". Twenty-one students agreed that "the achievement system motivated them to explore the campus".

The relatively simple gamification of an orientation event provided good results overall. Students seemed to enjoy the game element of their orientation, which would have been different to the regular orientation event. It is worth noting that the system encouraged students to add friends, explore the campus, and check in to events. This is all part of motivating the students to engage more with the campus and the other students of the campus – and they are doing so while fulfilling their own desire to gain more achievements. The use of gamification imposes a certain aspect of flow. Again, flow is the immersion of oneself in an activity, with positive emotions attached. The positive reinforcement from completing tasks and consequently receiving achievements, creates a sense of flow, and encourages students to want to engage with the activity, in order to receive further positive reinforcement.

The positive reinforcement for completing tasks is also seen in [Lawley, 2012]. Lawley's article describes gamification as beneficial if correctly constructed. She discovered that only eight-five percent of students were passing the introductory programming course within her institute of technology. She devised a gamification approach to resolve the problem with the low pass rate. Students were told that they would all earn an achievement on their interactive achievement system – Just Press Play – if ninety percent of students passed the class. This encouraged senior and junior students to organise study sessions for the freshmen students before their final exam. The freshmen students successfully passed the course at a rate of ninety-one percent, and unlocked the achievement. The upper-class students enjoyed the experience so much, that they asked if they could tutor every quarter. The incentive was to unlock the achievement, but the ultimate benefit was that student pass rates increased largely, and students wished to continue the effective tutoring sessions.

The message learned from Lawley's approach, is that gamification can be a useful and enjoyable tool to encourage student engagement.

2.8 Summary

The goal of this dissertation is to engage first-year students with the available campus events and activities. Currently, information about the ongoing activities within the

Trinity campus are dispersed amongst different mediums. In order for the goal to be accomplished, several different avenues must be investigated to effectively bring the information to the user. This involves viewing the technical aspects of the application design, and also the examination of the collegiate aspects.

The area of engagement and retention was investigated for the project. As we have seen, the term engagement encompasses an array of descriptions. Amongst these is the action-cognition-perception loop which sees engagement as a process of understanding, interpretation, and reaction.

Authors explained several principles and conditions required to successfully lead students to continue to degree completion. The main points taken from the papers mentioned engaging the student with the college and its facilities, providing feedback to the students, setting clear and high goals for students to achieve, and effectively reviewing the students' progress, using surveys and interviews.

Later, we explored the usability element of navigation systems on mobile devices. A desire for the application, is to provide the most effective interaction with the application so that cognitive load is reduced, and there is ease of access to the application. Various interface types have been evaluated. These explored the effectiveness of map interfaces which were reliant on several human senses. These senses were visual, audio, and tactile. The visual application [Mahler *et al.*, 2007] is the most widely used and natural to users. However, this does not cover all demographics, and other sensory channels can be efficiently used to accompany the vision system. Audio maps [Magnusson *et al.*, 2009] were examined which can be used in the presence of a limited screen estate or by the visually impaired. Evaluations showed that users could navigate terrains by relying entirely on audio maps. The same can be said for tactile feedback maps [Pielot *et al.*, 2010] where the pattern of vibrations used, intuitively guided a user to their destination. A comparative study concluded that presenting information in a list format, was the least abrasive in terms of time on task. However, the authors also mention that a mixture of interfaces, such as list view paired with an interactive map, may be more effective.

This review of the literature also explored the context of the user's location. This describes the application's reaction to the user's environment. In the first paper [Chabridon *et al.*, 2011], the quality of the context information was evaluated and an importance was emphasised on this quality of precision. Next, the IBM research [Anhalt *et al.*, 2001] presented several context-based systems. One allowed users to the location of members in their group. Another actively suggested that the user print from a nearby printer as it had a shorter print queue and would be much faster than using the user's current printer. Finally, a preference application was mentioned which allowed users to input their interests within the building and if they were within a short distance of the interest, it would

announce this information to the user.

The area of semantics was researched. Two different kinds of semantic applications have been reviewed. One explored the estimation of outdoor semantic location [Liu *et al.*, 2006] by gathering a user's geo-location and using various resources to determine where the user was located. They produced a location that would detail the shop or building the user was in, the street, and the type of building they were in (for example, a restaurant). The second of the semantic studies [Plumbaum *et al.*, 2011] provided an approach to map words that had the same meaning but were of a different spelling. It calculated a relatedness value in order to match the words.

The interactive engagement aspect of the project was also examined. This incorporated the social networking element and its effectiveness to create a more socially engaging environment. An analysis was provided of the offline sociability of Facebook in university students. The authors concluded that Facebook was an excellent communication tool for lowering social barriers and easing social engagement.

The IBM social network, Beehive, constructed a novel approach to encourage users to view more diverse content. Users promoted content which they particularly enjoyed, but had not been promoted before. This forced promoters to view a diverse set of content, where they would then bring that content to the forefront of the website. An interesting attribute to this was the positive praise which a promoter received. This created interaction between the promoter and the author of the content, which would not normally have happened – thus, creating greater social engagement.

Aside from social networks, UniVote encouraged students of a university to engage with peers anonymously. This was by connecting wireless via their mobile phones, to a public display, and through multiple choice, they voted on a topical question.

The final area for investigation was gamification. This concept is adding a game element to an activity that would not usually be seen as a game. The literature gamified an orientation event. It encouraged social interaction and exploration of the campus, and received very positive feedback. Moreover, the use of an achievement system encouraged students to work more diligently toward passing exams.

Lastly, an achievement system was used by Lawley to increase student pass rates. Students were told that they would all unlock an achievement if at least ninety percent of the class, passed. Study sessions were set up, and the students accomplished their goal. More interestingly, they enjoyed the study sessions, and asked to continue hosting them.

Chapter 3

Design

3.1 Introduction

After acquainting ourselves with the relevant literature, we find ourselves well equipped to propose additional research to the field of student engagement. This chapter introduces the Trinity Impulse application, which is the proof of concept for the dissertation. Requirements for the application are defined, and the process of designing the application is described in detail. The areas of design include the: gathering and refining of requirements; scenarios; interface prototyping and design; and use cases.

3.2 Terminology

This brief section introduces the reader to common terminology used throughout the chapter. Presented is some background information for terms which may be unfamiliar to the reader, or which hold a meaning specific to this research.

Trinity Impulse

Trinity Impulse is the name given to the website or physical implementation of this dissertation. It is the mobile website used as the proof of concept. The use of the words "website", "web application", "application", and "research approach" are used interchangeably throughout the reading, to refer to Trinity Impulse.

Facebook

Facebook is a popular social networking website used by millions around the world. Facebook allows developers to integrate its website and functionality with their own websites and applications. They allow for interactivity through an API.

Facebook 'Pages'

A Facebook 'Page' is a web page which can be created by any user on Facebook. Generally, users create Facebook 'Pages' for specific interest groups. A feature is available to create events on a Facebook 'Page' and these events can be retrieved using the API. Users can subscribe to the page by clicking a 'like' button. This allows the user to receive informational updates that are posted by the page owners.

[Event] Organiser

An event organiser is an individual who creates and manages events for Trinity Impulse. They must register with Trinity Impulse and generally are the administrator of a Facebook 'Page' or organisation.

3.3 Requirements Gathering

This section details the requirements that the application must deliver to all relevant stakeholders. A description will be provided of the process that was undertaken to gather a list of requirements and refine that list into feasible functionality for the application. Afterward, the design of the application can begin, since there will be sufficient requirements obtained, and appropriate goals to strive toward.

First, it is important to re-iterate the objective of the research. The project is to create a mobile application which will broaden students' awareness of events and supports, and encourage students to attend those events. The initial scenario that was presented, explains how a student may have a large break between classes, or may just be on campus, and wish to consume their free time by doing "something" of interest. The student is searching for a convenient resource where she can quickly browse events of interest, and find an event that she can attend, to fill the space until her next class begins. In this brief scenario, we have identified many requirements of the research; the research approach must bring events to the student in a convenient and effective manner; and the student must be able to quickly browse events of interest, which are scheduled on the current day. These are the basic qualities that must be available in the research approach.

3.3.1 Stakeholder Requirements

To gather further requirements, meetings were scheduled with interested stakeholders. Specific college event organisers were seen to be crucial in the process of gathering requirements because they oversee many of the events within the college. They have experience

with the current ways of advertising events, and can give an insight into the way in which students access events. Presented, is a list of the stakeholders involved in the assembly of requirements. They are chronologically listed by our initial meeting.

Central Societies Committee (CSC)

The first stakeholder meeting was with the Central Societies Committee (CSC) marketing/office administrator, and colleagues. The CSC are responsible for the creation and maintenance of all societies within the college. They were seen as a valuable input into this research because they produce a large quantity of societal events throughout the academic year. Their current implementation for displaying societal events is to post them to a calendar on the CSC website; however, the marketing administrator mentioned that they have limitations on the amount of events that can be stored by the calendar, and that the calendar is currently not in use. We were also informed that many of the societies discontinued their use of the website, and advertised their events on a Facebook 'Page' instead. Providing a way to integrate Facebook 'Pages' into the research approach seemed to be an idea worth exploring. Other requirements mentioned in the meeting included: colour-coding events on the interface; providing a list/agenda view; having a map representation of events; the ability to see events which are at least one week into the future; and providing location details.

Student to Student (S2S)

A meeting was arranged with a member of the Student to Student (S2S) group. S2S are a group of students who volunteer to provide guidance to new entrants to the college, and to provide emotional support to any student. They host events to train mentors, and work toward student engagement and retention. The main features extracted from the meeting were to: synchronise with Google calendars; and to have a Google street view for event locations. An additional feature which was especially interesting, arose from the meeting when the member mentioned how she enjoyed having the ability to see who was listed as attending an event. She said that she would be more inclined to attend an event if she knew a friend was also attending. Conversely, it is nice to know if a specific person is attending, if you do not wish to interact with them.

Dublin University Central Athletics Club (DUCAC)

The final stakeholder involved in gathering requirements was the administrative assistant of the Dublin University Central Athletics Club (DUCAC). DUCAC are responsible for

sports clubs within the college. The only extra requirement acquired from the meeting was to ensure appropriate privacy if integrating with Facebook.

3.3.2 Scenarios

The use of scenarios in the design phase of the project allows for informal, contextual narrative of real-world uses of the research approach. Design problems and user requirements can be extracted using scenario analysis. In this section, a list of scenarios are created for the main requirements.

Viewing Today's Event

James is a second-year student in Trinity College Dublin where he is enrolled in the film studies course. He is twenty years old and competent on a computer. He finds that he has quite a scattered class schedule. On this day, he has a three-hour break until his final two-hour lecture. James has a one-hour commute to and from college every day, so it is not feasible for him to return home until the next class. It is also the beginning of the term, so he does not have much college work to do. He considers participating in an co-curricular activity, but is unsure of what activity, or where such an activity would be taking place. Suddenly, he remembers that there is a website that he can visit in order to find this event information – Trinity Impulse. He navigates to the website using his smartphone and is immediately presented with the option to view today's events. He clicks to view them and notices a digital arts guest speech that is scheduled to begin in ten minutes, which lasts for one hour. This suits James perfectly. James closes the browser window and makes his way toward the event venue.

Viewing an Event by an Organiser

Robert is a first-year student in Trinity College Dublin where he is studying psychology. He is attending 'Fresher's Week' in order to acquaint himself with the campus and its environment. Being of a sporty nature, he is looking for clubs to join while in his first year. He immediately sees a banner draped across the front entrance to the campus which advertises the Trinity Impulse web application. He visits the website on his Android device. After visually analysing the home page, he sees that he can view events by the organiser 'club'. He selects this option to view club events. He scrolls through a list of the events until he sees an event for weekly tennis classes. He now knows that there is a tennis club within the college and decides to find the tennis club stand in the 'Fresher's Week' event.

Searching for an Event

Jane is a second-year student in Trinity College Dublin. She remembers that her friend told her about an event that she would definitely like to attend. Her memory fails to remember the exact title of the event but the word "ted" is familiar to her. She frequently uses Trinity Impulse, so she navigates to the home page and clicks to use the search function. She types in the search-word "ted" and clicks to search. A list of results are displayed and she catches sight of the event titled 'TEDxDublin'. She clicks into the details of the event and is satisfied that this is the event that her friend was telling her about.

View People Attending an Event

[Continuation of previous scenario: 'Searching for an Event'] Jane wants to see if her friend has set herself as attending the event. She clicks to view people attending. She scrolls through the list and sees her friend's name accompanied by her Facebook profile picture. She also sees her other friend's name and Facebook profile picture. She now knows that two of her friends are attending the event, and she decides she also wants to attend.

Viewing an Event by Date and Category

Tom is a first-year student in Trinity College Dublin. He has been accepted into a computer science course, fresh out of secondary school. He is eighteen years of age, and naturally, with his interest in computer science, he knows his way around current technology. He finds himself with a busy class schedule and homework which demands a large portion of his free time. Constantly working, Tom is aware that he is beginning to burn himself out. He decides that during a less strenuous time of his academic year, he wants to attend an event to unwind. He takes his iPhone out of his pocket and enters the web address of the Trinity Impulse application. Upon entering the website, he is presented with a home page that provides various options. He clicks to view all events. Tom knows that his free time is next month – March, so he clicks to see all events in March by applying a filter. A large list is still displayed, so he narrows the event listing down to events of interest. He feels that he will enjoy attending a 'lesiure' event, so he applies the appropriate filter. He finds an event for an organised mountain hike. Although this is still an energy consuming activity, Tom feels that the fresh air and natural surrounding will help relieve some of the stress built up from his college course.

Saving an Event to a Personal Calendar

Alison is a first-year student in Trinity College Dublin. She is studying nursing as a mature student. Alison previously received an honours degree, but has decided to change her life direction, and go into nursing. She is twenty-four years old. It is now her third week in her new course and she is finding it difficult to follow the lecture material. During her induction, she was told about the Trinity Impulse application where she can search for events and supports. She takes out her smartphone and enters the web address to navigate to the website. She clicks to view all events and filters the event listing by the 'lessons' category. She scrolls through the list of events and sees an event titled 'Academic Support: Nursing'. She immediately sees that the event is on the following day at 3pm. This suits her, but she is afraid that she will lose track of the event. She decides that she wants to save this to her Trinity Impulse calendar so she logs into the application using her Facebook account. After logging in, she clicks on the option to save the event. The button has changed to read 'Remove Event' so she knows that the event is saved. She clicks to view her personal calendar and clicks tomorrow's date. The event appears, so she knows that the event is definitely saved. The next day, nearing 3pm, she opens the calendar in the application to view the event details. She makes a mental note of the location of the support event and begins to walk to its venue.

Setting Default View to 'List View'

Richard is a final-year student in Trinity College Dublin. Being a strong student in his course, he rarely is required to study, and has very few class hours. He spends a lot of his time attending campus events and finds these events by using Trinity Impulse. His frequent use of the application allows him to save many of events which interest him, and he can maintain a schedule. He has grown tired of using the calendar to view the events that he is attending. He prefers to see his events in a list format. A new feature has been implemented in the application where it allows users to set their default view for saved events. He logs into the website using his Facebook credentials, to display the extra options available as a logged-in user. He clicks the drop-down header to display a new option entitled 'My Settings'. Under the heading 'Default Calendar View' he selects the 'List' option and clicks to save. A small notification confirms his saving of the setting. Up until now, when he clicked to view his saved events, he would immediately be greeted with a calendar, which required him to click on a date to view the events of that day. Now, after changing his settings, he clicks to view his saved events and is met by the list view of his saved events. He finds that this is a more convenient way to view his events, and this new setting has saved him a few extra clicks and bandwidth.

Register a Facebook 'Page'

Sam is a fourth-year student in Trinity College Dublin. Throughout his years in college, he has been the administrator of the chess society. He previously created a Facebook 'Page' where he creates events for members to see. He has recently heard of the Trinity Impulse website and wishes to get involved. He has previously received training on how to register his Facebook 'Page' with Trinity Impulse. He is sitting at a desktop and clicks the bookmark for the registration site of the website. He logs in with his Facebook account, which is the same account he uses to administer the society Facebook 'Page'. He sees that he is asked to enter the 'Facebook Page ID' in order to register the page. There is a help-tip with an image explaining how to get the 'ID'. In a separate browser tab, he navigates to the Facebook 'Page'. He copies the 'ID' from the address bar and pastes it into the field on the registration page. After clicking to save the information, he is provided with a message that informs him that the Facebook 'Page' was successfully registered.

3.3.3 Trinity Web Noticeboard

Gathering requirements by means of stakeholder interviews proved to be a good approach to gain a varied set of opinions on functionality. However, when searching for sources of college events to include in the application, it was important to consider the Trinity web noticeboard (Figure 3.1).

Figure 3.1: Trinity Web Noticeboard

The noticeboard is a website where events in Trinity are posted by any student or

personnel with a college login. It is used to advertise events, accommodation, seminars, small ads, etc. There is not a large amount of activity on the noticeboard but a weekly email is sent to students containing new noticeboard postings. Since this is a source of events that some people use to post events, it is worth parsing its events for the application. A semi-automatic parsing of events can be done where an administrator must manually convert the noticeboard events to the application events. The administrator must interact with the system, therefore requirements must be defined. Requirements for handling noticeboard events are as follows: parse the noticeboard; create, edit, and delete organisers; convert noticeboard events; and create, edit, and delete application events.

3.3.4 Use Cases

Until now, a loose, informal account of the requirements has been presented. The stakeholder interviews and scenario-based analyses have been useful in extracting the core functions required by the application. However, the level of detail in these analysis approaches is limited. In this section, a list of use cases will be formatted to explain the intended interactions with the system, in sequential steps. Use cases have the benefit of describing the successful scenario of a task, and also any alternate paths that the task can follow – the latter of which tends to be either a set-back in the successful scenario, or an undesired exit path.

Shown in Figure 3.2 is a high-level use case diagram representing the main actors that interact with the system, and the tasks that they perform.

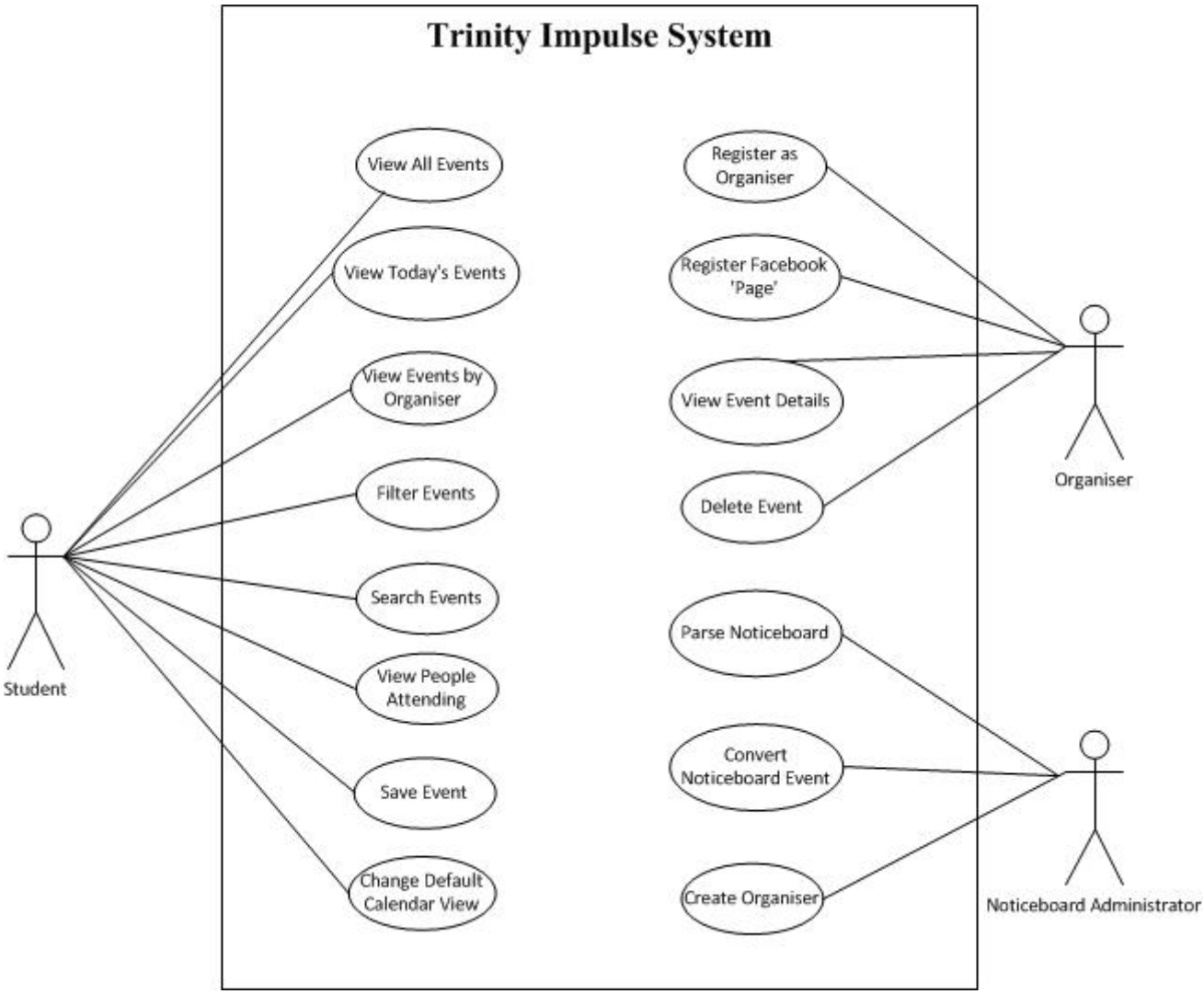


Figure 3.2: Use Case Diagram

The following, is a breakdown of each use case scenario. Included in each use case is the goal of the use case, the linear sequence of steps for the successful case, and the extension case, where applicable.

View All Events
Successful Scenario: 1. Click to view 'all' events.

View Today's Events
Successful Scenario: 1. Click to view 'today's ' events.

View Events by Organiser	
Successful Scenario:	1. Click the drop-down list containing the list of organisers. 2. Select an organiser from the list.

Filter Events	
Successful Scenario:	1. Click to view events. 2. Click the drop-down list containing filter options. 3. Select an option from the list. 4. Click to apply the filter to the events.

Search Event	
Successful Scenario:	1. Click to search an event. 2. Enter a search-word into the input field. 3. Click the 'search' button
Extensions:	3.a. Search-word is less than 3 characters in length. 1. Display error message. 2. Return to step 2.

View People Attending	
Successful Scenario:	1. Click to view details of a Facebook event. 2. Click button to see people attending event.

Save Event	
Successful Scenario:	1. Log in using Facebook login credentials. 2. Click to view details of an event. 3. Click button to save event.
Extensions:	1.a. Username or password is incorrect. 1. Return to step 1.

Change Default Calendar View	
Successful Scenario:	1. Log in using Facebook login credentials. 2. Click to view personal settings. 3. Select a default calendar view. 4. Click to save settings.
Extensions:	1.a. Username or password is incorrect. 1. Return to step 1.

Register as an Organiser	
Successful Scenario:	1. Log in using Facebook login credentials on Trinity Impulse registration page. 2. Click to register as an organiser. 3. Enter details. 4. Click to save.
Extensions:	1.a. Username or password is incorrect. 1. Return to step 1. 4.a. Email address already exists/required fields not entered. 1. Display error/informational message. 2. Return to step 3.

Register Facebook 'Page'	
Successful Scenario:	1. Log in using Facebook login credentials on Trinity Impulse registration page. 2. Click to register Facebook 'Page'. 3. Enter Facebook ID. 4. Click to register.
Extensions:	1.a. Username or password is incorrect. 1. Return to step 1. 4.a. Facebook ID is invalid/User is not an administrator on the Facebook 'Page'. 1. Display error/informational message. 2. Return to step 3.

View Event Details	
Successful Scenario:	1. Log in using Facebook login credentials on Trinity Impulse registration page. 2. Click to manage events. 3. Click an event.
Extensions:	1.a. Username or password is incorrect. 1. Return to step 1.

Delete Event	
Successful Scenario:	1. Log in using Facebook login credentials on Trinity Impulse registration page. 2. Click to manage events. 3. Click to delete an event.
Extensions:	1.a. Username or password is incorrect. 1. Return to step 1.

Parse Noticeboard	
Successful Scenario:	1. Select section of noticeboard. 2. Click to parse events.

Convert Noticeboard Event	
Successful Scenario:	1. Click to view noticeboard events. 2. Click convert on an event. 3. Enter event and organiser details. 4. Click to save.
Extensions:	4.a. Required fields not entered. 1. Display error/informational message. 2. Return to step 3.

Create Organiser	
Successful Scenario:	1. Click to view organisers. 2. Click create a new organiser. 3. Enter organiser details. 4. Click to save.
Extensions:	4.a. Required fields not entered. 1. Display error/informational message. 2. Return to step 3.

3.4 Interface Design

The chosen medium to interact with the Trinity Impulse application is the hand-held device. One requirement of the application is for it to be convenient for students. Allowing the web application to be used on a mobile device, enables ubiquitous access. With this in mind, the interface design must focus on the limitations of using the application on a mobile device. The main limitation of concern for the interface design is the limitation in screen real estate. Smartphones have a limited screen size when compared to a desktop/laptop screen. This governs the style of interface that we must design. In order to ensure the correct functionality was included, in a usable way, the design took a user-centered approach. User-centered design (UCD) is a developmental approach which includes your stakeholders in the design process of the application. To include stakeholders in the design phase, low-fidelity prototypes were constructed to gain initial feedback on the interface.

3.4.1 Low-Fidelity Prototypes

A low-fidelity prototype is a rough draft of a design. They are disposable and cheap to create. In this case, low-fidelity prototypes were created using paper. Quick visuals of the interface were constructed and shown to the stakeholders. They included the main functionalities intended for the application. Feedback that was generated from the stakeholders was considered for the final implementation of the application. Figure 3.3 and Figure 3.4 show the paper prototypes that were presented to the stakeholders.

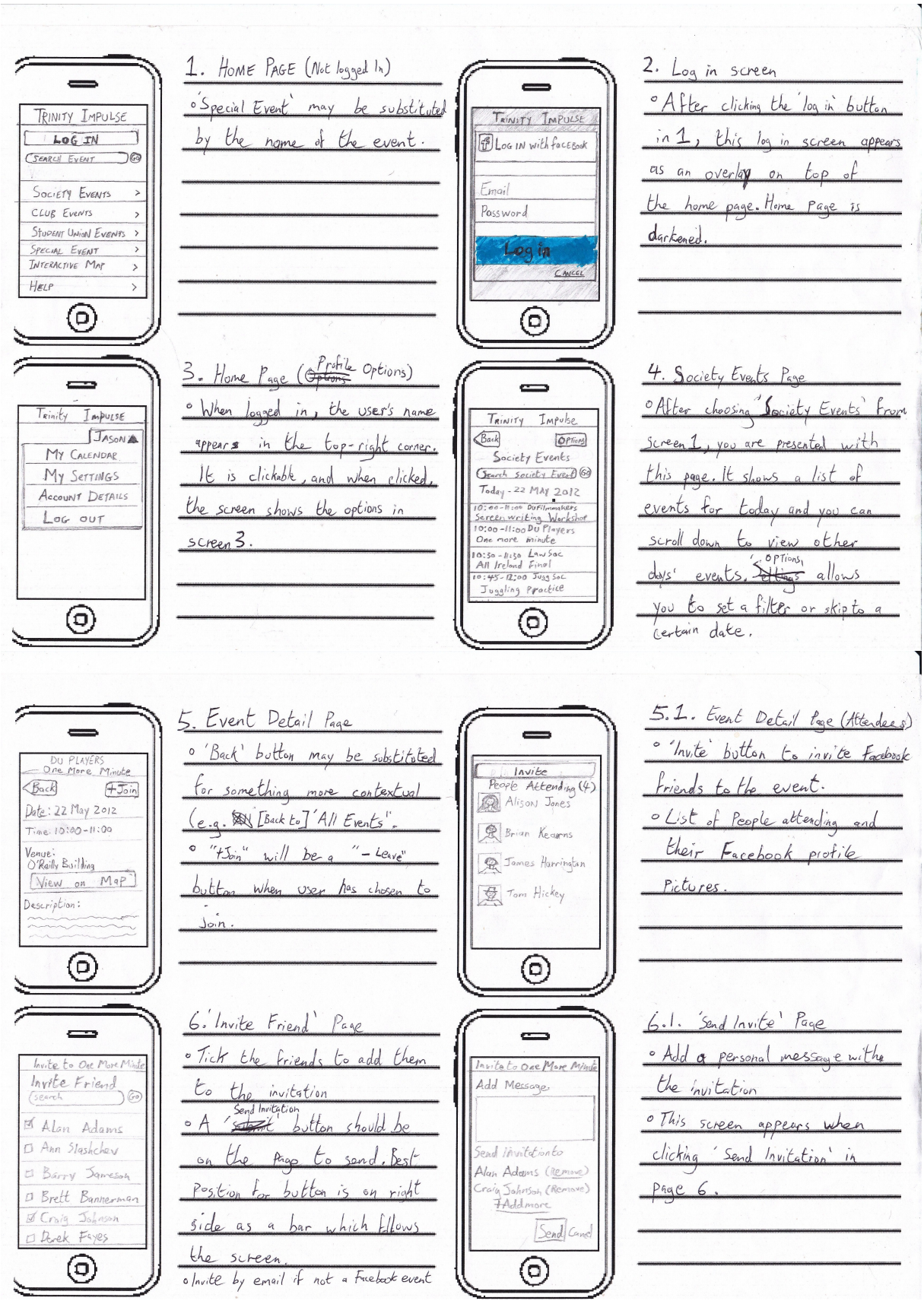


Figure 3.3: Paper Prototypes

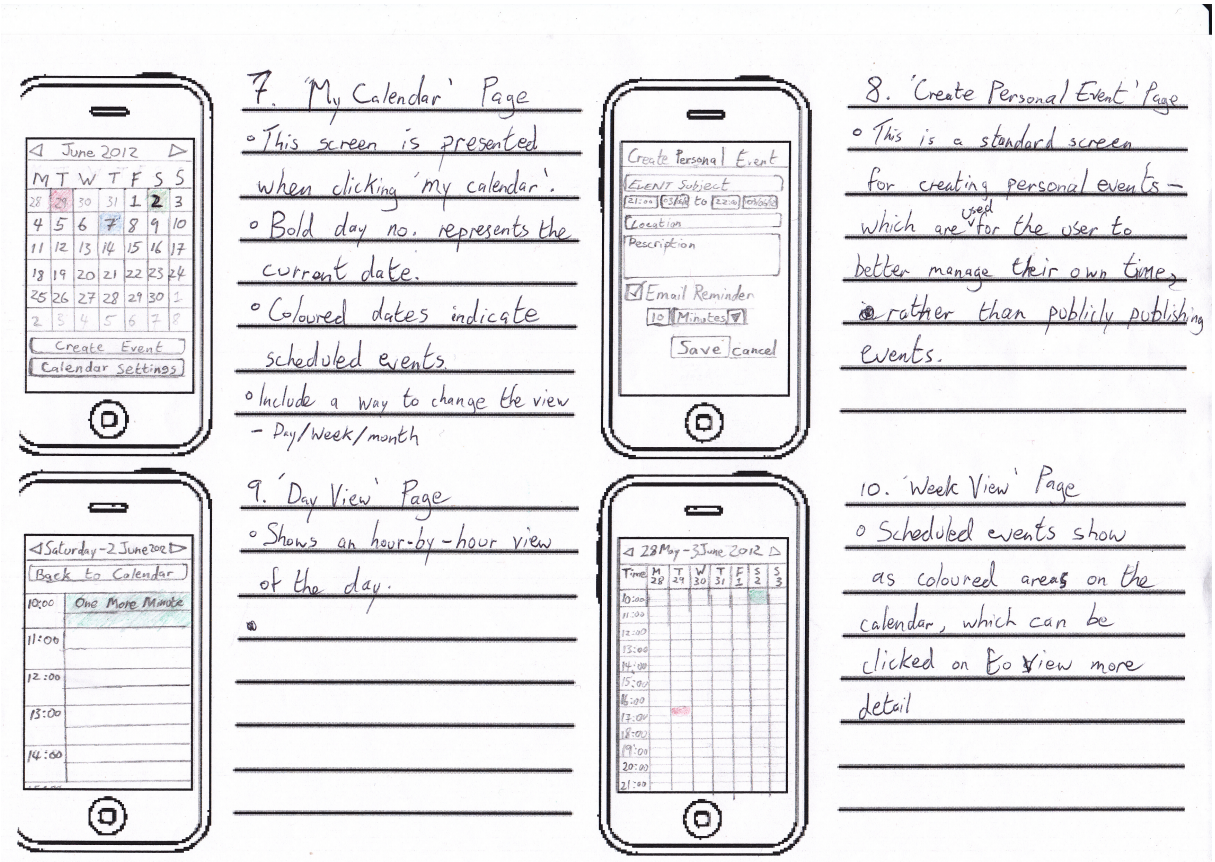


Figure 3.4: Paper Prototypes (cont.)

3.5 Summary

In this chapter, the design phase of the Trinity Impulse application was discussed. First, the terminology used in the chapter was explained – as some technologies may be unfamiliar, and some terms were used to have a specific meaning to the research. Next, we analysed the process for gathering requirements. Several areas of the requirements were explored – stakeholders were interviewed for their input into the requirements; scenarios were built to gain a real-world view of how the application would be used; current resources for broadcasting event information were researched – primarily, the Trinity web noticeboard; and use cases were constructed to provide a systematic account of the core functionalities of the application. Lastly, low-fidelity paper prototypes were included to show what was presented to the stakeholders during the user-centered design approach.

The requirements are separated by their type – functional requirements and non-functional requirements. The former describes the requirements which are behavioural, while the latter requirements are the system qualities. The requirements that can be brought forward into the implementation phase are:

Functional Requirements

- browse events of the current day;
- colour-code events on the interface;
- provide a list/agenda view of saved events;
- provide a map representation of events;
- provide the ability to see events that are scheduled to be on at least one week into the future;
- providing event location details;
- synchronise with Google calendars;
- provide a Google street view for event locations;
- and provide the ability to see people attending an event.

Non-Functional Requirements

- browse events of interest quickly;
- bring events to the user in a convenient and efficient manner;
- integrate Trinity Impulse with Facebook using their API;
- create a usable application;
- create a scalable, extensible model.

Chapter 4

Implementation

4.1 Introduction

With the exhaustive analysis of the application requirements, we are now in position to implement the proof of concept application. Some of the functional requirements mentioned in the design chapter were not implemented in the final application. This was mostly due to time restrictions. Notwithstanding, sufficient functionality was included, as we will see in this chapter.

This chapter aims to convey a vivid representation of the application, and the rationale behind the choices that were made when implementing the application. First, a discussion is provided to compare the chosen platform of the application with its alternatives. Second, the server-side and client-side programming languages used for development, are described. Third, the technical architecture of the system is outlined. Fourth, the functionality of the system is explored. Last, the database schematic is conveyed, and the reasons for its structure are explained.

4.2 Application Platform

To this point, we are aware that Trinity Impulse is a web application. However, there has been no discussion regarding the reason for choosing a web application as the platform, nor has there been mention of the available platforms to choose from. The top two platforms to consider were the web application and the native app. With respect to mobile access, a web application is a standard website which is tailored to suit a mobile device – usually aesthetically and functionally. A native app is software that is downloaded by a smartphone and installed to access the website's information. Native apps can access the hardware of a phone, such as the camera, accelerometer, gyroscope, etc., whereas a purely

mobile website cannot. Native apps can also be used offline and can make use of local storage, whereas a mobile website cannot. Native apps must be developed using specific languages for specific operating systems – Objective C for iOS, Java for Android, etc. Thus, native apps are bound to a specific operating system. In contrast, mobile websites can be created using HTML, CSS, PHP, etc., and can be accessed by any smartphone via their Internet browser. This was the deciding factor for implementing the application as a mobile website – ubiquitous access. It enables all smartphone owners to have access to the application, whereas creating an app would have restricted the audience to a specific operating system. Furthermore, this was an appropriate decision because there was a restricted amount of time to implement the application, and creating at least two different apps (iPhone and Android) would require programming in Objective C and Java.

Other approaches to creating mobile applications include the hybrid app and the dedicated web app [Cavazza, 2011]. A hybrid app is similar to a standard app but allows a single build of code to be expanded to multiple phone operating systems. Examples of hybrid development frameworks are PhoneGap, Sencha, and Titanium. A dedicated web app is a website which formats its style to specific operating systems. They focus on specific vendors to ensure that users of those devices have dedicated mobile access, and no attention is put on other vendors.

Future work may include the comparative research in implementing a native app, versus a hybrid app; for now, a mobile website will suffice.

4.3 Programming Languages

4.3.1 Server-Side

With the application platform chosen, it was time to decide which programming language was to be used for development. The sever-side code that is used for the application is PHP (PHP: Hypertext Preprocessor). PHP is a web scripting language, and was chosen because it works well with HTML, is a popular web language, is said to be easy to learn [Bradley, 2008], and communicates fluidly with MySQL databases.

Facebook

Facebook integration was chosen for multiple reasons. First, Facebook provides an application programming interface (API) to easily access its content and manage relationships between content. Second, many of the societies within Trinity College Dublin have already created pages individually, and use this as a primary source to promote their events. Despite the ease of access that comes with planning events on Facebook, students must

explicitly join a group or "like" the society's page in order to receive event information. This requires students to search for a society, however, if the student does not know a society exists, then they will not engage with it. In addition, this outlines the necessity for information to be brought to the user. Finally, Facebook is the most popular social networking site [Sparkes, 2011].

CodeIgniter Framework

PHP frameworks help programmers to code efficiently and correctly by generally enforcing the model-view-controller (MVC) architecture. The MVC model is an approach to programming which allows for separation of logic layers in the code. The model handles the interactions with the data. This module can typically create, read, update, and delete data. The controller processes the information to and from the model, and sends it to the view. The controller handles the business logic of the application. The view is the interface to display information and stands to accommodate user interaction with the application. Figure 4.1 shows an example of a six-step process in the MVC architecture for displaying an event's detail page.

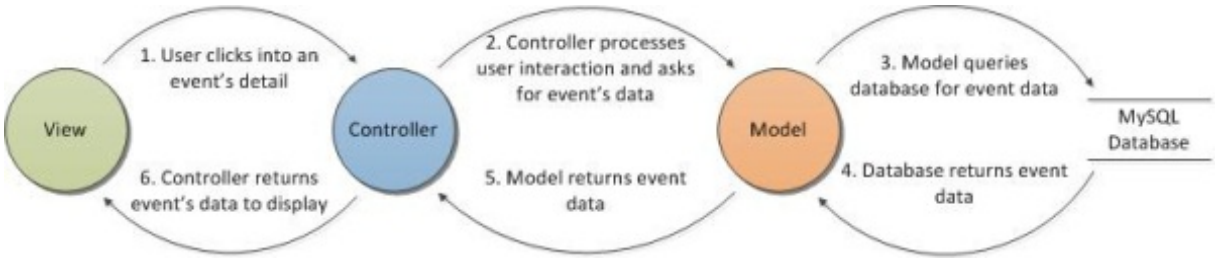


Figure 4.1: MVC Architecture

The MVC model helps to code modularly because a layer does not need to know how its neighbour layer functions, so long as it receives the expected inputs and returns the expected outputs. PHP frameworks generally provide helper libraries for "add-on" functionality. They also reduce the time for developers to create applications because they provide a foundation for code and pre-constructed functions for use. The CodeIgniter framework for PHP conforms to the aforementioned qualities, but they also brag to have a small footprint, good performance, and extensive documentation. They have an active community who are willing to help with technical issues and answer any questions asked.

There are several PHP frameworks – amongst them are Symfony, Zend, CakePHP, Yii, Kohana, and CodeIgniter. While some offer more strict coding conventions, more functionality, better scalability, more online support, etc., the reason for choosing CodeIgniter as the framework for the application is that it is seen as the easiest to learn. It also has

more than enough functionality for the intended application.

CodeIgniter provides helpers to interact with the database without the need to know the specific SQL code. To retrieve records from a MySQL database table, one would usually execute the command: *SELECT * FROM table_name*. The CodeIgniter equivalent to this SQL command is: *$this->db->get('table_name')* – where *$this* is a reference to the object, *db* is the database in question, and *get* is the function representing the *SELECT* query. This is just one example of how CodeIgniter makes database interaction more manageable. It also allows for custom SQL queries to be entered, providing maximum flexibility.

4.3.2 Client-Side

For the functionality and design of the client-side of the application, HTML and CSS were used. HTML was used to display common features of web pages such as buttons, text areas, drop-down lists, etc. PHP code in the view of the MVC model translated to HTML code. CSS was used for styling. Javascript and jQuery were used to modify the web page document object model (DOM). jQuery is imported by linking to its file which can reside in a different location, or in the same location as the HTML file. Google host jQuery files on their content delivery network (CDN) and allow developers to link to the files using HTTP. Linking to the Google-hosted files is advantageous for several reasons. Google have the jQuery files hosted on many servers across the world using the CDN. When the user opens the web page which is using the jQuery functionality, the jQuery file is fetched from the nearest Google server to the user, for decreased latency. Another advantage overcomes the fact that Internet browsers limit the number of concurrent connections to a single website. Having the jQuery request come from Google, means that this is one less request made to the application website – this entails increased parallelism. The final advantage of using the Google-hosted jQuery files is better caching. Many websites use the Google-hosted jQuery files so there is a chance that the user has already downloaded the jQuery file. The Google-hosted file has the same URL; thus, if the user is visiting the application for the first time, the browser may detect that the user has already downloaded the jQuery file, and will use the cached copy, instead of downloading it again from the application [Downey, 2012] [Ward, 2012].

jQuery Mobile Framework

The styling of the client-side interface, as mentioned, was done with CSS. However, a styling framework was used to simplify and hasten the process of designing the interface – jQuery Mobile. To integrate jQuery Mobile into the interface, an external link to its style

sheets can be placed in the HTML file. Once jQuery Mobile imposes its style upon the web page elements, they display in such a way that they simulate the appearance of a native phone app. At the source, jQuery Mobile wraps the HTML elements in *divs* and *spans* which have predefined styles. The styles include adding shadow, colour, size, position, font, etc, to the elements. A set of icons are provided to add to the elements which help identify the function of a button – for example, an icon with a 'magnifying glass' sign can be added to a button to indicate that clicking the button will lead to something being searched. Some aspects of the interface design did not satisfy the intended look of the application so custom style sheets were imported to override the jQuery Mobile styles.

AJAX

Asynchronous Javascript And XML (AJAX) is a way to communicate and transmit data with a server, without needing to reload the whole web page. For the application, AJAX was used to retrieve or update information on the database or retrieve information from Facebook. To illustrate, when a user clicks to save an event, instead of refreshing the whole web page, AJAX can be used to insert the event as a saved event into the database.

4.4 Technical Architecture

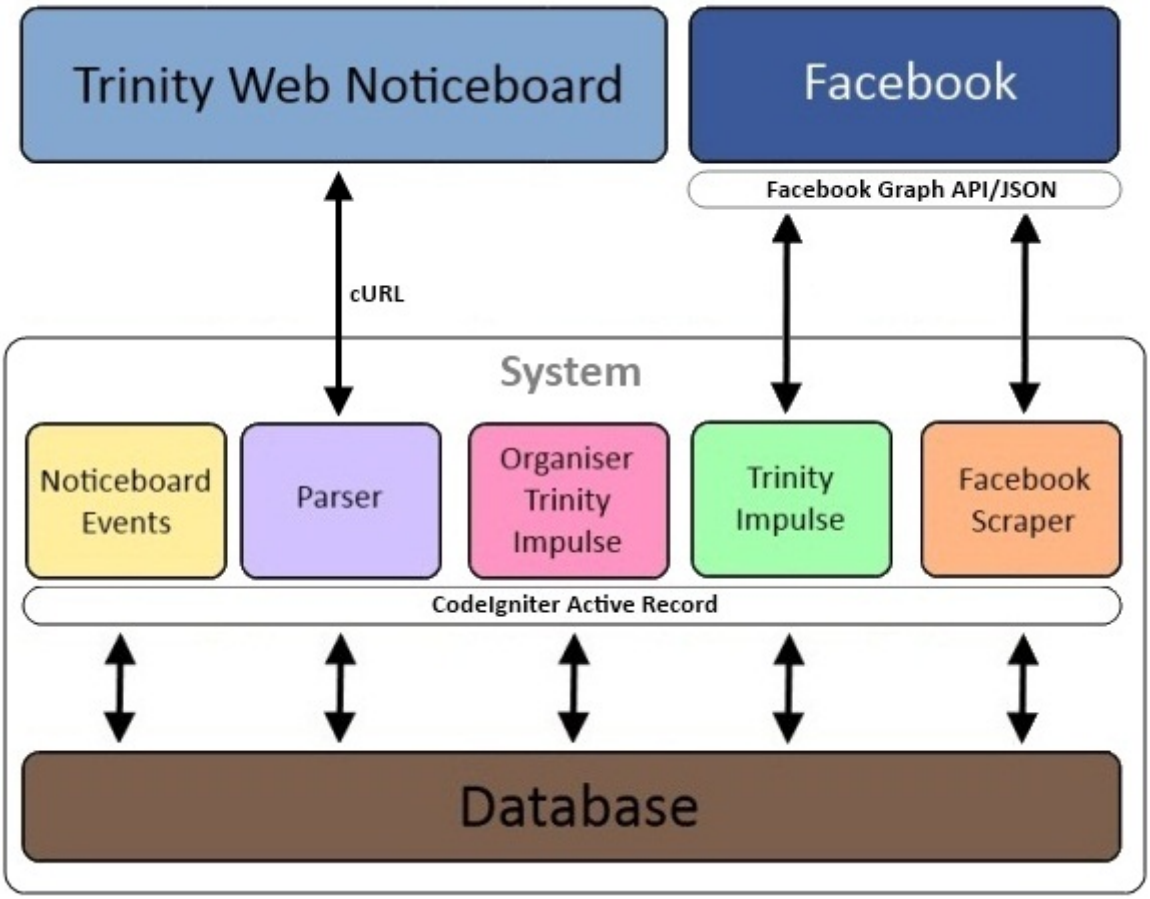


Figure 4.2: Technical Architecture Diagram

Figure 4.2 shows the technical architecture for the system. The core component of the system is the database, which stores the event information, the parsed web noticeboard events, users and their settings, registered Facebook 'Pages', and event organisers. All components which require database access, communicate via the CodeIgniter Active Record, which allows the application developer to perform database vendor independent queries. A developer can simply change database vendor by editing the configuration file, without the need to modify any queries. Another advantage of using CodeIgniter for the database is that its engine automatically escapes queries when inserting data – preventing malicious SQL attacks such as SQL injections.

Each component within the system is developed using PHP. The parser component parses the web noticeboard events using the cURL library. The Trinity Impulse component uses the Facebook Graph API in order to delegate the user's authentication. The Facebook Graph API allows for requests to come from the host, and allows Facebook data to

be retrieved in JSON format. This is done over HTTP. An app ID and app 'secret' are used to authenticate the application. An app access token allows requests for data; and parameters in the URL, can request access to specific permissions. The Facebook authentication process is shown in Figure 4.3.

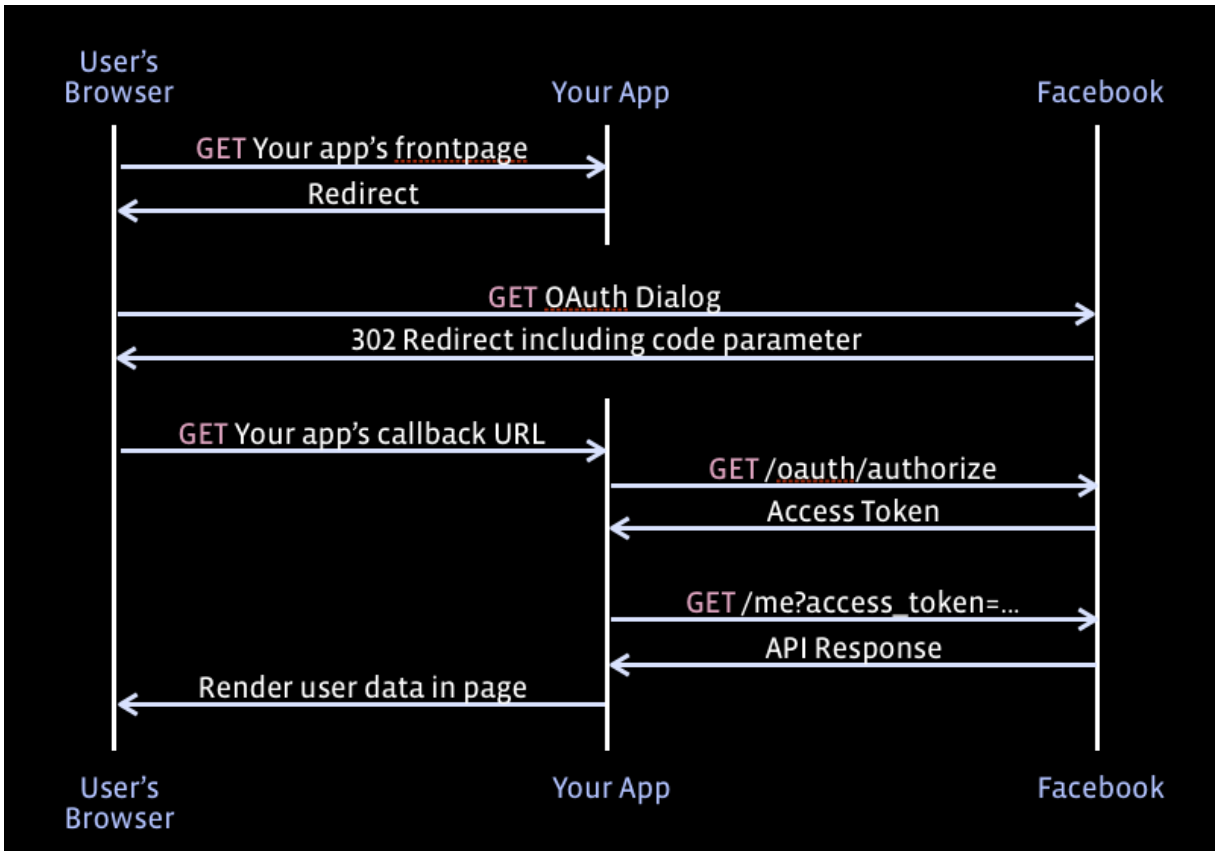


Figure 4.3: Facebook Authentication Process [Facebook, 2012]

To gain Facebook functionality, an app was created on the Facebook developer website. The hosting URL was entered into the app, so that the app could authenticate requests from the hosting URL. In this case, events from Facebook 'Pages' were retrieved. The Facebook Scraper component requests event information from the Facebook 'Pages' also using the Facebook Graph API. The result data are returned in JSON format.

4.5 System Functionality

In this section, the functionality of the entire system will be described. The functionality of each component in the technical architecture will be explained, and details will be provided of its internal workings. The intention is to provide a thorough walk-through of the application.

4.5.1 Trinity Impulse Application

The proof of concept for this dissertation is the application. It is the application that students will interact with to view campus events. Users access this application using their mobile web browser, as they would with any other mobile website. It is targeted at and formats visually to smartphone browsers. Since the application has several web pages with varying functionality on each, a description and view of each page will be provided.

Figure 4.4 is a sitemap to gain a broad overview of the application.

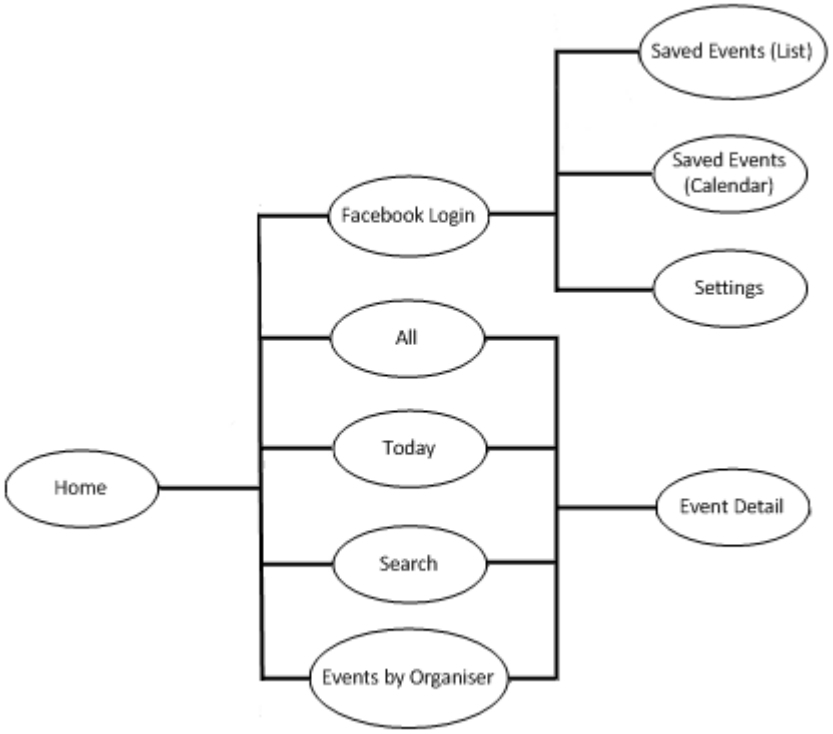


Figure 4.4: Sitemap

Home Page

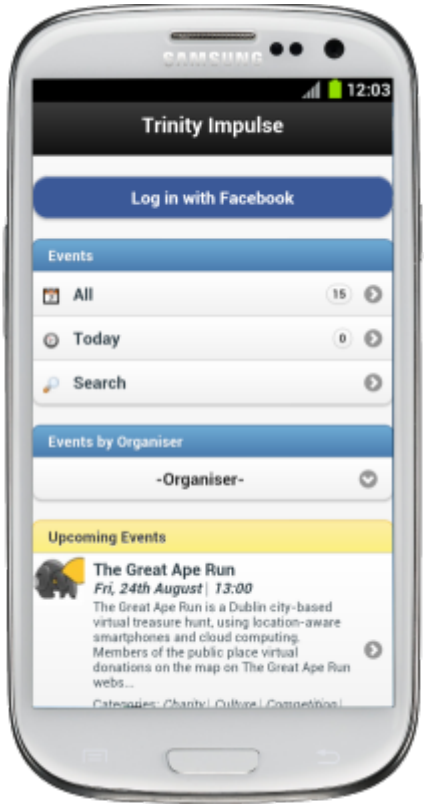


Figure 4.5: Home Page

To start, the initial web page is the home page, which is shown in Figure 4.5. This is the expected web page to see when you first enter the website. At the top of the page, the user can log in to the system, using their Facebook credentials. This uses the aforementioned Facebook authentication process.

Next, there is a section titled 'Events' which has three options available. The 'All' option will present the user with all events currently in the system. A small bubble on the right-hand side of the option displays the number of events that are within the 'All' section. The 'Today' option will present the user with all events that are scheduled for the current day. Again the option is accompanied with a bubble to represent the number of events within that section. The third option, 'Search', brings the users to a web page where they can search for events by a search-word.

The drop-down list titled 'Events by Organiser' allows users to view events that are scheduled by specific organiser types. The current options available in the drop-down list are: 'society'; 'club'; 'student union'; 'noticeboard'; and 'other'.

The yellow section titled 'Upcoming Events' is a way to immediately provide users with events that may interest them. They are the five temporally nearest events to the

current date and time. Each event is shown in summary, and they conform to the same format. The format shows an icon on the left side of the event summary, the event title, the event date and time, a short description of the event, and the categories of the event. If there is no icon specified, the icon defaults to an image of a grey calendar. The event title is not truncated, but it is limited to two-hundred characters in the database. The start date is a mandatory field. If the event has no end date, it will only show the start date. Conversely, if the end date is specified, it is included. This is similar for the start time and end time; however, the start time is not mandatory and will be completely omitted if it is not specified. If the event is an all-day event, no time will be shown, but instead, it will read 'All-day event'. The summarised description of the event is tapered to two-hundred characters. Categories put events into interest groups. Categories on events are distinguished by the organiser who owns the event. This will be explained in more depth later in this section.

All/Today/Events by Organiser Pages

The pages that are displayed when a user clicks 'All', 'Today', or 'Events by Organiser' show events specific to their function. However, the underlying code is the same. It is a single PHP function which interprets the option chosen, and retrieves the appropriate events to display. Simply put, each page looks the same as in Figure 4.6 but with different events.

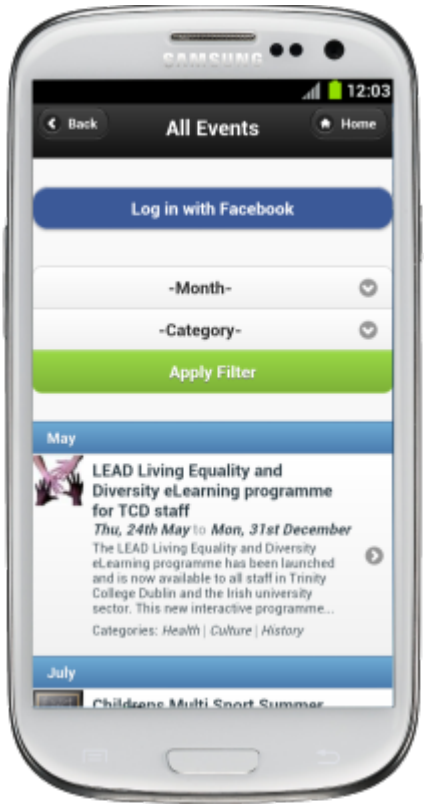


Figure 4.6: All/Today/Events by Organiser Page

There is one exception to this, whereby if a user chose 'Today' in the home page, there is no month filter displayed. The reason for excluding the month filter on the 'Today' page is because the events displayed will only be scheduled for the current date.

In Figure 4.6, there are two filters. The month filter allows users to see events that are scheduled within a particular month. If this application was to be used commercially, this filter would have finer granularity – for example 'show events this week'. However, to gather results for this research, a month filter was used because there are not many events ongoing during the Summer period in Trinity, as the societies and clubs have disbanded. Events were manually entered into the system which were sourced from the Science Gallery. The second filter allows users to view events by their tagged category. It is worth mentioning that events only appear on the application if their end date is equal to or greater than the current date, and if it is set as a live event, in the database.

A 'Home' button is placed in the right side of the header so users can quickly navigate to the home page. This button reoccurs in several of the web pages of the application.

Event Details Page

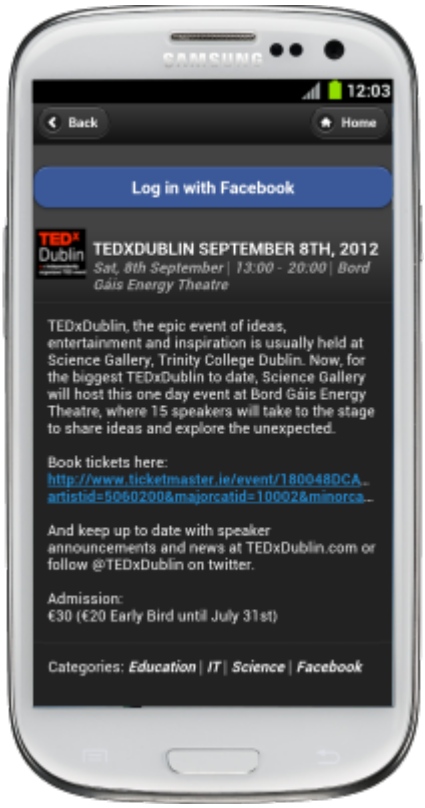


Figure 4.7: Event Details Page (Top Section)

Figure 4.7 shows the detailed view of a single event. The location of the event is available to the user and the description is no longer truncated. The event venue information is now displayed in the subtitle of the event.

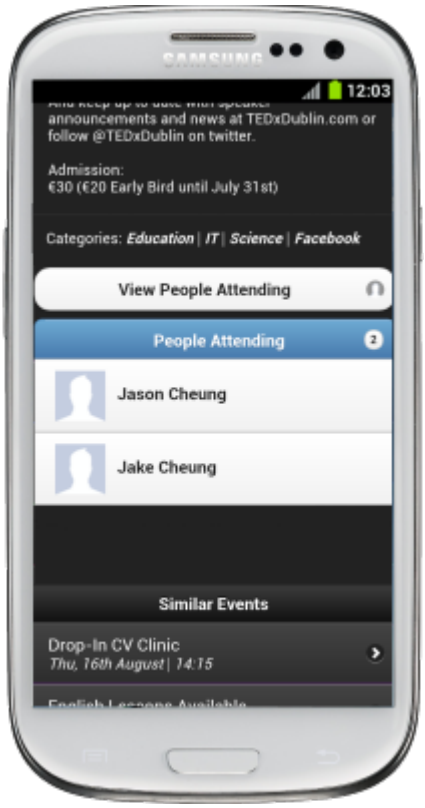


Figure 4.8: Event Details Page (Bottom Section)

The bottom section of the event details page (Figure 4.8) displays a button to view a list of the people who have said they are attending the event. This functionality is only available for events that were retrieved from Facebook. On Facebook, within an event's details, users are allowed to specify if they are attending the event, may be attending, or not attending. The application retrieves the list of people who have clicked to say that they are attending the event. When a user on the application clicks the 'View People Attending' button, jQuery is used to invoke a PHP function which uses the Facebook API to query Facebook, and retrieve the most up-to-date list of people who are attending. Data are sent to the function by the jQuery POST using AJAX. jQuery is then used to manipulate the DOM by inserting the HTML elements into the web page which contain the list of people attending. A small bubble in the right side of the header provides a summation of the number of people in the list.

Another feature which is displayed in Figure 4.8 is the listing of similar events. The events are similar because they are tagged with at least one of the same categories as the event detailed on the page. On the server-side, all events with matching categories are retrieved from the database. The events are then shuffled in a list and the top five events from the list are displayed as similar events on the interface. Random shuffling was used

so that the user would not be presented with the same list of similar events each time they view the details of that event. The purposes of providing similar events are that users can click through the application without the need to use the 'back' button as often, and so the application can bring events of interest to the user.

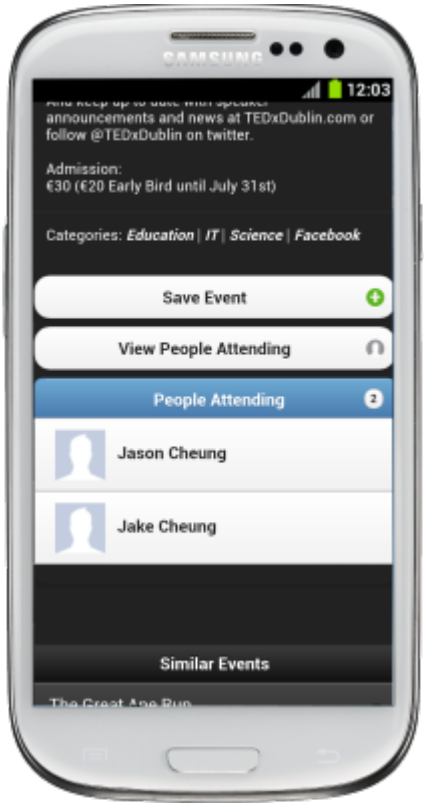


Figure 4.9: Event Details Page (Logged In)

When logged in to the application, users are provided with features. One of which is the ability to maintain a personal calendar of saved events. Events that interest the user can be saved to their personal calendar to serve as a reminder of the event's existence, and to help maintain a schedule for attending events. In Figure 4.9, when the user clicks the 'Save Event' button, the event is saved to their personal calendar. A controller function is called using jQuery and the data are sent using AJAX. The data are the user's email address and the ID of the event. A database entry is inserted into the user's personal calendar table. The appearance of the button then changes to read 'Remove Event' with a red minus sign as the icon. This indicates that the event has been saved.

Logged-In Menu

Figure 4.10: Logged-In Menu

When a user is logged in to the application, a blue header appears displaying the user's Facebook name and profile picture, as shown in Figure 4.10. This is retrieved by using the Facebook Graph API. When the user clicks the header, a menu expands to present extra or quick-to-hand functionality. The first menu item allows the user to quickly navigate to the search page. With the second menu item, the user can view all events that were saved. In Figure 4.10, a number is shown within brackets, both beside the user's name and beside 'My Saved Events'. This indicates the number of saved events which are scheduled for today. It serves to inform the user that there is an event on 'today'. Although it is not immediately intuitive that it represents this meaning, a belief is construed that a user will understand its function after frequent use of the application. The menu item titled 'My Settings' allows users to navigate to the page where they can modify their application preferences. Lastly, the menu allows for users to log out of their account. When a user clicks to log out, they are asked to confirm their action. This additional confirmation was implemented because some users may accidentally mis-click the option, and without the additional confirmation, the user would have unintentionally logged out, which may cause frustration.

Saved Events Page – Calendar View

Figure 4.11: Saved Events (Calendar View)

In the application, there are two different formats to view saved events – calendar view and list view. By default, after clicking to view saved events, the user is presented with a screen similar to that in Figure 4.11. This is the calendar view of the saved events. To view the saved events in the list view, the user can click the button titled 'Go to List View'. The 'Skip to Month' drop-down list will be explained in full in the following section. The calendar shows a red heading which displays the month being viewed. The information within the brackets tells the user how many events are saved for the month being viewed. The right and left arrows in the calendar heading allow the user to skip to the previous and next calendar months. Blue-coloured calendar dates show days with saved events. The date with a blue background and italic font is the current date. The date with the purple border and bold font is the selected date. When the user clicks a date with a saved event (25th of August in Figure 4.11), the interface changes to that which is displayed, and the event summary appears in a section below the calendar. This is done through jQuery and AJAX, similar to described previously. The user is then able to click the event to view the detail page of the event.

Saved Events Page – Calendar View (Skip to Month)

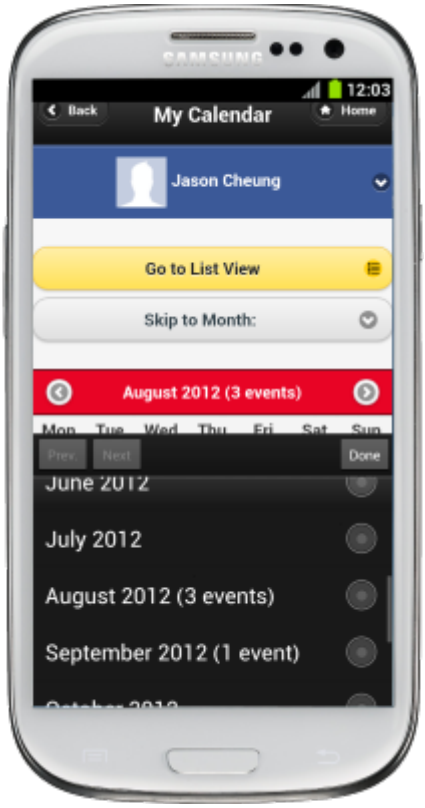


Figure 4.12: Calendar View (Skip to Month)

When the 'Skip to Month' drop-down list is clicked, the mobile browser displays the drop-down options (Figure 4.12). The purpose of this button is to allow users to quickly navigate to a desired month, without the need to manually press the calendar arrow buttons multiple times. The user can also see how many events are saved for each month, so the user does not have to blindly search for their saved events.

Saved Events Page – List View

Figure 4.13: List View

In Figure 4.13, we see the saved events presented as a list view. A button is available to go to the calendar view. The saved events are listed by nearest date. If there is a saved event that is scheduled for today, it is specified by the blue text in the section separator. The start time of each event is shown. When the event is clicked, the user is brought to the detail page of the event.

Settings Page

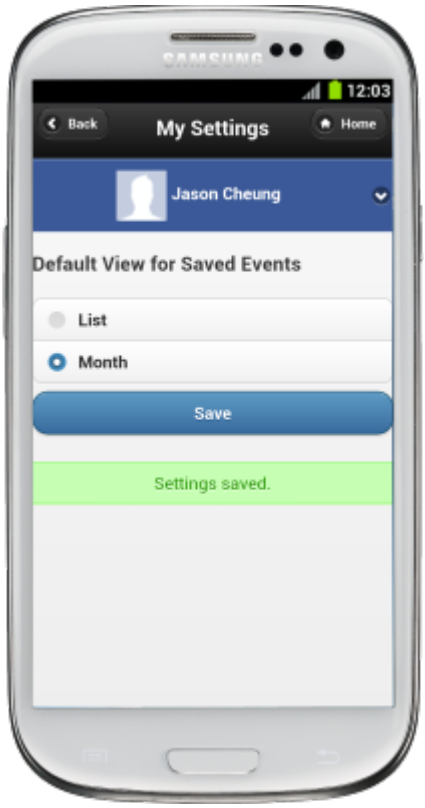


Figure 4.14: Settings

While logged-in, a user can view their settings for the application by clicking 'My Settings' in the expanded header menu (Figure 4.14). The user can select their default view for saved events. By default, when a user clicks to view their saved events, the events are shown in the calendar view; by saving the default view as 'List', they will see the list view of saved events when they click to view their saved events. The green informational message indicates that the settings were successfully saved.

4.5.2 Noticeboard Events System

In Figure 3.1, we saw the Trinity web noticeboard, which is a source for campus events. As part of the requirements, the noticeboard was said to be a valuable resource for event data. For this reason, the noticeboard was parsed to extract the event data, to store in a local database. The developed system to manage the web noticeboard events is called the 'noticeboard events system'. The system has several functional requirements. Its purposes are to: parse the noticeboard events; convert those events to the format of the Trinity Impulse events; create and assign event organisers to events; and manipulate the

application events. An operator must maintain the noticeboard events system. Ideally, this would be an administrator of the original noticeboard. It would be beneficial if the data came directly from the source of the noticeboard events, so that the parsing step could be removed. In this section, we explain how each component functions.

Parsing

Since this was not a client-facing website, the interface was created with minimal design. Figure 4.15 displays the home page of the noticeboard events system.

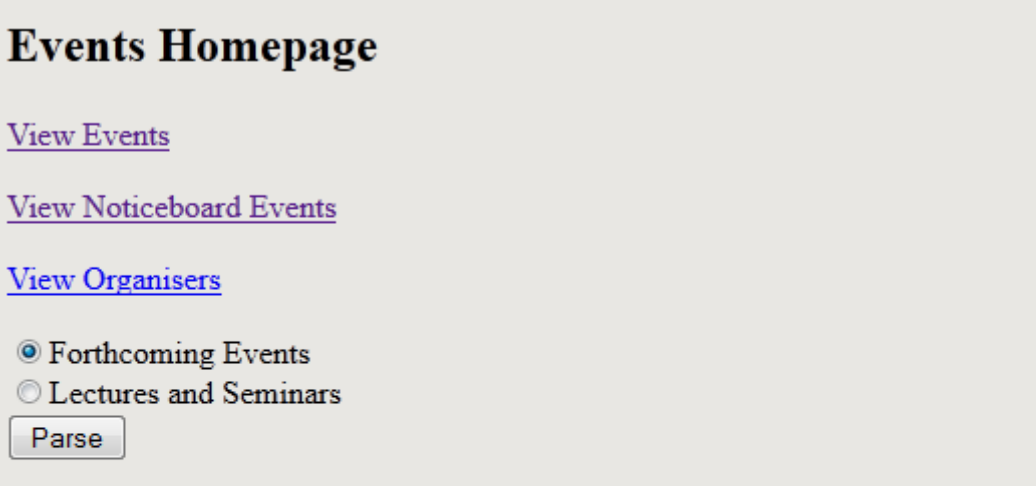


Figure 4.15: Noticeboard Events – Home

On the Trinity web noticeboard, there are two relevant sections to parse – 'forthcoming events', and 'lectures and seminars'. Other parts of the noticeboard are irrelevant to the purpose of the application, as they are related to personal ads, accommodation, and scholarships. To use the parser, a user chooses the event source to parse, and clicks the 'parse' button. The parser uses the cURL library to automatically log in to the web noticeboard, and download the web pages. Certain aspects of the web noticeboard follow a format. For instance, the date is always formatted as '<day> <month> <year> to <day> <month> <year>'. Thus, PHP is used on downloaded web pages to automatically extract formatted data, using regular expressions. The whole process is not automated because the web noticeboard events do not have a format for the start and end times of events. People submit event times to the noticeboard by including the information in the description. It was seen as too difficult a task, to use regular expressions to retrieve time values. After methodically analysing multiple events, it became clear that users were too unpredictable in the way in which they insert time information. To illustrate, some users enter multiple times for multiple days of the event, as it was a recurring event.

Each web noticeboard event contains a seemingly unique ID which is present in its URL. Upon parsing events, the system checks that the event does not exist in the database, by matching this ID to event IDs in the database entries. This ensures a cleansed database, by preventing duplicate events from entering the database.

Although not implemented for the application, the parser was designed as a separate component so that it could be mounted as a CRON task, or similar periodic scheduler. This would allow the web noticeboard events to get parsed periodically, and the operator of the noticeboard events system could manipulate the events to include them in the Trinity Impulse application, without needing to manually parse events.

Organiser Creation

An organiser in the application is the owner of an event, or set of events. Each event must have an organiser in order to exist. This will be explained later in the section, at an appropriate time. When creating an organiser, the user is presented with the screen shown in Figure 4.16.

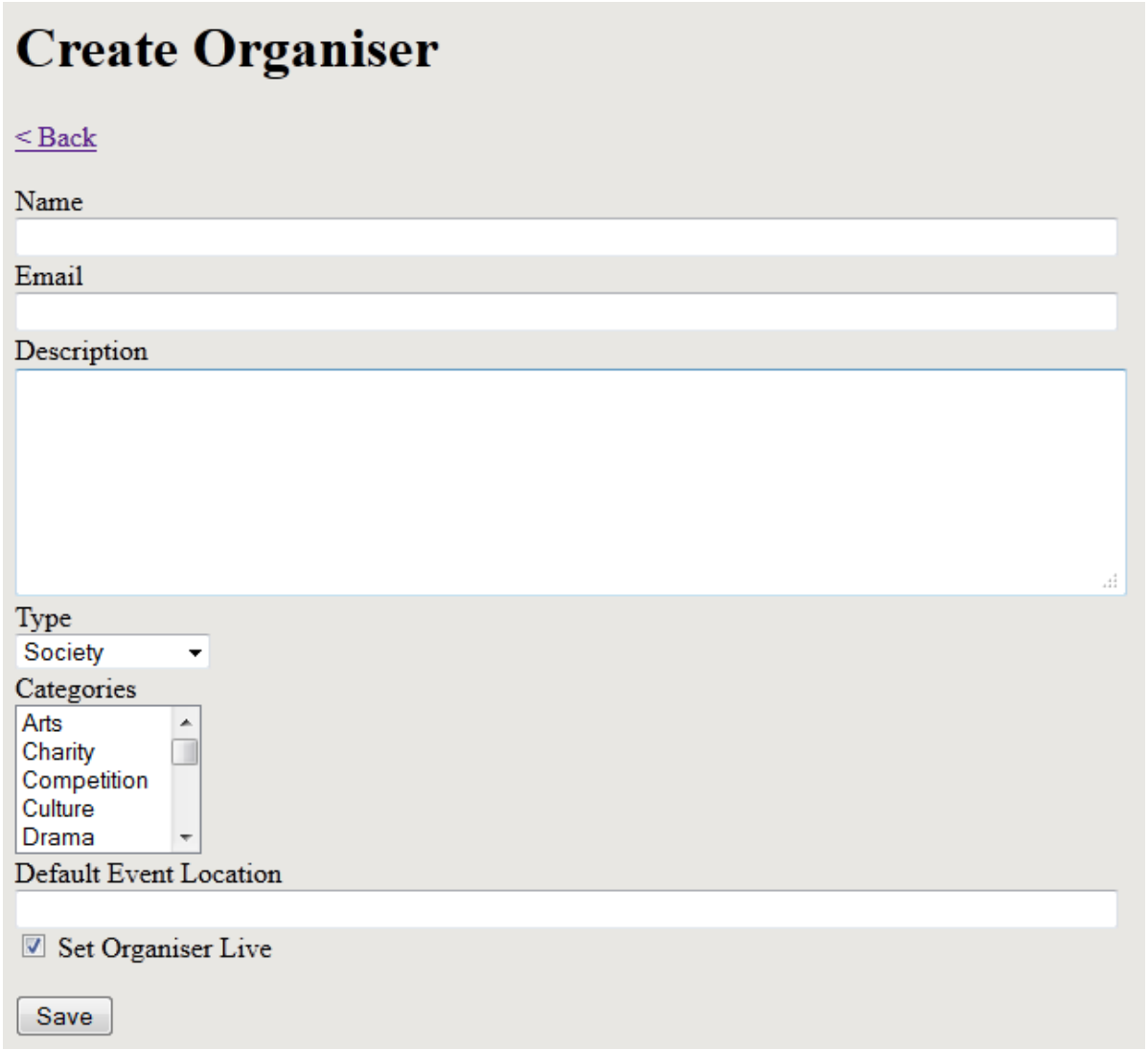


Figure 4.16: Noticeboard Events – Create Organiser

The organiser must have a name, email address, and at a minimum, one category. The 'Type' field defines the organiser, and as seen in Figure 4.5, application users can view events by the organiser. The 'Default Event Location' can be set so that the location of an event can be automatically populated when it is being created. The user has the option to create the organiser, and set them to an inactive state. They can then be activated in the future.

As for the categories, each organiser is required to select at a minimum, one category, and a maximum of three. The restriction of three categories was an arbitrary threshold. Organisers are assigned categories, and all events created by the organiser, have the categories attached. For instance, suppose the organiser is a drama society. They may choose categories such as 'arts', 'drama', and 'leisure'. With this approach, an assumption

is made that all events created by the drama society, will lie within those categories. This is a problem with the approach. If the drama society wished to create an event that was in a different category, they would not have the option to do so. The reason the system has been developed this way, is because the events which are sourced from Facebook, have no way to specify a category. A workaround could be implemented whereby the category names could be embedded in the Facebook event description. Then, a regular expression could extract the categories and attach them to the event. The reason this was not implemented, is that the organiser would have to know how to format the categories, for the regular expression to find. Moreover, the organiser would have to know the list of categories available, and typographical errors may occur, requiring the application to semantically match the error to a category. For these reasons, it was decided that the organiser should retain the categories.

Event Conversion

When speaking about "converting events", we are referring to the process of formatting noticeboard events, to adhere to the specifications of a Trinity Impulse event. The user of the noticeboard events system is presented with the screen in Figure 4.17, when converting an event.

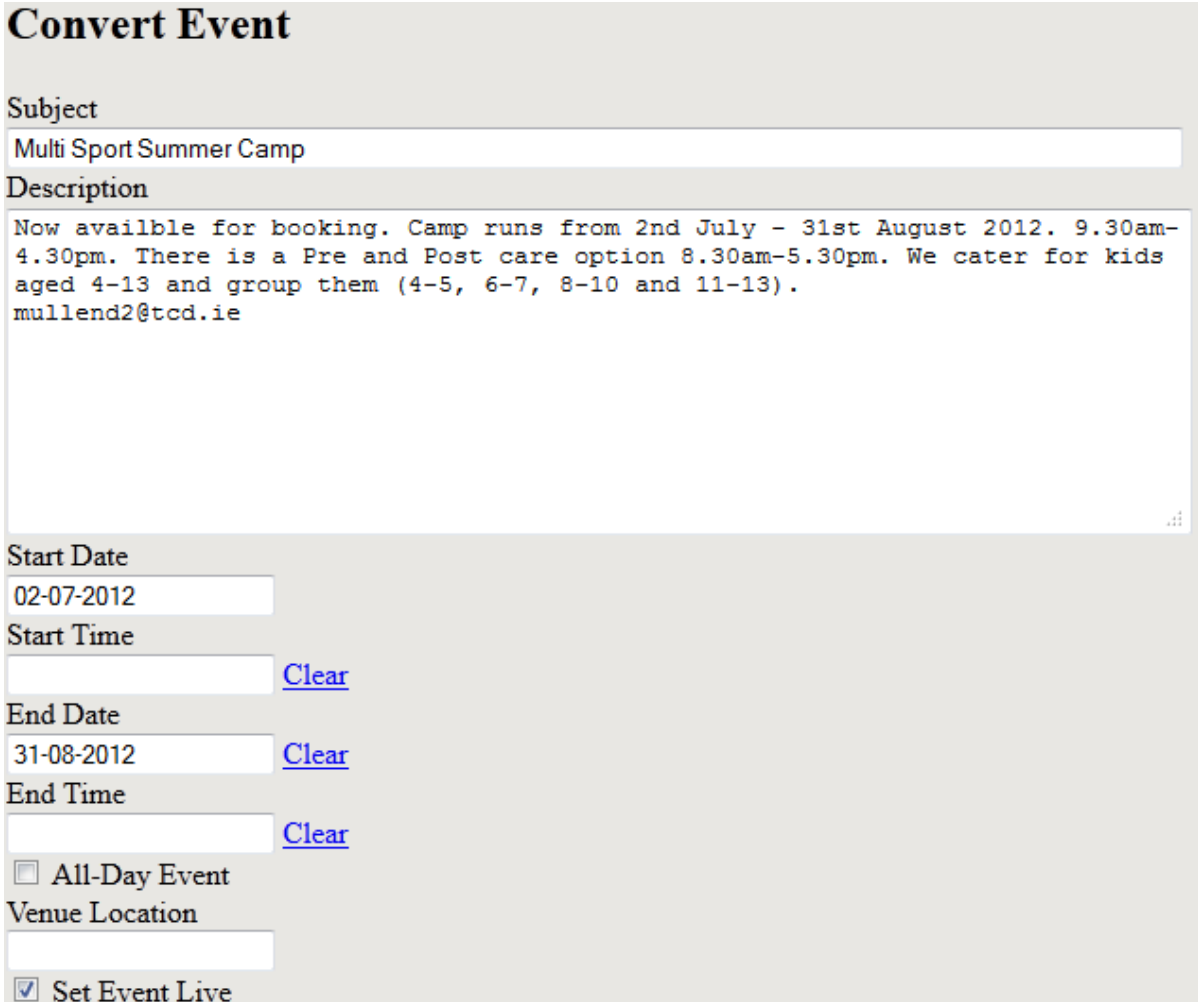


Figure 4.17: Noticeboard Events – Event Conversion (Top Section)

The 'subject', 'description', and 'start date' are required fields for the event to be converted, and are pre-populated with the regular expression values, retrieved during the parsing. Upon clicking the start date, a graphical calendar appears to help the user to set a date. A similar interface appears for the time fields. Constraints are set on the date and times of the events: start date is mandatory; end date cannot be before start date; end time cannot be before start time; and end time cannot exist without start time. If the event is set to an all-day event, the start and end times are disabled for input. The event can be converted and set inactive, allowing for future activation.

Figure 4.18: Noticeboard Events – Event Conversion (Bottom Section)

The bottom section of the conversion page is shown in Figure 4.18. The 'Price' field allows users to input prices for events. Two fields are available to allow users to input the price title and the price value. An example of this would be formatted like so: 'Student: €10'. Many events had different prices for different people. Another feature worth mentioning with the price, is that javascript is used to dynamically allow for more prices to be input. Although the price functionality is fully implemented, at this moment, it is not used in the Trinity Impulse application. Similar to the issue with categories, Facebook do not provide an event field for prices. In the application, prices could be used to filter events. To demonstrate, a user may only want to browse free events or events which cost less than ten euro. The final element of the conversion screen is for assigning an organiser to the event. If the email value does not exist in the database, it is assumed that a new organiser is being created. The user can type an email address and click the link to check if the organiser exists. This is done via jQuery and AJAX, as described previously. If the organiser exists, all organiser fields are populated. If the 'Venue Location' field is empty at this time, then it is populated with the default event location of the organiser. If an update is made to any organiser field (excluding the email address), it is updated in the database.

4.5.3 Organiser Trinity Impulse Website

In this section, we will explain how organisers register their Facebook 'Page' with the Trinity Impulse application. The website is referred to as the organiser Trinity Impulse website. The system is designed so that organisers require minimal effort in order to

advertise their events on the application. The idea is for organisers to register their Facebook 'Page' once, and then maintain their events from Facebook.

Register Organiser

Figure 4.19: Organiser Trinity Impulse – Register Organiser

When an organiser first visits the website, they are asked to log in using their Facebook credentials. Upon initially entering the website, the organiser is only presented with the option to register as an organiser. Figure 4.19 shows the registration screen. It is similar to that in Figure 4.16. The Facebook name and profile picture of the organiser appear in the top-right corner of the screen, where they can log out. The email field is pre-populated with the organiser's email address from Facebook. When focus is put on a field, a blue label appears next to the field to inform the organiser of the expected value to be entered.

Register 'Page'

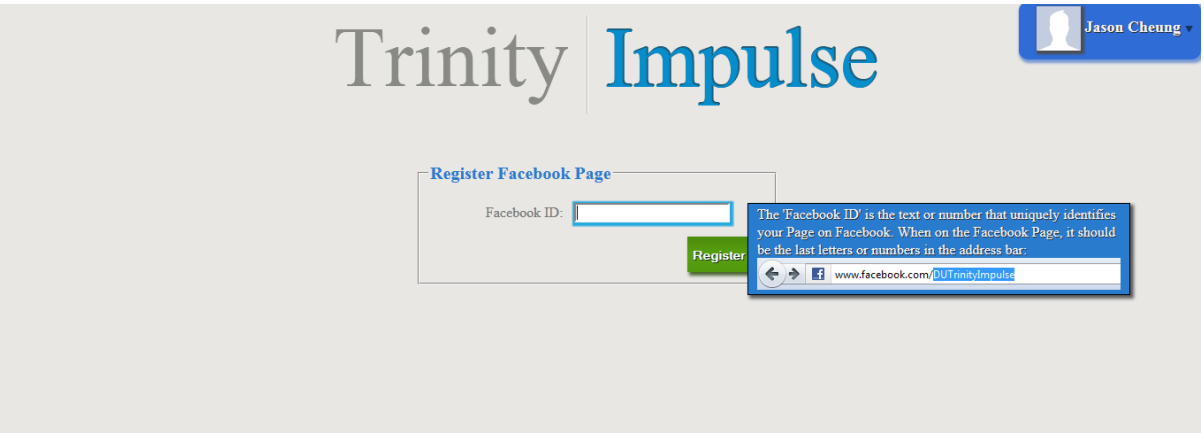


Figure 4.20: Organiser Trinity Impulse – Register 'Page'

After the organiser has registered, they are redirected to the home screen and presented with two options – register 'Page' and manage events. Clicking to manage events will incur a redirect to the home page, presenting an error message to inform that they have no events. First, the user must register a 'Page'. Figure 4.20 displays the screen where the user can register their 'Page'. To register a 'Page', the user must enter the 'Page's' unique Facebook 'Page' ID. On Facebook, when on the main page of the Facebook 'Page', the ID is the last character-set at the end of the URL. This is explained to the user by means of the blue pop-up label.

Facebook Scraper

Despite registering a Facebook 'Page', the events of the page will not immediately be present. The reason for this, is that the information was only entered into the database; it has not been retrieved from Facebook. This is the function of Facebook Scraper. It is a component in the system which is executed to retrieve events via the Facebook Graph API. It queries the database to obtain Facebook 'Page' IDs, and uses the IDs to request events from Facebook 'Pages'. If an event currently exists in the database, it is deleted and re-inserted to allow for updates from the Facebook event. This was a quick workaround, however, a real solution would search for the updated area, and replace it in the database.

Although not implemented, ideally the Facebook Scraper will be executed on a CRON task or similar scheduler. One issue with the Facebook Scraper, which is currently a bug recognised by Facebook, is that events can only be retrieved from Facebook 'Pages' which have their age restriction set to 'Anyone (13+)'. It is a permissions issue which incapacitates the Facebook Graph API.

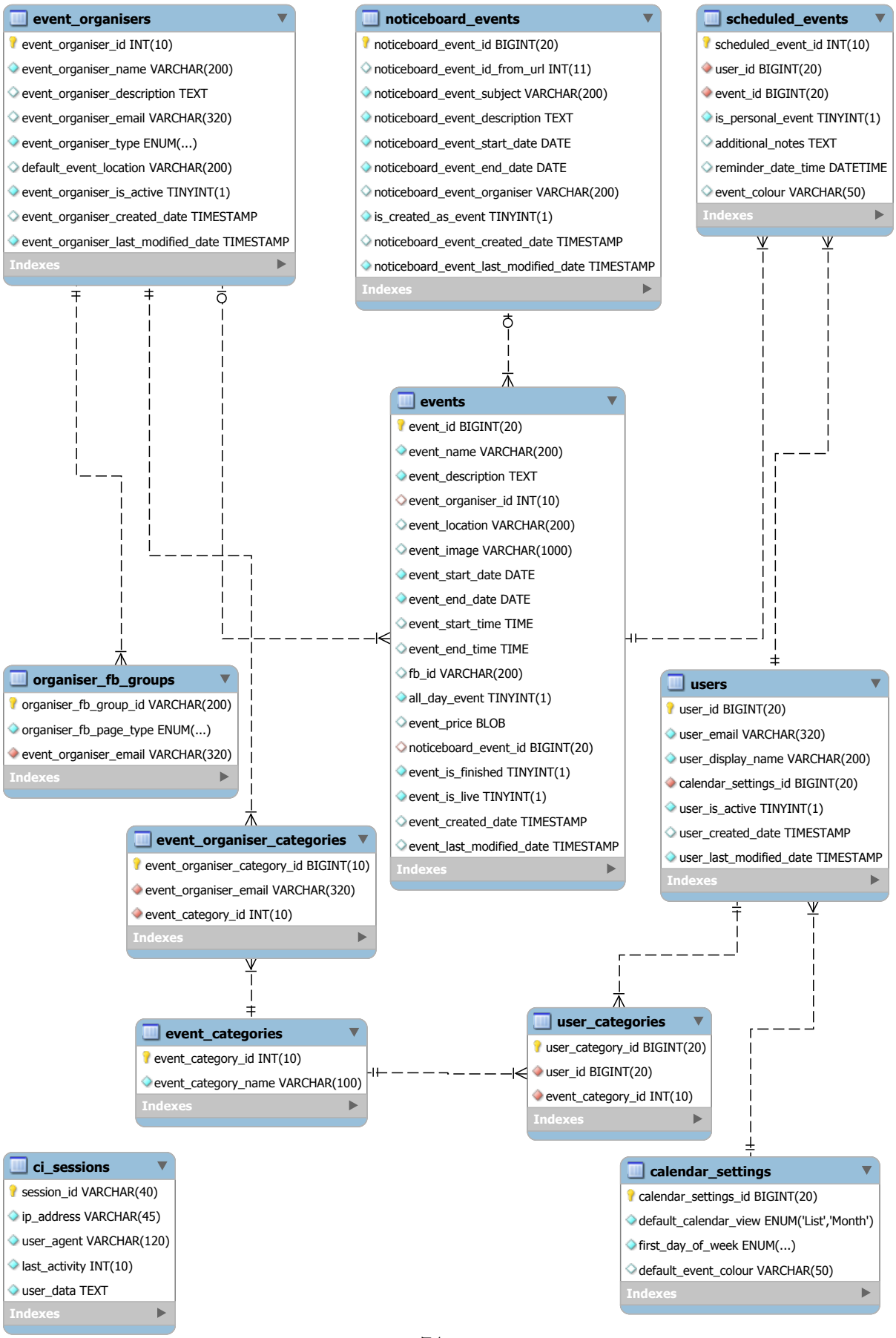
Manage Events

Figure 4.21: Organiser Trinity Impulse – Manage Events

The final piece of functionality on the organiser Trinity Impulse website is the 'manage events' page. Provided the events have been retrieved using the Facebook Scraper, the 'manage events' page shows all events from the organiser. Figure 4.21 shows the events owned by the organiser, which were retrieved from Facebook. Clicking on an event allows the organiser to view the full details, which are the details seen on the application. As mentioned previously, to update an event, the update is done on Facebook, and when the Facebook Scraper is run, the update is applied – or more accurately, the event is re-inserted. One issue arises with the Facebook integration – if an organiser deletes an event on Facebook, it is not deleted from the application. The manage events sections allows users to delete their events, and immediately have it removed from the application.

4.5.4 Database Schematic

After gaining extensive knowledge about the system functionality, the database schematic can be more easily understood, and may expose any unclear areas of the functionality. The following image provides the visual schematic of the database used for the entire system.


event_organisers
event_organiser_id INT(10)
event_organiser_name VARCHAR(200)
event_organiser_description TEXT
event_organiser_email VARCHAR(320)
event_organiser_type ENUM(...)
default_event_location VARCHAR(200)
event_organiser_is_active TINYINT(1)
event_organiser_created_date TIMESTAMP
event_organiser_last_modified_date TIMESTAMP
Indexes
noticeboard_events
noticeboard_event_id BIGINT(20)
noticeboard_event_id_from_url INT(11)
noticeboard_event_subject VARCHAR(200)
noticeboard_event_description TEXT
noticeboard_event_start_date DATE
noticeboard_event_end_date DATE
noticeboard_event_organiser VARCHAR(200)
is_created_as_event TINYINT(1)
noticeboard_event_created_date TIMESTAMP
noticeboard_event_last_modified_date TIMESTAMP
Indexes
scheduled_events
scheduled_event_id INT(10)
user_id BIGINT(20)
event_id BIGINT(20)
is_personal_event TINYINT(1)
additional_notes TEXT
reminder_date_time DATETIME
event_colour VARCHAR(50)
Indexes
events
event_id BIGINT(20)
event_name VARCHAR(200)
event_description TEXT
event_organiser_id INT(10)
event_location VARCHAR(200)
event_image VARCHAR(1000)
event_start_date DATE
event_end_date DATE
event_start_time TIME
event_end_time TIME
fb_id VARCHAR(200)
all_day_event TINYINT(1)
event_price BLOB
noticeboard_event_id BIGINT(20)
event_is_finished TINYINT(1)
event_is_live TINYINT(1)
event_created_date TIMESTAMP
event_last_modified_date TIMESTAMP
Indexes
organiser_fb_groups
organiser_fb_group_id VARCHAR(200)
organiser_fb_page_type ENUM(...)
event_organiser_email VARCHAR(320)
Indexes
users
user_id BIGINT(20)
user_email VARCHAR(320)
user_display_name VARCHAR(200)
calendar_settings_id BIGINT(20)
user_is_active TINYINT(1)
user_created_date TIMESTAMP
user_last_modified_date TIMESTAMP
Indexes
event_organiser_categories
event_organiser_category_id BIGINT(10)
event_organiser_email VARCHAR(320)
event_category_id INT(10)
Indexes
event_categories
event_category_id INT(10)
event_category_name VARCHAR(100)
Indexes
user_categories
user_category_id BIGINT(20)
user_id BIGINT(20)
event_category_id INT(10)
Indexes
ci_sessions
session_id VARCHAR(40)
ip_address VARCHAR(45)
user_agent VARCHAR(120)
last_activity INT(10)
user_data TEXT
Indexes
calendar_settings
calendar_settings_id BIGINT(20)
default_calendar_view ENUM('List','Month')
first_day_of_week ENUM(...)
default_event_colour VARCHAR(50)
Indexes

Database Tables

In this section, we will elaborate on the function of each database table, its containing fields, any constraints on those fields, and relationships between tables. Only ambiguous fields will be explained, as many of the fields are self-explanatory in nature. Commonly accessed fields were indexed to provide for faster querying.

noticeboard_events: This table stores all events which are parsed from the Trinity web noticeboard. *noticeboard_event_id_from_url* is a field which contains the unique ID of the noticeboard event. Mentioned previously, this is used to ensure no duplicate entries are inserted into the database. The *noticeboard_event_organiser* field stores the email address parsed from the web noticeboard. *is_created_as_event* is used to determine whether the noticeboard event has been converted to an application event. If the noticeboard events system's administrator deletes a converted event, the *is_created_as_event* field is re-set to *false*.

event_organisers: This table retains the information for all event organisers in the system – created both from the events noticeboard system, and the organiser Trinity Impulse website. An event organiser is uniquely defined by their *event_organiser_email*, meaning that two entries cannot exist in the database, having the same email address. The *event_organiser_type* field was explained in an earlier section to be the grouping which best describes the event organiser. It is an enum field so that it can be expanded upon easily. Moreover, the PHP code of the application dynamically retrieves these field values, so adding new *event_organiser_type* values can be done without the need to modify the PHP code.

event_categories: This table stores somewhat static data. These are the catagory values for the event organiser, and in turn, for each event. The *event_category_id* uniquely defines the entries, while the *event_category_name* holds its textual value. In the application we saw example values such as 'arts', 'drama', and 'leisure'. Entries which are added to the table, propagate through the system, similar to the way in which the *event_organiser_type* propagates. This is one of the tables which was constructed to normalise the database. Two tables have a relationship with this table – *user_categories* and *event_organiser_categories*.

event_organiser_categories: This table is a bridge between the *event_organisers* table and the *event_categories* table. It allows for the second normal form of database normalisation, whereby an *event_organiser* can own multiple *event_categories* in a separate table. The *event_organiser_email* field connects organisers to categories, using the *event_category_id*. This is a scalable and expandable solution, as categories can be associated to an event organiser by simply adding an entry into this table. A drawback

of this approach was the additional complexity when querying data. Multiple database *joins* were often required to retrieve a grouping of event organiser information. It incurs computational overhead.

organiser_fb_groups: This table is used when event organisers register their Facebook 'Pages'. The *organiser_fb_group_id* is entered by the user on the organiser Trinity Impulse website, and it is used to uniquely identify a database record. The *organiser_fb_page_type* is used to specify the type of page which contains the events. This field is available for future implementation. Initially, the specification of the application included event retrieval from Facebook 'Group' pages, however, a late realisation was made that it was not trivial to retrieve these events. It required a client-side access token, which is not accessible using the Facebook app.

events: As seen in the schematic, the *events* table is the centre of the database. It is used to store the data of all events which will display on the application. The *event_organiser_id* relates an event to an event organiser. Since an event organiser is required for an event to exist, rules are applied in the database to cascade the effects of deleting an event organiser. To elaborate, when an event organiser is deleted from the database, all events which were "owned" by that organiser, are consequently deleted.

The *event_image* field stores URL values. The application utilises the URLs to display event images using HTML. An alternative method to display images would be to serialise the image data and save it into the database as a binary large object (BLOB). However, using URL values saves memory in the database because image data are generally larger than string data. Furthermore, on a wider-scale, images could be stored and replicated across distributed servers, allowing users to access the nearest image to their location – similar to how the Google CDN distributes jQuery files.

The *fb_id* field is populated when an event has been sourced from Facebook. The ID allows the application to distinguish regular events from Facebook events – the latter of which provides additional functionality on the event details page.

The *noticeboard_event_id* indicates that the event was converted from a noticeboard event.

users: When a user logs in using their Facebook credentials, a user profile is created for them in this table. The initial login process informs users that their email address will be stored; however, no password information can be stored, as this information is delegated to the third-party Facebook authentication process. Each user is automatically assigned calendar settings, with default values. The *calendar_settings_id* links the user to their calendar settings. If a user is deleted from the database, their corresponding calendar settings are also removed.

The *user_is_active* field exists for future development. The purpose of the field, is to

allow users to "delete" their account, while still having the option to re-enable it. If this were implemented, it must follow the data protection act with respect to the acceptable duration of time for retaining user data.

user_categories: This table is similar to the *event_organiser_categories* table. It is not in use, but is available in order to implement a user preference system, whereby the user can choose which categories they favour, and the application can adjust to present events within these categories.

calendar_settings: This table allows users to have their own settings for their calendar. The *default_calendar_view* field lets users set the initial view for displaying saved events. The *first_day_of_week* field is not currently supported by the application, but will function to present the order of the calendar days, depending on this setting.

Another field which is not currently supported by the application is the *default_event_colour* field. Its purpose is purely aesthetic, allowing users to change the colour of their saved events in the calendar view.

ci_sessions: Lastly, this stand-alone table is used in conjunction with the CodeIgniter framework to manage user sessions through the database. CodeIgniter will automatically create, maintain, and purge these sessions by its own accord. The reason for delegating the session management to the database, rather than the standard protocol to use the browser, is due to its added security to the application [CodeIgniter User Guide, 2006]. If the browser's session ID does not match its corresponding session ID in the database, the session is destroyed – "otherwise, an old session could be restored by a user modifying their cookies" [CodeIgniter User Guide, 2006].

4.6 Summary

This chapter detailed the implementation of the proof of concept application. We began by conducting a comparative analysis of the possible application platforms. Next, the client-side and server-side programmings languages, used for the application, were elaborated on, including the reasons for choosing them. Then, a brief section provided a graphical insight into the architecture of the system and its interacting components. Finally, the functionality of the various parts of the system were explored for clarity – primarily, the main client-facing application, the noticeboard events system, the organiser Trinity Impulse, and the database schematic.

Notwithstanding, the explanation of the implementation of the system provided a detailed view of the way in which it functions. We saw that multiple event resources were utilised, and the method required for organisers to register their Facebook 'Pages'. This sufficiently prepares us to enter the test and evaluation section, which is chapter 5.

Chapter 5

Test and Evaluation

5.1 Introduction

The Trinity Impulse application is fully implemented. Many of the necessary functional requirements for the application have been integrated, and the application can be hosted online. Now that the proof of concept is in place, we are in position to test and evaluate the hypotheses of this dissertation. The main goals, as outlined in chapter 1, are:

- to broaden students' awareness of campus events and supports;
- for students to engage more with their college environment by attending events more frequently;
- for the application to be accessible;
- for the application to be usable;
- and for the application to be used on a frequent basis.

In this chapter, the aim is to successfully prove the hypotheses, and accomplish the goals. First, the process of creating an appropriate test will be established. Next, the gathering of participants, the test process, and data collation will be explained. Finally, an analysis and evaluation of the test data will be done to convey the results, and whether they aligned to prove the hypotheses and goals.

5.2 Test Establishment

Since the proof of concept for the dissertation is to use a mobile web application, it is imperative to construct a test which is appropriate to gather the desired feedback. In this case, the primary goal is to broaden students' awareness of events by means of the application. We look to gain an insight into whether an event aggregation system can

successfully achieve the goal. With this research, we hypothesise that the application can successfully further student engagement with campus events and transitively, the college environment. This binds a requirement for the test to extract specific data in order to prove hypotheses and goals.

It was decided that a task-based analysis was necessary, whereby a participant would be asked to complete a list of tasks on the application. The list of tasks were to be basic, and must incorporate the common tasks that a user would do on such an application. This testing approach gently allows participants to familiarise themselves with the application, while having a set of objectives to complete. For evaluation, a task-based test can capture the usability element of the application, using the methods: time on task; direct observation; and the think-aloud protocol. A mixture of approaches were used to avoid biases from any single approach.

Time on task involves measuring the time it takes for a participant to complete the tasks listed on the sheet.

Direct observation involves monitoring the participant's actions and vocal utterances. This approach is effective when used with the think-aloud protocol.

The think-aloud protocol involves asking participants to speak out loud about what they are thinking. The reason for asking a participant to think aloud is that they may stare at the screen for a long period of time, without interacting with the application [Rogers *et al.*, 2011]. In that time, evaluators are unsure as to what the participant is thinking. They may have become confused by a feature that is genuinely confusing to the general audience, but the evaluator would not know that it is a problem. If the participant vocally informs the evaluator that they are confused by a feature, then the evaluator can document the issue. The think-aloud protocol may negatively affect the time on task measurements because a participant may not cognitively perform as fast when also asked to verbalise their thoughts [Rogers *et al.*, 2011].

After the participants have completed the task set, they were asked to complete a questionnaire. The questionnaire was used to gain quantitative and qualitative data. This is necessary for several reasons: we can determine if the participant found the application usable by asking questions about the difficulty of tasks and their understanding of the application; and we can correlate the participant's regular abilities on applications, with their experience on the application and their questionnaire answers. For example, a participant who infrequently uses technology, may produce obscure results which do not align with the results from the general demographic. These obscure results can greatly affect the mean time and standard deviation, when dealing with a small sample of participants. This information can be found by asking background questions regarding their experience with technology. Last, the primary reason for using a questionnaire, is to ensure that the

hypotheses and goals of the research have a defined conclusion. Specific questions can be asked to extrapolate the answers to the research questions and goals.

5.3 Test Process

Having the structure of the evaluation complete, the testing was able to begin. An outline of the test process was as such: participants were asked to complete an ethics form to ensure anonymity and data protection; they were then asked to complete the task set and think-aloud; finally, they were asked to complete the questionnaire.

5.3.1 Participant Selection

Participants were selected on the basis of availability. Rather than probability sampling, participants were a convenience sample. This means that the participants were not selected based on specific qualities or attributes. The ideal sample group would be formed purely from new entrants to the college. However, with the lack of accessibility to these resources, participant availability was more of a concern. The chosen method of non-probability sampling is not as robust as probability sampling [Rogers *et al.*, 2011].

At the beginning of the research, I had joined and befriended the majority of Facebook 'Pages' managed by societies. To gather participants, I sent a message to each society on my Facebook list, to request participation. Several of the societies responded, which led to them participating in the testing. Emails were sent to the Central Societies Committee, the Student Union, Student2Student, and Dublin University Central Athletics Club. Some participants were sourced from those organisations. The organisations forwarded emails to relevant people who may be interested in participating. The final group of students who agreed to participate in testing were from Dublin Business School (DBS). One participant is a previous college associate, and the other three participants were his current DBS classmates, whom I had never met.

Altogether, twelve participants were gathered. More people asked to participate but due to time restrictions and their late responses, they did not participate. Also, some researchers argue that no more participants are required after the overall impression of the testing has converged [Rogers *et al.*, 2011]. Put simply, the testing phase can end when you are no longer gaining new insight with the testing.

5.3.2 Test Execution

The participant tests were held over a one week period, in different rooms on and off campus. The setting was private and quiet. Participants were asked to read and sign ethics

forms. They were then asked if they had any questions regarding the forms, and it was ensured that they fully understood their rights. A one-page debriefing form was provided to each participant which explained basic information about the application. Participants were asked if they were comfortable with being timed and thinking aloud; no participants had any issues with either. They were then presented with the nine tasks and asked to complete them in their own time. The participants used a Samsung Galaxy S3 mobile device and its native browser to interact with the application. This was so all participants had the same experience of the application, and processing speeds were similar. Each task was timed from the moment they began reading the task description. The reason for timing them from the beginning of their reading, instead of the moment they touch the screen, is because participants have different techniques for completing the tasks – some may read the full task description and then interact with the application, while others may read the task description and interact with the application simultaneously. During the task-based testing, notes were taken to document the information retrieved from the think-aloud protocol and direct observation. After the task-based testing, the questionnaire was handed to the participants. Upon completing the questionnaire, participants were thanked for their participation.

5.4 Evaluation

In chapter 1, the primary aim of this research was conveyed. The aim is to broaden students' awareness of events and supports. Several additional aims are included but cannot be statistically proven within the scope of this research, and can only be evaluated through user feedback. These goals include:

- identifying the amount of users who have the technology available to access this application;
- determining that the application is usable and effective;
- determining if users would use this application on a frequent basis;
- and determining if using the application would increase users' attendance to events.

In this section, we will analyse and evaluate the data that were retrieved from the user testing. We begin by studying the data from the task-based test, then evaluate the questionnaire data.

5.4.1 Task-Based Test

The task-based test consisted of nine tasks for participants to complete. The list of tasks was created based on the most likely used functionality in the application. Despite initially

having twelve participants, two participants were excluded due to a late revision of the task list. For our evaluation, data were analysed from ten of the participants. All tasks were one-hundred percent completed by all participants. Participants were assisted only when they were completely unable to proceed with the task, and assistance involved me reading the task description, putting emphasis on specific words, important to completing the task.

Presented in Table 5.1, is the list of tasks which participants were asked to complete. The corresponding mean times, standard deviation times, and clicks to complete each task are shown.

No.	**Task**	**Mean**	**Std. Dev.**	**Clicks**
1	You want to view the full details of any upcoming event on the home/main page.	18.8s	15.9s	1
2	You want to view events with the organiser: 'Noticeboard'.	26.8s	22.5s	2
3	You want to view all events and filter the list of events by the category: 'Leisure'.	38s	18.6s	5
4	Using the 'Search' function, you want to find the event titled 'The Great Ape Run'.	25.8s	16.8s	4
5	You want to see who is attending the event: 'The Great Ape Run'. Within the details of that event, you can choose to see who is attending.	16.8s	14.2s	2
6	You want to log in with Facebook so that you can save 'The Great Ape Run' to your personal calendar.	33.2s	12.7s	3
7	You want to view that saved event in your personal calendar.	43.6s	33.4s	3
8	Now that you have seen it in the calendar view, you want to see the saved events in the 'list view'.	5.2s	3.9s	1
9	You want to change the settings of your saved events so that the default view is 'List View'. View your saved events again to verify that it goes directly to the list view.	38.3s	20s	6

Table 5.1: List of Tasks

Mean Times

Immediately, we can see that every task was completed in less than one minute, on average. There are no standards set to determine which times are seen to be "fast" – in terms of how quickly the participant completed each task – however, a mean time of less than one minute can be considered not to be an excessive amount of time. This is also true when considering that this was the first time the participants had seen the application, and were not given time at the beginning to browse the application. It was evident from direct observation and in the mean time for Task 1, that participants took time to adjust to the newly seen interface – it took 18.8 seconds on average for the one-click task to be completed. Also, one participant commented that she was trying to get familiar with the first-time view of the interface. This may present an issue with the interface, which addresses the cognitive load required to absorb its information. A future comparative analysis could be done to gauge the speed of comprehension, of different presentation techniques.

Some participants misinterpreted the wording of tasks. For example, Task 5 says that "within the details of that event, you can choose to see who is attending"; some participants were scanning through the event's description to see a list of people attending. The misinterpretation of the task goal, led to longer completion times. Similarly, in Task 1, some participants thought the brief summary of the upcoming events were the "full details". This may have been more of a mistake in the chosen wording of the task descriptions, rather than participant misunderstanding.

One observed factor which also lengthened the mean time was the ability for participants to interact with the smartphone. In the extreme case, one participant had never used a touchscreen phone before, and was unfamiliar with its interactions – in particular, the participant was pressing the screen as if it was a physical button. The intention was to tap the screen swiftly, however, the phone was interpreting the action as if the participant was holding down the screen. Also, the participant used a large amount of the surface of the finger to tap options. This led to multiple buttons being pressed at once. The issue brings attention to the size of components on-screen. Further study is required to determine if the interface components need size or spacing adjustment.

In Task 7, participants were asked to view a previously saved event in the calendar. Due to the task-based nature of the test, participants had not taken note of the date for the saved event. When they opened the calendar view, they were unsure which date to click, to view the event. This opened an issue in the interface design. Although there was a way to indicate that an event was saved, there was no way to immediately see what events were saved on which days. Future development should take this into account.

Using the think-aloud protocol, information was gathered with regards to the participants' understanding of the interface. After the previously mentioned issue with the unlabelled calendar events, the most noticeable issue with the interface, was with the category and month filters on the event listing page. In this interaction, the user must select the filter criteria and then click the green 'Apply Filter' button. Many participants failed to click the button, and idly sat waiting for the page filter to be applied. The reason for the failure was later discovered. In Task 2, participants were asked to view events by an organiser, which entails selecting an option from the drop-down list, which immediately directed them to their intended page. With the filter task, participants were required to select the option from the drop-down list, and perform an extra step, which was clicking the 'Apply Filter' button. The design rationale was that a user may want to apply a filter by category and month simultaneously – so having the page arrange the events upon selection of the drop-down list option, may have been cumbersome to those users, as they would have to wait for the page to reload before applying the second filter. Further research over a long-term would be required to determine whether users would more frequently filter by one filter or both, and the implementation could be modified to suit. After questioning, participants were asked if they were expecting to see the page change immediately after choosing a filter option – they agreed that this was the case. One participant made a comment that she did not understand the button because she would have expected it to read 'Apply', and she did not see it because it was coloured green, whereas the rest of the interface sections were mainly coloured blue. Initially, the design choice for the button colour to be green, was to emphasise its existence, and to hopefully make it stand out from the background [Hamill, 2009]. The participant's comment assumed that the opposite was true. She claims that the button was not visible to her immediately. Future tests could be done to determine the visibility of the button, using eye-tracking equipment.

Standard Deviation Times

With a relatively low sample of participants, the mean times and standard deviations were quite sensitive to any events that were greatly varied from the mean. The standard deviations of the tasks were relatively high with respect to the mean times. There was no outstanding pattern to be seen from the data to explain the high numbers for the standard deviation times. Thus, some participants were better at specific tasks than others participants, and conversely, some participants were worse than other participants.

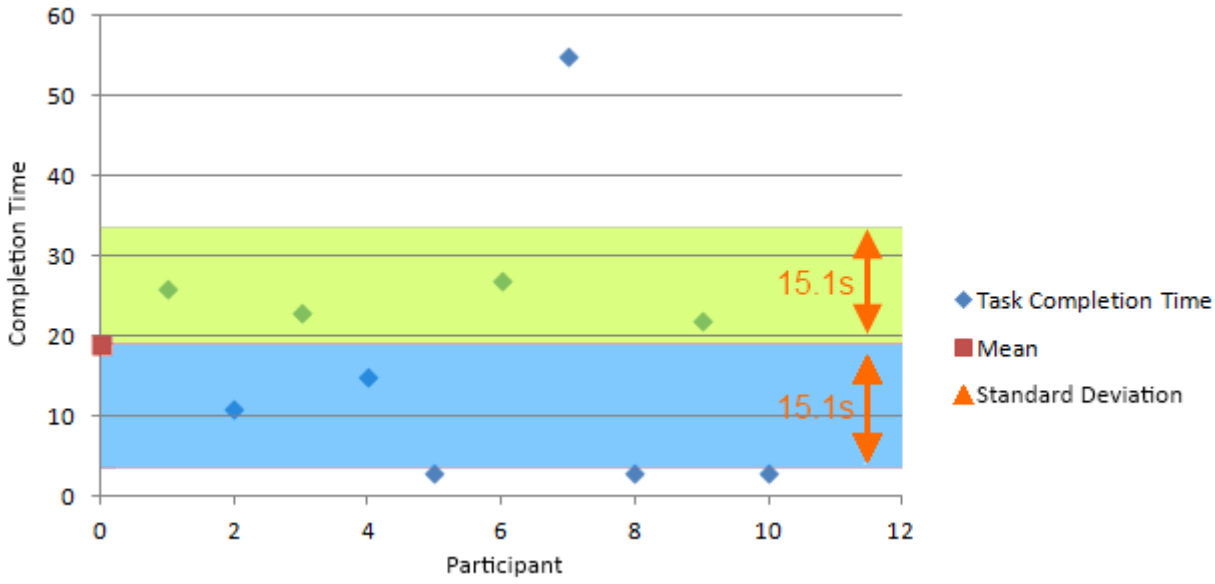


Figure 5.1: Task 1 – Standard Deviation

In Task 1, the mean time for participants to complete the task was 18.8 seconds. This is represented in Figure 5.1 as a maroon-coloured square. The standard deviation from the mean is shown by the height of green and blue regions. It was 15.1 seconds. This provides a loose measurement of "slow" and "fast" times for completing the task. Figure 5.1 shows that six participant times lie within the coloured regions. These participants are within the average range of time to complete the task. Three participants completed the task in 3 seconds, and are seen to have completed the task in a quick time because they are not within the coloured regions. One participant can be seen situated far from the coloured regions with a task completion time of 55 seconds. This participant's time is seen to be slow. During the participant's task, he navigated to the wrong page, unsure of which page was the home page. This was a misunderstanding of the terminology used in the task description. It read 'You want to view the full details of any upcoming event on the home/main page'. The participant immediately went searching for the home page, without realising that he was currently on the home page. Although this was a once-off occurrence, perhaps the design of the application requires revision. There is no indicator to announce which page is the home page.

All results for the standard deviation times showed a similar plot, varying by one or two participants each way.

Additional Information

At the bottom of the task sheet, participants were told that they could now take the opportunity to freely browse the application before continuing. Nine of the ten participants browsed the application out of their own free will. This conveyed that the participants had a genuine interest in the application.

5.4.2 Questionnaire Analysis

After participants had finished browsing the application, they were asked to complete a questionnaire comprised of twenty-nine questions. The questionnaire was structured beginning with eight gentle background information questions, followed by eighteen more probing questions, and finally, three open-ended questions. Asking background information questions allows responses to be put into context [Rogers *et al.*, 2011]. This point was expanded on earlier in the chapter, where we spoke of the participant's technical background, and what it ensues in relation to the gathered results.

Open-ended questions were included in the questionnaire to gain qualitative data. Participants were provided with an area to communicate their thoughts and emotions without restriction.

Twenty-one of the questions on the questionnaire were five-point Likert-type scale questions. The Likert scale allows for quantitative feedback – measuring student satisfaction. Choosing five points for the Likert scale seemed sufficient, as a more granular scale (e.g. seven-point) would not have provided any additional, valuable information.

The questions were divided into four sections: participant background information; application experience; application influence; and uncategorised open-ended questions. Participant background information included questions regarding participants' details, and familiarity with mobile applications and websites. Application experience asked questions which focused on the effectiveness and usability of the application. These questions intended to gain data on participant satisfaction and ease of interaction with the application. Some of the questions were sourced from an online usability questionnaire template [Borysowich, 2007]. Application influence questions were asked to determine the effects of using the application. These questions were imperative to the research, as the hypotheses and goals were dependent on the responses. Lastly, the open-ended questions served to gain an insight into the likability of the application, what improvements could be made, and any additional comments. The improvements that were suggested by participants can be brought forward into the future work of the application. This section chronologically evaluates the questionnaire responses, with thorough analysis presented on questions which are paramount to the research.

Participant Background Information Questions

The demographic information is as follows:

- Gender: six male; four female.
- Student: nine students – four of which are from Trinity College Dublin; one non-student.

One question asked participants which smartphone model they owned. This question was included in the questionnaire to gain a perspective on the penetration of smartphones in the student population. Eight out of ten participants owned a smartphone; thus, eight out of ten participants would have access to the application if it was available live.

Question	**Several times a day**	**Once a day**	**Several times a week**	**Once a week**	**Once a month or less**
Q3a. I use Apps or browse websites on my smartphone	7	-	-	1	-
Q4. I browse events online	1	3	1	3	2
Q5. I attend events	-	1	2	1	6

Table 5.2: Participant Background Information

Table 5.2 provides the five-point Likert scale responses to three background questions. In Q3a, we can see that seven out of eight participants with smartphones use their phones for apps and websites several times per day. From this data, it is apparent that participants are familiar with interacting with smartphone functionality. Q4 shows a dispersion of participants' browsing of events. Q5 presents interesting information regarding the participants' attendance to events. Six out of ten participants go to events only "once a month or less". This evidence strongly coincides with the research from [Kuh *et al.*, 2006], which explains that few people attend co-curricular events.

Participant Experience Questions

Question	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Q6. I feel that I successfully completed each task	7	3	-	-	-
Q7. The menu items were well organised and the functions were easy to find	7	3	-	-	-
Q8. I immediately understood the function of each menu item	5	4	1	-	-
Q9. It was easy to find upcoming events	8	2	-	-	-
Q10. It was easy to find events by an organiser	6	4	-	-	-
Q11. It was easy to find events in a category	7	3	-	-	-
Q12. It was easy to use the 'search' function	8	1	1	-	-
Q13. It was easy to view people attending	6	4	-	-	-
Q14. It was easy to save an event	7	3	-	-	-
Q15. It was easy to view saved events	5	5	-	-	-
Q16. It was easy to change the settings	5	5	-	-	-

Table 5.3: Participant Experience Questions

Table 5.3 presents data related to the usability of the application. All participants completed each task successfully, and we see from Q6 that they agree they were successful in completing the tasks. The high rate of successful completion and the participants' confidence in their completion, demonstrates the effectiveness of the application. The remainder of the questions targeted specific functionality, and their ease of completion. The table shows that for all functions, participants agreed that the function was easy to use, with more in general, strongly agreeing with their ease of use. Q8 and Q12 each have one response with a neutral opinion. The participant who responded with "neutral" for

Q8 was the participant who had never used a touchscreen phone. The lack of familiarity with mobile websites and apps may have been the reason that he was neutral to immediately understanding the function of each menu item. With regard to Q12, the participant mentioned that he was expecting the search function to be at the top of the page, rather than as a separate list option. The former, is a frequent location for the search option to appear. The design of this function should be analysed to determine which is the more likely location of the function, as seen by users.

Application Influence Questions

The questions in this section are composed to gauge the effects the application have on the participants. The responses to these questions are key to this research, and envelop the purpose of the dissertation. A chart representation of the data is provided for these questions, to emphasise their importance. In chapter 1, the hypothesis was made that event aggregation, with ease of access, will broaden students' awareness of events and supports. Thus far, we know that smartphone browsers can access the application, and that there is a high rate of smartphone penetration. In addition, participants found the application easy to use, and performed well when asked to complete tasks. The remaining question is whether the application increased participants' awareness of events. Figure 5.2 displays the responses to this question.

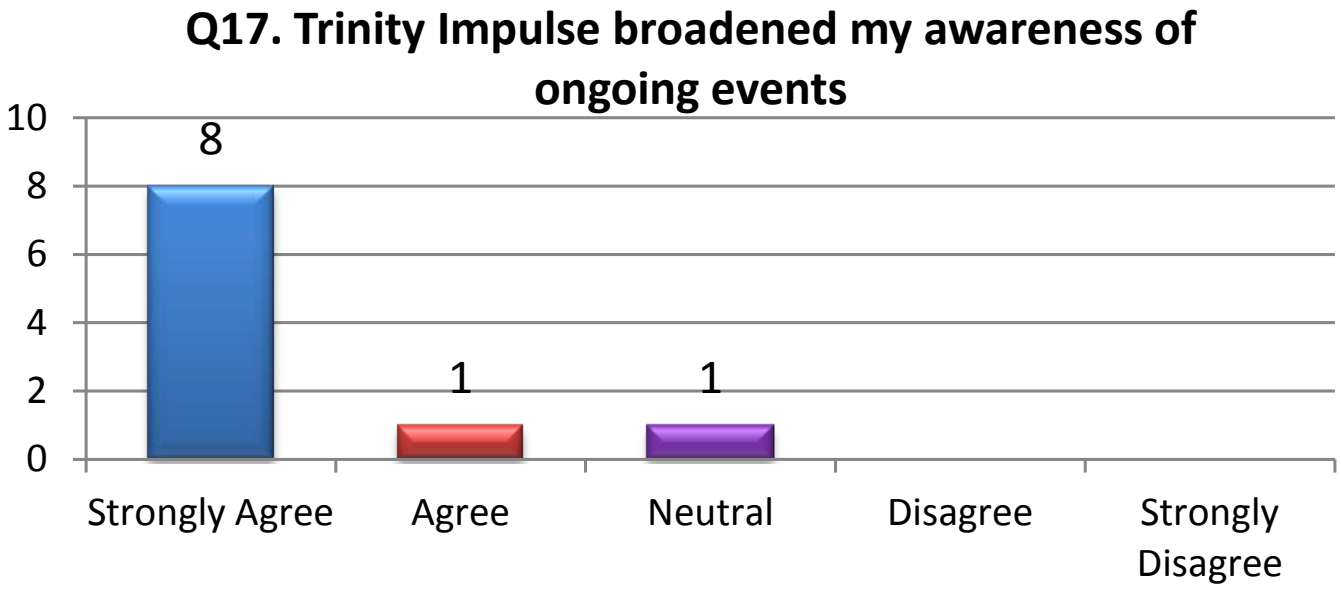


Figure 5.2: Q17. Results

As we can see, eight in ten participants strongly agreed that the application increased their awareness of events. One participant also agreed, while one participant was neutral

about the statement. In light of this information, we can conclude that the research has successfully achieved its aim to broaden students' awareness of events.

We have accomplished the primary objective of this research, however, further questions were constructed to explore other effects of the application. These bind to the secondary aims mentioned in chapter 1.

Question	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
Q18. I would use Trinity Impulse again	7	3	-	-	-
Q19. I would use Trinity Impulse frequently	6	2	2	-	-
Q20. I enjoyed using Trinity Impulse	7	3	-	-	-

Table 5.4: Participant Attachment

Table 5.4 shows the results which relate to the participants' attachment to and potential continual use of the application. All participants agreed that they would use the application again, with eight in ten agreeing that they would use it on a frequent basis. Two participants said they were "neutral" when asked if they would use the application frequently. They did, however, agree that they would use the application at least one more time, since they both responded with "agree" to Q18. In Q20, the same two participants said that they enjoyed using the application, along with the remaining eight participants.

Q4 asked participants how often they browse events online. Q19 asks participants if they would frequently use the application. These questions are connected, in the way that frequently using the application entails frequently browsing events. In Table 5.5, we can see each participants' response to Q4 and Q19.

Participant	Q4. Browse events online	Q19. Use application frequently
P1	Once per month or less	Strongly agree
P2	Once per week	Agree
P3	Once per day	Strongly agree
P4	Several times per day	Strongly agree
P5	Once per week	Neutral
P6	Once per day	Neutral
P7	Several times per week	Strongly agree
P8	Once per month or less	Agree
P9	Once per day	Strongly agree
P10	Once per week	Strongly agree

Table 5.5: Likert Scale Correlation between Q4 and Q19

The substantial finding from these data, is that many of the participants who infrequently browse events online say that they would frequently use the application – which in turn, means they would frequently browse events using the application. Two exceptions appear in the data – participants P5 and P6 are neutral to the idea of frequently using the application. No information was found to expand on their opinion. A drawback of this comparison is that the word "frequently" is undefined. It may be equivalent to once per day, or even several times per week. Regardless, eight in ten participants say they would use the application continually.

Question	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Q20. I enjoyed using Trinity Impulse	7	3	-	-	-

Table 5.6: Q20. Enjoyed using Application

Table 5.6 shows the number of participants who enjoyed using the application. All participants enjoyed the experience, with seven of the ten strongly agreeing with the statement. This adds to the notion of user satisfaction.

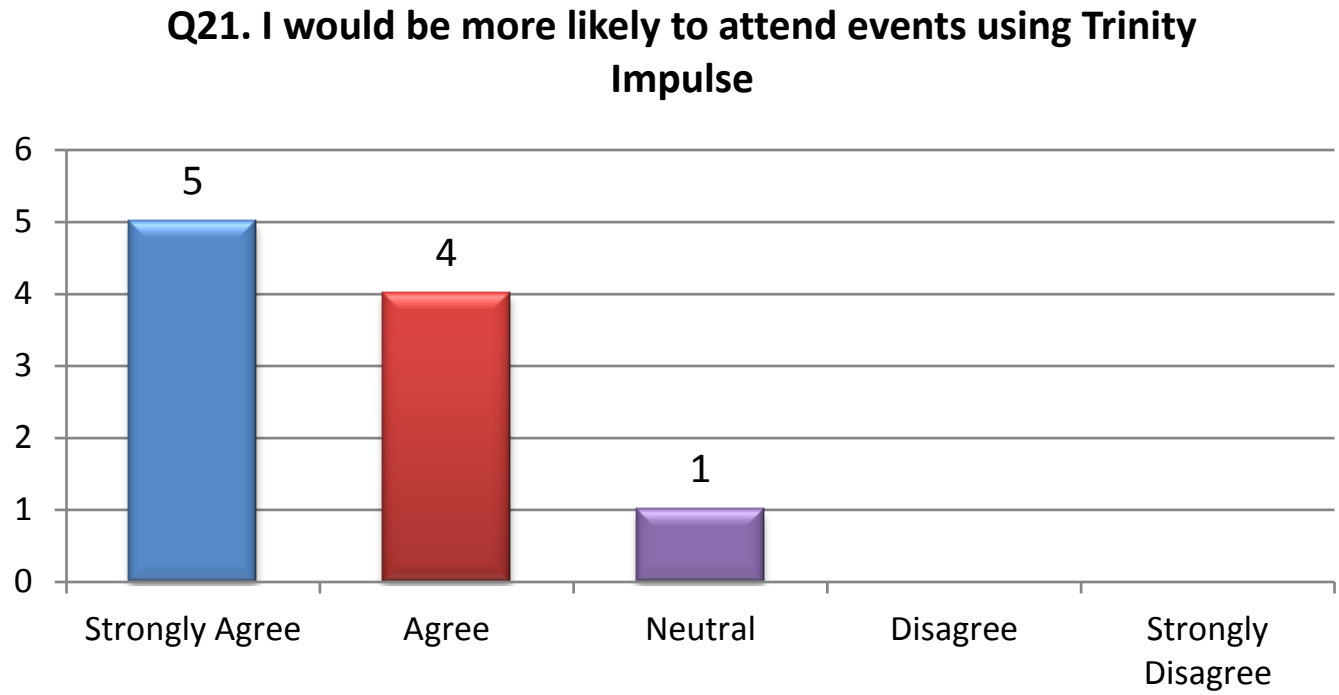


Figure 5.3: Q21. Results

Figure 5.3 reveals the number of participants who are more likely to attend events with use of the application. Nine in ten participants agree that they would be more likely to attend events after using the application, with five of those participants strongly agreeing with the statement. The one participant who was neutral to the statement, mentioned in Q5, that she attends events several times per week – she is already very engaged with the college environment.

We strongly link Q21 with Q5, as it shows the affect imposed by the application, on the participants. Initially, in Q5, participants were asked how often they attend events, whilst in Q21, they are asked if they would attend events more frequently while using the application.

Participant	Q5. Attend events	Q21. Attend while using application
P1	Once per month or less	Strongly agree
P2	Once per month or less	Agree
P3	Once per day	Agree
P4	Once per month or less	Strongly agree
P5	Once per month or less	Strongly agree
P6	Once per month or less	Strongly agree
P7	Several times per week	Strongly agree
P8	Once per week	Agree
P9	Several times per week	Neutral
P10	Once per month or less	Agree

Table 5.7: Likert Scale Correlation between Q5 and Q21

In Table 5.7, we see that six participants attend events only once per month or less. Those same participants, agreed or strongly agreed that they would be more likely to attend events while using the application. This is a significant discovery. Although we cannot truly say they would attend events more frequently while using the application, they inform us that they would be more likely to attend. Notwithstanding, the data tell us that all participants would attend more frequently, except for the aforementioned participant who already frequently attends events.

Question	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Q22. I would be more likely to attend events if I knew who is attending	5	3	2	-	-
Q23. I would be more likely to attend events if I could save events to a personal calendar	5	5	-	-	-

Table 5.8: Features to Influence Attendance

The following two questions focus on the influence of specific application features, to encourage students to attend events. We see in Table 5.8, that participants say they are more likely to attend events if they have certain features to use in an application. Q22 shows that eight in ten would be more likely to attend events if they knew who was attending – five of which had strongly agreed. These findings may coincide with the findings in the research by [Barkhuus & Tashiro, 2010], whereby a person said they

would attend an event if they knew their friend was also attending. Two participants were neutral to the statement; one participant did not mention a reason, but the other participant said that she often enjoys attending events where she does not know anybody, as she enjoys meeting new people. Another participant mentioned that she may not attend an event if she saw specific people attending. This is another side to the functionality, which can be useful, but would deter the participant from attending the event.

Q23 shows that all participants would be more likely to attend events, if provided with the functionality to save events; one half of the participants strongly agreed.

Open-Ended Questions

The final questions of the questionnaire provided a space for participants to share their personal opinions and emotions regarding the application. Some participants had a strong opinion, and contributed numerous thoughts to each question; other participants were less involved. Table 5.9 displays the list of open-ended questions.

Question
Q24. Is there any function of Trinity Impulse that you liked or found particularly useful?
Q25. What improvements would you like to see in Trinity Impulse?
Q26. Addition comments

Table 5.9: Open-Ended Questions

Several of the participants found the same functionality useful. Table 5.10 is comprised of a list of the participant responses, and the number of participants who mentioned the function, in a positive way (Q24).

Q24. Liked and useful functionality – responses	No. of participants
Login with Facebook	1
List view of events	2
User friendly	2
Clear and concise pages	1
See who's attending	2
Home page contents	3
Saved events	2
Event categories	1
Ability to see today's events	1

Table 5.10: Q24. Liked and Useful Functionality

For Q25, participants were asked if they would like to see any improvements, and what those improvements would be. The responses are shown in Table 5.11. These improvements will be explored in the 'Future Work' section of the next chapter.

Q25. Application improvements – responses	No. of participants
Synchronise calendar with external calendar	2
Display the number of people who viewed the events	1
View all events in calendar view	1
Larger on-screen touch areas	1
Implementation as a native app	1
Click to attend an event, which updates personal Facebook	1
Twitter integration	1

Table 5.11: Q25. Application Improvements

Finally, Q26 has no objective except for participants to provide additional comments. Again, many of the responses were similar to other participants's responses. Table 5.12 shows the information that participants volunteered.

Q26. Comments	No. of participants
Application was user friendly	3
Excellent event calendar	1
Easy to maintain	1
Well designed interface	1
[Wants to have functionality] to share events to Facebook 'wall'	1
Never used touchscreen phone causing slowness and nervousness in case of damage to phone	1
Could be really useful in first year	1
'Apply Filter' could be better if it just said 'Apply', and if it looked more like a button	1
Great app	1
Definitely would use [the application]	1
Currently save drafts of text messages to remind myself of events. Sometimes they get accidentally deleted. This application proves to be convenient	2

Table 5.12: Q26. Additional Comments

5.5 Summary

In this chapter, we discussed the tests and evaluation of the proof of concept application. The aims of the research were reiterated from chapter 1, and goals were set to produce real feedback from the use of the application. First, an explanation was given which detailed the process of constructing an appropriate test model. The participant selection method was outlined, as well as the reasoning for the types of evaluation techniques used – namely, task-based analysis, time on task, the think-aloud protocol, direct observation, and questionnaire feedback. Questionnaire responses were conveyed and analysed, gaining qualitative and quantitative feedback.

In essence, this chapter was imperative to the research, as all hypotheses were challenged, and brought to a confident conclusion. From participant feedback, we learned that the application was successful in broadening students' awareness of events, and that it was likely to increase student engagement with the campus, while participants enjoyed the experience of using the application.

Chapter 6

Conclusion and Future Work

6.1 Conclusion

This dissertation put forth the aim to broaden students' awareness of campus events and supports. An application was developed as a novel proof of concept application, which allowed for an exploration of the design space for increasing user engagement, amongst others. This prototype provided a medium to gain user and stakeholder feedback, for such an event system. It serves to aggregate events from current college event sources, and new sources – primarily, Facebook. This Facebook integration provides a flexible, unlimited, and scalable platform for event collation. A powerful characteristic of the application is its potential ability to integrate into any campus environment, allowing institutions to gain its inherent benefits. The evaluation of participant feedback confirmed that the application was successful in its aim. Moreover, participants enjoyed using the application, and agreed that they would be more likely to attend events while using the application. The implications of which, lead to a greater probability of student engagement with the college environment; thus, increasing the likelihood of student retention, as was discovered in the literature.

Notwithstanding, this application is only a proof of concept. Further research is required to determine its effectiveness as a real-world application, that is integrated into the college structure. It is possible that a live implementation will not gain the intended results, as were acquired from the evaluation. Nevertheless, should the live implementation achieve similar results, we must consider the underpinning significance of the application. Its deployment could see increases in student retention rates on a grander scale. It can be included as one, of the many current approaches, to strive toward higher attainment of degree completion.

6.2 Future Work

Throughout the research, several ideas have emerged from the literature, and also from participant feedback. Mostly, these are future implementation features and functionality. Participants were vibrant with new feature ideas. This section allows us to explore these additional approaches, and to discuss their potential benefits.

6.2.1 Student Engagement and Retention Research

Additional research can be done after allowing all students to access the application and effectively "going live". Societies and other event organisers can compare empirical attendance data, to attendance data after the application's implementation. Thus, we can determine if the application truly led to greater student engagement.

After some time, if student engagement increases, prior data on retention rates can be compared to retention rates at the time, in order to decide if the application's success was a factor in increasing retention rates.

6.2.2 Usability Research

Several participants in testing, reported usability issues, either in the open-ended questions or during the think-aloud protocol. Examples of the issues included: inability to see the green 'search' button; unawareness of the ability for the profile heading to expand; and small touchscreen surfaces. This may be evidence that an interface redesign is required, and should be evaluated and compared against the current interface. In this case, time on task measurements will hold purpose, as a direct time comparison can be done to see which interface is faster to use, to complete the same tasks.

6.2.3 Platform Research

Presented in chapter 4, was a brief overview of the attributes relating to different mobile platforms. Implementing a dedicated web app, thus far, seems to hold no added value to the current approach. However, benefits were mentioned with the implementation of native apps and hybrid apps – in particular, native hardware accessibility. Further research is required to identify the most advantageous development, with respect to native apps versus hybrid apps. Also, a desktop-tailored website should be created.

6.2.4 Creative Interfaces

In chapter 2, the state of the art research explored several interface designs. Amongst them were visual, audio, and haptic. One feature that was strongly emphasised by participants and in this dissertation, is the inclusion of an interactive map. The map could pair with GPS technology – which has a standards specification [W3C, 2012] – to identify the user's location. Then, users could be directed through the campus to the event venues. A map representation of events could be displayed, whereby users can set a time for the events they want to see, and the map will display all buildings with events scheduled for that time.

A conclusion was made in chapter 2, which agreed that there are advantages to interfaces that are not visual. Tactile and audio interfaces can be utilised effectively. Assuming an app is a developed, an envisioned idea presents a context-aware setting, which will vibrate, and play sound to tactilely and aurally inform users that they are passing a venue where an event of interest is scheduled to begin. A non-context-aware approach could allow users to subscribe to organisers or event categories, so if a new event appears with either, the user is notified by email, sound, or device vibration.

6.2.5 Saved Events

Participants in testing found that saving events was a useful feature in the application. However, one problem arose, where participants wanted to find an event in their calendar, but did not know the date it was scheduled for. The current application lacks visibility when viewing the calendar of saved events. Event titles should be added to the calendar days to hint to the user, what event is saved on that day.

An issue was found with the removal of events from users' saved events – there is no function to mass-remove events. This was not mentioned by any participants. If a participant was asked to test the application over an extended period of time, and asked to log entries in a diary, they may have encountered the functional drawback. This highlights the significance of indirect observation.

One participant explained that he would like to access all events, in a calendar view. This was overlooked in the initial requirements but is seen to be a useful feature.

Several participants mentioned that they would like to synchronise the saved events with an external calendar system. This would allow users to have the saved events in their personal calendar system, which could be more successful for reminding users that an event is scheduled, as they are more likely to check their personal calendar system.

A personal idea for the saved events system, is for Facebook logged-in users to be able to share a public or invitation-only version of their saved events. With this, the friends of

the user can view their events, and will be more encouraged to attend the events. Issues concerning privacy should be addressed when considering the inclusion of this feature.

6.2.6 Event Details

The detail and functionality in the event details page can be enhanced. For instance, a comment section could be added to the event so users can share their opinions regarding the events' popularity, previous experiences with its predecessor, etc.

A rating system could be added to each organiser, so users can rate organisers and the events they schedule. This may work to increase the quality of organisers' events, as they may strive for good ratings.

One participant would have liked if there was a counter which displayed how many views an event had. This could be useful for users to immediately see popular events. However, this can pose the problem that unpopular events are never seen, and popular events remain at the top. A similar occurrence is found in the researched literature [Farzan *et al.*, 2009], along with an effective solution.

Facebook Functionality

Adding Facebook functionality to the application was seen to be an enjoyable feature by participants. One participant commented that it would be useful to have a 'like' button or 'share' button, which would display on the user's Facebook page that they liked an event or so they can share it to their Facebook 'wall'. Currently, there is no way on Facebook to 'like' an event, however, the application could 'like' the Facebook 'Page' of the event. This would increase awareness of events and organisers as it would be directly advertising on the Facebook website.

The action to view who is attending an event, is a read-only action. An additional feature could allow users to click to attend the event from the application, and update their Facebook profile to indicate that they are attending. Another feature could highlight the user's friends when they view people attending an event.

6.2.7 Semantics

Chapter 2 explored the idea of semantic mapping in order to automate processes that required matching of similar words. A restriction of sourcing events from Facebook, is that it does not allow the assigning of categories to events. It may be possible to exploit semantic logic to match event descriptions into an appropriate category on the

application. This would enable individual events to have their own categories, rather than the workaround to assign categories to event organisers.

6.2.8 Gamification

Gamification was a researched topic in chapter 2 because if done effectively, it can engross users in a state of flow. A gamified system produces a fun, interactive environment. Users who enjoy the application, become more engaged [Fitz-Walter *et al.*, 2011]. Adding gaming elements to the application could encourage students to use the application more frequently. There are endless possibilities when gamifying a system. The core elements that would be desired, are an achievement system, a points-based system, and a level-up system. Users could have a personal profile on the application where they gain achievements and points to level up their profile. To acquire achievements, context-based goals could be set; for example, a user must attend the college orientation event to unlock the achievement. The user would navigate to a specific GPS location (the venue) between a specific time range. This aims to encourage students to attend the event. Unlocking the achievement would provide the user with points toward their level/rank. Event organisers would be allowed to create a set number of achievements per month, with a restricted number of points per month.

During the user-centered design meeting, a member of the Central Societies Committee (CSC) was told about the gamification idea. She mentioned that she is often gifted with free concert tickets. She continued, that competitions could be run so that students with a high number of points in the gamified system, would win the tickets. The idea requires further thought to fairly choose the winners of the prizes, but the CSC were aboard the idea.

6.2.9 Additional Features

The remaining list of ideas and amendments will be listed before concluding this section. A participant in testing mentioned integrating the application with Twitter. This broadens the scope of the application, and provides additional event sources. Since Twitter is a micro-blogging website, with a restriction on the amount of characters that can be "tweeted", an assumption is that it would be difficult to create whole events on the application, using only 140 characters. Despite this setback, the application could have an explicit section for Twitter events. They could be identified and parsed using the hash-tag '#TrinityImpulse'.

Many participants in testing spoke about adding reminder alerts, so that they could be reminded of the events. This could be done via emails, or if the events synchronise to

the phone, a reminder could be included. Moreover, a native app would be able to store its own reminders to alert the user.

A sorting function for events may be useful, to allow users to sort their event listings by terms such as event name, category, date, venue, etc. This is different to the filter function, as the filter refines the list of events, whereas the sort function would arrange the event list.

A user preference system could be implemented, whereby users specify the categories they prefer, and only those categories are shown; or those categories are shown at the forefront of the application. As seen in chapter 4, the database schematic is prepared for this functionality, however, the application has not been developed to include it.

QR codes are similar to the common barcode. Many smartphones can scan QR codes containing URLs, and be immediately directed to a website. An idea emerged where QR codes would be placed on buildings around the campus, and once scanned by a smartphone, the QR code would direct the student to a web page displaying all events scheduled within that building. For example, a drama club could attach a QR code to their drama theater, and it would direct the student's smartphone browser to their events on the application. Another example, would be to attach the QR code to the door of a lecture theater, and upon scanning, the student would be directed to a listing of support events scheduled in that theater.

Augmented reality pairs with a smartphone camera to present a virtual overlay of the image the camera is currently capturing. In the Trinity Impulse application, the overlay could show users which events are on in the building, pointed to by their smartphones. Moreover, the user could rotate their position to see which events are on in their surrounding area.

6.2.10 Concluding Remarks

This section explored new ideas and features that could be added to the Trinity Impulse application. The aim is to amend current issues and expand on functionality. Moreover, the abundant amount of ideas is evidence that there is greater potential for this application. It could be embellished, and integrated into the campus environment, in hope to produce a greater user experience, and increase student awareness and engagement.

Appendix A

Participant Test Sheets

Prototype Evaluation

TRINITY COLLEGE DUBLIN

INFORMATION SHEET FOR PARTICIPANTS

Thank you for participating in this study!

This study will require to you interact with the Trinity Impulse events application. You will be asked to perform as set of tasks such as ‘search for an event’, ‘add an event to calendar’, etc. Finally, you will be asked to fill out a small satisfaction and usability questionnaire.

During the time you interact with the application, you will be observed by a researcher, who will document your feedback, interactions, and progress. The collected data will be analysed and may be used to improve the application. Some results may appear in scientific publications, where no personal information will be disclosed and all data will be anonymous. It will be impossible to trace the material back to you. The original data will be kept secure and will not be circulated.

You have the right to abandon the study anytime. You don’t need to provide an excuse for your decision to do so.

Trinity Impulse – Background Information

Trinity Impulse is a mobile website which is designed to show upcoming events within Trinity. Users can navigate the website to view information about events. The website gets its events from the college noticeboard, and most importantly, from Facebook pages. A Facebook page can register with Trinity Impulse so that all of the Facebook page’s events are automatically entered into Trinity Impulse.

Users can then view these events on the Trinity Impulse mobile website. In addition, users can log in using their Facebook account, where they will then be provided with additional features – in particular, the user can save events to their personal online calendar, so that they can maintain a schedule of events that they are interested in attending. Also, if the event has been retrieved from Facebook, you will have the option to see who is attending that event.

In order to make Trinity Impulse easy to browse, and to find events which interest you, there are features to view events by ‘category’ (e.g. leisure, arts, history, science, etc.), ‘organiser’ (society events, club events, etc.), month, and there is also a search function to enter a search-word if you are looking for a particular event.

Trinity Impulse – Task List

Please complete the following tasks. You may tick the box to indicate that the task has been completed.

1. ☐ **Task**: You want to view the full details of any **upcoming event** on the home/main page.
2. ☐ **Task**: You want to view events with the **organiser:** 'Noticeboard'.
3. ☐ **Task**: You want to view **all** events and **filter** the list of events by the **category:** 'Leisure'.
4. ☐ **Task**: Using the 'Search' function, you want to find the event titled 'The Great Ape Run'.
5. ☐ **Task**: You want to see **who is attending** the event: 'The Great Ape Run'. Within the details of that event, you can choose to see who is attending.
6. ☐ **Task**: You want to **log in with Facebook** so that you can **save** 'The Great Ape Run' to your personal calendar.
7. ☐ **Task**: You want to view that **saved event** in your **personal calendar**.
8. ☐ **Task**: Now that you have seen it in the calendar view, you want to see the saved events in the '**list view**'
9. ☐ **Task**: You want to change the **settings** of your saved events so that the **default view** is '**List View**'. View your saved events again to verify that it goes directly to the list view.

Now that you have completed the tasks, you may take this opportunity to freely browse Trinity Impulse.

Trinity Impulse – Questionnaire

Each question is optional. Feel free to omit a response to any question; however the researcher would be grateful if all questions are responded to. Please do not name third parties in any open text field of the questionnaire. Any such replies will be anonymised. In the extremely unlikely event that illicit activity is reported I will be obliged to report it to appropriate authorities.

Demographic Information

Please circle your answer or fill in the text line.

Q1. Gender:

Male Female

Q2. I am a student:

Yes No

If you answered 'No' to Q2, please skip to Q3.

Q2 (b) The name of my college is:

_____

Q2 (c) My college course is:

_____

Q3. My smartphone model is:

iPhone Android BlackBerry Don't own a smartphone Other:_____

If you 'don't own a smartphone', please skip to Q4.

(a) I use Apps or browse websites on my smartphone:

Several times per day | Once per day | Several times per week | Once per week | Once per month or less

Q4. I browse events online:

Several times per day | Once per day | Several times per week | Once per week | Once per month or less

Q5. I attend events:

Several times per day | Once per day | Several times per week | Once per week | Once per month or less

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