Redistrict: Designing a Self-Serve Interactive Boundary Optimization System

Andreea Sistrunk*
sistrunk@vt.edu
Virginia Tech
Virginia, USA

Nathan Self*
nwself@vt.edu
Virginia Tech
Virginia, USA

Subhodip Biswas*
subhodip@vt.edu
Virginia Tech
Virginia, USA

Kurt Luther
kluther@vt.edu
Virginia Tech
Virginia, USA

Nervo Verdezoto
verdezotodiasn@cardiff.ac.uk
Cardiff University
Cardiff, UK

Naren Ramakrishnan
naren@cs.vt.edu
Virginia Tech
Virginia, USA

ABSTRACT

The assignment of parcels of land affects many communal activities, from voting to public school assignments. This process creates unease and often has a strong impact on communities. We propose Redistrict, an interactive web-based system designed to support redistricting deliberations for public school zoning. Redistrict helps community members explore and experiment with the possible consequences of various zoning scenarios. This point-and-click digital discovery activity allows the user to understand long-term implications of proposed zonings and to provide feedback in an easy, intuitive way. By providing the opportunity for more people, individually or collectively, to look at the problem from different points of view, Redistrict promotes transparency, shared understanding, and cooperation. We designed Restrict to serve as a common information space to help cultivate trust and enable communities to grow stronger, smarter, and more resilient.

CCS CONCEPTS

• **Human-centered computing** → *Empirical studies in visualization*; **Collaborative interaction**.

KEYWORDS

connected communities, transparency, visual learning, public school, boundaries

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*These authors contributed equally to this research.

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Figure 1: User Consent and Login Landing Screen

INTRODUCTION

Decisions about boundaries can have extraordinary impact on citizens affected by them [13] and often create conflicts and disputes at the highest levels of government, whether county, city, state, or national [2, 4, 6]. Often the community constituents rely on knowledgeable specialists to interpret the results of boundary changes because the data is too difficult for most to understand. Indeed, capturing, storing, curating, and displaying geographical data is a complex and resource-intense task which has matured into its own field: Geographic Information Systems (GIS) [1].

To make boundary changes more accessible to the public without requiring GIS expertise, we introduce an interactive web-based system, called Redistrict, designed to support redistricting deliberations for public school re-zoning. Redistrict can help bring transparency and engagement into the cooperative work of school attendance boundary assignments, where public school officials and

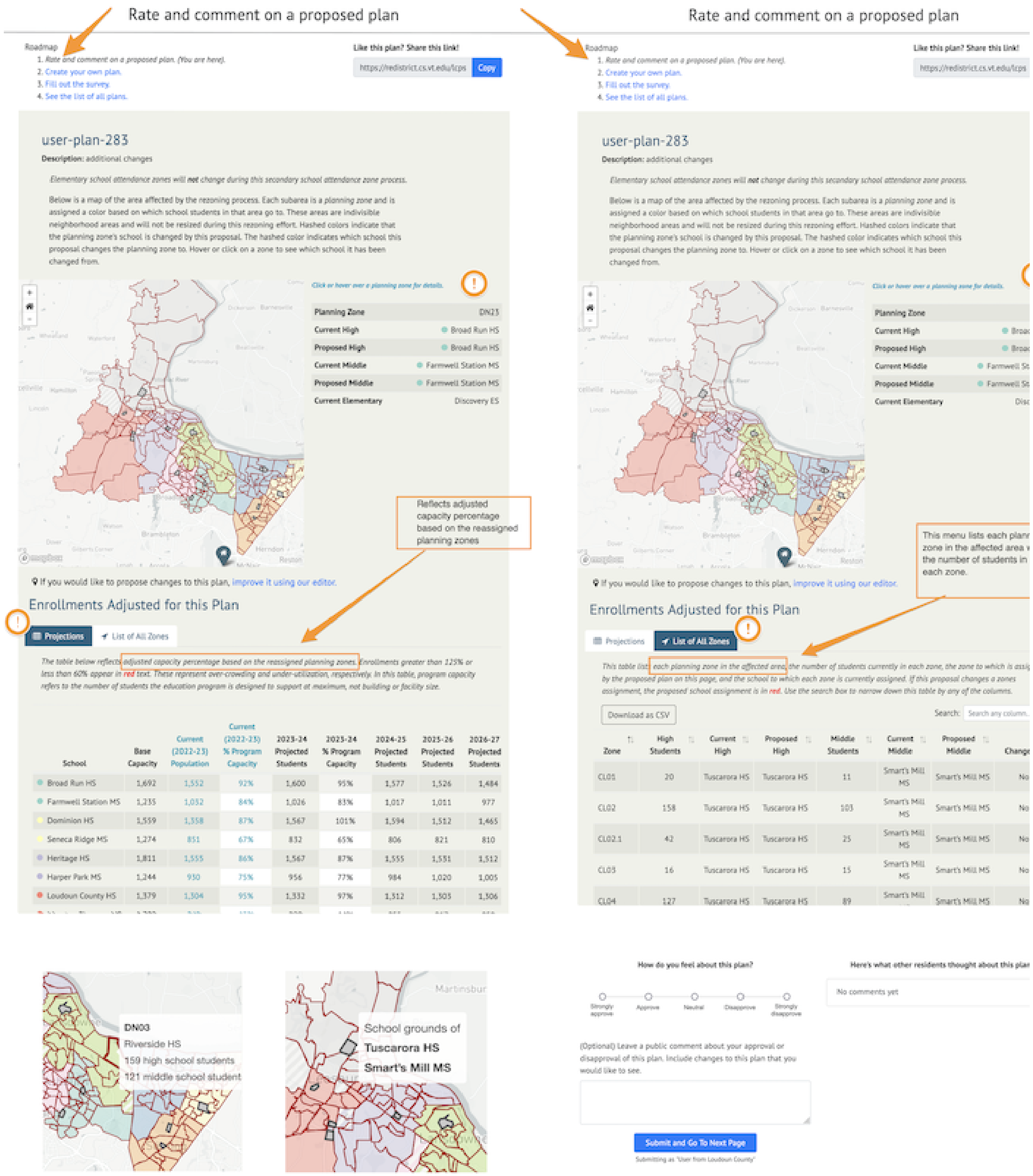

Figure 2: Redistrict Interactive System allows users to review all details of the proposed school boundary change.

the community can take part. This demonstration fits in the DIS 2023 "Change Through Design" theme.

Redistrict is an online tool for gathering feedback for public school boundary re-assignment efforts and has been supporting rezonings for the last 6 years (including during the COVID-19 pandemic). Redistrict could influence how communities interact and sheds light on the short- and long-term consequences of school rezoning [15].

At the DIS2023 conference, we will demonstrate the fully-fledged interactive system. Participants will be able to access and explore the site through a QR code[1] and engage in a school boundary optimization scenario by themselves.

Redistrict Facilitates School Rezoning

In areas that have strong public school systems with proximity-based attendance assignments, parents seek housing in neighborhoods around high-quality schools [12, 16]. This demand often influences neighborhood composition, growth, and house prices, among

[1] https://redistrict.cs.vt.edu/lcps-2022/testuser/plan/user-plan-283/

other considerations [14]. New housing developments and population increases generate a continuous need for more school space, which necessitates redrawing school attendance zone boundaries. A typical process involves intense review and thorough deliberations by school authorities and community members, traditionally with a projector presentation and printed maps as handouts for participants.

Redistrict can perform GIS calculations involving the populations of the land parcels in play to give users the ability to experiment and see immediate feedback about the potential consequences of their experimentation. Community members gain transparency and understanding through a self-driven virtual geographic exploration.

The usability concepts built into the interface leverage human visual and spatial awareness. Redistrict fosters curiosity using a "what-if" point-and-click discovery approach at the user's own pace. This approach not only allows users to understand what is proposed, but goes one step further, enabling the user to experiment with the tool, either in collaboration with school officials or by themselves. This "try-and-see" visual scaffolding of otherwise advanced concepts is novel with respect to previous practices [8]. Enhancing and promoting active participation in Redistrict deliberations has the potential to uncover new ideas that might have been previously overlooked. With the power of community, more eyes and more brains can make sharper decisions.

REDISTRICT SYSTEM DESCRIPTION

Redistrict is a web-based software application. Users first navigate to the landing page where they complete an IRB consent form and then sign up for a free account, including providing their home address to personalize the experience (see Figure 1).

View Proposed Plans. When a plan subjected to debate is uploaded in Redistrict, the user has the option to actively discover what is proposed not only through reading and writing text, but by a self-directed investigation of a map where every single parcel is visualized and interactive (see Figure 2).

Figure 2 (top) displays two screenshots side-by-side. They represent the same view of the map. When the user hovers the mouse over a parcel (planning zone), the right-hand panel displays its current and proposed assignment for a middle school (MS) and a high school (HS). Hovering also displays a hovercard with the parcel school assignment, and number of students residing in this parcel, split by middlen and high school (see Figure 2, bottom).

The parcels are color coded so that parcels with the same color share the same school. We can tell the user is focusing on a *blue* parcel as all the dots next to all schools are also *blue*. This color consistency bridges the information between the map and menu labels on the right-hand side.

In this case, the user's declared location (home address), indicated by a dark-teal marker near the bottom of the map, is outside the boundaries of the rezoning effort.

Underneath the map, the screen has two tabs showing enrollment figures. In Figure 2(left), the user has selected the "Projections" tab, showing projections for student population and school building occupancy using the Census Bureau Data [7]. When the school population projection exceeds maximum capacity or highly underutilizes the capacity of the school, the table highlights these values in red. In Figure 2 (right), the "List of All Zones" tab is selected, highlighting in red any schools changing to the proposed plan.

At the bottom of the page is a form (see Figure 2, bottom) where users can express their opinion and see the anonymized opinions of others participating in this rezoning effort.

Create Your Own Plan. The functionality of this page is a superset of the page from the previous section. Additionally, the users can review the plans individually. Here, users can create their own plan, freeing them to explore solutions outside the limits of official proposals. Figure 2 shows a side-by-side comparison of the "Create New Plan" screen compared to the "View Proposed Plans" screen in Figure 4; exclamation marks denote areas of difference. For every change the user would like to make, the user clicks on the land parcel, then changes the assignment on the right-hand side.

As users change parcel assignments, Redistrict re-calculates projected capacity utilization on-the-fly for all schools impacted by that change. This is the moment when the users can realize the small tolerances at play in boundary rezoning. There are many competing constraints at play. When testing the software, public school officials found this feature highly entertaining, almost like a puzzle or game of trying to identify a better distribution of student allocations and building capacities than in proposed plans.

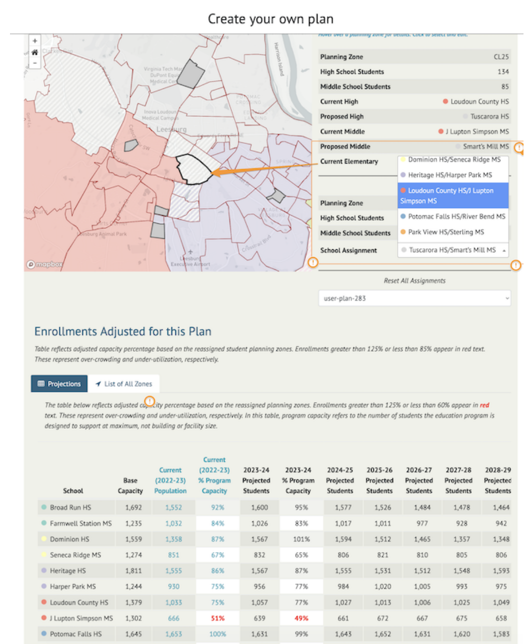

Figure 3: Users are able to propose new parcel assignment.

Complete Survey . The users have the option to take a detailed survey meant to gather their opinions about school rezoning processes in general, while also informing the users about the limitations faced when re-assigning school boundaries. Here the user is asked to rank their agreement with each statement on a Likert scale. Listing the factors considered in creating the current boundary change process plan also has an educational outreach aspect. By reviewing the description of each of the factors considered, the users gain visibility to many important aspects that weigh in the decision. Collecting user input has value for the public school officials responsible for considering all expressed opinions, and can broaden their perspective, as well as consolidate the opinions in further reports to present in upcoming public meetings.

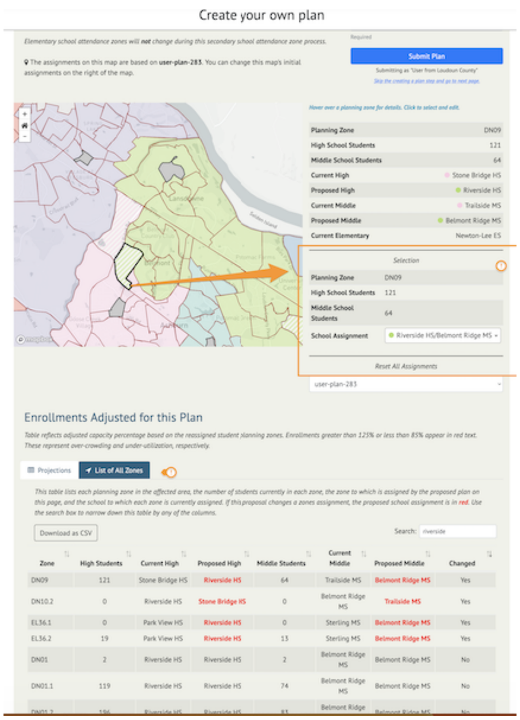

Figure 4: Users have the ability to evaluate the impact of new parcel assignment.

Summary of All Plans. In this part of Redistrict, the user can find a summary with links to all the plans created for the current effort. Any plans that would change a user's school assignment (based on their physical address) to another school will have a red asterisk next to them.

For the DIS 2023 demonstration, the authors will load shape files representing maps from the northeast US with a fictional disposition of school attendance zones. Users will be free to declare their own address, or choose from a set of sample addresses our team will offer so they can experience the full functionality of the interactive system. In the latter case, users will be able to double check the "Summary of All Plans" screen and dynamically review the impact of proposals to their sample address.

SYNOPSIS

With Redistrict, we sought to shift the design concept of public boundary deliberations [5] from lengthy presentations to interactive participation from all interested community members. This usable, interactive system sits on top of a geographical optimization tool [3, 11] and can handle large amounts of complex data to offer users the ability to experiment with "what-if" scenarios. Redistrict leverages visual scaffolding and geographic awareness [9] to help users in this virtual interactive exploration without the need of verbose user instructions. While the current application focuses on public school boundaries, we envision other problems that could benefit from shifting the design to a community-centered approach; e.g. political voting districts and other land-use decisions that involve public support. Redistrict brings transparency to opaque communal debates. This carries positive ethical implications [10] and opens the door to more diverse input from a more diverse crowd that can now participate in the design process.

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