An Applied Game for Flood Mitigation: Automated level Generation

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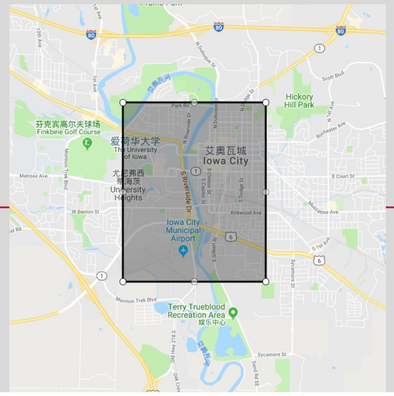
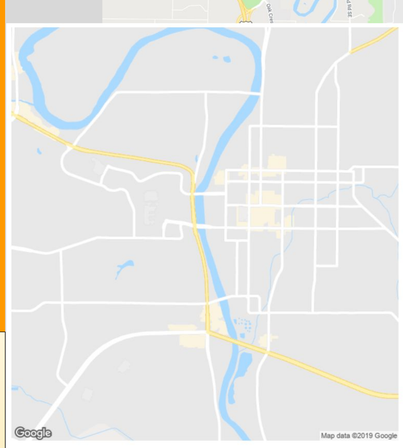
Background

- Flood simulations have long been a concern to both conduct studies and raise awareness for such studies on open sourced sites. Though it had been conducted before, this study seeks to create a simulator in a online video game format that would semirealistically demonstrate a terrain on the bank of a river during the time of a flood.
- It is shown that such studies are able to raise awareness among individuals not previously acquainted with the topic, as show by a study conducted on students. (Felicio et al., 2014).
- A previous system called Stop Disasters was an inspiration for the design of the game, though with several modifications (Blasko-Drabik et al., 2013).
- The program is created mainly with JavaScript with HTML. The JavaScript reads from the Google Maps API and is central to most of the programming involved in the designing of this game.
- The project is divided into two sections, one section for autogenerating a level of the player's choice and another for laying out the graphics of the level per information from the first section. This study seeks to complete the former.

Method

- The generation of levels requires the program to read the pixels of the map and generate a corresponding map. The process of generating a map is beyond the scope of this presentation.
- The program generates on click a region on the map that can be manipulated by the player to conform with the player's desired playing field. The player selects the desired region allows the program to analyse the region. This is done by converting the Google Maps into a static image suing the Google Maps Static API. The program removes labels and minor roads to allow for ease of analysis.
- The program divides each pixel into a rgba (Red-Green-Blue-alpha) value and identifies it as a type of terrain since the map already colors it. These can then be processed by the game and generated into a level. The division into terrain types is precise since for most of Google Maps similar types of constructions (i.e. buildings, roads, etc.) are marked with similar colours, though there are exceptions.
- The terrain types can then be mapped to a tiling system and tiled into a game level. That is the main involvement of the second section and is beyond the scope of the first.





rgba(232, 232, 232, 1, land)

```
function pick(event, type) {
  var x = event.layerX;
  var y = event.layerY;
  var terrain = ["water", "building slot", "pavement", "
    land", "nothing"];
  var pixel = ctx.getImageData(x, y, 1, 1);
  var data = pixel.data;
  if (data[0] == 170 && data[1] == 218 && data[2] == 255)
     {
    type = terrain[0];
  } else if (data[0] == 238 && data[1] == 238 && data[2]
    == 238 || data[0] == 254 && data[1] == 247 && data[2]
     == 238) {
    type = terrain[1];
  } else if (data[0] == 255 && data[1] == 255 && data[2]
    == 255 || data[0] == 255 && data[1] == 242 && data[2]
     == 175) {
    type = terrain[2];
  } else if (data[0] == 0 && data[1] == 0 && data[2] == 0
    ) {
    type = terrain[4];
  } else {
    type = terrain[3];
  }
  var rgba = 'rgba(' + data[0] + ', ' + data[1] + ', ' +
    data[2] + ', ' + (data[3] / 255) + ', ' + type + ')';
  color.style.background =  rgba;
  color.textContent = rgba;
}
canvas.addEventListener('mousemove', pick);
```

Examples

(Top Center) The program analyses the pixels of the image and maps them to an array defining the terrain types. It then returns the rgba values of a pixel and the terrain type it maps to. Since in Google Maps with labels removed separate terrains are indicated with colour, it becomes possible to identify them this way. The result is show in the demonstration designated by the arrow.

(Center) The selection of a Google static image on the map and the analysis of the pixels as demonstrated in the code above are shown. The selecting section is draggable and editable by mouse movements and is therefore flexible. The selection also results in the program analysing the pixels of the static image and identifying the type of block represented by the pixels, as show.

Further Developments

- The two sections of the game remain to be integrated.
- Certain aspects of the game remain incomplete and require modification in order to make it sufficiently realistic. Several other serious games have already become sophisticated enough such that they are realistic on a 3D scale (Khoury, et al., 2018).
- Details regarding the workings of a disaster remain to be implemented.
- The program has inaccuracies with mapping since there are exceptions to colouring on Google Maps with some of the pixels marked with unusual rgba values between an ordinary value that can be identified and a generic tile.

Sources

- Felicio, S.P.A.S., Silva, V.S.R., Dargains, A.R., et al., 2014, Stop Disasters Game Experiment with Elementary School Students in Rio de Janeiro: Building Safety Culture, Proceedings of the 11th International ISCRAM Conference.
- Blasko-Drabik, H., Blasko, D., Lum, H., et al., 2013, Investigating the Impact of Self-Efficacy in Learning Disaster Strategies in an On-Line Serious Game, Proceedings of the Human Factors and Ergonomics Society 57th Annual Meeting.
- Khoury, M., Gibson, M., Savic, D., et al., 2018, A Serious Game Designed to Explore and Understand the Complexities of Flood Mitigation Options in Urban–Rural Catchments, Water.