Automatic AOI

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Abstract

Citizen science has emerged as a pivotal approach in expanding the horizons of scientific research on a global scale. A current study exemplifies the involvement of citizen scientists who create a virtual 3-kilometer by 3-kilometer grid, termed an Area of Interest (AOI), in their local surroundings. Within these AOIs, 37 evenly-spaced land cover observation points are generated using an external tool and conducted using the NASA-funded GLOBE Observer mobile app. However, participants have highlighted the inconvenience of navigating to the designated points within the AOI grid, posing challenges to their active engagement in the study. To address these concerns, we propose the development of an integrated web application that offers visualizations of the AOI points, ensures accessibility to each point, and facilitates seamless navigation to the locations in real-time. This project aims to present a comprehensive system that graphically plots a user's AOI points on an interactive map, leveraging the centroid location, empowering them to effortlessly complete the necessary observations at each point and keep track of these observations. By streamlining the AOI setup process and enhancing user experience, we envision broadening the accessibility of AOI observations and citizen science data to the wider public. The project will employ cross-platform frameworks, namely ASP .NET Core integrated with TypeScript and PostgreSQL, to expedite the development and deployment of the app on web-based systems. Validation and fine-tuning of the app's design will be conducted using previously-established AOI grids. The potential impact of this application encompasses enhanced user satisfaction, increased AOI creation rates, and reduced AOI setup and navigation times. These improvements can significantly contribute to the success of citizen science initiatives, fostering meaningful participation and high-quality data contributions from the open-science community.

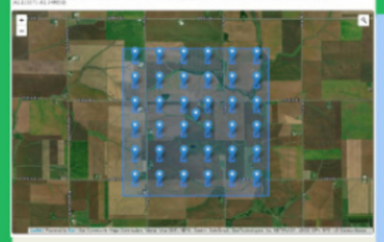
Introduction

An AOI (area-of-interest) is a standardized data set that can create a high resolution model of an area's land cover ("Observation Stations"). This type of model is more efficient in its resolution compared to satellite imagery which cannot create such high-quality imagery data. Each AOI is mapped by a given set of coordinates, evenly spaced in a 3-kilometer by 3-kilometer square grid. Using the GLOBE Observer app (GLOBE Observer, 2019), which is the main instrument used to observe points on Earth, any given citizen scientist is able to record AOI observations. Users must classify each point by taking photos which are then uploaded to a NASA database. Our main premise is the need for accessibility of science, particularly for citizen scientists. This was based on our mentors, Russanne Low and Peder Nelson, who proposed the problem of the AOI that we currently have with the app. With the current revisions of the AOI that we would need to put in the data, it would be an exceedingly long process.

Research Question

This study aims to answer the following research questions: Does this app succeed in optimizing AOI (area-of-interest) creation and increasing citizen scientists' comfort with the method in which these observations are taken? If it does, how does it hold up to the current system in place? As citizen science grows in importance with regard to data collection, it has become more crucial to ensure applications used by citizen scientists are effective and easy to use. This research project aims to achieve just that, exploring our web application's ability to consistently create an accurate AOI based on previously input information, while ensuring users are satisfied with the app's ease-of-use.

Existing AOI Grid



New Grid

Methodology(Identifying Weaknesses in Existing Systems)

Before starting our research, we first assessed the weakest aspects of the existing process to address in our limited time frame. In order to do so, we created a satisfaction survey that quantitatively measured users' opinions about the AOI process as a whole by asking an array of different questions. This survey, shared with all 52 interns on the Earth Systems Explorers team, included questions such as "How convenient was it to create your AOI?", "What additional features would you like to see in GLOBE Observer?", and "How likely are you to repeat this process." This gave us the information regarding the initial blueprint we needed to start developing our web app.

The survey revealed that as reported by our GLOBE Satisfaction Survey, over 80% of GLOBE interns answered above a 6 on the inconvenience scale, with a 1 being not inconvenient and a 10 being very inconvenient, and 66% of total interns would not repeat the AOI process. When presented with this data, it is quite clear that the current system tasked with the AOI process has fallen substandard.

Discussion

Our web app proved highly efficient when compared to the current system, with an 80% faster AOI creation process and 16.67% faster data collection despite having a group of volunteers inexperienced in the AOI creation process; this demonstrates our app's ease of use and efficiency in comparison with the current system.

Although our app did yield positive results in comparison to the current system in place, there are several limitations to the app. Firstly, unlike GLOBE Observer, the app we developed is a web app not a mobile app, hence it is limited in its adaptability and the number of different scenarios it can be used in (onsite, etc). We initially planned to adapt our web app to a mobile app but due to time constraints, we were not able to. Furthermore, data collection methods may not be accurate or consistent between volunteer observers. For example, due to the lack of an in-built navigation tool there may be discrepancies in travel time data. No navigation tool was specified, hence one group may have employed Google Maps as their navigation tool while the other employed Maps, which could have resulted in different routes and travel times. Observation time was also not specified which likely affected the data. One user specifically took observations for his first AOI at 7:34 AM on a Saturday and took the second at 5:23 PM on a Wednesday. The traffic situation was obviously different at those times and led to the experiment being less of a comparison between two systems and more of traffic and other scenarios playing an active role.

Similar platforms, like the ArcGIS (Map Viewer, n.d.) dashboard, employed the use of a built-in navigation system which gave step by step directions as well as a route to each selected point. While our app did not accomplish this feature, we decided to instead give a set number of points closest to the user based on the user's location.

There are a variety of improvements we hope to make given the time and resources. First and foremost, we would like to make a cross platform mobile app version of the web app we currently have, preferably for IOS and Android. This would enable it to be used in the field and across as many devices as possible. We would also like to improve our navigation system. Currently, the system simply gives a set number of points closest to the user based on their location, while we would like to keep this feature, we would also like to include a true navigation system similar to the ArcGIS (Map Viewer, n.d.) dashboard that creates a more organic path between points. Finally, we would like to implement an automatic avoid water tool. We currently have a "drag and drop" system in place that mainly serves this purpose where users can drag and drop pins manually to avoid water. However, this is essentially just a manual workaround, hence we aim to automate this process by including a feature where the app automatically detects if a point is on water and moves it a set number of pixels to the east, west, north or south until it is on land.

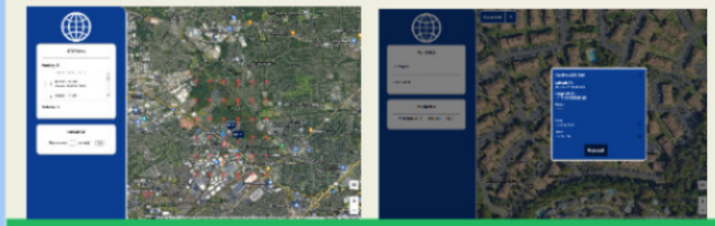
Database

Conclusion

Our research highlights the exceptional efficiency of our web app when compared to the current system in place, improving upon it by as much as 80%. The mass adoption of our web app or a similar performing one could greatly improve the sheer amount of data citizen scientists have access to due to the faster and more efficient methods our app has in place. With less time spent on the field taking observations and more data, ranging from land cover to mosquitoes (About - GLOBE Observer - GLOBE.gov, n.d.), available to citizen scientists, the prediction of disasters such as wildfires, floods and landslides will increase tremendously.

Our results provide valuable insight for future research aimed at improving data collection for citizen scientists. In particular, a project aimed at creating an application designed to replace GLOBE Observer or serve as a helper tool would benefit from these results, combined with additional features such as an automatic image classification tool to achieve better results. Future work could also explore the addition of an automatic avoid water tool as well as integrate a larger data set in a more controlled environment for more consistent findings.

Coordinates Generated by Automatic AOI



Source Code

https://github.com/yuviji/SEES-Automatic-AOI.