GNG1103 Report

Project Deliverable - F

Submitted by

Group B03-5

Briar Vandenberg, 300058322

Victoria Jancowski, 300203985

Lauren Healy, 300131780

Edwin Jazvac, 300211195

Maya White, 300117859

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University of Ottawa

Abstract

This report details the organization of a prototyping test plan to develop a product that ultimately fulfills the previously identified needs and design criteria of the client, EllisDon Construction, represented by Patrick Lalonde. The team plan includes identified objectives that should be achieved in the prototyping phase. Primarily, this report outlines the prototyping plan through the description of six focused prototypes (developed from previously identified subsystems) including detailed graphics to provide proof of concept. Furthermore, the testing summaries and feedback of each focused prototype are analyzed to ultimately determine where each concept needs to be improved or modified in future prototypes.

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1 Introduction

This report outlines a detailed prototyping test plan which was developed to fulfill the individual needs and subsystems identified in the previous phases of this project. Six focused prototypes are identified, organized, and explored through testing and analysis. It is important to note that prototyping will be done in stages beginning with this prototype; the alpha prototype, which consists of several focused prototypes. The focused prototypes are outlined in this deliverable and include the main menu interface, navigation toolbar, camera navigation system, multi-user interface and programming, safety warning pop ups, and a dimensioning tool. These prototypes are tested and appraised based off of client and user feedback. According to the plan, a comprehensive prototype will later be developed by combining and integrating the focused alpha prototypes. Then, within the last weeks of the design process, the third prototype will be the complete and fully functioning prototype which will be distributed to the client: EllisDon Construction, represented by Patrick Lalonde.

Table 1.1 Updated Design Metrics

No.	Metric	Units	Target Value
1	Ability to view 3D Building Information Models (BIM) in Virtual Reality.	Y/N	Y
2	Compatible with common Mobile Devices (iOS or Android).	Y/N	Y
3	Viewing of BIM is available offline and cloud syncing available online.	Y/N	Y
4	Ability to view 3D internal systems in BIM's in Virtual Reality.	Y/N	Y
5	Navigation and interface must be user friendly.	Subjective Rating*	6
6	In app safety reminders and warnings for hazards on work site.	Y/N	Y
7	Software application must be open source or free to use.	Y/N	Y
8	Training and implementation documentation must be provided.	Y/N	Y
9	Software application must be free to users.	$	0
10	At minimum be accessible in the form of a mobile application.	Y/N	Y

2.1 Prototype Objectives

Capture the reasons for the test, giving enough background information to justify doing any prototyping at all. Is the general objective one of: learning, communication, de-risking, etc.

In order to create an application that fulfills all the needs and criteria requested by EllisDon Construction, prototyping will be done in stages beginning with the alpha prototype which is several focused prototypes, then a comprehensive prototype will be developed by combining and integrating the alpha prototypes and then finally the third prototype which will be the complete and fully functioning prototype which will be distributed to the client.

The objective of the alpha prototypes presented in this document is to provide proof of concept as well as serve as a learning opportunity to address any risks that may arise with our fundamental concept. Prototyping and prototype evaluation is very important to creating the product which the client requested, it also gives the designers the opportunity to modify the concept early on in development in order to improve it.

What are the specific test objectives?

The ultimate purpose of prototyping testing is to confirm that the prototype fulfills the clients needs and reaches the target specifications. As well, the prototype should address the problem statement posed by the client; “Design a technology that allows construction workers to view all aspects of 3-D Building Information Models (BIM), including mechanical, electrical, structural and architectural systems in Virtual or Augmented Reality. The product should be cost effective, user friendly and accessible on all mobile devices.”

Testing will also serve as a learning experience to determine where our concept needs to be improved or modified in order to provide a seamless user experience while providing all the functionality requirements which the client asked for.

What exactly is being learned or communicated with the prototype?

This prototype is communicating and displaying several focused prototypes that are being used to provide proof of concept as well as allowing designers a chance to further enhance their base knowledge of all the capabilities of Unity. The six focused prototypes all represent a subsystem that was previously identified in the stage of concept generation, now they are being created to verify feasibility and functionality in the final prototype. Focused prototypes allow designers to save time in later development by isolating and testing subsystems of the main system.

What are the possible types of result?

The alpha prototype is thoroughly outlined and displayed in the following sections and is tested against the previously determined (and reiterated) metrics in table 1.1. The results of testing will indicate the strengths and weaknesses of the prototype based on the client's needs which were used in developing the metrics. The results of alpha prototype testing will indicate whether or not our concept is on the right track to satisfying all the client's needs.

How will these results be used to make decisions or select concepts?

The results of the prototype testing will provide crucial data that will largely influence further development. The results of each focused subsystem prototype will be analyzed to ensure that development of each concept will be an asset to the final prototype. If it does not fulfill its

purpose and provide the client with what they requested, the decision will have to be made to replace this subsystem with a new idea or one of the previously eliminated ones. As well, these results will be used to show the strengths of the design and aid in further development and integration of the focused prototype into a complete and comprehensive prototype.

What are the criteria for test success or failure?

In the case of the prototype testing outlined in this document, the metrics will be used to measure whether the prototype was a failure or a success. The focused prototype is a success if it fulfills its respective criteria and it is a failure and will need to be modified or replaced if it doesn't fulfill its required specifications.

2.2 Prototyping Process

Describe the prototype type (e.g. focused or comprehensive) and the reason for the selection of this type of prototype.

As aforementioned the prototype documented in this report consists of several focused prototypes. Each focused prototypes represents a previously identified subsystem, focused prototypes were chosen over a comprehensive prototype to ensure that each subsystem fulfills its purpose in the entire system and addresses its respective metrics. Focused prototypes allow easier identification of problems in early developmental stages.

Describe the testing process in enough detail to allow someone else to build and test the prototype instead of you.

The testing process will involve interaction with the developed focused prototypes in order to determine if they fulfill any and all associated metrics. In the case of the focused

prototypes outlined in this document, to execute prototype testing the tester would need to use unity and navigate through the individual scenes of each prototype and determine if it satisfies the metric of which the majority are yes or no answers.

What information is being measured?

The protypes competency to fulfill the client's needs is being measured based off of the metrics and specified target value.

What is being observed and how is it being recorded?

The prototypes features are being observed in order to determine if it satisfies the metrics outlined in this document. The results are being recorded by the designers in tabular format for each focused prototype and will be summarized in one single table.

What materials are required and what is the approximate estimated cost?

To produce the focused prototypes required at this stage no cost will be associated and no physical materials will be used. Only Unity and the Unity asset store will be needed to create prototype 1.

What work (e.g. test software or construction or modeling work or research) needs to be done?

The completion of prototype 1 will require independent research mainly into how to use Unity and its functionalities as well as further benchmarking where applicable and then

development in Unity. No external test software will be required to test this prototype against the metrics.

2.3 Prototyping Schedule

How long will the test take and what are the dependencies (i.e. what needs to happen before the testing can occur)?

Testing of this prototype will not require much time, since several focused prototypes were used each will be independently analyzed. Total time for testing of all the focused prototypes should not exceed one day. Before testing can occur, each prototype will need to be complete and in a presentable format in which it can be tested against its metrics.

A separate test planning Gantt chart can be created to help making sure that the testing fits with the overall project schedule or it can be defined as part of that schedule (i.e. as a sub-task).

In the previous deliverable a Gantt chart was created, in which subtasks were defined to account for prototype testing time to ensure our team stays on track with prototype development and testing. This schedule has been followed thus far without issues and we are on track for successful integration of the documented focused prototypes into a comprehensive protype for the submission of deliverable G on November 12th.

When are the results required (i.e. what depends on the results of this test in the project plan)?

The results of the testing of prototype I are required by November 5th for the submission of this deliverable which will also keep us on schedule for creating a comprehensive prototype by November 12th using the results of testing prototype I.

3 Prototype I and Prototype Appraisal

This section of the report thoroughly documents six focused prototypes with descriptions and figures. Each of these prototypes is then appraised using the metrics in table 1.1.

3.1 Main Menu

The first focused prototype is the main menu user interface. The main menu will be the home screen of the application and the first thing the user sees when they open the app. The main menu will allow the user to log in to their account or continue as an unregistered user as well as allow them to select whether they would like to work on line in which case they can import a file from the cloud or off line where they will be given the ability to import a file from the device. On the main menu screen there will also be a help button that will lead the user to a short tutorial on how to use the application as well as an FAQ page. The first prototype of the main menu home screen is in figure 3.1.1.

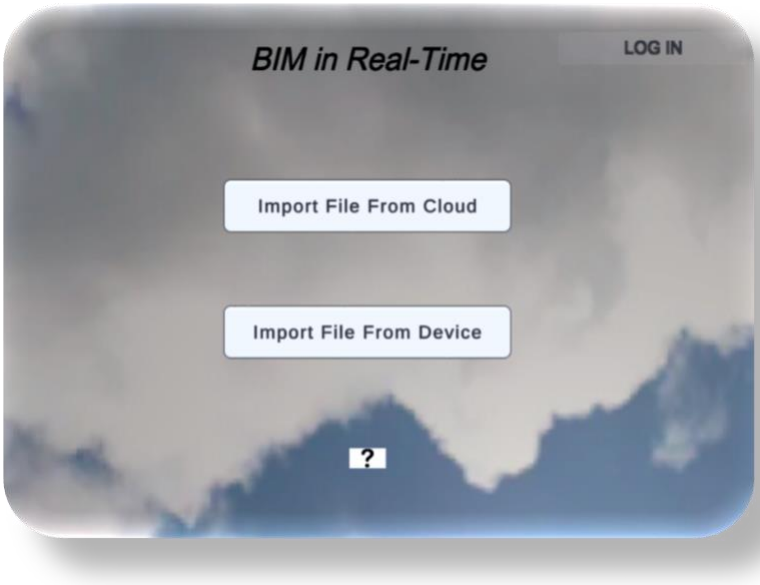

Figure 3.1.1 Main Menu User Interface

Table 3.1 Testing of Main Menu

No.	Metric	Unit	Target Value	Actual Value
3	Viewing of BIM is available offline and cloud syncing available online.	Y/N	Y	Y
5	Navigation and interface must be user friendly.	Subjective Rating*	6	7
8	Training and implementation documentation must be provided.	Y/N	Y	Y

3.2 Tool bar

The next focused prototype that was developed was the navigation tool bar. This tool bar will be the main tool the user will use to navigate through the app and perform many key functions while a BIM file is open. The tool bar will contain various icons which will give the user the ability to view dimensions, rotate or change their view, view different internal systems, add annotations, zoom in and out, a cloud sharing button, a help button that will link to tutorials and FAQ section and a settings menu to adjust lighting, quality and other accessibility settings. This prototype focuses on creating a tool bar that will allow the best possible user experience and seamless navigation through the interface, the tool bar will be a crucial piece in integrating all the focused prototypes into a comprehensive prototype. This tool bar was created in Unity and can be seen in figure 3.2.1

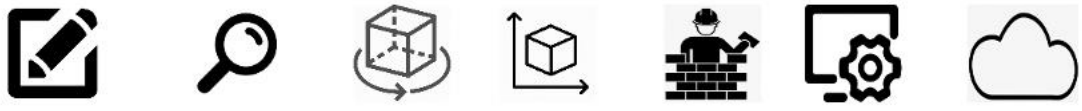

Figure 3.2.1 Toolbar

Table 3.2 Testing of Tool Bar

No.	Metric	Unit	Target Value	Actual Value
2	Compatible with common Mobile Devices (iOS or Android).	Y/N	Y	Y
3	Viewing of BIM is available offline and cloud syncing available online.	Y/N	Y	Y
4	Ability to view 3D internal systems in BIM's in Virtual Reality.	Y/N	Y	Y
5	Navigation and interface must be user friendly.	Subjective Rating*	6	9
8	Training and implementation documentation must be provided.	Y/N	Y	Y

3.3 Camera Angles

The third prototype developed was the various camera angles represented through augmented reality. The first camera view created was the real-time, augmented reality walk-through of the provided BIM files. The second, was designed as the aerial view of the BIM files in AR. These camera angles allow the user the ability to navigate the construction site, and view the various systems relayed by the BIM files, including structural, HVAC, electrical and plumbing. This design is central to the functionality of the identified subsystems in the subsequent reports. Images of the initial camera testing are included in figures 3.3.1 and 3.3.2.

Figure 3.3.1 : Interior camera view

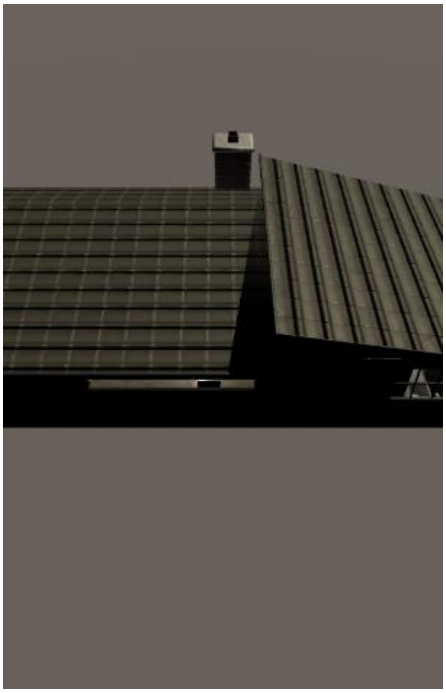

Figure 3.3.2 Aerial camera view

Table 3.3 Testing of Camera Angles

No	Metric	Unit	Target Value	Actual Value
4	Ability to view 3D internal systems in BIM's in Virtual Reality.	Y/N	Y	Y
1	Ability to view 3D Building Information Models (BIM) in Virtual Reality.	Y/N	Y	Y
5	Navigation and interface must be user friendly.	Subjective Rating*	6	8

3.4 Multi-User Interface

The fourth prototype developed was a system allowing many users to work on a single file in both online mode and offline mode. The app will have a save feature where all changes made to a file by a user will be saved locally or to the cloud (if connected to the internet). The changes made by every user will be amalgamated into one online save. With this, every future opening of that BIM model will have everyone's changes and notes added.

Figure 3.4.1 Save Menu for Multi-User Interface

Table 3.4 Testing of Multi-User Interface

No.	Metric	Unit	Target Value	Actual Value
3	Viewing of BIM is available offline and cloud syncing available online.	Y/N	Y	Y
5	Navigation and interface must be user friendly.	Subjective Rating*	6	8

3.5 Safety Warnings

An important aspect of the generated design criteria is the ability for the product to have built-in safety warnings. Specifically, the warnings act as notifications for the user to alert them of the required site-specific safety equipment, as well as other precautions or dangers in effect. As aforementioned, the safety warning will be site-specific and vary according to the site files in use. It was decided by the team that the safety warning would be most effective if it was presented initially when the app is opened, with a clear and concise message. The following graphic illustrates the planned appearance for the safety warnings in the product.

Figure 3.5.1 Safety Warning Notification: Safety Helmet

Figure 3.5.2 Safety Warning Notification: Protective Footwear

Table 3.5 Testing of Safety Warnings

No.	Metric	Unit	Target Value	Actual Value
6	In app safety reminders and warnings for hazards on work site.	Y/N	Y	Y
5	Navigation and interface must be user friendly.	Subjective Rating*	6	9

3.6 Dimensioning Tool

An important part of the design criteria is the dimensioning tool. The dimensioning tool will give users the ability to click on an object and view its information, measurements etc. And when clicked off screen the window disappears. All measurements and information will be put in before given users easy access. The team decided that this feature would be most effective as it is easy to navigate and provides the user with the most amount of information. The following graphic demonstrates the use of this feature.

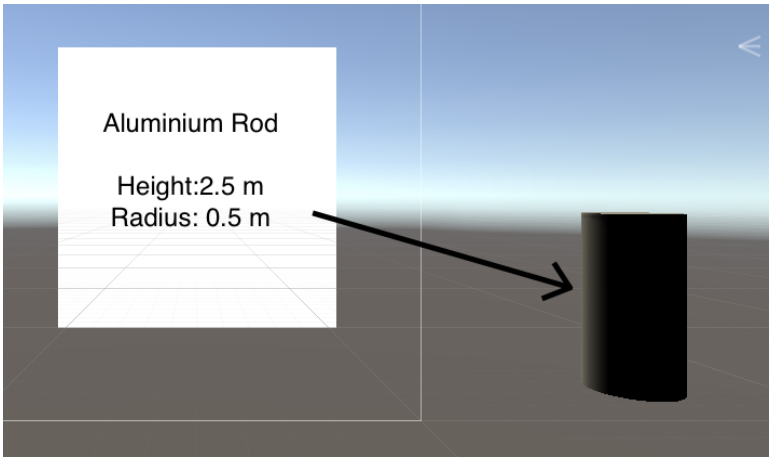

Figure 3.6.1 Dimensioning tool sample

Table 3.6 Testing of Dimensioning Tool

No.	Metric	Unit	Target Value	Actual Value
2	Compatible with common Mobile Devices (iOS or Android)	Y/N	Y	Y
3	Viewing of BIM is available offline and cloud syncing available online.	Y/N	Y	Y
4	Ability to view 3D internal systems in BIM's in Virtual Reality	Y/N	Y	Y
5	Navigation and interface must be user friendly.	Subjective Rating*	6	9
8	Training and implementation documentation must be provided.	Y/N	Y	Y

4 Prototype Testing Summary and Feedback

The results of the prototyping testing and appraisal indicated that we are on course for successful development, we were able to achieve all the functionality we anticipated with the focused prototypes. The focus of this prototype was to provide proof of concept and verify that

our proposed solution would fulfill the defined metrics. This goal was achieved as documented in section 3, the testing results are summarized in table 4.1

Table 4.1 Prototype Testing Summary

No.	Metric	Units	Target Value	Tested Value
1	Ability to view 3D Building Information Models (BIM) in Virtual Reality.	Y/N	Y	Y
2	Compatible with common Mobile Devices (iOS or Android).	Y/N	Y	Y
3	Viewing of BIM is available offline and cloud syncing available online.	Y/N	Y	Y
4	Ability to view 3D internal systems in BIM's in Virtual Reality.	Y/N	Y	Y
5	Navigation and interface must be user friendly.	Subjective Rating*	6	8
6	In app safety reminders and warnings for hazards on work site.	Y/N	Y	Y
7	Software application must be open source or free to use.	Y/N	Y	Y
8	Training and implementation documentation must be provided.	Y/N	Y	Y
9	Software application must be free to users.	$	0	0
10	At minimum be accessible in the form of a mobile application.	Y/N	Y	Y

This prototype was presented to the client in the third client meeting on November 6th, and we obtained very good feedback and thus far the client is very pleased with our progress. We have also obtained positive feedback from colleagues and peers, especially on our additional features we have begun implementing including the multi-user functionality, safety warnings and the dimensioning tool feature.

5 Conclusions and Recommendations for Future Work

In conclusion, the content of this report outlined the team objectives and the organization of a prototyping test plan to develop a product that ultimately fulfills the previously identified needs and design criteria of the client. It detailed and analyzed six focused prototypes: the main menu interface, navigation toolbar, camera navigation system, multi-user interface and programming, safety warning pop ups, and a dimensioning tool. Based on the testing summaries. the concepts of each focused prototype will be developed, and in the future will be combined to produce a functioning comprehensive prototype.