SOAP Collaborative Assignment
Stage II - Inception

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CSC 415 -- Software Engineering

Problem Statement and Objective

One of the key features of SOAP is the data visualization module that can be accessed from the navigation bar. Data visualization allows for users to make sense of a large data set quickly and at a glance. SOAP currently has a Google Maps API implemented that allows users to search for specific facilities based on information like facility name, address, danger level, and longitude/latitude coordinates. Beyond that, the data visualization features of SOAP are highly simplistic and do not allow a user to draw conclusions about New Jersey's pollution from macro perspective.

A major problem in the current implementation of the data visualization module is it assumes that a user knows what he or she is looking for. An objective we hope to accomplish with the module is to provide an overview of the pollution of New Jersey and to bring the attention of the user to areas that are highly affected and need immediate attention. From there, a user can then dive deeper and use the other features on the site to research and draw his or her own conclusions.

Description of the module

The module we are designing is an implementation of a heat map to better show correlation between the data that SOAP has access to. In order to do this we're making a scalable heat map module that allows for different data points to be mapped. Since heat maps are the individual points of a matrix represented by a color it allows us to create a versatile module. So in order to map a specific data tag we have to develop an algorithm to correlate data points into matrixes. Once the data points are grouped together into matrixes they could easily be mapped by our heat map module. An example of a heatmap can be seen in Google Maps heatmap API JS tutorial. The scalability of this Heat Map module is not limited to only current data tags, as the SOAP grows so will this module with very little overhead.

Statement about the importance and need for the module

The heat map module will give all users of SOAP improved visualization of the data already held within the SOAP database. By having this module it will allow prospective homeowners and parents the ability to visually see where the highest concentration of carcinogenic chemicals are in relation to their future home. Being able to display just carcinogenic chemicals easily gives parents the ability to make sure their children grow up in the healthiest environment. This could be easily changed to also see the concentration of a given chemical, or chemicals all used by a specific facility. Given the nature of heat maps this module would be beneficial for all users of SOAP. For policy makers to see where an abundance of particular chemicals are grouped up. A place for manufacturing companies to find locations already to polluted for residential areas to ensure they don't pollute any or grounds. This could

also help with farmers finding which grounds are best for certain crops. This module only gets more use as more data is imported into SOAP.

Other similar systems / approaches

There are other developed systems with functionalities similar to the ones we wish to implement in our project. One is a US Air Quality Gradebook created by Creativemethods.com. On this platform, users are able to view the air quality levels of the different counties in all 50 states, represented by heatmaps based on the "emission" and "ambient" gradesheets provided on the website. The information represented on the maps and gradesheets; however, are based off of 1999 data obtained from the EPA online database and is therefore out of date.

Another developed system is the Air Quality Index (AQI) map created on AirNow.gov. On this platform, users are able to view up-to-date air quality forecasts, provided by the EPA and other state and local monitoring agencies, for the current day or for the following day, depicted through heatmaps. The map and forecast data shown are collected using federal reference or equivalent monitoring techniques or techniques approved by the state, local or tribal monitoring agencies. This map also features the individual pollution ratings of cities all over the country.

These systems are similar to the one we wish to implement in our SOAP module because they provided visual representations of processed data. Much like the map provided by Creativemethods.com, our map aims to distinguish the pollution levels of segmented regions of an area; however, our map would would show pollution levels as more of a gradient depiction. This model also fails to provide information relevant to today's data. The map provided by AirNow.gov uses similar methods of rating areas for pollution that we will be implementing in our project, as every individual city is given an AQI rating that contributes to macro-scale depictions of pollution levels through use of heatmaps.

The purpose of a heat map is to represent data using colors to show the different levels of use. Heat maps are easy to understand because dark colors show little usage and bright colors show high levels of use. Our heat map feature is innovative because it allows for people to analyze an area of land that has not been tested by looking at the surrounding land. A person looking to buy a piece of estate could look at our map and draw a conclusion on its level of pollution. It provides a free alternative to soil testing and would save hundreds of dollars.

Other systems have used heat maps to display areas based on emissions and air quality but none have created heat maps based on pollution or chemicals. Our heatmap would be a lot more useful because many different people could benefit from it. The EPA could use the heatmap to know where to focus its cleaning efforts. Real estate developers would also be able to use the map to avoid toxic land. Health workers could also use the map to identify illnesses based on a patient's proximity to a polluted site. All in all our heat map feature would be an addition that many would benefit from.

Technologies

This module will rely mainly on the Google Maps JS API to visualize a heatmap layer for different metrics on the SOAP maps page. Google's JavaScript API for Maps has a package that integrates Fusion Tables and Maps. Fusion Tables are similar to a database (like SQL); they are meant for storing large amounts of data in a quickly accessible fashion. One downside of this approach is that the data are already in the SQL database, which means it must be mirrored.

However, since the scripts that update the database already pull from a csv file, the same file can be imported directly into Fusion Tables to simplify the process.

Once the data have been imported to the Fusion Table, the Maps API, through the use of JavaScript, allows querying the table for specific columns, displaying a heat map based on a given value. This also allows great scalability and flexibility. Depending on the customer needs or user interest, Fusion Tables can be used to automatically aggregate certain data. For example, we could combine the scores of all carcinogenic chemicals, and construct one heatmap based off that. Or we could combine the amounts found in water and make a one heatmap of that, and another of the chemicals found in the air and make a heatmap of that. Although we do not yet have a full understanding of which of these data are important for the client or for users, the module should be flexible enough to add these options as needed. This interface will be made using HTML, JavaScript, and possibly some PHP. This will allow the user to interact with the website which will pass their requests to the Google Maps JS API.

Open source license

For SOAP we are going to use the MIT Open source license. The MIT license is a permissive license that has very little limitations on reuse. It allows for SOAP to be integrated into copyrighted source code, which would allow for a government agency to utilize SOAP. The only requirement of the MIT license is when reusing code that the license is still present.

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Diagrammatic Representation of the System Boundary