Software Requirements Specification

for

Augmented Reality for Hydrology (Ver 2)

Version 2.0 approved

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Revision History

Name	Date	Reason For Changes	Version
First Draft	10/19/2018	Initial Draft of Document	1.0
Final Draft	03/06/2019	Final Draft of Document	2.0

1. Introduction

1.1 Purpose

The purposes of this document are to:
1. Identify the requirements for Augmented Reality for Hydrology (Version 2) which will cover all aspects of the software; providing enough information for the reader to understand the purpose of the project, how the user will interact with the application, and how the application will interact with external services.
2. Describe concepts that will help clarify the operations for Augmented Reality for Hydrology (V2).
3. Provide requirements that are necessary for the completion and operation of the product.

1.2 Intended Audience and Reading Suggestions

This document is intended for developers, testers, project managers, users, and the customer to understand the purpose, operation, and requirements of the project. The specific intentions for for the various readers and the suggested reading sequences are the following:
- Product Manager - Understand use and requirements of the product to help guide the development of said product; Recommended Reading: Section(s) 2 through 5.
- Developers - Understand what is required of the product and guidance to the implementation of the requirements; Recommended Reading: Section(s) 3 through 5.
- Testers - To understand the purpose and requirements of the product to guarantee proper functioning of the product; Recommended Reading: Section(s) 3 through 5.
- Customer - Guarantee that the product meets the customers needs; 1.3, 2.1, 4, 5

1.3 Product Scope

Augmented Reality for Hydrology (Version 2) is an Android application. The software retrieves scientific data from Jet Propulsion Laboratory (JPL) Watertrek database. Watertrek is a database that stores hydrology data retrieved from sensors in rivers, mountains, wells, etc or it calculates predictions given a set time period. With the implementation of Augmented Reality (AR), the software will provide a visualization of the various datasets provided by Watertrek. AR objects,

which are points of interest (POI) in the real world, rendered in the scene will open a door to a wider array of data. When a POI is selected, the program will then display a graph, a set of data related to the graph, and filters representing the selected POI's history data, allowing the user to filter time periods and different information for a given POI. Aside from the POI, the software will provide a way for the user to point their device in a specific direction and retrieve the height of the land within that line of sight. In the AR view the software will also generate a two and a half dimensional mesh that will mimic and blanket the surrounding land around the device.

The objective is to create an application that visualizes the datasets from the Watertrek database. Software will be used for educational purposes.

1.4   Definitions, Acronyms, and Abbreviations

Refer to Appendix: A

1.5   References

Title: Software Requirements Specification for Augmented Reality for Hydrology
Authors: Wilbert Veit, Christopher Hung Nguyen, Ernesto Padilla, Cuong Pham, Kaichen Zhou
Date: September 5, 2017

2.   Overall Description

2.1   Product Perspective

Augmented Reality for Hydrology (Version 2) relates to a website created by JPL that represents the hydrology dataset. The website is not a product available to the public since it requires credentials to gain access to it. Our product will use a subset of the data provided by JPL to provide an application for the public to use.

This product is a continuation of last years Augmented Reality for Hydrology Senior Design project. This product is unique to the market such that there is no other mobile application that implements JPL's WaterTrek database that represents its data in any way. The application, and the framework from last year, is meant to provide an interactive way for anyone to learn about hydrology from the scientific dataset provided by JPL.

2.2   Product Functions

2.2.1 Augmented Reality Function
      2.2.1.1 Computer generated graphics
      2.2.1.2 Provides visualization of POI(s)
2.2.2 Details Function
      2.2.2.1 Provide detailed information for selected POI(s)
2.2.3 Query Function
      2.2.3.1 Access Watertrek database with REST API calls
2.2.4 Local Database Function
      2.2.4.1 Store queried data onto devices local database
      2.2.4.2 Local database will populate data in the application

2.3   User Classes and Characteristics

This product does not have different levels of functionality based on a particular user class. There is only one general user class that will provide all the functionality that requires only general knowledge of using an android device.

2.4   Operating Environment

2.4.1 The application will run on an Android device with API 15 and above
2.4.2 The application will use the back facing camera
2.4.3 The application will need an internet connection
2.4.4 The application will use sensors to detect rotation
2.4.5 The application will need GPS Location enabled
2.4.6 The application will need OpenGL ES 2.0

2.5   Design and Implementation Constraints

2.5.1 Sensor Accuracy - Various devices have different quality sensors
2.5.2 Weak/Unstable Network Connectivity - May cause issues in retrieving data from database
2.5.3 Watertrek database - Database being down or REST calls that are needed are not provided
2.5.4 Device Performance - Need adequate performance from the device to render meshes and/or any other computer generated objects
2.5.5 Device Storage - Need for caching large amounts of data retrieved from database
2.5.6 Budget - Open source application program interfaces are the only option; paid services would help to improve performance

2.6   User Documentation

User documentation will not be provided with the delivery of the software. Hints may be provided in the application to assist with the ease of use of the program.

2.7   Assumptions and Dependencies

2.7.1 Android Device is assumed to have Android API level 15 or higher.

2.7.2 Android Device is assumed to have a working camera and location sensor.

2.7.3 Users are expected to have credentials from JPL to access the database on their devices.

2.7.4 User is expected to have a stable internet connection to retrieve data from the database.

2.7.5 Developers assume all necessary API calls are provided by JPL ,and are operating, for their database.

2.7.6 Developers assume access to the OpenStreetMaps API calls are continuously operating.

2.8   Apportioning of Requirements

2.8.1 App shall superimpose river network on the generated mesh

2.8.2 App shall superimpose snotel data on the generated mesh

3. External Interface Requirements

3.1 User Interfaces

3.1.1. The user interface shall be prompted with the loading screen upon executing the application.

3.1.2. The preliminary load shall request, upon first launch of the application, permissions that will be specified by the user.

3.1.3. Subsequently, the app shall immediately gain access to the device's camera, location services, and device storage.

3.1.4 Credentials/Login will prompt after loading screen.

3.1.5 Upon logging in, the main (camera) screen will appear with two buttons: one for preferences and one for elevation retrieval.

3.1.6 Upon selecting the preference button, or swiping from the left edge of the screen to the right, the preference screen will appear.

3.1.7 The preference screen shall include filter options for the billboards, range adjuster, and a login/logout button that will open the credentials page again.

3.1.8 After activating a filter in the preferences, the selected POI will appear in the main screen, allowing the user to click it.

3.1.9 Once a POI is selected, a details page appears with a graph, filters for the data, and an option to view all the data for the selected POI.

3.2   Hardware Interfaces

3.2.1 Android devices are the supported device types

3.2.2 Android devices with a back facing camera

3.2.3 Android devices with a location (GPS/GLONASS) sensor

3.2.4 Android devices with a magnetic sensor

3.2.5 Android devices with a gyroscope sensor

3.2.3 Android devices with internet access

3.3   Software Interfaces

3.3.1 Android devices with API level 15 & up

3.3.2 Android devices with OpenGL ES 2.0

3.3.3 JPL Water Trek API

3.3.4 SQLite 3.x.x

3.3.5 OpenStreetMap API

3.4   Communications Interfaces

3.4.1 HTTP GET

3.4.2 HTTPS GET

3.4.3 Water Trek credentials access

4. Requirements Specification

4.1 Functional Requirements

4.1.1. Application Requirements
    4.1.1.1 The application shall run on an Android device
    4.1.1.2 The application shall process permissions upon first launch.
        4.1.1.2.1 The application shall prompt for location permissions
        4.1.1.2.2 The application shall prompt for camera permissions
        4.1.1.2.3 The application shall prompt for storage permissions
    4.1.1.3 The application shall provide an interface for credentials
        4.1.1.3.1 The application shall disable functions that need the credentials if the credentials are incorrect
    4.1.1.4 The application shall provide an interface to select data types
        4.1.1.4.1 The application shall provide river data
            4.1.1.4.1.1 The application shall provide river flow rate information
        4.1.1.4.2 The application shall provide soil moisture data
        4.1.1.4.3 The application shall provide reservoir data
        4.1.1.4.4 The application shall provide well data
            4.1.1.4.4.1 The application shall provide DBGS information
            4.1.1.4.4.2 The application shall provide WSEL information
            4.1.1.4.4.3 The application shall provide water table depth information
        4.1.1.4.5 The application shall provide snotel data
    4.1.1.5 The application shall provide an interface to filter the range for the data
    4.1.1.6 The application shall provide a billboard for the data types
        4.1.1.6.1 The application shall allow the user to select the billboard
    4.1.1.7 The application shall provide a separate activity for the selected billboard
        4.1.1.7.1 The application shall provide a graph to represent time range data
            4.1.1.7.1.1 The graph shall represent mean respect to a range of time
            4.1.1.7.1.2 The graph shall represent standard deviation respect to a range of time
        4.1.1.7.2 The application shall provide a tool to filter dates
        4.1.1.7.3 The application shall provide a tool to filter data information for the data types
        4.1.1.7.4 The application shall provide a panel to view history data
    4.1.1.8 The application shall superimpose mesh objects onto terrain
    4.1.1.9 The application shall provide an implementation of OpenStreetMaps.

4.1.2. Mesh Function

4.1.2.1 The mesh function shall generate a mesh from the provided DEM data.
    4.1.2.1.1 The mesh function shall retrieve a Tiff file type
    4.1.2.1.2 The mesh function shall process the Tiff file
    4.1.2.1.3 The mesh function shall subsample the data from the Tiff file
    4.1.2.1.4 The mesh function shall send the processed data to OpenGL to be rendered

4.1.3 Line of Sight Function
    4.1.3.1 The line of sight function shall retrieve the devices roll
    4.1.3.2 The line of sight function shall retrieve the devices pitch
    4.1.3.3 The line of sight function shall retrieve the devices yaw
    4.1.3.4 The line of sight function shall retrieve the devices coordinates
    4.1.3.5 The line of sight function shall retrieve where the device is point at provided the previous parameters
    4.1.3.6 The line of sight function shall display the elevation of land that it's pointing to

4.2 External Interface Requirements

4.2.1 User Interfaces

    4.2.1.1 Credentials

        4.2.1.1.1 When inputting a password, the characters on screen should be formatted to be hidden.

    4.2.1.2 Filter Options

        4.2.1.2 The filter options of what to display such as mountains, rivers, soil moisture, rivers, and reservoirs determine which type of POI (Point of Interest) should be retrieved.

        4.2.1.3 The input for the type of data is that of an on/off button that will call a method retrieving its respective dataset.

            4.2.1.3.1 The output of this method is to fill the screen with the points of interest.

        4.2.1.4 Additionally there is a Range function that acts as a slider input in which the user selects a range between 5-25 kilometers.

    4.2.1.3 Details/Graph page

        4.2.1.3.1 The inputs of the details page is retrieved from the respective POI dataset.

        4.2.1.3.2 If applicable, the graph will use data that is conveyed in the details page as inputs to display its data.

4.2.2 Hardware Interfaces

    4.2.2.1 None of the hardware interfaces take in input from the user

    4.2.2.2 The hardware outputs the sensor readings respectively

4.2.3 Software Interfaces

    4.2.3.1 JPL Water Trek API

        4.2.3.2 The Water Trek API's purpose is to provide REST calls for hydrology related sensor data.

        4.2.3.3 The inputs for the API calls vary depending on which data type is being called upon.

4.2.3.3.1 Each input as well will vary on their input ranges

4.2.3.4 The output of the calls are returned in a JSON format.

4.2.3.2 SQLite

4.2.3.2.1 The query input revolves around the type of type of sensor data that is being called from the Water Trek API

4.2.3.3 OpenStreetMap API

4.2.3.3.1 The input for the OpenStreetMap API is the user longitude and latitude.

4.2.4 Communications Interfaces

4.2.4.1 HTTPS GET request

4.2.4.1.1 A secured URL connection is required to gain access and retrieve sensor related data from the Water Trek server.

4.3   Logical Database Requirements

4.3.1 Types of information

4.3.1.1 Scientific Data

4.3.1.1.1 Well Data

4.3.1.1.2 River Data

4.3.1.1.3 Snotel Data

4.3.1.1.4 Reservoir Data

4.3.1.1.5 Soil Moisture

4.3.1.1.6 Mountain Data

4.3.1.2 Line of Sight Data

4.3.2.1 Longitude

4.3.2.2 Latitude

4.2.2.3 Roll Angle

4.2.2.4 Pitch Angle

4.2.2.5 Yaw Angle

4.2.1.3 Mesh Data

4.2.1.3.1 Height values from Tiff image

4.2.1.3.2 Vertices transformations to be within range of -1 to +1

4.3.2 Frequency of use

    4.3.2.1 Scientific Data

        4.3.2.1.1 Entity values will be displayed whenever the user selects them in preferences.

        4.3.2.1.2 Upon selecting a billboard, a details page will open with the POI's relevant data.

4.3.3 Accessing capabilities

    4.3.3.1 HTTPS GET

    4.3.3.2 HTTP GET

    4.3.3.3 Scientific Data

        4.3.3.3.1 Accessed only through methods related to handling the scientific data

    4.3.3.4 Line of Sight

        4.3.3.4.1 Accessed only through methods related to handling the line of sight

    4.3.3.4 Mesh Data

        4.3.3.4.1 Accessed only through methods related to generating the mesh

4.3.4 Data entities and their relationships

    There are no relationships between the different types of data at the moment.

4.4   Design Constraints

4.4.1 Sensor Accuracy - Various devices have different quality sensors

    4.4.1.1 - Different devices may vary in range of accuracy based on hardware.

    4.4.1.2 - Different levels of sensitivity to electromagnetic interference.

    4.4.1.3 - Stability of gyroscope when experiencing accelerations.

4.4.2 Weak/Unstable Network Connectivity - May cause issues in retrieving data from database

    4.4.2.1- Slow network speed will cause lag in data being displayed

    4.4.2.2- Weak network connectivity will affect location services

4.4.3 Watertrek database - Database being down or REST calls that are needed are not provided

    4.4.3.1- Database being down will cause certain features to not work or be displayed

    4.4.3.2 - Database being down upon login will cause app to not run.

4.4.3.3 - Database calls that are not provided will limit or slow down production of the application

4.4.4 Device Performance - Need adequate performance from the device to render meshes and/or any other computer generated objects

4.4.4.1 - Using underperforming CPU and GPU might not be able to render meshes

4.4.4.2 - Wireless network chipset will load data slow

4.4.5 Device Storage - Need for caching large amounts of data retrieved from database

4.4.5.1 - Tiff files used for rendering meshes is large since it covers a large area, storing many of these will take up a large amount of the phones storage.

4.4.5.2 - Mesh models used to represent POIs will need to store vertex data.

4.4.6 Budget - Open source application program interfaces are the only option; paid services would help to improve performance

4.4.6.1 - Open source applications have limited functionality.

4.4.6.2 - Open source applications have poor performance since they do not have the same resources as paid services.

5. Other Nonfunctional Requirements

5.1 Performance Requirements

5.1.1 The application shall perform smoothly, taking at most 5 seconds to retrieve calls from the database with a good internet connection.
5.1.2 The number of simultaneous users, initially, should support two to three dozens.

5.2 Safety Requirements

5.2.1 User is expected to be aware of their surroundings.
5.2.2 User is expected to obey posted signs (ex. 'Restricted Area', 'No swimming','No Trespassing').

5.3 Security Requirements

5.3.1 User must have credentials for access to Watertrek database

5.4 Software Quality Attributes

5.4.1 Product should be adaptable by using model view viewmodel architecture.
5.4.2 Product should implement an object oriented design to be modular in which the modules are flexible for change.
5.4.2 Product should be correct as far as the sensor readings are correct.

5.5 Business Rules

5.5.1 Any individual can perform any function when using the product as long as they have credentials for Watertrek.

6.   Other Requirements

6.1 The scientific datasets shall be represented appropriately, with either graphs or charts, to allow users to understand the data.

Appendix A: Glossary

Augmented Reality (AR): A technique in computer graphics that superimposes (places) a computer generated object into a devices camera view to alter the perception of the real world.

Application Program Interface (API): Functions or methods for accessing software services or libraries.

Framework: One of the software deliverables from Augmented Reality for Hydrology (Version 1) that provides components to assist in the development of the AR objects in the application.

Hydrology: A study of the properties of earth's water, focusing on the movement of the water in relevance to the land.

Point of Interest (POI): A place in the real world that is represented by a computer generated object in the AR view of the program.

REST API: An API practice that uses HTTP or HTTPS request to GET, PUT, POST, and DELETE data from a database.

Watertrek: A database provided by JPL that stores Hydrology data and is accessible using a REST API.

Appendix B: Analysis Models

No analysis models are provided with this SRS.

Appendix C: To Be Determined List

No TBD references provided with this SRS.