All the way USA!

Design Documentation

Mojo james

Contents

Introduction

This document shows the processes behind creating a visualisation that creatively presents data that is generally difficult to imagine without visualisation. This document also justifies some of the design choices used and critically evaluates the final product.

Subject Matter

The subject matter chosen to be visualised is the United States geography and general information. This subject was chosen as there seems to be a gap in the market when it comes to learning all the state names and capitals which seems to be a feat that many Americans and non-Americans wish to accomplish.

Software used

The software used to create the visualisation was mainly Unity 3D (a game engine) and 3DS max (a 3D modelling software). However, CAD Exchanger was used to convert model types and the 3rd party software Vuforia is used within the application to make use of augmented reality.

Goals of the Product

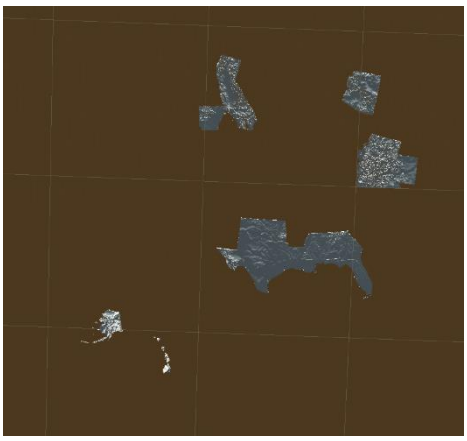
- Display an accurate map/model of the USA.
- Correctly display the location of the capitals of each state.
- Present information about each state when triggered to do so including:
  - Flag Image
  - Seal Image
  - Generalised information about the state
- Contain name plates that allow the user to easily identify parts of the map.
- Can test the user's knowledge of the state names, flags, and capitals in a quiz like mode.
- Have augmented reality functionality that is easy to use.

Design Justification

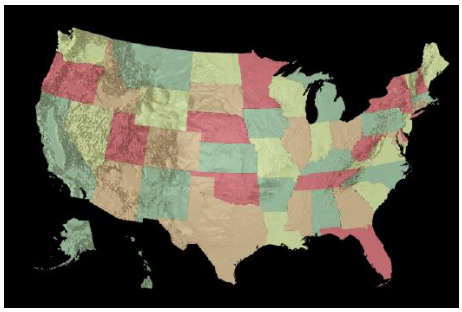
Map of America

Model

A multitude of models put together to make a map of the United States of America was the chosen method to display an accurate map. It was chosen due to being accessible as the models were created for 3D printing and can be found at this link: https://www.thingiverse.com/thing:1524543. This method was also chosen as it can clearly show the height discrepancies across the USA and the sear difference between the east and west. Having separate models for each state was also a critical factor into why this method was chosen as without the separation the pressing of each state for the test and information trigger would be harder to implement. The models were downloaded from the link, converted with CAD Exchanger, and then placed into the app by hand. This is an image showing said part of this process:



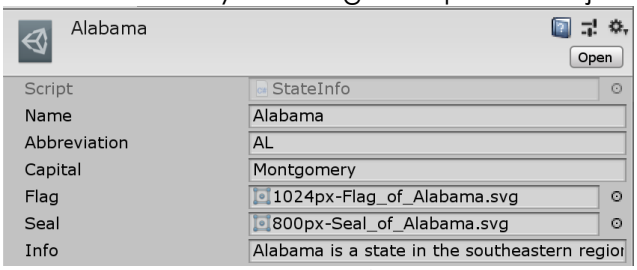
Texture



Once the model was imported to the project it seemed to be lacking distinction between states. Thus, a coloured material had been added to each state to allow for clearer state borders. However, due to the model having a height map which caused some users to question what the higher parts of the model indicated a high-resolution satellite image of the USA was used to texture each model instead. The images were sourced from Shutterstock. Using a texture required each model to be UV mapped to the image which is when 2D artwork is placed on a 3D object as demonstrated by Chang (2006). This was done using the software 3DS Max.

Data Entry

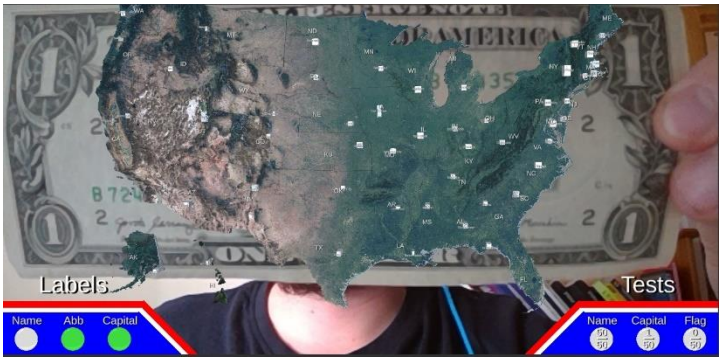
To achieve the goal of presenting information about each state the app needs access to a database or a data entry containing the information. The ideal approach would have been to query the Wikipedia API to have the app have up to date accurate information. However, a manual approach was opted for as to avoid learning the nuances of said Wikipedia API as the manual approach was simplistic and could be implemented easily. This was done by creating a scriptable object (data structure) that contains fields for each piece of information needed for the designer to fill in for each state. This data entry interface field is shown here:



This design minimises "garbage in garbage out" by only allowing the correct type of data in each field for example only images in the flag field which makes data entry more efficient as shown in by Sutcliffe (1988). The user interface is populated from this data structure when called upon.

User interface

The main points of the user interface are:



- Toggleable labels that automatically swap if the opposite label is pressed for example if the name of a state is displayed and then the user toggles on the abbreviations the name of each state will animate out and the abbreviation will animate in. The buttons also have memory so that the user's preferences are remembered and loaded up on start-up.
- All elements are animated for closing, toggling, and opening with the accompaniment of sounds. The animations created follow the principles of anticipation and follow through which make the animations seem more realistic as explained by Thomas and Johnston (1984).
- Whilst in testing mode the bottom buttons get disabled as to not accidently leave testing mode.

- Each state on the map is used as an actual element and thus can be pressed. Whilst in testing mode the states change material to indicate if the user is correct or not. If the user got a state correct or incorrect it will stop the user from pressing said state another time thus minimising aggravation of double tapping or not being able to answer the test as eventually there will only be one correct option left to pick from.

The user interface went through several iterations throughout the project. The first iteration had greyscale colours, but this was quickly changed to fit the theme of the application better to red white and blue like the American flag. The "Labels" and "Tests" titles were also a late addition to increase the readability and shorten the time it takes for the user to understand the applications functionalities. Another iteration that occurred was the general alignment of elements as the flag and seal section did not line up with the information panel and the buttons in the bottom corner had no uniformity and thus was corrected to make the project seem more professional and crisp which is what good alignment is said to do as described by Brown (2020).

AR ease of use

Gestures

One main gesture that was added to the project is pinch to zoom. This allows the map to be scaled easily and intuitively. The main benefit of this is that the user does not need to move their phone closer to the dollar bill to select a state as you can just zoom in instead. This seems to be an intuitive way to add this gesture as it is the same for zooming in on most phone applications for example image zooming and webpage zooming. Quigley (2013) goes into depth about prevalence of pinching to zoom in the conference proceedings he produced which backs up my statement. Here is an example of the zooming in action:

Dollar bill as anchor

A one-dollar bill was chosen as the augmented reality anchor point due to it being a common and distinct item in the region that this application is marketed for. An anchor point was opted for due to its ease of use and it saved time creating surface detection script it also means that the object has permanence meaning if the user moves away they model will stay in place as explained by Jakl (2018). Vuforia was used to handle the augmented reality part of this application. Vuforia was chosen as it seemed like the best choice for compatibility due to it being able to run on older smartphones that do not have access to AR Core which would have been the alternative.

Future Improvements

- The model used for the map does not contain south east Alaska due to it being a model for 3D printing and that part of the state being too finicky to print. Thus, the addition of south east Alaska could be an improvement.
- A better solution to displaying the score of the tests as the readability on the buttons seems quite poor.
- A pop up element for when you finish a test indicating your score as currently there is no popup and only saves the highest score meaning you cant see what you get if you get lower than the high score. Within the pop up there should also be motivational messages like "Keep going you almost got it!" depending on the score you got to help keep the user engaged with the application.
- A gesture to move the whole map around could be added to help with accessibility as it is hard to press the states on the edge of the map.
- Better sound design could be introduced to increase immersion.
- More thorough bug testing could be implemented to allow any potential bugs to be pinned down and ironed out.

References

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