

CSE 564

Project Preliminary Report

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1 Project Title

Immersive visualization in Augmented Reality

2 Preliminary Progress Report

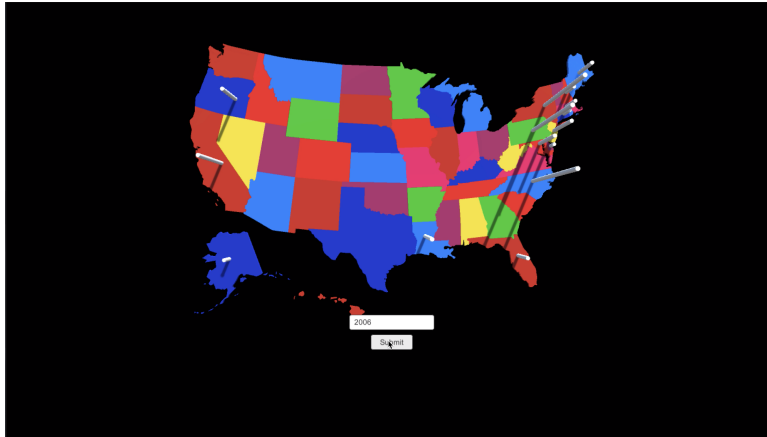


Fig. Projecting Hurricane data on USA Map. This map is 3D and projections are 3D as well

For our project, our objective is to augment information on a map of the USA. To this end, we are using Vuforia with Unity, which provides us with a platform to identify planes.

The task that we have so far been working on is to import a prefab of a 3D model map of the US into Unity, identify the states, and project the number of natural disasters per state as a bar chart protruding from each state. One can enter a year in the input field and the graph will update with the new values. The video demonstration of this can be found out on this link:

<https://drive.google.com/open?id=1qSIrFku-4EjBCkuxZz09KYjuB9raSTGS>

This demonstrates that we have been successful at identifying states on the prefab and charting information on it in a 3d model. This step will further allow us to plot more complex visualizations on the 3d model, including animations and particle system.

3 Remaining Work

We plan to render hurricanes using Unity's particle system, with different sizes/colors/intensities depicting different sizes of the affliction. We will also use Machine learning to depict predicted occurrences or intensities of natural disasters. After this, we intend to place the map as augmented reality on world on places like table top, mid air and walls.

4 Background

There have been lots of work in visualization using conventional tools like D3 and java script libraries.

Though, these are sufficient in themselves when it comes to creating powerful real world visualizations, we wanted to explore the abilities of Unity, a cross-platform real-time engine, which is gradually making its mark in various fields such as gaming, scientific simulations and medical field to create real world visualizations. This would further unlock the capabilities of visualizing information in three dimensions.

It is always nice to have a clear and interactive visualization placed in front of user view. It would be nicer if we could place this visualization anywhere we want, while dynamically changing the content based on the data or context. This can be achieved via Augmented Reality, a technology that superimposes a computer-generated image on a user's view of the real world, thus providing a composite view.

This provisions us to visualize data in 3 dimensions, and view from various angles. This is a provision that is bestowed by the fact that, unlike conventional screens, visualizations projected on the world are in three dimensions by nature.

We find validation in the idea behind our project by the fact that a similar work by Ssin et [1] has recently been accepted in IEEE VR 2019 as a conference submission. Their proposal, to visualize data using hololens is reassuring, in that we know that our work into this nascent field is on the right track.

5 Problem

The aim of the project is to create visualization imposed on the real world using Augmented reality. We plan to use Unity tool for this problem. The engine has support for the following graphics APIs: Direct3D on Windows and Xbox One; OpenGL on Linux, macOS, and Windows; OpenGL ES on Android and iOS; WebGL on the web; and proprietary APIs on the video game consoles.

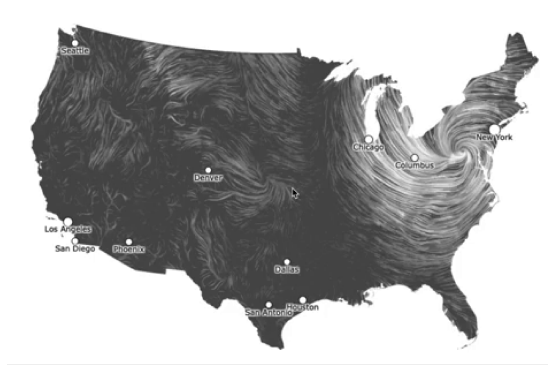


Fig. [2] Historical data of wind flowing over various US states.

6 Datasets

We are planning to combine or use one of the following two datasets which we will use to create our visualizations.

1. The first data is about storm events taken from National Centers for Environmental Information. The dataset contains storm (hurricane) events in United States from January 1950 to January 2019, as entered by NOAA's National Weather Service (NWS). Bulk data are available in comma-separated files (CSV). Please visit this url to view the dataset:[3] <https://www1.ncdc.noaa.gov/pub/data/swdi/stormevents/csvfiles/>

2. The second dataset is about flooding occurring in the United States. It provides latitude, longitude, number of annual occurrences of flooding per state. The data is in an xlsx format, on the FEMA website, and is aggregated from different sources, which are cited in the dataset. One can view the dataset on the link below:[4]

<https://www.fema.gov/data-visualization-disaster-declarations-states-and-counties>

7 Approach

Our approach will be following:

1. We have planned on the two datasets, information about which has been presented in the previous section.
2. We will create the visualization using Unity where user and this will be superimposed on reality, i.e. user can simply open an application on its mobile phone and she can see the visualization of the dataset on the plane of her choice. The projection plane will be selected buy touch on phone screen. After choosing the plane, she will be able to interact with it using her mobile phone, focus on a specific information and view the visualization from different viewpoints as the created visualization will be three dimensional. Following image demonstrates how this visualization will appear to the user.

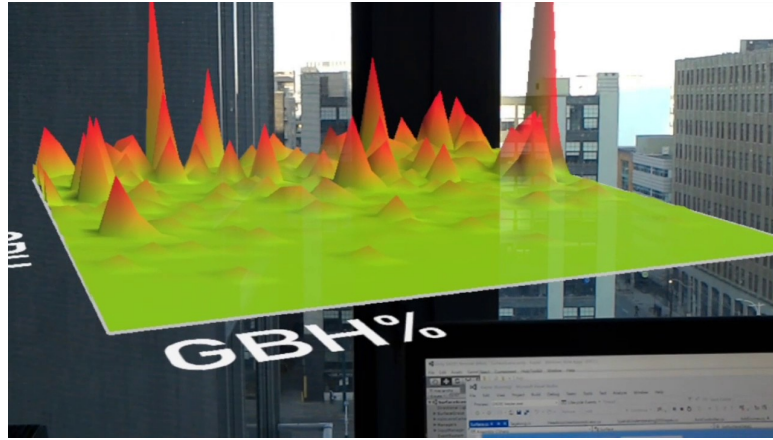


Fig. [5] Projecting visualization on real world using Augmented reality.

3. We plan to project our visualization on multiple planes that user can choose from. This means that user will be able to select the plane where she can project the created visualization. This plane can be a tabletop, a desktop, a whiteboard or any horizontal plane.

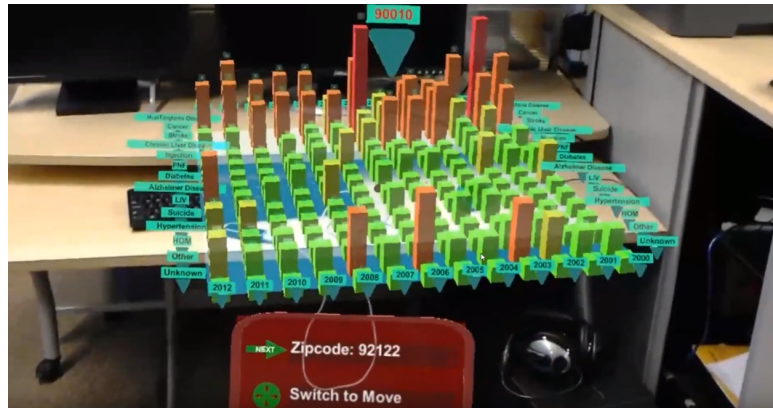


Fig. [6] Projecting data on several planes, eg. On Table top.

8 Visualizing the data

We aim to use datasets about hurricanes or floods in the US. In order to visualize, the user will point his/her mobile phone at a physical map of the US. The application will identify parts of the map, and will overlay historical information about hurricanes on the map. One can playback a video depicting the the hurricane occurrence as a function of time. Through this, one can gain a deep insight into the occurrences of hurricanes by simply pointing a smartphone camera at a map. This can be further extended for rainfall visualization, flight data visualization, crime, among other things.

9 Future Scope

We plan to extend our work and take our work to be visualized using Microsoft Hololens or MagicLeap so that the user can also interact with the visualization not just by touches on phone screen but also using hands and eye gestures. Hololens provides users the capability to interact with the augmented world like she interacts with real world objects. Currently, in our project we will be using the touch on phone screen to project our visualization on multiple planes. With tools like Hololens or MagicLeap, we will be able to give user the capability to interact with the visualization at the exact place where it is being projected.

References

- [1] <http://ieeevr.org/2019/program/papers.html> <https://www.youtube.com/watch?v=Tomeu5qQqxU>
- [2] <http://hint.fm/wind/gallery/oct-30.js.html>
- [3] <https://www1.ncdc.noaa.gov/pub/data/swdi/stormevents/csvfiles/>
- [4] <https://www.fema.gov/data-visualization-disaster-declarations-states-and-counties>
- [5] <https://medium.com/@wanze.xie/mixed-reality-data-visualization-tool-on-hololens-bceba2d37027>
- [6] <https://www.youtube.com/watch?v=Tomeu5qQqxU>