Title
Visualizing Global Inequality on the Web

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Abstract
In this work, we simplify and enhance the visualization currently supported by the UC Atlas Website for mapping global inequality by (i) creating a simple user interface, (ii) supporting time series animation of global maps, and (iii) simplifying and integrating the line graphs, bar graphs, and ranked bar graphs. The visualization system is accessible at http://atlas-dev.ucsc.edu/ian. Our vision is to enhance the visualization system by adding additional types of charts including scatter plots, star plots, parallel coordinates, and small multiples visualization while keeping the user interface simple and integrated.

Keywords: Global inequality, visualization, web, animation, plots, graphs, mapping.

Section 1. Introduction and Motivation

Popular websites that support visualization of global indicators on a world map include UCAtlas [1], GapMinder [2], NationMaster [3], WorldBank [4] , and WorldMapper [5]. These web sites differ in many characteristics including the supported data sources, and types of maps, charts, visualization techniques and user interface. One of the common goals is to allow a common user to visualize one or more global indicators for one or more countries for one or more time periods in real time. Many of these web sites are evolving as developers integrate newer techniques.

Two of the authors of this work have been involved in developing the UC Atlas web site over a period of more than 5 years. One of the motivations in developing the website has been to motivate discussions around interesting and emerging themes surrounding global inequality. Therefore, the web site supports articles, discussions, and more recently, wikis authored by a small group of editors. Also, due to limited resources and the changing nature of technical personnel, navigation of the visualization of global indicators supported on this website has become complex.

The focus of this work is simplify and enhance the visualization currently supported by the UC Atlas Website for mapping global inequality. We achieve this by creating a simple user interface at the top level, where the user has essentially a choice between maps and charts (that include line graphs, bar graphs, and additional types yet to be supported). Furthermore, user choices in drawing the graphs have been simplified compared to the UC Atlas. Finally, we add an animation facility for viewing global maps of indicators over time by providing a slider.

Section 2. Visualizing Global Inequality

Our global inequality visualization system is accessible at
http://atlas-dev.ucsc.edu/ian

Section 2.1 Maps

World Maps and Animation
The user can choose an indicator from a drop-down menu. The program automatically load the data for the time period 1960 to 2000 and presents a slider that can be used to view the maps for any intermediate year (see Figure 1). The data is mapped to a color using a color scheme that is shown in the legend. We have used the Peters' projection system and quantile mapping (mapping the top 20% of the countries using the same color, the next 20% in a different color, and so on) currently used in the UC Atlas.

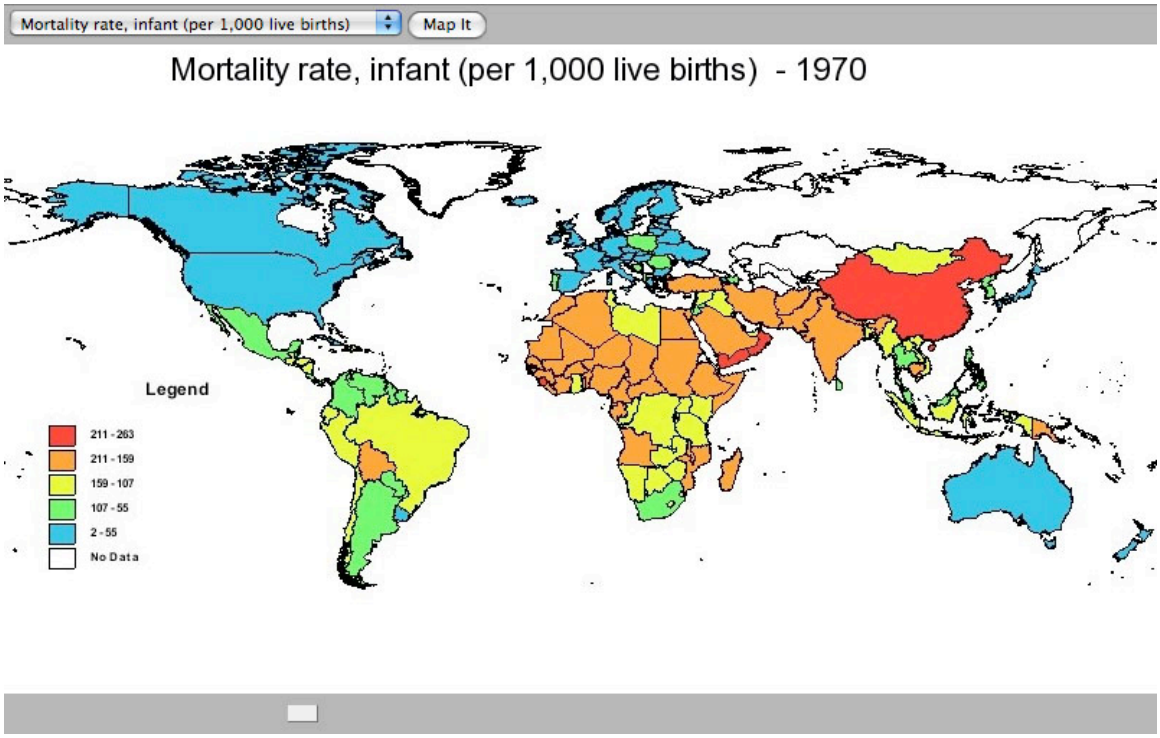
Section 2.2 Graphs and Charts

Line Graphs
The user can choose an indicator, a time period and many countries. The line graph shows the values of the indicators over the chosen time period, one line for each country (see Figure 2).

Bar Graphs
Similar to the line graph, the user can choose an indicator, a time period and many countries. The bar graph shows the values of the indicators for the chosen time period for different countries (shown in different colors) (see Figure 3). The user interface is the same as the user interface for the line graph. A facility to display data over non-consecutive years can be easily added by providing a choice of interval between the years.

Ranked Bar Graphs
Ranked bar graph requires that for each choice of an indicator, every country is ranked. These ranks are then shown by a bar. Although not a very popular form of visualization, UC Atlas supports this visualization. Currently, we have an elementary version of this visualization where the user can display the ranked bar graph for a few countries for a couple of indicators for a chosen time period (see Figure 4). Further enhancements can be easily provided with minimal effort.

While most world wide web sites support one or more of these visualization techniques, our vision is to enhance the visualization system by adding additional types of charts including scatter plots, star plots, parallel coordinates, and small multiples visualization while keeping the user interface simple and integrated. We further expect to incorporate additional visualization techniques using glyphs (symbols), sizes, and novel use of boundaries to display multiple global indicators at the same time without overloading the users cognitively.



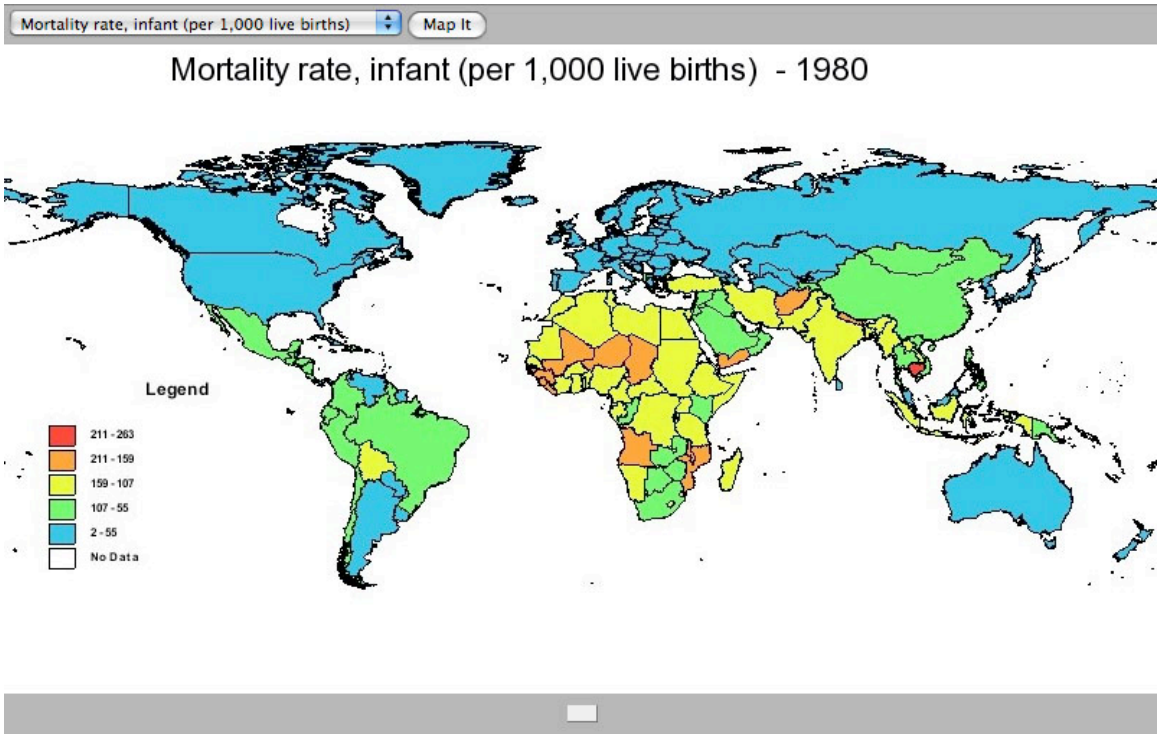


Figure 1: Infant mortality rate for each country is shown on the world map using the color scheme described in the legend above for 1970 (top) and 1980 (bottom). The user can choose the indicator from the drop down menu shown at the top of the bar. The user can choose the year using the white slider in the bar at the bottom.

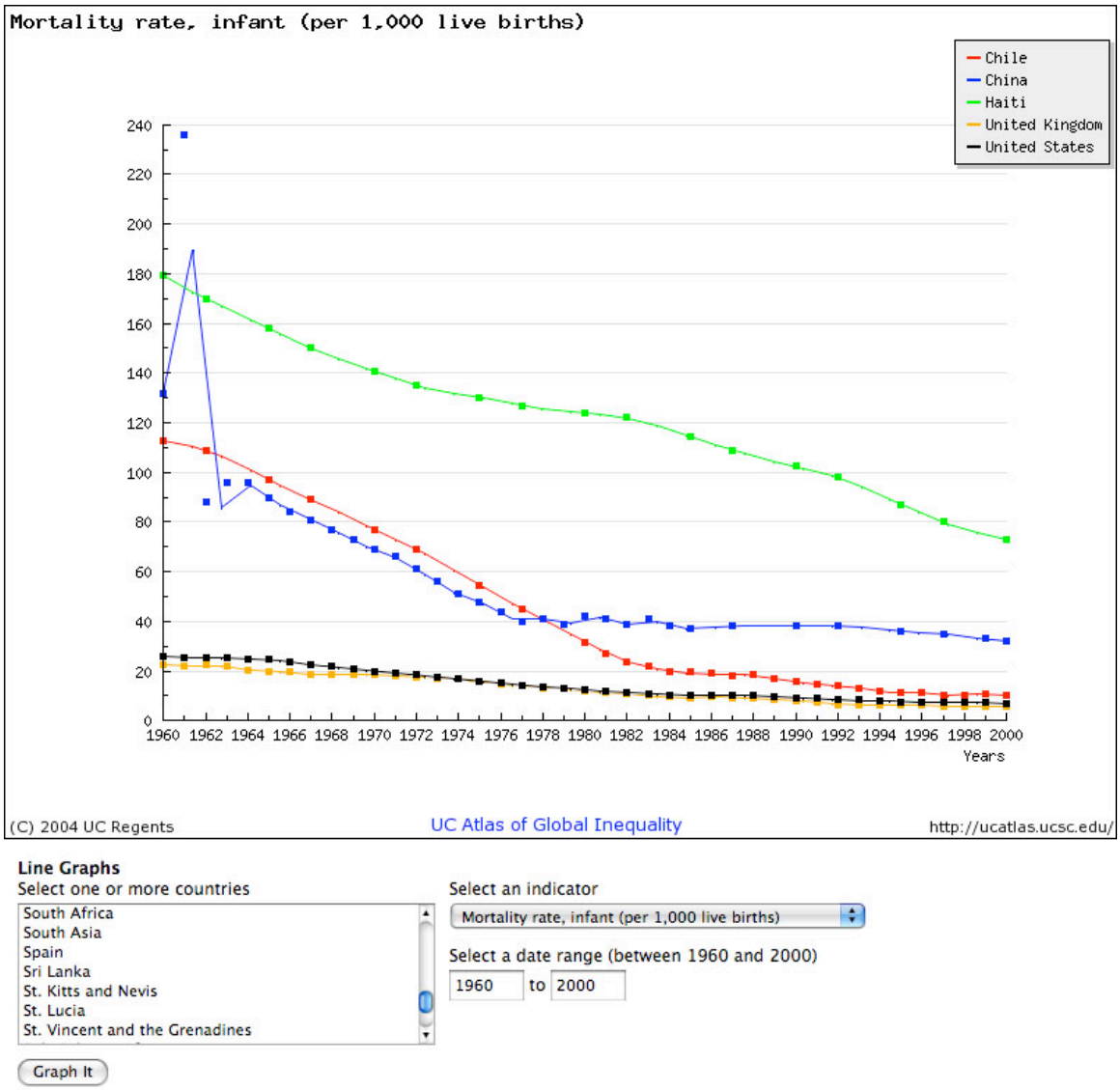


Figure 2: Infant mortality rate for 5 countries (China, Chile, Haiti, UK, and USA) over the time period 1960 to 2000. The user can select the indicator and the time period from the simple user interface shown (bottom right) and the countries from the list (bottom left).

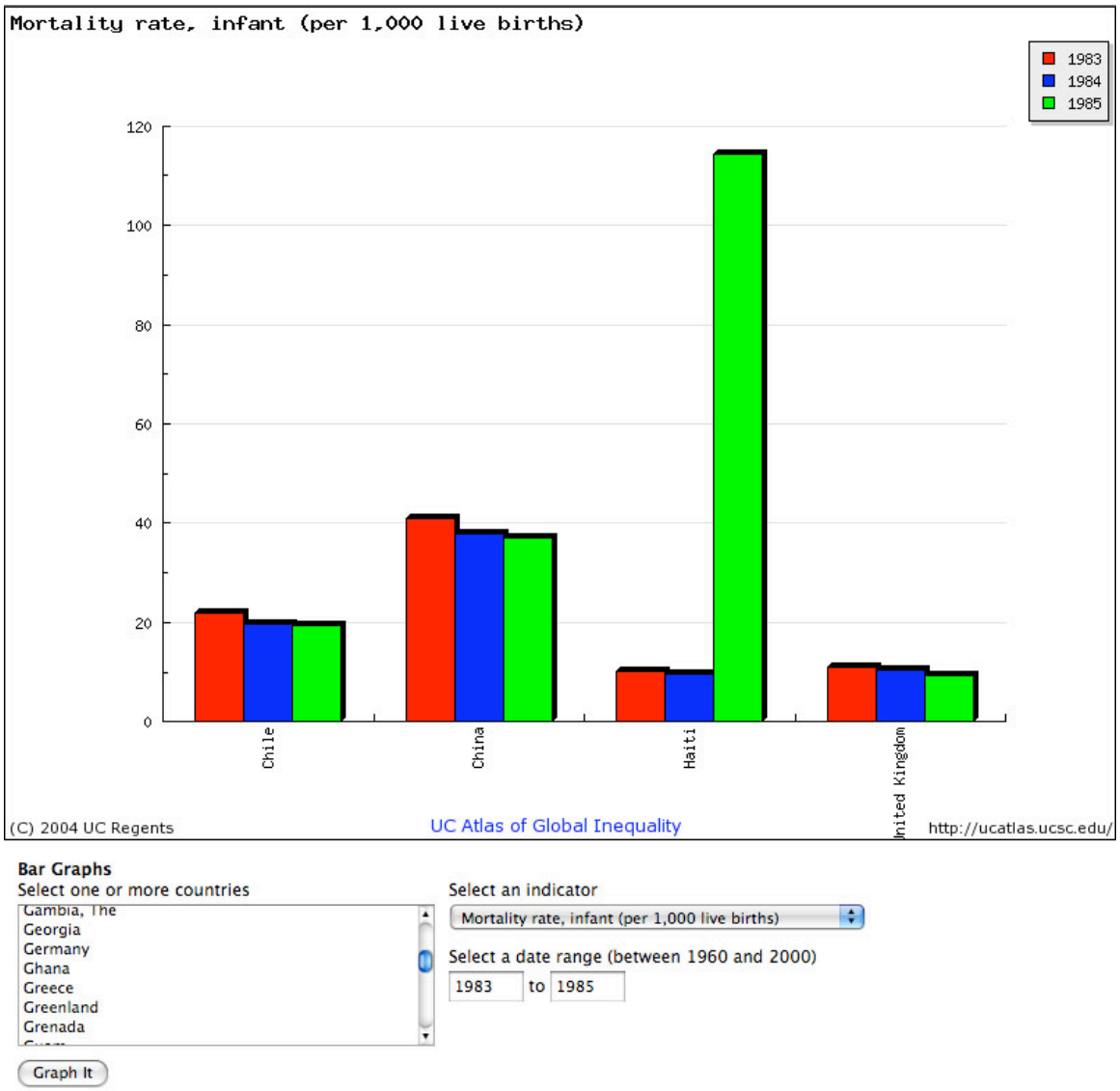


Figure 3: Infant mortality rate for 4 countries (Chile, Chile, Haiti, and UK) for the time period 1983 to 1985. The user interface is same as the line graph.

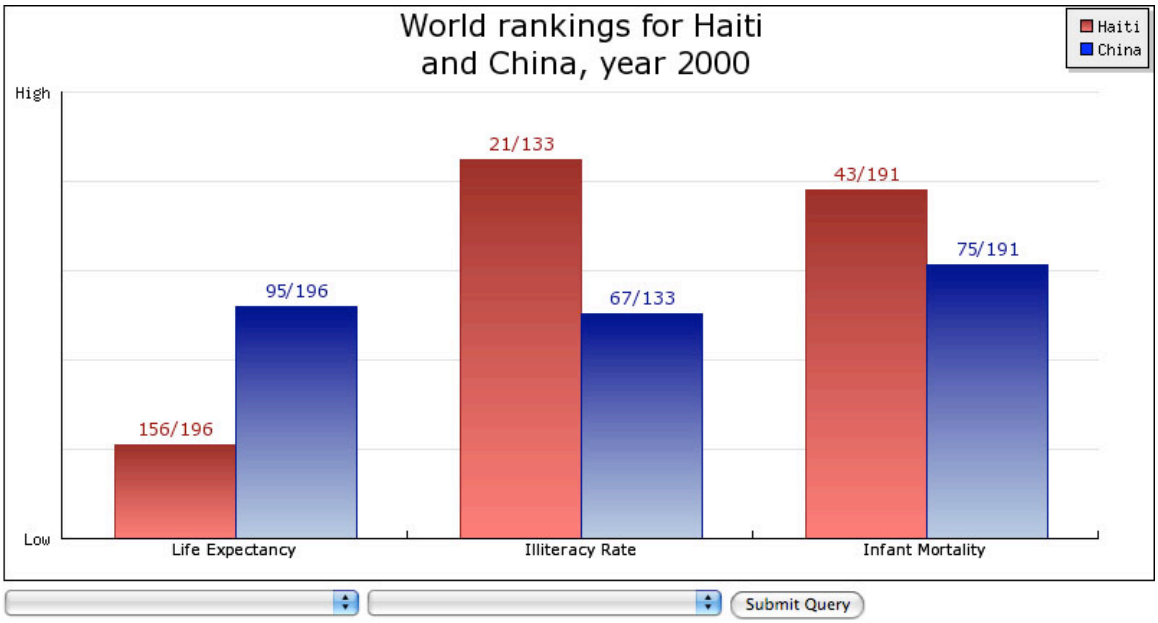


Figure 4: Ranked bar graph shows the world rankings for Haiti and China for life expectancy, illiteracy rate, and infant mortality for the year 2000. The numbers x/y means that the country's rank is x out of y countries. For example, Haiti is ranked 156 out of 196 countries in life expectancy.

Section 3. System Issues and Implementation

Languages and software used

For this project we chose to use XHTML, CSS and JavaScript for interface coding. JPgraph, which is an open-source PHP library is used to generate line and bar graphs. For mapping we are using World Bank data, which is stored in a MySQL database. This data is mapped using ArcIMS. In the near future, we plan to shift the bar and graph coding away from JPgraph to the newly released Google Charts, which we believe will give us better speed and greater flexibility with our graphs.

Dynamic data loading vs Pre-generating the images

While coding the maps portion of this project, a choice is to be made between dynamic data loading versus pre-generating the images. Dynamic data loading is certainly desirable to allow a wide variety of choices to the users that cannot all be pre-generated. At the same time, in order to provide a satisfying user experience, computing and loading of maps while moving the slider for viewing time series maps must be done without delay.

Because of the relative slowness of the ArcIMS software in generating images, we found that the improvement to animation from pre-generating the images outweighed the desire for dynamism in map generation in our current implementation. Thus, the images we use for mapping are generated prior to the user accessing the site. However, we have overcome this difficulty by developing independent software (that does not depend upon ArcIMS) that allows computing and loading the images on-the-fly without delay. In our future implementation, we expect to integrate the two to provide the best of both the choices – dynamic computation of maps and loading of maps without delay.

Section 4. Conclusions and Future Work

Although there is a growing number of web sites that seem to support visualization of global indicators, we believe that the task of visualizing global indicators to provide a deeper understanding has just begun. It is well recognized that there is a need for a variety of visualization methods and a variety of data sources that is well integrated with a simple user interface. Even this user need is not met with the existing web sites. More importantly, deeper exploration of relationships between various global indicators and countries through visualization is in its infancy [6].

Acknowledgements
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