Augmented Reality for Real-Time Visualization Requirements

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Abstract:

This project aims to develop a software for the microsoft hololens hardware that will allow our client Dr. Chris Higgens to view the results for concrete strain tests on the testing site without requiring a lab dissection. In order for our system to provide these services for our client we will need to devise and meet several requirements of functionality, usability, and performance. Certain requirements will be more important than others and as such, a higher weight will be put on meeting these requirements. To this end we will make metrics to test these requirements and make sure we have adequately met our goals.

1. Introduction

1.1. Purpose

The Purpose of our system is to provide a software compatible with the Microsoft Hololens that will allow the client to view the results of concrete strain tests on site. To do this we will implement an augmented reality application that when combined with the strain gauges will let the client see the information on the Hololens screen.

1.2. Scope

1.2.1. Deliverables:

The Project delivers a software application for the Microsoft Hololens. This software provides an interface to view strain within concrete through the use of strain gauges and augmented reality. Our project should work without needing to make any major changes to the way the test is performed, and rather act as an add-on or optimization tool for the current tests.

1.2.2. Functionality:

The Software should allow the user to don the Microsoft Hololens and initialize the software. Then during or after the test the Hololens screen should display a reading of the strain gauges allowing the user to view the data in real-time through augmented reality.

Figure 1

Example of a strain gauge with remote readout functions [1]

Data from these strain gauges should also be contextualized through a heat-map view of the slab of concrete allowing the user to see the movement of the strain gauge and wires through the augmented reality.

1.3. Product Overview

1.3.1. Perspective

The software will be made specifically for the Microsoft Hololens and use augmented reality to read in data from strain gauges. The strain gauges will be baked into concrete and then they will shift during the strain test of the concrete and take measurements. The software using

the Hololens' Mixed Reality software will then allow the user to see those measurements as well as a heatmap of their movement within the slab.

1.3.2. Functions

Our software has two primary functions it aims to provide to the client through the hololens:

Read in data from strain gauges embedded within the concrete, either through some kind of Mixed Reality functionality or through the use of a software providing wireless readout.

Map the movement of the strain gauges within the concrete slab and present that data to the user through the use of a heatmap and the Hololens' Mixed Reality functionality [2].

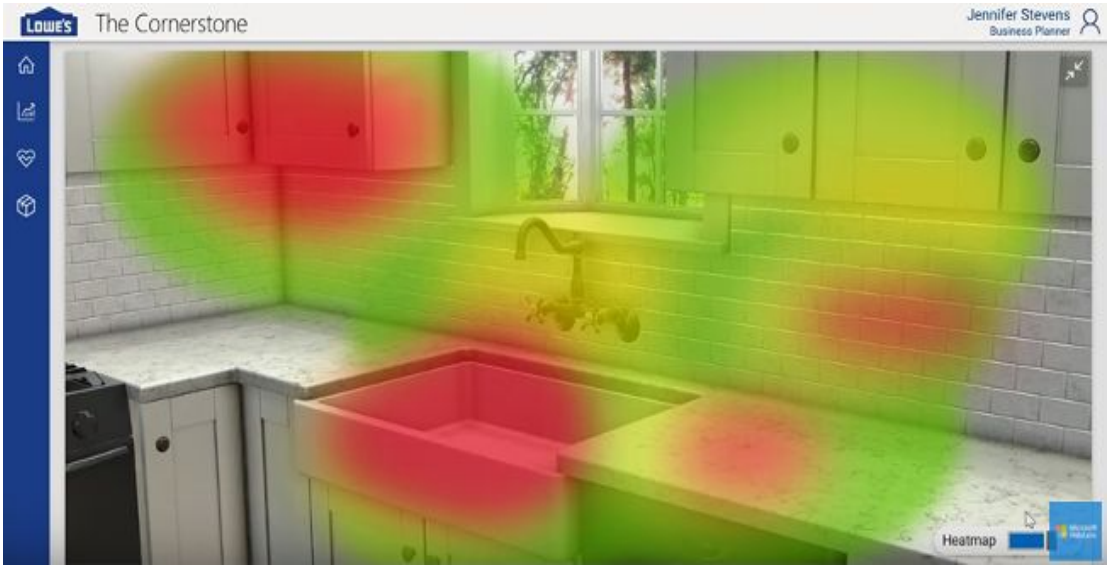

Figure 2

Example of a Mixed Reality Heatmap created with the Hololens

1.3.3. User Characteristics

Our client is Dr. Chris Higgins of the Oregon State University Civil Engineering Department. He wants the system to make concrete and timber strain tests more efficient and allow him and his team to make

changes to the tests on the fly rather than requiring a lab dissection to learn the results.

2. References

[1] E. Rite, “Strain Gauge: Principle, Types, Features and Applications”, May 8, 2019 [Online] Available: https://medium.com/@encardio/strain-gauges-are-an-important-geotechnical-tools-that-measure-strain-in-underground-cavities-8826098b957e [Accessed: October 18, 2020]

[2] J. Beinz, “Mixed Reality Analytics Sample”, February 2, 2018 [Online] Available: https://www.roadtomr.com/2018/02/02/2430/mr-analytics-sample/ [Accessed: October 18, 2020]

3. Specific Requirements

3.1. External

3.1.1. Strain Gauge

Our software needs to be able to interface with the strain gauges utilized by the Oregon State University Civil Engineering Department. These gauges will be provided by Chris Higgins and we will use features such as Bluetooth or Wireless to read information generated during the test and display the results directly to the Hololens.

3.2. Functions

3.2.1. Add/Remove Strain Gauge

The client must be able to pick which strain gauges to track for the sake of the tests. The software must be able to establish a connection with the strain gauge as well as be able to disengage from the gauge once the test for that slab has concluded.

3.2.2. Gauge Information Readout

The system must be able to read the information transmitted from

the Strain Gauge onto the visor of the Microsoft Hololens and display it for the user.

3.2.3. Heatmap View

The software must allow the user to utilize the mixed reality software to view a heatmap which displays the movement of the gauges and their components during the test. This functionality should be accessible at any time during the test process.

3.2.4. State Switch

The software must have the functionality to switch states between the Strain Gauge readout and the Heatmap visualization of the Gauge Movement.

3.3. Usability

3.3.1. UI Standards

The User Interface for our software should be simple and easy for users to pick up but also provide an efficient system that allows the client perform the functionalities they desire. We will adjust the software UI to the specifications of Dr. Higgens and his team.

3.4. Performance

3.4.1. Display Speed

Users should receive information quickly and efficiently during the test. Information should be displayed as soon as possible allowing the user to see the results in real-time.

Additionally, when the user switches between states (readout and heatmap) the change should be as fast as possible to allow the user to quickly shift when needed.

4. Verification

4.1. External

4.1.1. Strain Gauge

The strain gauge functionality will be verified once the hololens is able to receive the readout from the strain gauge, either through Bluetooth or Wireless and it can display this information on the Hololens Screen for the user to see.

4.2. Functions

4.2.1. Add/Remove Strain Gauge

To verify this feature the user will need to be able to add and remove a strain gauge from the softwares tracking. This function will be verified once we have adequately tested adding and removing a large number of strain gauges and are reading out properly.

4.2.2. Gauge Information Readout

Verifying this function will require the software to be able to render the gauge readout to the screen. To make sure this functionality is working properly we will make sure that the strain gauge values update during all stages of the testing process.

4.2.3. Heatmap View

This function will be verified once we can enable heat map view and see the strain gauges moving in real-time through the mixed reality software. We will need to make sure that the client can see the shift of the gauges as it happens.

4.2.4. State Switch

This is verified once the user is able to shift between readout mode and heatmap mode and vice versa.

4.3. Usability

4.3.1. UI Standards

This will be verified in two steps. First we will provide prototypes and design updates to our client and make sure that before we begin active development the software's UI design is desirable to the client.

Once we begin to roll-out the software we will meet again and let the client try it out in real-time to get feedback and make changes if necessary or desired.

4.4. Performance

4.4.1. Display Speed

To verify this requirement, we will run tests to make sure that the speed of switching between states is adequate through time-trials and repeated use during a single session of the software. Ideally this should take a few seconds at most.