

Redefining the Use of Augmented Reality

A Project Proposal For
LUMINARY

Version 1.1
20 April 2015

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0.0 Version History

VERSION 1.0

Version 1.0 is the original version of the Project Proposal Document. This version of the document was presented to the panel of judges at AUT for consideration on Wednesday 25 March 2015. The project proposal was approved, and the following recommendations for Version 1.1 were given:

- 1) It is unclear from proposal that development using XP is iterative. You need to define things like duration and iterations. Your plans need additional details to clarify your approach and activities.
- 2) Your proposal should define quality assurance approach and the practices that will be applied during the project phases. The practices need to match the tasks being undertaken.

VERSION 1.1

Version 1.1 implements the recommendation given by the AUT panel of judges. Version 1.1 was due on 21 April 2015, and will be presented to Luminary Promotions following approval. Below is an outline of the changes made to sections of this version:

Section	Overview of Changes	Date
Title Page	Date and version number updated.	20/04/15
Contents	Contents outline updated to reflect new structure.	20/04/15
0.0	Version History section added.	15/04/15
3.2	Extreme Programming section updated to include clearer information about the iterative processes.	19/04/15
4.2	Project Roles section changed to make Project Team Member roles, responsibilities and expectations more clear to the reader.	16/04/15
4.3	Work Breakdown Structure changed to better show the iterative process of XP Development in phase 3.	14/04/15
4.4	Time Management section changed to reflect revised dates and durations of tasks. Total project time reduced from 30 weeks to 27 weeks. Information about working weeks and break weeks added.	14/04/15
5.0	Quality Assurance Plan added.	15/04/15
9.0	Glossary of Terms updated to include: Pages, OS X, iCloud.	16/04/15
10.0	Reference List updated to reflect newly added references.	19/04/15

1.0 Introduction

1.1 Project Background

Announced on 2 March 2015, four AUT students ('the group,' see 1.2) were selected to work with Luminary Promotions ('the client,' see 1.3) on a BCIS Research and Development project.

Luminary Promotions (hereinafter 'Luminary') require a system to streamline their deployment process for Augmented Reality (AR) content. Luminary's previous development practices required the creation of an entirely new application (app) for each client, and users were not engaged with the app longterm — resulting in a lack of use and quick deletion of the app.

Luminary's original project proposal defined a system which would be "created within the Unity 3D engine following Luminary standards." They explained, "It will be a base shell so that it can be built upon and evolve with the technology around it."

Luminary also mentioned how the use of GPS/geolocation services would allow the user to "point [their] mobile phone at a building/environment and it will display information about it." Luminary described the application as a "platform for AR content which has a GPS component". The scope of the project was otherwise undefined.

After two meetings with the client and six collaborative group meetings, the group suggested to the client that the platform may require a utility function in order to solve the user engagement issues experienced with their past offerings. Luminary agreed with this idea and tasked the group with the challenge of discovering a new utility purpose for AR as part of the scope of the project.

To account for the possibility that a utility purpose was not discovered, the group also offered an alternate development approach. In this alternate approach, rather than creating an AR platform which groups together AR content, an app plugin would be created which could be added to pre-existing apps. This would allow an extended functionality of apps already in use.

Luminary were pleased with both suggested application approaches. The creation of the AR platform is considered viable only if a utility purpose (or purposes) can be discovered by the group. It is planned that if no utility purposes are found, the group will instead start development on the app plugin extension approach.

Luminary informed the group that their intentions were to expand their user and client base, while improving their customer's experience and satisfaction. Luminary wish to position themselves as the leader in AR technology in New Zealand, and are more concerned about having a strong brand than profiting in the short term. They expect to make a loss with the system initially due to marketing and development costs.

The group will be offered support by Luminary's Managing Director, Ahmed Almukhtar and developers as necessary. The group will not be required to produce any of the AR content, as this will be created by Luminary's in-house development team, inline with Luminary's standards.

This project plan is to be presented to a panel of judges on 25 March 2015 for approval.

1.2 The Group

AUT STUDENTS

Name	Student ID	Area of Study	Email	Phone
Jason Gerbes	1274664	Major in Computer Science, Minor in Software Development	srr2206@aut.ac.nz	027 543 7237
Joshua Son	1388288	Major in Computer Science	hpg4759@aut.ac.nz	021 187 9608
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Sean Young	1302108	Major in Software Development	crp8296@aut.ac.nz	021 113 6388

SUPERVISOR

Name	Email	Office	Phone
Roopak Sinha	roopak.sinha@aut.ac.nz	WT408	09 921 9999 ext. 6256

1.3 The Client

LUMINARY PROMOTIONS

Luminary Promotions LTD are a marketing and experiential agency based in Auckland CBD. They are a young company consisting of twelve full-time employees. 'Luminary' is a noun and defined as "a person who inspires or influences others, especially one prominent in a particular sphere" (Oxford Dictionaries, 2015).

Luminary's sole focus, as stated by the founder Ahmed, is "to deliver outstanding campaigns for our clients through experiential campaigns and Augmented Reality marketing app development." Luminary believes in order to achieve their goals they must continuously evolve business operations with creative "out-of-the-box" ideas, introducing new technologies at a high standard.

Luminary aims to be the forefront leader in the New Zealand advertising market, by using new technologies, like Augmented Reality, that people have not seen before. Luminary has a strong emphasis on using the latest advanced technology as a part of their digital strategies to meet brand communication objectives. Luminary has delivered results for several iconic kiwi and international brands such as AA Insurance, LG and Twentieth Century Fox. Luminary also reference traditional advertising media, such as TV, billboards, radio and print.

STAFF

Name	Position	Email	Phone
Ahmed Almukhtar	Managing Director	ahmed@luminarygroup.co.nz	021 844 522
Alexis Rabadan	Lead Developer	alexis@luminarytech.co.nz	021 065 3537

Ahmed is a former University of Auckland student, completing study with a bachelor, majoring in computer science and information systems. He is the founder and managing director of Luminary Promotions, which he founded in March 2013. Ahmed sees himself as a visionary and wishes to ensure business sustainability and growth for Luminary.

Alexis is Luminary's Lead Developer. He has overseen many of Luminary's past projects, and will be one of the groups main contact points during development.

2.0 Rationale for the Project

2.1 Complications with Current Approach

As part of their experiential advertising options, Luminary offer tailor-made Augmented Reality applications. The app is built from the ground up, and often consists of a very simple user interface and a very limited amount of content.

Historically, the app is built in unison with a larger campaign. For instance, Luminary created an app for the January 2015 issue of M2 magazine. Several pages of the magazine were linked to an augmented experience of the accompanying application. The app was intended to enhance the users experience and engagement with the magazine.

The issue with Luminary's current approach of development is that each campaign requires a new app to be built from the ground up. Also, if more content needed to be added (e.g. a new issue of M2 magazine), then a new version of the app must be downloaded by the user.

Luminary have discovered that their app's usage drops significantly shortly after the campaign, and the user often deletes the app once it is no longer being used. It is also possible that some users choose not to participate in the campaign as they wish not to download a new app.

2.2 Need for a Streamlined Approach

Luminary would like to implement a more systematic and streamlined approach to the use of AR. This new system would allow Luminary to address the complications they are facing with their current development regime.

Creating a new application for each marketing campaign involves a large workload and limits the number of clients Luminary can service at any given time. The current development practices used by Luminary vary for each application, making development specific to each app (cannot be reused for other apps).

Implementing a streamlined development system would allow Luminary to focus less on the technology and more on the promotional content. Development would be standardised, allowing for more rapid expandability and deployment. This system would also have the side effect of creating a well known brand for Luminary, positioning them as a 'top player' for Augmented Reality development.

The requirement of a standalone AR app is also a discouraging factor for the user. The appeal of the limited content of each app is not long-standing, causing users to quickly lose interest . Each app requires a significant amount of storage space (around 50 - 70mb), making retention of the app unappealing to the user.

Users would immensely benefit from a streamlined system for the consumption of Augmented Reality content. Removing the need of downloading a campaign specific application would improvement customer retention, and assist in expanding the user base. This less intrusive approach would also improve the customers experience and enhance their engagement.

The usage data of the application would provide Luminary valuable and strategic insight into the ways that the user engages with the content. The potential implementation of GPS services would also allow for the gathering of foot traffic information. These valuable metrics would give Luminary a strategic and competitive advantage when expanding their marketing client base.

3.0 Project Approach

3.1 Research Methodology - Action Research

Action Research process follows the principle of “learning by doing” (Kemmis *et al.* 1988)— a group of people identify a problem, do something to resolve it, see how successful their efforts were and if not satisfied, try again. Developed by Stephen Kemmis, Action Research follows a “simple model of cyclical nature of the typical action research process” (Web.net. 2015).

Action Research tends to be:

- Cyclic — similar steps tend to recur, in a similar sequence.
 - Participative — the clients and informants are involved as partners, or at least active participants, in the research process.
 - Qualitative — it deals more often with language than with numbers.
 - Reflective — critical reflection upon the process and outcomes are important parts of each cycle.
- (Dick, B. 2000).

RATIONALE

- Action Research enforces collaborative work.
- Each participant in the project is considered a co-researcher, so everybody researches solutions to a given problem.
- Every participant’s ideas are equally significant and should be discussed and negotiated.
- Action Research avoids skewing from the idea-holder.

Our project requires a significant amount of creative, collaborative and critical research. Action Research enables the group to work independently to form ideas, and then critically refine the ideas collaboratively.

Action Research results in solutions to a given problem that have been verified.

PHASES / TASKS

Each cycle of Action Research has four phases (see Fig 1):

1. Plan
2. Act
3. Observe
4. Reflect

(Web.net. 2015)

DELIVERABLES

Action Research deliverables include:

- Recommendations
- Action plans
- Procedures, protocols, guidelines and programmes
- Prototypes and models

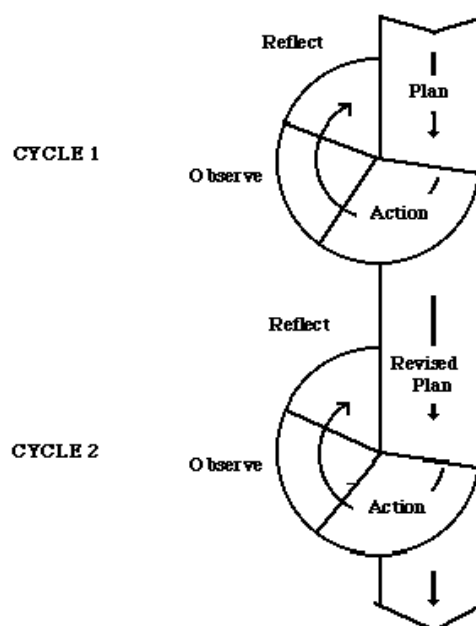


Fig 1: Action Research Development Cycle
(Source: MacIsaac, 1995)

3.2 Development Methodology - Extreme Programming

Extreme Programming methodology (XP) is an iterative process originally designed for small team working with uncertain and changing requirements. Other approaches were considered to be 'overkill' for such small development teams. XP was developed for small teams without discarding most of the ideology of other methodologies. It focuses on the "timely delivery of software that meets users' requirements" (Hunt, J., 2006).

XP development is very lightweight meaning you can "take what you think you need from XP and create something which is neither XP nor particularly agile." (Pierce, D., 2002)

USER STORIES

XP development breaks down the features of the system into multiple user stories. User stories are short, simple descriptions of a feature told from the perspective of the person who desires the new capability, usually a user or customer of the system (Cohn, 2014). They typically follow a simple template: As a <type of user>, I want <some goal> so that <some reason>.

User stories are often written on index cards or sticky notes, stored in a shoe box, and arranged on tables to facilitate planning and discussion. They strongly shift the focus from writing about features to discussing them. In fact, the discussions are more important than whatever text is written.

ITERATIONS

XP development is divided up in to multiple iterations — one to three weeks in length. The short iteration durations allow for uncertain or changing requirements, and enforce regular updates with stakeholders. Iterations should be kept consistent in length, as the consistency will make measuring progress and planning simple and reliable (Wells, 1999a).

Programming tasks are scheduled during an 'Iteration Planning Meeting' at the beginning of each iteration. This is a just-in-time approach which provides an easy way to stay on top of changing user requirements, a key advantage of XP development. User stories are chosen for the iteration by the client (Luminary) from the Release Plan, in order of the most valuable to the client first.

RELEASE PLAN

The Release Plan is a document which lays out the overall project, specifies which user stories are going to be implemented for each system release (iteration of development) and dates for those releases (Wells, 1999b). A Release Planning Meeting is held to create the release plan.

The client selects the user stories with estimates that total up to the project velocity from the completion of the previous iteration. Developers sign up to complete tasks and then estimate how long the tasks will take to complete. It is important for the developer who accepts the tasks to be the one who estimates the completion time.

Estimations of the tasks should be estimated as one half, one, two or three ideal programming days in duration. Ideal programming days are how long it would take to complete the task if there were no distractions. Tasks that are shorter than one day can be grouped together and tasks longer than 3 days should be broken down further.

The project velocity is used again to determine if the iteration is over booked or not. If the iteration has too many tasks, then the client must choose which user stories will be put off until a later iteration (snow ploughing). If the iteration has too few tasks, then additional user stories can be added.

The task and user story duration estimates must not be changed. The planning process relies on the cold reality of consistent estimates, but re-estimates and re-negotiations may need to be done every three to five iterations based on project velocity, so long as the most valuable stories are being implemented first.

RATIONALE

- XP allows for uncertain and changing requirements — our requirements will not all be discovered in the early stages in development, so the ability to change and add requirements essential.
- XP targets small development teams — e.g. our development team of four students.
- XP is adaptive — It adjusts to the needs of the group.
- XP is simple — It has clear and concise values and practices
- XP utilises small processes — planning, then lifecycle of designing coding, testing and listening.

XP is an agile development methodology. It adapts to suit the needs of the group, enforces collaboration and follows simple, clear and concise processes. XP allows for development amongst small teams with limited time and limited certainty around the requirements of the project.

XP suits our clients requirements as it allows them to have a hands on influence on the application implementation. The client will be kept up-to-date, and will be able to make changes as needed. The processes of development will be divided into sub processes in order to have more frequent deliverables for the clients' input.

XP has a customer focus. Customers are involved right throughout the development process. Our project relies on customer satisfaction, making XP an ideal fit.

PHASES / TASKS

The phases of each iteration of XP development are:

1. Planning — Requirements elicitation and user stories. Time and cost are usually estimated between each iteration.
2. Designing — Simplicity is the main ideology during the design phase of each iteration.
3. Coding — Using agreed coding standards allows for a more fluid collaboration between the group. Pair programming occurs at this phase, adopting the collective ownership policy.
4. Testing — Code is tested against unit tests eliminated bugs while acceptance tests ensure the intended functionality of the system meets the requirements.
5. Listening — Feedback from customers ensures that the customer is satisfied with the features and functionalities of the iteration.

Bright Hub Inc. (2012).

DELIVERABLES

Extreme Programming uses User Stories, Acceptance Tests, and planning documentation (including the release plan) as deliverables. CRC cards are also used occasionally.

XP delivers frequent iterations of a system, giving the client and customer the ability to provide input throughout the development.

4.0 Project Plan

4.1 High Level Overview

APPROACH A: AN AUGMENTED REALITY PLATFORM APPLICATION

Approach A will result in a singular Augmented Reality platform application. The application will group together AR content from all of Luminary's clients, and may allow the creation of content by the platforms users.

It has been decided that the usefulness of the application depends on the discovery of a new utility purpose for the Augmented Reality technology. Approach A is preferred by Luminary.

APPROACH B: AN AUGMENTED REALITY APP PLUGIN EXTENSION

Approach B will result in an Augmented Reality plugin extension which adds AR capabilities to pre-existing applications. This technology will allow app developers to implement Augmented Reality technology into their app without having to invent the technology.

The plugin would allow developers to focus more on the AR content and less on the technology. Luminary would be wholly satisfied with this approach, but it is to be considered a backup plan.

PHASE ONE: INVESTIGATE POTENTIAL USES OF AUGMENTED REALITY

Phase One will reference Action Research methodology to discover, investigate and verify possible uses for Augmented Reality technology. The creation of an Augmented Reality platform (Approach A) relies on the discovery of a utility purpose of the technology.

Phase One will be concluded after four weeks, or once an appropriate use for the AR technology has been discovered.

PHASE TWO: DETERMINE THE APPROACH TO BE IMPLEMENTED

Phase Two will include the deciding of the approach we are to implement. This decision will depend entirely on the outcome of Phase One. We will implement Approach A only if a utility purpose was discovered in Phase One, or we will instead implement Approach B if Phase One was unsuccessful.

The outcome of Phase One will be discussed with the project supervisor and the client, and a decision will be jointly made about which approach will be implemented.

Phase Two is expected to be concluded after one week.

PHASE THREE: IMPLEMENT THE DECIDED APPROACH

Phase Three will implement the approach decided at the conclusion of Phase Two. We will follow the Extreme Programming methodology for the planning, execution and evaluation of the software system.

Phase Three will result in a completed implementation of either Approach A or Approach B.

The exact timeframes for Phase Three must be decided after Phase Two's completion, but the expected overall duration of Phase Three is fourteen weeks.

4.2 Group Roles

Disclaimer: The roles and responsibilities of each group member are indicative only and may not encompass the entirety of the students workload. It is expected that the roles and responsibilities are subject to change throughout the duration of the project.

Each group member is considered a 'Project Team Member,' and takes on the Project Team Member roles, responsibilities and expectations listed below. Each member will be part of the development team during phase three — implementation of the system. Quality assurance roles will also be given to each member, in accordance to the Quality Assurance Plan (see section 5.0).

GROUP MEMBER'S ROLES: (as of 20 April 2015):

Name	Roles	Responsibilities
Jason Gerbes	Project Leader, Project Team Member	Head of communications, organisation of meetings, document creation & general project team member.
Joshua Son	Risk Manager, Project Team Member	Head of risk management & general project team member.
Paul Lee	Project Task Coordinator, Quality Control, Project Team Member	Task delegation, quality assurance/control & general project team member.
Sean Young	Researcher, Analyst, Project Team Member,	Head of research and analysis & general project team member.

PROJECT TEAM MEMBER ROLES, RESPONSIBILITIES & EXPECTATIONS:

- Research
- Development (implementation / coding)
- Group communication
- Attendance of meetings
- Attendance of project workshops
- Meeting minutes recording (rotational task)
- Maintaining a log book record of all meetings, workshops and tasks
- Peer review
- Meet given deadlines

4.3 Work Breakdown Structure

Disclaimer: The processes stated are indicative only and subject to change later into development. It can be expected that some sub-processes cannot yet be accounted for.

Below is a high-level work breakdown structure in tabular form with PMI numbering:

1. Phase One: Investigate Potential Uses of Augmented Reality
 - 1.1. Individual Research (based on Action Research Methodology)
 - 1.1.1. Plan
 - 1.1.2. Act
 - 1.1.3. Observe
 - 1.1.4. Reflect
 - 1.2. Collaboration of Ideas
 - 1.2.1. Presentation of Individual Research
 - 1.2.2. Group Discussion
 - 1.2.3. Prioritisation of Ideas
 - 1.3. Proof of Concept
 - 1.3.1. Qualitative Assessment
 - 1.3.2. Prototyping
 - 1.3.3. Determination of Viability of Ideas
2. Phase Two: Determine the Approach to be Implemented
 - 2.1. Determine the Viability of an Augmented Reality Platform
 - 2.1.1. Assess the Discovered Uses of Augmented Reality
 - 2.1.2. Discuss the Discoveries with the Client
 - 2.1.3. Assess the Risks of the Platform
 - 2.2. Compare the Viability of the Two Approaches
 - 2.2.1. Determine the Risks of the App Extension Approach
 - 2.2.2. Compare the Risks of the Two Approaches
 - 2.3. Decide Which Approach to Implement
3. Phase Three: Implement the Decided Approach (based on Extreme Programming Methodology)
 - 3.1. Execute Development Iteration (repetitive process)
 - 3.1.1. Plan
 - 3.1.2. Design
 - 3.1.3. Coding
 - 3.1.4. Testing
 - 3.1.5. Evaluate (Listening Through Feedback)
 - 3.1.6. Return to 3.1

4.4 Time Management

PROJECT SCHEDULE

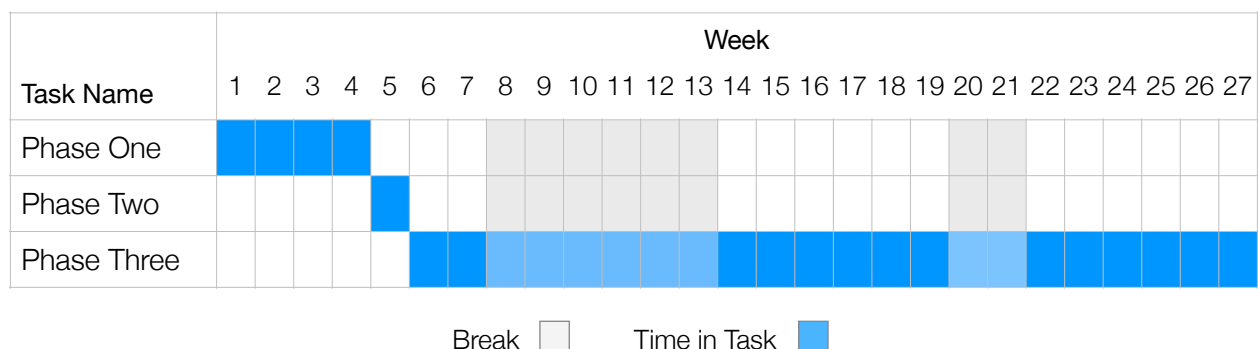
Disclaimer: This project schedule is indicative only and subject to change. It is to be interpreted as a high-level overview of the project tasks only and will be refined later into development.

TIME MANAGEMENT PLAN

Each project team member will work 10 hours per week during working weeks. A reduced number of hours will be worked during break weeks, as decided by the group on a case-by-case basis. Development tasks may be scheduled during break weeks, but meeting duration and frequency will likely be reduced during these times.

Project Start Date: 21 April 2015 (week 1)

Project End Date: 25 October 2015 (week 27)



- **Phase One: Investigate Potential Uses of Augmented Reality**

Duration: 4 working weeks

- Start Date: 21 March 2015
- End Date: 18 May 2015

- **Phase Two: Determine the Approach to be Implemented**

Duration: 1 working week

- Start Date: 19 May 2015
- End Date: 25 May 2015

- **Phase Three: Implement the Decided Approach**

Duration: 14 working weeks (+ 8 weeks during breaks with reduced work hours)

- Start Date: 26 May 2015
- End Date: 25 October 2015

MILESTONES

Each of the three phase end dates will be considered a major milestone of the project, as will the project start date and end date. As the phases are broken into smaller sub-processes, minor milestones will be set during each phase (especially during the implementation - Phase Three).

These milestones will be agreed with the supervisor and client, and will usually result in a deliverable of some description. The final deliverables of each phase are crucial for the following phase, with Phase Three resulting in the completed project.

4.5 Scope

The project is split into three phases: an investigation phase, a decision phase and an implementation phase. The result of the investigation phase will determine the outcome of the decision phase.

The decision phase will then determine which approach will be followed in the implementation phase. The scope of the implementation phase will be determined after the decision phase as many of the requirements have not yet been determined.

Disclaimer: The information below is a current, incomplete view of the scope as of 25 March 2015. It is expected that the scope will change throughout the projects' phases.

OBJECTIVES

We aim to create a system which:

- Implements Augmented Reality in a new way.
- Provides value for the user.
- Is bug-free.
- Can handle multiple content types.
- Efficiently manages storage and cellular data usage.
- Is expandable — can be developed by Luminary further.

HIGH-LEVEL REQUIREMENTS

The high-level requirements of the system are below. These requirements will be refined throughout the project.

- We need to complete a methodical investigation of the possible uses of Augmented Reality.
- We need to collaboratively determine with Luminary the viability of the two proposed approaches.
- We need to implement an Augmented Reality system based on the chosen approach.

MAJOR DELIVERABLES

Each phase will result in a key deliverable:

- Phase One — Research findings document for discussion with client and supervisor.
- Phase Two — An overview of the assessment of the viability of the two approaches. Luminary will provide us with a letter of confirmation of their chosen approach.
- Phase Three — The completed application will be delivered at the conclusion of this phase.

BOUNDARIES

The boundaries of the scope are as follows:

- We will not be creating the Augmented Reality content. This will be done by Luminary.
- We will not be responsible for marketing the application.
- The UI and UX design will be decided by Luminary (in part).
- We will not be creating the Augmented Reality technology itself. Vuforia will instead be used. Our focus will be on the implementation of the technology.

5.0 Quality Assurance Plan

The quality of documentation, research and development will follow standard practices outlined in this section. Each project team member will be expected to adhere to these practices, and a quality assurance review will take place during each weekly team meeting.

5.1 Documentation Quality Assurance

All documentation will be produced in Pages for OS X. These files can be edited and viewed using Pages for OS X, Pages for iOS or Pages for iCloud. A PDF exported version of the document can be viewed by any appropriate PDF reader, but cannot be edited.

CONSISTENCY

All documentation should follow a consistent style. All text should use 'Helvetica Neue' font, except in special circumstances. The AUT logo should be present in a corner of the document (usually top-right), and the name and page number of the document should appear in the footer (except on the title page). Font and line weights should be thinner than regular (e.g., 0.75pt line weight and 'Light' font weight), to give the document a 'lightweight' overall look and feel.

PROOFREADING

All documents must be proofread by at least two team members (including the Quality Control team member — see 4.2) before being presented to the client or any AUT staff.

EXPORTING

Document files may be exported for viewing on non-supported devices or when read-only viewing of a document is required. Files must be exported in PDF format, using the "Best" quality setting for image quality. Exported files must have an appropriate, unambiguous name which directly encompasses the contents of the document.

SHARING & EDITING

Sharing of the document files should be done using Pages for iCloud wherever possible to ensure that only a single, fully updated version of the document exists. It is foreseeable that documents may need to be shared in offline form (where incompatibilities may exist), therefore any changes that need to be made to the offline document must be made to the online master copy.

IMAGES

Images must be of a resolution and size appropriate for the intended purpose — they must not appear blurry or otherwise visually unappealing. Text in images must be clearly legible. Resized images must match the proportions of the original image — as to not 'skew' the image in any way.

REFERENCES

All direct and indirect quotes, and images from external sources must be referenced using APA 6th referencing. A reference list is to be maintained near the end of the document (usually before the disclaimer).

PRINTING

Documents that are to be printed must fit cleanly within the margins of the intended page size. All text should be clearly legible, all images must be clear, and (where possible) the document should be professionally bound. Pages with colour images or text should be printed in colour, rather than black and white.

5.2 Research Quality Assurance

We will undertake research throughout all three stages of this project. Our first stage is entirely research-based and will reference a well formed and regarded research methodology; Action research. Action research is a cyclic process, which means that it is flexible and responsive. While we research and develop an understanding we are ensuring that in each cycle process our answers become more precise.

The following stage, stage two, requires the group, supervisor and client to come to a decision on which development path will be followed for the remained of the project. This decision will be heavily influenced by the outcome of the research in stage one. It is essential that all findings during research are correctly recorded, and this valuable data will influence the decision in stage two.

The final stage of the project, stage three, is our development stage. Extreme Programming development is an iterative process. Each iteration has an evaluation stage that will heavily rely on research to correctly evaluate the outcome. It is also foreseeable that research will need to be conducted during the planning and execution of each phase as Augmented Reality technology is a new field for the group.

The skills and knowledge involved in this project (see section 7.0) do not necessarily match the current skill-set of the group. The group will need to research new technologies in order to gain the skills required to complete the project. High quality research practices are essential in this practice.

SCHOLARLY SOURCES

Research consisting of the analysis of scholarly publications, which have been peer reviewed. These sources provide credible depth into the field of interest and enhance credibility in our own research. All external sources of information must be referenced both inline and within a maintained reference list; following the APA 6th standard of referencing.

SHARING FINDINGS

The findings of all research should be discussed with the other team members. This can be achieved formally (e.g., during our weekly meetings), or less formally (e.g., through FaceBook posts, emails, txt messages, etc.)

The comments and suggestions received by the group are important in project development and progress. The feedback received assists in assessing and assuring the quality of work that has been undertaken by other team members.

PEER REVIEW

Peer review is similar to sharing findings, but research is evaluated by qualified members within a field of profession. Articles are sent to scholars in the same field of study to get their confirmation (or disapproval) on the quality and validity of the work.

MONITORING AND OVERSIGHT

The client and AUT staff (particularly the group supervisor) will act as the overseer of the research being undertaken by the group.

We will provide the client with periodic status reports to ensure the project is progressing as planned. "Such processes can help in keeping projects on track, and in resolving issues and problems as they arise" (Gray, 2010).

DOCUMENTING FINDINGS

It is essential that all valuable findings discovered during the undertaking of research are properly documented. Findings that are shared internally within the group should be conveyed via the communication means outlined in the internal communication plan (see section 6.1).

Any findings that are to be shared with the client should be formed into a brief report-like structure or presentation form. These materials should be treated as formal communication means.

INTERVIEWS

To ensure that our interviews are of the highest possible quality, a recording of the interview should be taken using high quality recording equipment. The audio should then be transcribed and made available to the group for cross-analysis.

The interviewee should be encouraged to talk, and should not be disrupted while speaking. The interview should be taken in a quiet, non-public place to ensure the quality of the audio recording and to limit possible distractions (Amanda, 2014).

SURVEYS

To ensure high quality surveys we should have a specific goal for the survey that is clear cut and unambiguous. The surveys should set out to answer a specific question, or series of questions. Alternatives to surveys should always be considered to ensure that the best form of research is being utilised.

Advantages of surveys include:

- A large sample size is possible.
- They are relatively easy to administer.
- They can cover a vast range of information.
- They are economical.

Disadvantages of surveys include:

- They are extremely subject dependant.
- Validity issues may arise.
- Errors may occur due to non-response.
- They are limited by response choices.

A good survey should:

- Select samples that represent the population to be studied
 - Use designs that balance costs with errors
 - Clearly define topics, concepts and content (attention to question wording and order, attention to survey length and format)
 - Pretest questionnaires and procedures to identify problems prior to survey. (ensure that the participants understand the questions)
 - Use statistical & analytical report techniques appropriate to the data collected (data analysis and interpretation should be competent and clear, findings should be easy to understand)
 - Carefully develop and fulfil pledges of confidentiality to respondents
 - Disclose all methods of the survey to permit evaluation and replication (description of population and sampling frame used, purpose of study with specific objectives)
- (Johnson, 2011).

5.3 Development Quality Assurance

Extreme Programming (XP) Development leverages a number of quality assurance methods to enforce good programming practices. Being an agile development practice, it is essential that quality assurance is taken into consideration at all phases of development — as to enforce an expected of deliverables (Balkanski, 2003).

UNIT TESTS

According to Osherove (2014), a unit test is an automated piece of code that invokes a unit of work in the system and then checks a single assumption about the behaviour of that unit of work. A unit of work is a single logical, functional use case in the system that can be invoked by some public interface (in most cases). A unit of work can span a single method, a whole class or multiple classes working together to achieve one single logical purpose that can be verified.

A good unit test:

- Is able to be fully automated
- Has full control over all the pieces running (use mocks or stubs to achieve this isolation when needed)
- Can be run in any order if part of many other tests
- Runs in memory (no DB or File access, for example)
- Consistently returns the same result (You always run the same test, so no random numbers, for example. save those for integration or range tests)
- Runs fast
- Tests a single logical concept in the system
- Is readable
- Is maintainable
- Is trustworthy (when you see its result, you don't need to debug the code just to be sure)

Under XP Development, all code must be bound by appropriate unit tests. All relevant tests must pass before the code can be release. If any bugs are found in the system, tests must be created to fix it. The unit tests are run often, and the score is published.

TEST-FIRST DEVELOPMENT

XP utilises a test-first development practice. Unit tests are created first, before the code has been written. The code is then written with the intention of passing the unit tests. Creating a unit test helps a developer to really consider what needs to be done. Requirements are nailed down firmly by tests. Specifications cannot be misunderstood written in the form of executable code (Wells, 2000).

Unit tests give the developer immediate feedback as they work. It is often not clear when a developer has finished all the necessary functionality. Scope creep can occur as extensions and error conditions are considered. If we create our unit tests first then we know when we are done; the unit tests all run.

A test-first approach also benefits system design. It can be very difficult to unit test some software systems. These systems are typically built code first and testing second, often by a different team entirely. By creating tests first, the design will be influenced by a desire to test everything of value to the client. The design will reflect this by being easier to test.

PEER PROGRAMMING

All code sent into production in XP development is created by two people working together at a single computer. Peer programming increases software quality without impacting time to deliver. Peer programming assures that the entire source code is reviewed all the time.

Wray (2010) explained peer programming using the metaphor of one programmer being the “driver” and the other the “navigator.” In this metaphor, the driver controls the keyboard and focuses on the immediate task of coding, and the navigator acts as a reviewer, observing and thinking about more strategic architectural issues.

CODE INTEGRATION

Only one pair integrates code at a time. (because of parallel integration there is a combination of source code which may not have been tested together before. This is likely to lead to problems. Strictly sequential (or single threaded) integration by developers themselves is a simple solution to this problem. All new code is released to the source code repository by taking turns. That is, only one development pair integrates, tests and commits changes at any given moment. Single threaded integration allows a latest version to be consistently identified.)

Developers should be integrating and committing code into the repository every few hours, whenever possible. Continuous integration often avoids diverging or fragmented development efforts, where developers are not communicating with each other about what can be re-used, or what could be shared. Everyone needs to work with the latest version. Changes should not be made to obsolete code causing integration headaches.

CODE STANDARDS & REFACTORING

All code must be written to agreed standards (camel casing etc). Committing to use agreed standards allows for consistent code that is easy for the entire team to read and refactor. A refactoring practice is agreed and adhered to, where duplicated code is removed, code integration is increased and the mixture of the code is reduced.

COLLECTIVE OWNERSHIP

Collective ownership encourages everyone to contribute new ideas to all segments of the project. Any developer can change any line of code to add functionality, fix bugs, improve designs or refactor. No one person becomes a bottle neck for changes. To do this, developers are to create unit tests for their code as it is developed. All code that is released into the source code repository includes unit tests that run 100%. Code that is added, bugs as they are fixed and old functionality as it changed will be covered by automated testing.

CLIENT INTERACTION

The client is always available during development for consultation. XP development utilises an iterative development practice where deliverables are produced during each iteration. These deliverables are communicated to the client, and the client can provide valuable feedback.

The client is accessible by all members of the team, and frequent communication can be expected. Regular meetings are planned, and communication via other means (e.g. email) will be used for questions and concerns mid-development.

6.0 Communication Plan

Disclaimer: The communication plan below is indicative only and may not encompass the entirety all communication protocols. It is expected that the communication means are likely to change throughout the duration of the project.

Below is the group communication plan, as of 25 March 2015:

6.1 Internal Communication

Purpose	Parties Involved	Frequency	Communication Method	Initiator
Discussion of research and analysis	Group Members	Weekly	Organised meeting, Skype or Facebook Group.	Group Members
Progress Update of Given Tasks	Group Members	Weekly	Organised meeting, Skype or Facebook Group.	Group Members
General Discussion	Group Members	When Required	Facebook Group, Email, Skype or SMS.	Group Members
Update of project progress	Group Members & Supervisor	Weekly	Organised meeting at AUT or Facebook (last resort)	Team Leader
Personal Issues	Group Members & Supervisor, Other AUT staff	When Issues Arise	Email, Calls, or Organised Meetings	Group Members
Mid Project Review Presentation	Group Members & Supervisor, Anne Philpott	One-off	Email, Calls, Organised Presentation	Team Leader, Supervisor, Anne Philpott
Project Closure Presentation	Group Members & Supervisor, Anne Philpott	One-off	Email, Calls, Organised Presentation	Team Leader, Supervisor, Anne Philpott
General Queries/ Discussion	Group Members & Anne Philpott	When Required	Email, Calls, or Organised Meetings	Group Members or Supervisor

6.2 External Communication

Purpose	Parties Involved	Frequency	Communication Method	Initiator
Supervised meeting to discuss project progress.	Group Members & Supervisor, Luminary	Fortnightly (Temporary)	Organised meeting at AUT or Luminary's offices.	Team Leader or Supervisor
Unsupervised meeting to discuss project progress.	Group Members & Luminary	Fortnightly (Future meetings)	Organised meeting at AUT or Luminary's offices.	Team Leader
General Discussion	Group Members & Luminary	When Required	Email, SMS, Calls or Organised meetings.	Group Members
Change Requests	Group Members & Luminary	When Required	Email, SMS, Calls or Organised meetings.	Luminary
Training or Collaborative Working	Group Members & Luminary	When Required	Organised meeting at Luminary's Office, Email, Calls.	Luminary or Group Members

7.0 Skills and Knowledge Involved

7.1 Skills and Attributes Present

Name	IT Skills	Personal Skills & Attributes	Technical Skills
Jason Gerbes	Java, Basic Objective C & Swift, Word Processing, SQL, Algorithm Design & Analysis, Data Structures.	Perfectionism, Reliability, Communication, Determination, Dedication, Creative & Critical Thinking.	Project Management, Design, Collaboration, Time Management, Research, Literacy.
Joshua Son	Java, Word Processing, SQL, Algorithms, Data Structures, Mathematics.	Accuracy & Detail, Communication, Reliability, Creative Thinking.	Design, Research, Literacy, Time Management, Logical Thinking.
Paul Lee	Java, Word Processing, Excel, SQL, File Systems, HTML, PHP, CSS.	Cooperative, Hard Working, Communication, Open Minded, Flexible, Determined, Attentive.	Visual Learner, Time Management, Research, Prioritisation, Planning & Preparation.
Sean Young	Java, Basic Objective C, SQL, HTML, PHP, SQL, Basic CSS.	Communication, Optimistic, Loyalty, Determination, Creativity, Adaptability, Assertiveness, Team Work.	Time Management, Physical Learning, Project Management, Quality Control, Design.

7.2 Skills Required

IT SKILLS

Skill	Rationale
3D Modelling	Augmented Reality displays in 3D space, we need to understand 3D modelling techniques in order to develop AR content.
Android Development	It is possible that the application will be deployed on Android. We may need to understand Android development techniques.
API Use	We will need to understand the use of APIs when developing for a mobile platform. This will include accessing hardware systems, e.g. the camera.
Bitbucket	Bitbucket is a web based hosting service for projects that use revision control systems. We will use it to host our project code.
Data Storage and Deployment	We need to develop a deployment technique for the system which likely includes locally stored data and remotely accessed content.
GPS/Geolocation Implementation	The application may have a location based component. We will need to be able to implement GPS services if this comes to fruition.
iOS Development	It is possible that the application will be deployed on iOS. We may need to understand iOS development techniques.
UI / UX Design	We will need to be able to use effective UI and UX design techniques when developing the mobile application.
Unity Development	Unity will likely be our primary development program. Unity can deploy both iOS and Android versions of an application concurrently.
Vuforia Development	Vuforia is an open-source mobile vision platform used for interactive 2D and 3D AR applications. We will be using this as an extension of Unity Development.
Word Processing	We will be required to produce professional documentation through the project's development. Strong word processing skills are required.

TECHNICAL SKILLS

Skill	Rationale
Collaboration	As with any group initiative, collaboration is vital to the success of the project. We must work as an effective team to deliver at a high standard.
Communication	Communication across the group must be frequent and professional. Communication is a key element of collaboration.
Creative Thinking	We have been tasked with creating a system based on all-new idea. We must think creatively to discover new uses for AR.
Critical Thinking	The success of the AR system will depend on its usability and usefulness; if the system adds no value for the user, they will not use the app. We must think critically about our ideas to determine their worth.
Presentation	We will need to present our intentions, discoveries and progress to the panel of judges and to our client throughout the project.
Professional Conduct	As we are working with an external client, we must ensure that we conduct ourselves professionally.
Research	Research will be a key component of this project. We must employ effective researching techniques in order to develop our ideas.
Time Management	The duration of the project is relatively short. Good time management will ensure that we are able to deliver the product within our given timeframe.

7.3 Skills Currently Absent

Listed below are the skills currently absent from the group's combined skills and attributes:

- 3D modelling (marginal skills present)
- Mobile Application Development
 - Unity Development
 - iOS Development
 - Android Development
 - API Use
- GPS / Geolocation Implementation
 - Associated APIs
 - Accuracy Limitations
- Bitbucket
- Data Storage and Deployment Techniques
 - Local Data Storage
 - Remote Data Access
 - Data Compression Techniques
- UI / UX Design (marginal skills present)
- Vuforia Development
 - Vuforia SDK Usage
 - AR Content Management

7.4 Plan to Acquire Absent Skills

AUT STUDY

Relevant papers will be studied by members of the group at AUT during semester 1 and 2 of 2015. The skills, knowledge and experience gained will directly benefit the development of the project throughout the year. Lecturers will also be valuable resources of information and advice.

A breakdown of the AUT study plan is below:

Paper	Semester	Student(s)	Rationale / Relevant Skills
Distributed & Mobile Systems	S1	Jason Gerbes Joshua Son	Teaches skill relevant to mobile application development and data storage & deployment.
Applied Human Computer Interaction	S1	Jason Gerbes Joshua Son Paul Lee	Broadens understanding of how human behaviour impacts the use of computer technology. Improves UI / UX design skills.
Software Engineering	S1	Paul Lee Sean Young	Develops understanding of concepts and methods required for development of software intensive systems.
Software Development Practices	S2	Jason Gerbes	Extends software development skills into a team environment.

ONLINE MATERIAL

Online tutorial videos, courses and guides will be referenced to gain skills. Group members will complete training material independently, and then teach the rest of the group the new skill.

- Lynda.com - provides end-to-end courses to AUT students for free.
- iTunes U - provides courses from around the world (including top universities) for free.
- YouTube - has an endless amount of instructional videos from IT professionals.
- Khan Academy - provides free educational videos of all types.

RESEARCH

Traditional research sources will be referenced to gain valuable skills. We will access reputable, scholarly sources of research to strengthen our understanding. These sources include:

- AUT Library
- Auckland Public Library
- University of Auckland Library
- Google Scholar
- Science Direct (online)
- IEEE

LUMINARY PROMOTIONS

Luminary Promotions will provide education and assistance on development related queries. Ahmed will also be able to strengthen our marketing-related skills, which will be invaluable when designing the application.

Alexis and other developers will assist in the design of the UI and UX of the application, and will help to ensure that our outputted work is aligned with Luminary's strategy and brand image.

8.0 Estimated Costs Incurred

Disclaimer: The cost break-down below is indicative only and is subject to change. Values are accurate or based on reasonable estimates as of 25 March 2015.

8.1 Staffing Costs

Staff Member	Hourly Rate	Hours per Week	No. of Weeks	Total Cost
Jason Gerbes	\$ 20.00	10	20	\$ 4,000.00
Joshua Son	\$ 20.00	10	20	\$ 4,000.00
Paul Lee	\$ 20.00	10	20	\$ 4,000.00
Sean Young	\$ 20.00	10	20	\$ 4,000.00
Total Staffing Cost				\$ 16,000.00

8.2 Software Licensing Costs

Software Item	Notes	Annual Cost	Actual Cost
Android Developer Account	Already paid by Luminary	\$ 33.50	\$ 0.00
Bitbucket	Free for 5 users	\$ 0.00	\$ 0.00
iOS Developer Account	Already paid by Luminary	\$ 132.67	\$ 0.00
Lynda.com	Free with AUT account	\$ 250.00	\$ 0.00
Unity 5 Basic	Free version	\$ 0.00	\$ 0.00
Unity 5 Pro*	Free for 30 days	\$ 900.00	\$ 0.00
Vuforia	Open-source	\$ 0.00	\$ 0.00
Total Software Licensing Cost			\$ 0.00

- The features of Unity 5 Pro will likely not be needed during the development of the application. If for some unforeseen reason we do need Unity 5 Pro, the 30 day free trial should suffice.

8.3 Total Costs

Expense	Total Cost	% of Total
Staffing Costs	\$ 16,000.00	100%
Software Licensing Costs	\$ 0.00	0%
Total Overall Cost	\$ 16,000.00	100%

9.0 Glossary of Terms

Term	Definition
Agile (methodology)	A methodology for the creative process that enforces the need for flexibility and applies a level of pragmatism into the delivery of the final product.
Android	Android is a mobile operating system developed by Google.
API	Application Protocol Interface, is a set of routines, protocols and tools for building software applications.
Application / App	A software implementation which can be run on a device.
Augmented Reality / AR	A technology that superimposes a computer-generated image on a user's view of the real world (an overlay on the cameras view in our usage).
AUT	Auckland University of Technology.
BCIS	Bachelor of Computer and Information Sciences - an undergraduate study program provided by AUT University.
Client (Luminary's client)	A company who pays Luminary Technologies to market a product or service.
Client (the group's client)	The client of the BCIS Research and Development Project - Luminary Technologies.
Customer	A customer of the project — the user of the end application.
Deployment	All of the activities that make a software system available for use.
GPS / Geolocation	A space based satellite navigation system that provides location information.
Group	Jason Gerbes, Joshua Son, Paul Lee and Sean Young - the four AUT students working on the project.
iCloud	An online 'cloud' based web service host by Apple Inc.
iOS	iOS is a mobile operating system developed by Apple Inc.
Luminary Promotions	An Auckland-based promotions company and client of the BCIS Project.
OS X	OS X is a desktop operating system developed by Apple Inc.
Pages	A word processing application created by Apple Inc. Part of the iWork suite.
Project	Usually referring to the BCIS R & D project being proposed.
Research and Development / R&D	A general term for activities related to the investigation of activities that a business chooses to conduct, & the resulting development of new products.
SDK	Software Development Kit. A set of software development tools.
Supervisor	Roopak Sinha - A senior lecturer at AUT who supervises the project.
UI / User Interface	The system's human-computer interaction interface.
Unity	A cross-platform game creation system developed by Unity Technologies.
User	The user of the system. See customer.
UX / User Experience.	Referring to the experience that the user has with the software.
Vuforia	A mobile vision platform developed for Qualcomm to display AR content.
We	Usually referring to the group and perhaps other people (see group).
Wi-Fi	Wireless local area technology that allows computer networking.

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11.0 Disclaimer

Clients should note the general basis upon which the Auckland University of Technology undertakes its student projects on behalf of external sponsors:

While all due care and diligence will be expected to be taken by the students, (acting in software development, research or other IT professional capacities), and the Auckland University of Technology, and student efforts will be supervised by experienced AUT lecturers, it must be recognised that these projects are undertaken in the course of student instruction. There is therefore no guarantee that students will succeed in their efforts.

This inherently means that the client assumes a degree of risk. This is part of an arrangement, which is intended to be of mutual benefit. On completion of the project it is hoped that the client will receive a professionally documented and soundly constructed working software application, some part thereof, or other appropriate set of IT artefacts, while the students are exposed to live external environments and problems, in a realistic project and customer context.

In consequence of the above, the students, acting in their assigned professional capacities and the Auckland University of Technology, disclaim responsibility and offer no warranty in respect of the “technology solution” or services delivered, (e.g. a “software application” and its associated documentation), both in relation to their use and results from their use.