

# Requirements Document Draft

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# 1. INTRODUCTION

## 1. Purpose

This document describes the functional and nonfunctional requirements of MR Maintain being created by xRLucid. MR Maintain will allow users to view BIM models in mixed reality on a mobile tablet device. Allowing them to view and modify BIM information, as well as a full-scale 3D model of the structure overlaying the physical structure in the real world.

## 2. Scope

MR Maintain is a mobile application that will allow users to access and see full BIM models overlaying the physical models in the real world. The application will additionally allow users to modify maintenance information associated with the structure through an intuitive MR interface.

## 3. Product Overview

### 1 Product Perspective

#### User Interfaces

Android/iOS will allow hardware and software keyboard input to edit information.

#### Hardware Interfaces

No hardware interfaces are included.

#### Software Interfaces

Software Interface: Autodesk BIM 360

MR Maintain will connect to Autodesk BIM 360 using the Autodesk Forge SDK to access and edit BIM data.

Upon transmission of edited data, software will notify users of the transmission's status.

#### Communications Interfaces

No communication interface is included at this time.

#### Memory

The BIM file will be downloaded and stored on the device for the software to display the 3D model.

#### Operations

The device will utilize the camera to overlay objects from the BIM file to their real-life counterparts. The user will be able to select specific components to view a more detailed model as well as additional information.

#### Site Adaptation Requirements

The device's GPS and camera's sensors will be used to pinpoint the user's location in relation to the object being examined. The camera will be used to keep objects anchored and overlaid onto the real-world components while the user moves around and interacts with the virtual objects.

## 2 *Product Functions*

- FUNC 1: Connect to cloud interface for BIM.
- FUNC 2: Display 3D model from BIM overlaying real world structure.
- FUNC 3: Access and edit BIM maintenance information.
- FUNC 4: Submit edited BIM information to cloud.

## 3 *User Characteristics*

Maintenance Employee: The maintenance employee is the person/s that will be on site of a structure performing inspection/maintenance and logging inspection/maintenance data through MR Maintenance. They will also be viewing detailed BIM models over the real world structure. Training of employees may be needed.

## 4 *Limitations*

Limitations for the software include the use of mobile tablet device, restricting software to run on iOS and Android operating systems.

## 4. *Definitions*

Building Information Model(BIM)	3D model and data of a structure, recording all information from design to the structure's demolition [1].
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## 2. REFERENCES

[1] Autodesk.com. (2018). What Is BIM. [Online] Available at: <https://www.autodesk.com/solutions/bim> [Accessed 29 Oct. 2018].

## 3. SPECIFIC REQUIREMENTS

### 1. *External Interfaces*

The software needs to be able to connect to the BIM 360 database to download, update, and upload BIM files. The software itself can be used on any mobile device with a front-facing camera, accelerometer, gyroscope, GPS, and an internet connection.

### 2. *Functions*

#### a) *Validity checks on the inputs*

Using an on-screen keyboard in the software for input to prevent nonchar input errors.

#### b) *Exact sequence of operations*

- 1) Import/Load BIM from IFC files into the software.
- 2) Render a 3D model of the objects from the BIM file.
- 3) Pick anchor points in the real-world for the 3D model and match the virtual objects to the real-world structure based on the anchors.
- 4) Overlay the 3D model onto the real-world structure.

- 5) The software's 3D engine will keep the objects in position while the phone camera moves.
- 6) The user can select a specific component of the 3D model to get more information on that object.
- 7) Access/edit maintenance info from BIM.
- 8) Save new updated maintenance info to the cloud database.

*c) Responses to abnormal situations*

Error handling and recovery

Display an error message if:

- There is no backfacing camera on device.
- There is no accelerometer, gyroscope, GPS.
- No internet connection is available.
- The software is given an unreadable BIM file.
- Redo all checks if phone is locked then unlocked, relocate the device and re-anchor the objects.

*d) Effect of parameters*

Initial parameters of the software include the BIM model requested. This parameter impacts the 3D model to be rendered, as well as all information to be accessed from Autodesk BIM 360.

*e) Relationship of outputs to inputs, including*

The relationship of output and input for this software will be mainly the user's satisfaction of how the BIM model requested is presented. The client and users satisfaction will be the output for the performance of software application implemented. The functions in the software will be considered as the input of this sequence.

### 3. Usability Requirements

Some important usability requirements that our team has established based off of H.C.I. usability specialists in our team are to make sure that all functions and options of functions are in a 'recall' from experience instead of having the user 'learn' how to operate and use our application. This means we will be incorporating the functions in a way that will have the user understand where the settings and functions like it is second nature to them. Another target our team established for usability requirements is to make sure our overall application is as simple to operate as possible, this means on the homepage of the application will ask the user whether or not they would like to use the tablet function or others options.

### 4. Performance Requirements

- A single user will be supported for use of the software.
- Software will access and handle one complete BIM model with all relevant data.
- 90% of all 3D models will be loaded and rendered in no more than twice the time for equivalent models to be loaded in Autodesk Revit.
- 90% of all maintenance information transactions with the BIM 360 database will be processed in less than 5 seconds(allowance made for mobile device in the field as expected platform).

## 5. *Logical Database Requirements*

Information to be placed into a database will be placed utilizing the Autodesk Forge SDK. The SDK functions will manage inputs into the BIM 360 database. Data entities and their properties are governed by the BIM 360 system. Access to these entities will have a high frequency, estimated average of one access per minute of use.

## 6. *Design Constraints*

Some design constraints that may occur is that there may be a limited way of using BIM and putting it into only using tablet devices. A personal error and issue our team has realized that we may face is the fact that if we build this application there would be some contract complications with IOS hardware, where as if we used tablets powered by androids it would be easier and less constricting when creating our application and using it.

## 7. *Software System Attributes*

### a) Reliability

- Utilize Autodesk Forge SDK to ensure proper access to BIM 360.
- Connect to BIM 360 for proper storage of BIM data.

### b) Availability

- Update BIM 360 database after each edit in case of need for recovery after error.

### c) Security

- Require login for access to BIM 360.
- Assure privacy of login credentials.

### d) Maintainability

- User Interface, user position tracking, and 3D model rendering should be kept modular to not only support maintenance of the software, but support upgrade potential to future MR devices.

### e) Portability

- 50% of code, dependent on mobile device (i.e. phone, tablet) as hardware.

## 8. *Supporting Information*

- The problem to be solve is a lack of software to help maintenance employees visual maintenance information in the field with BIM models. This is to be considered part of the requirements.
- Software will be packaged using the Unity Game Engine to support all requirements of software deployment. This is not to be considered a part of the requirements.

## 4. VERIFICATION

### 1. *External Interfaces*

The software should be able to connect to the BIM 360 database with whichever device it is installed on. There isn't one specific device that must be used, as long as the device meets the software's requirements.

### 2. *Functions*

An on-screen keyboard will be provided for user input to prevent input errors. When inspecting an object, the user will be able to import a BIM file from IFC files after connecting to the BIM 360 database. After loading the BIM file, the user sets anchor points in the real-world using the device's camera. These anchor points help overlay the real-world object with the virtual model from the BIM file. When the user physically moves, the virtual objects will continue to be an overlay on the real-world components. Selecting a specific component on the device will display more specific information for the user. The BIM can be modified using this software, and the file itself can be updated and uploaded into the cloud database. We will need to handle different situations when the software isn't functioning properly. When the app is first launched, it needs to check if the device has all of the necessary hardware and features needed to use the software properly. If the phone is ever locked while the app is in use, it will need to relocate the device and where it is located compared to the object being inspected. This ensures that the object overlay isn't corrupted by a lapse in connection. The function of this software is to be used to streamline maintenance inspections with construction. The user will be inputting different changes they want to make to objects being displayed on their device while seeing their changes updating the object, as well as the BIM file if they choose to update it.

### 3. *Usability Requirements*

The overall usability and function of the software should feel familiar for users who are experienced using other infrastructure software. The software should be simple enough for new users to operate with little to no experience.

### 4. *Performance Requirements*

The software will be able to load and use one BIM model including all of the information that comes with the model. Most 3D models will be able to be imported and processed on the mobile device at no more than double the time that Autodesk Revit will be able to load the same 3D models.

### 5. *Logical Database Requirements*

Database system is controlled by Autodesk through the Autodesk BIM 360 system. As such, there is no verification required for this software.

### 6. *Design Constraints*

No verification required for existing design constraints.

### *7. Software System Attributes*

All tests involving BIM 360 integration will verify BIM 360 database, after inputs into the software, for updated values.

### *8. Supporting Information*

Software will have acceptance testing by a select group of Civil Engineering students and instructors who are given a survey as to how they felt about the software being useful for on-site visualization of BIM information and if they would consider using it in the future. This test will aim for 80% positive rating from surveys to verify that the software is useful for workers in the field.



## 5. APPENDICES

### *1. Assumptions and Dependencies*

Assumption 1: Users have access to Autodesk BIM 360 with BIM models in their account.

### *2. Acronyms and Abbreviations*

MR     Mixed Reality

BIM    Building Information Model

## 6. GANTT CHART

### MR for Infrastructure Maintenance Schedule

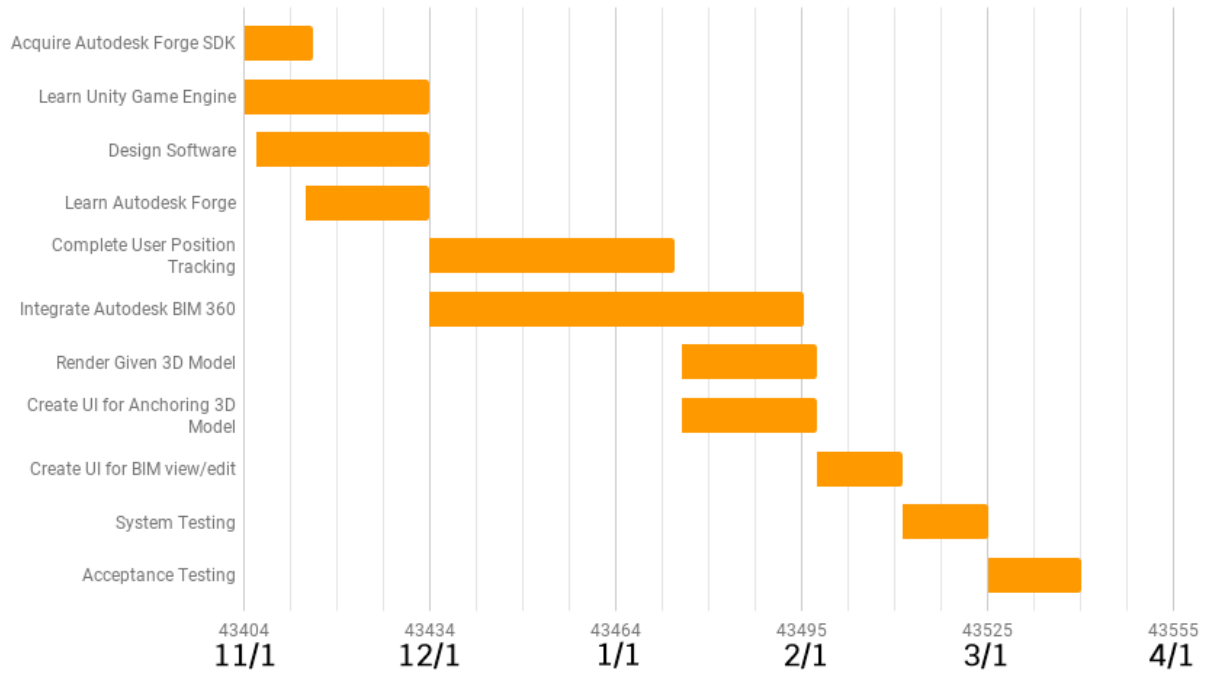


Figure 1. Tentative Schedule for Software Completion