Augmented Reality for Real-Time Strain Visualization: Technology Review

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Abstract

In order to properly develop the system software for the microsoft hololens the client Dr. Chris Higgins has requested, the team will be doing research into the technology topics necessary for the system. This document briefly covers the technologies needed to read in data from the concrete strain gauges, an overview of the heat map we'll be creating and what data it will use, and the kind of system we will employ to allow users to adjust their lab environment before a test. This document will then be combined with additional research from the team to create a basis for the project's technology going forward as development begins in earnest.

Introduction

This project aims to develop an application to view strain within concrete and timber structures using the microsoft hololens. Dr. Chris Higgins has requested a software that will allow him to view the movement of strain gauges within concrete and timber slabs effortlessly and make lab work faster and more efficient. In order to create this system the team will need to employ a multitude of technologies to make it work. One part of the project involves researching technologies that will deal with the strain gauge readout, the movement of the gauge within the heat map and the augmented reality mode that will let us add and remove strain gauges from the current simulation.

Strain Gauge Value Transmission

When using the system the strain gauge results should be read out and automatically send that information to the microsoft hololens for the user to view on their screen. This will allow users to quickly analyze the changes within the concrete quickly as well as watch the shift in the concrete through the heat map. To this end the software will implement technology that allows for wireless readout. The microsoft hololens has the ability to both connect to wireless networks as well as bluetooth devices in order to receive data readout, however the bluetooth functionality isn't as robust due to it mainly supporting mouse, keyboard and audio device functionality [1].

Strain Gauges come in many different sizes and shapes, with different functionalities as well. To make a well rounded system it must be able to handle multiple different types of strain gauges, however it is likely that the first iteration of this software will focus on the strain gauges provided through the client, Dr. Chris Higgins. For Strain Gauge readout, they can either be fitted with wireless receivers allowing for data to be streamed along a network, or they can be

physically wired to a computer or readout device that saves the data such as the Model EDS-12V Strain Meter [2].

Figure 1

Model EDS-12V Strain Meter, a wired strain gauge [2].

To this end the system will use the microsoft hololens api (which can make use of basic networking tools such as tcp [3]) to either receive the data transmitted from the stain gauge directly or to receive the data second hand from the computer or device that receives the readout from the wired form of the strain gauge.

Heat Map Mode

Users need to be able to access a heat map tracking mode through the use of a UI element with the system. This mode will allow the user to visualize the movement of the strain gauges within the slab of concrete and see how they move. This will facilitate faster and more efficient tests and allow users to see a graphical representation of what the movement looks like in augmented reality.

Heat maps are graphical representations of some kind of data which uses color to show density of data points within a particular area [4]. This can allow visualization for things like, where a mouse tends to hover on a website, or where a person's eyes look while watching a screen or entering a room as examples. Heat maps can be generated from a wide variety of data including location data, a good example of this using google maps timeline functionality to create a heatmap of a person's movement with a cell phone [5].

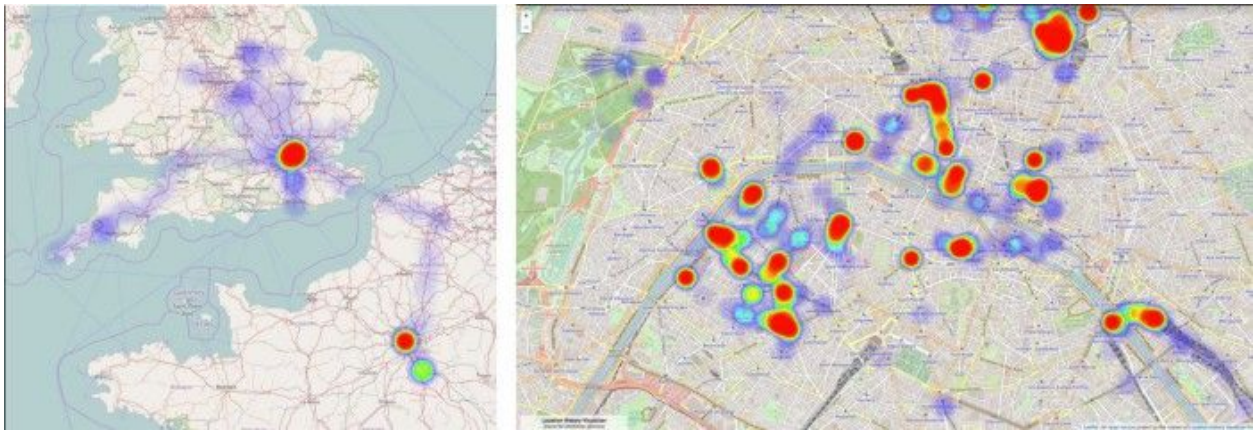

Figure 2

Heat Map Generated from Google Maps data

Using this technology the system aims to create a heat map visualization from the data that is pulled in from the strain gauges. Similar to the above example, it will map out the

movement of the strain gauges and project a model of the gauge moving through the concrete with a heat map color scale to show how long a gauge stays in each location it travels through.

Synchronization Mode Interface

For the system to properly function the team will need to implement a synchronization mode where the user will be able to use UI elements to add and remove strain gauges from the mapping software. Different sized concrete slabs will require the client to use different numbers of strain gauges to accurately measure the strain within the slab.

To do this, the software will make use of the Hololens 2 gesture technology for navigating to allow the user to add and remove gauges. The Hololens mixed reality will allow for the gauges to be seen as holograms and be interactable in real time through an interface within the software, and the client will be able to edit the projection to fit the test they are doing within synchronization mode.

Figure 3

Example of editing a hologram within the hololens 2 [6].

References

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