Living Globe: Tridimensional interactive visualization of world demographic data

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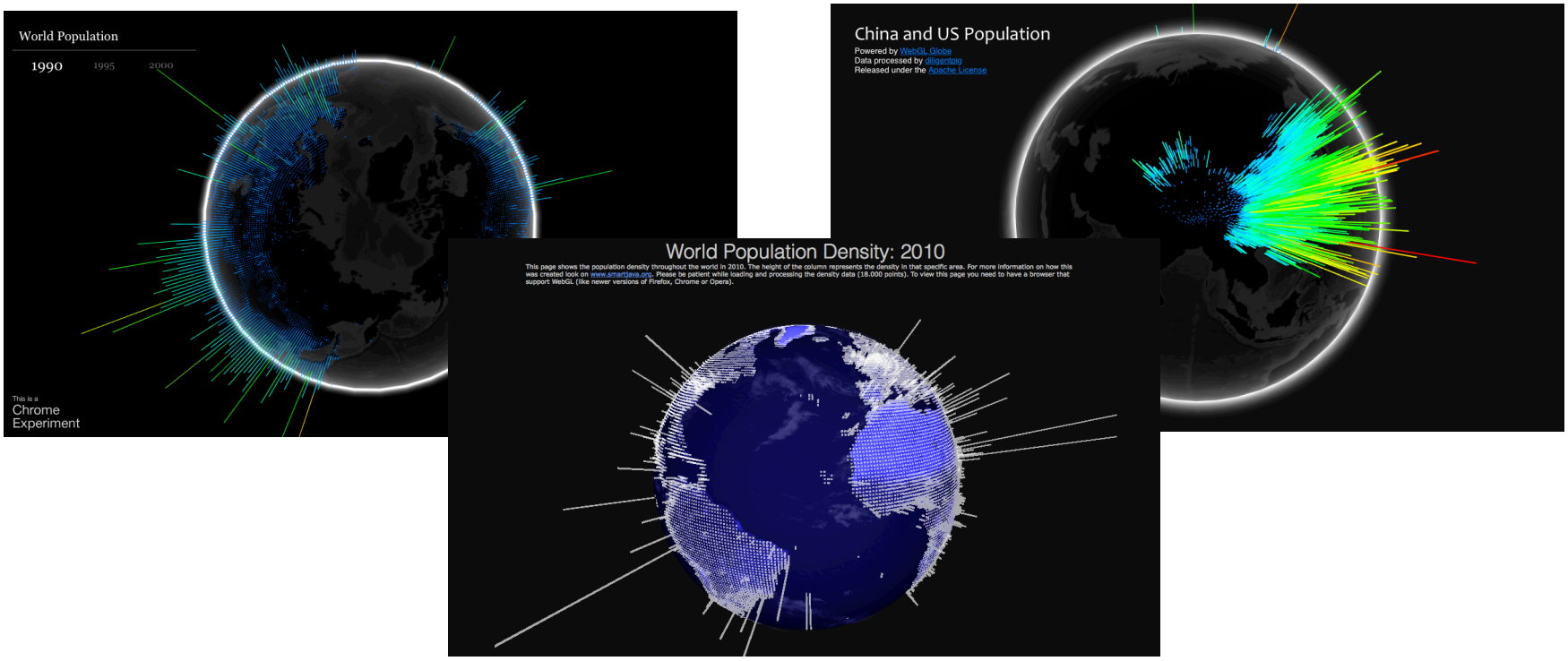
Introduction

- tri-dimensional worldwide demography
  - display spatial data on a 3D globe;
  - conventionally:
    - the globe can be dragged to adjust the observed location;
    - vertical bars / pillars are displayed on top of every country or city;
    - values are represented by the height of these bars.

State of the Art

- WebGL Globe – World Population
- WebGL Globe – China and US Population
- World Population Density - 2010



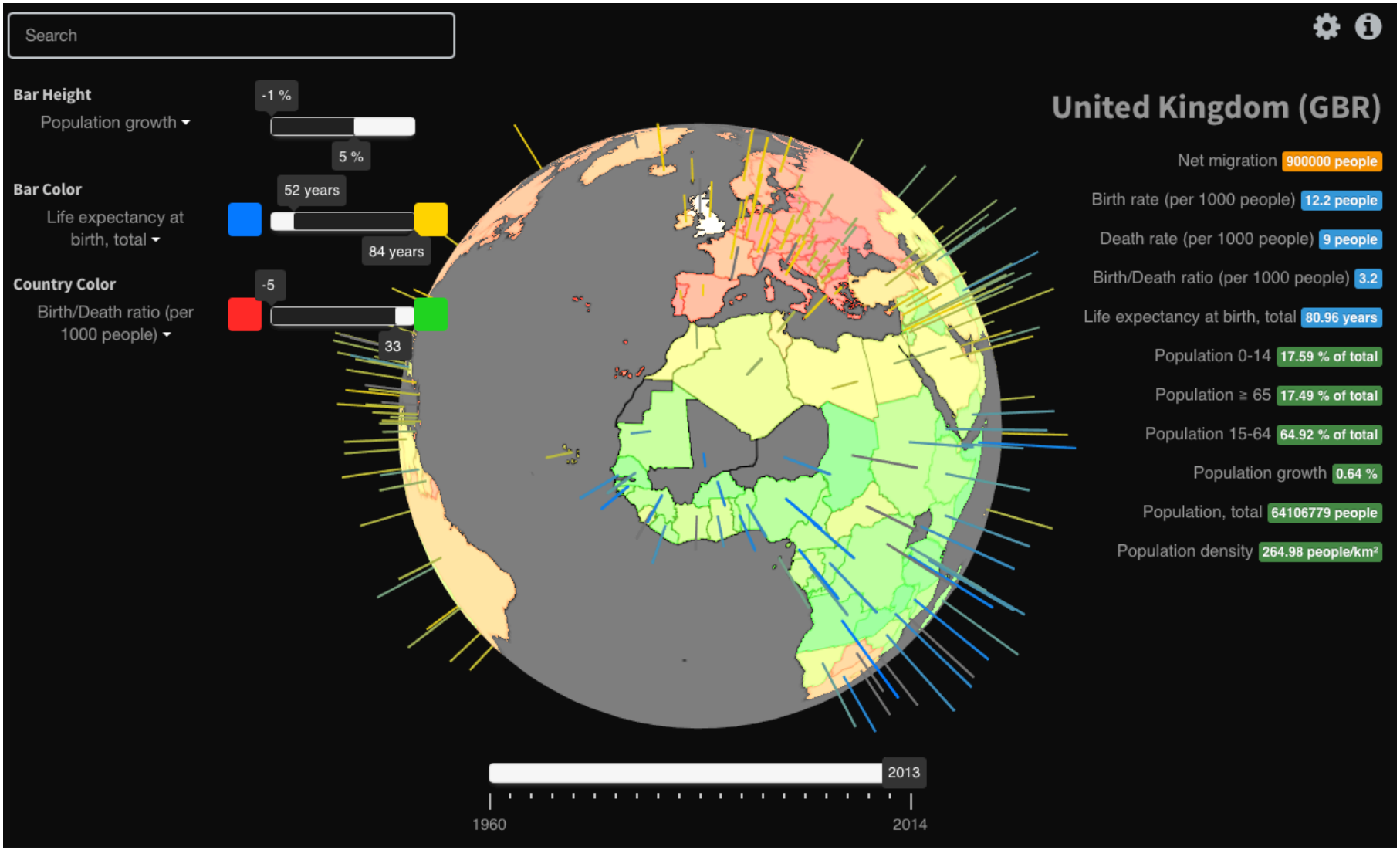
State of the Art

- The state of the art works:
  - display only one data type;
  - extremely high/low values affect readability of the remaining data;
  - lack user customization;
    - default preferences differ from the user's;
  - lack usability features;
    - no data-zoom / selection of subsets.

Proposal

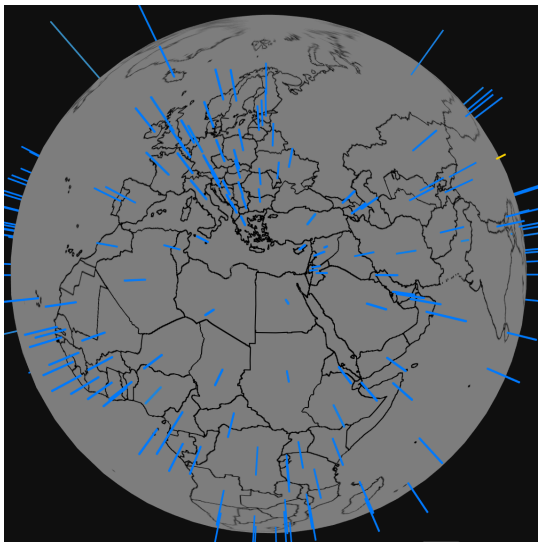
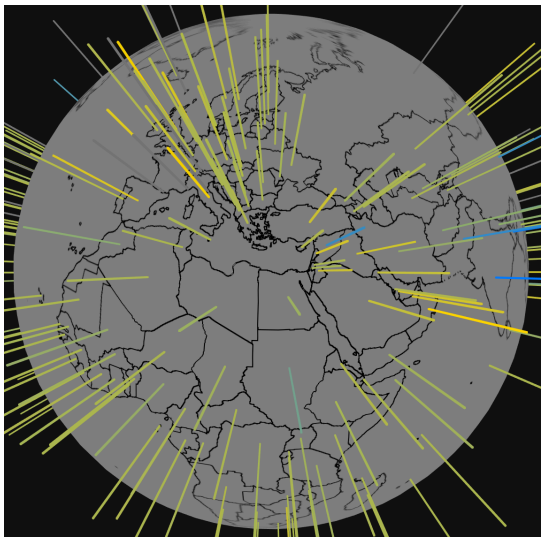
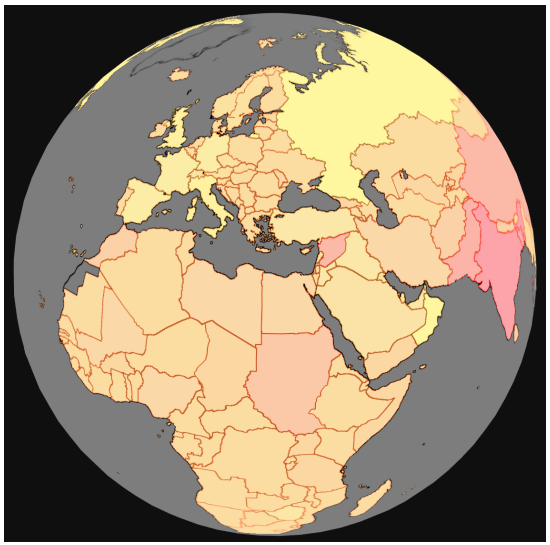
- allow visual exploration of multiple demographic indicators simultaneously along a set period of time;
  - pattern detection through visual stimuli only
- introduce conventional usability features;
- targeted at:
  - unexperienced users;
  - users with some computer and statistics literacy;

Prototype


Search
Bar Height
Population growth
-1 %
5 %
Bar Color
Life expectancy at birth, total
52 years
84 years
Country Color
Birth/Death ratio (per 1000 people)
-5
33
United Kingdom (GBR)
Net migration 900000 people
Birth rate (per 1000 people) 12.2 people
Death rate (per 1000 people) 9 people
Birth/Death ratio (per 1000 people) 3.2
Life expectancy at birth, total 80.96 years
Population 0-14 17.59 % of total
Population ≥ 65 17.49 % of total
Population 15-64 64.92 % of total
Population growth 0.64 %
Population, total 64106779 people
Population density 264.98 people/km²
2013
1960
2014

Prototype

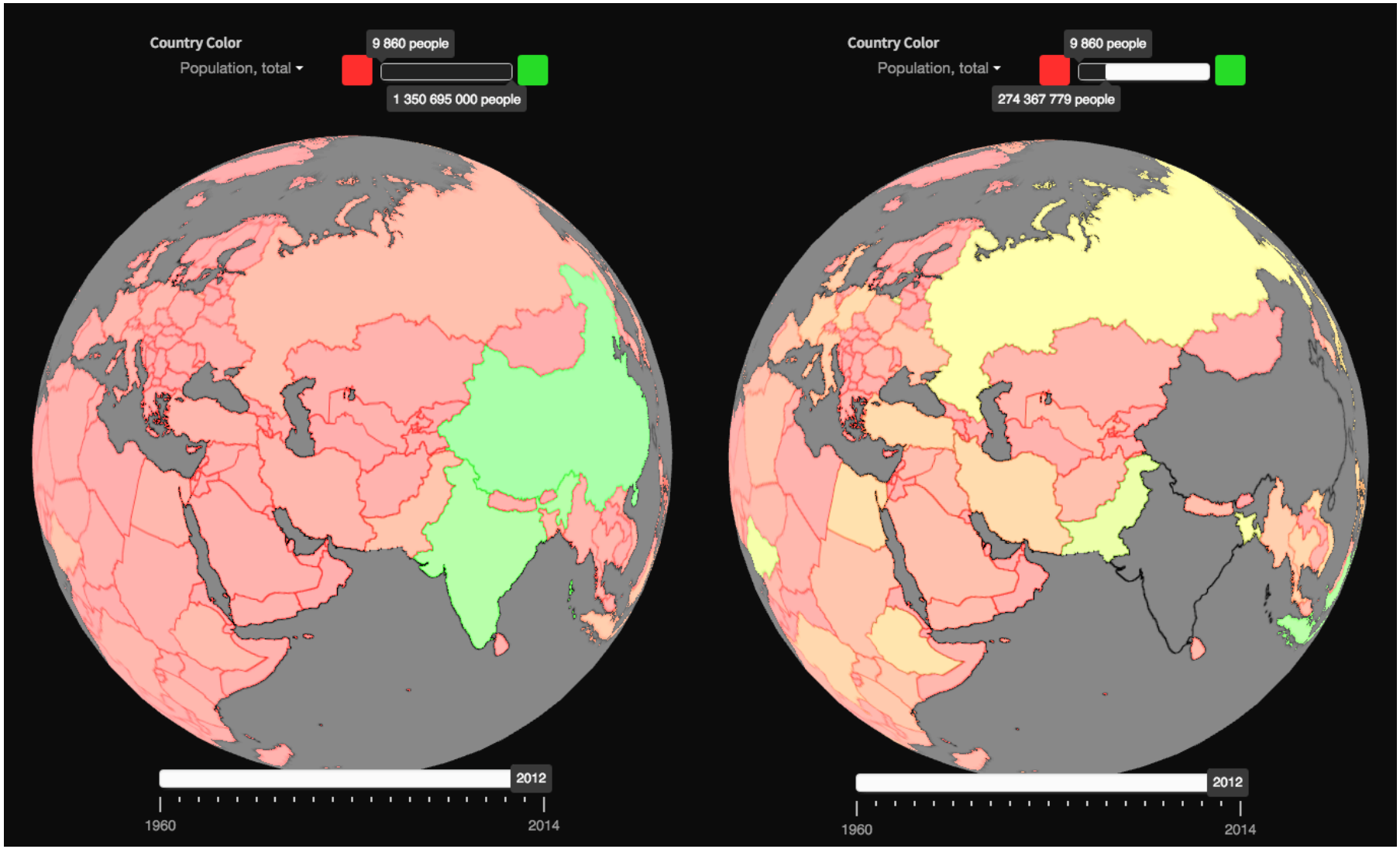
- features (1/2)
  - 3D globe with three visual variables;
    - height of vertical bars / pillars;
    - color of vertical bars;
    - color of countries.
  - configurable data-to-visual mapping;

Prototype

- features (2/2)
  - selection of countries;
  - adjustable year;
  - country name-search (with dynamic suggestion)
  - configurable minimum and maximum values;

Prototype


Country Color
Population, total
9 860 people
1 350 695 000 people
2012
1960
2014
Country Color
Population, total
9 860 people
274 367 779 people
2012
1960
2014

Prototype

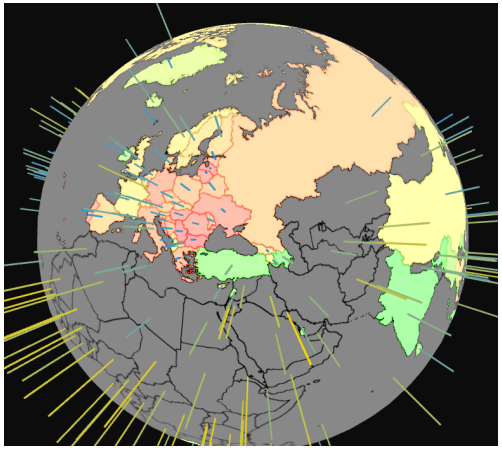
- technologies used:
  - HTML, CSS and Javascript + libraries (three.js, chroma.js, jQuery);
- successfully tested in Firefox 44, Chrome 48 and Safari 9.1;
- data collected:
  - 8 indicators;
  - 1960 to 2014.

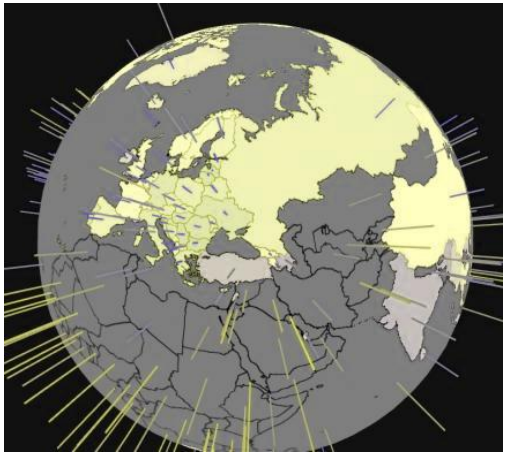
Evaluation

- Heuristic evaluation (1/2)
  - 3 evaluators with some experience in IV;
  - heuristics used:
    - Nielsen's heuristics;
    - two visualization-specific sets of heuristics (Zuk and Carpendale; Forsell and Johanson);

Evaluation

- Heuristic evaluation (2/2)
  - main issues found:
    - default color mappings may be difficult to differentiate with color blindness;
    - cluttered widgets for smaller sized browser windows or smaller data sets.





Evaluation

- Usability testing (1/3)
  - 3 phases (brief introduction, task solving and questionnaire;
  - 4 users with various degrees of computer literacy;

Evaluation

- Usability testing (2/3)
  - the first 3 tasks:
    - put the user at ease;
    - encourage usage of usability features, i.e. search and selection;
  - the 4th task:
    - encourage usage of filtering;
  - the 5th task:
    - find out if inherent symbolism of default colors might lead user to the wrong conclusion.

Evaluation

- Usability testing (3/3)
  - findings:
    - all users preferred using country colors;
    - additional optional widgets were not considered to be useful;
    - application was easy to learn and use;
    - default color scales in country colors can be misinterpreted.

DEMO

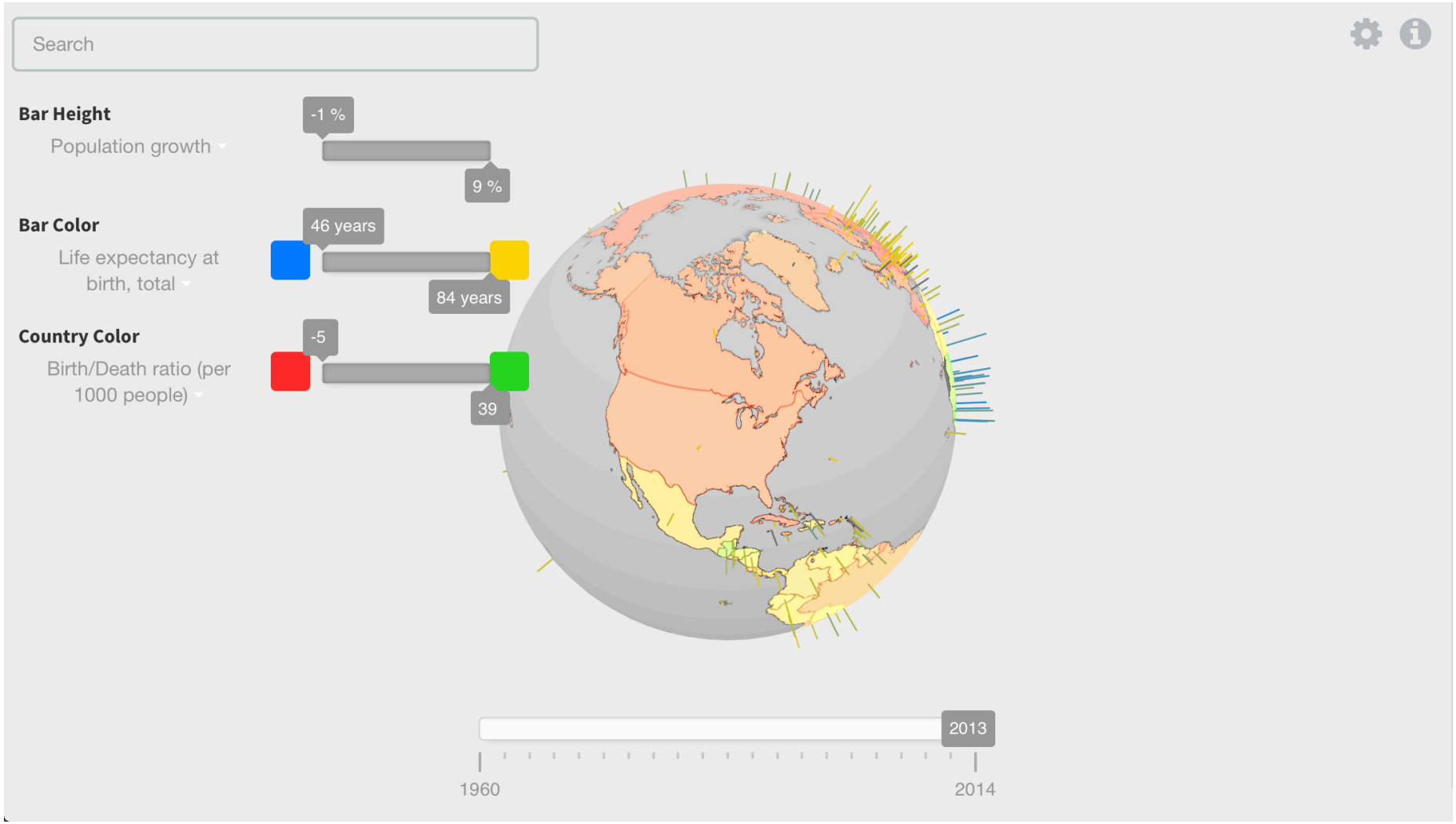
Conclusions and Future Work

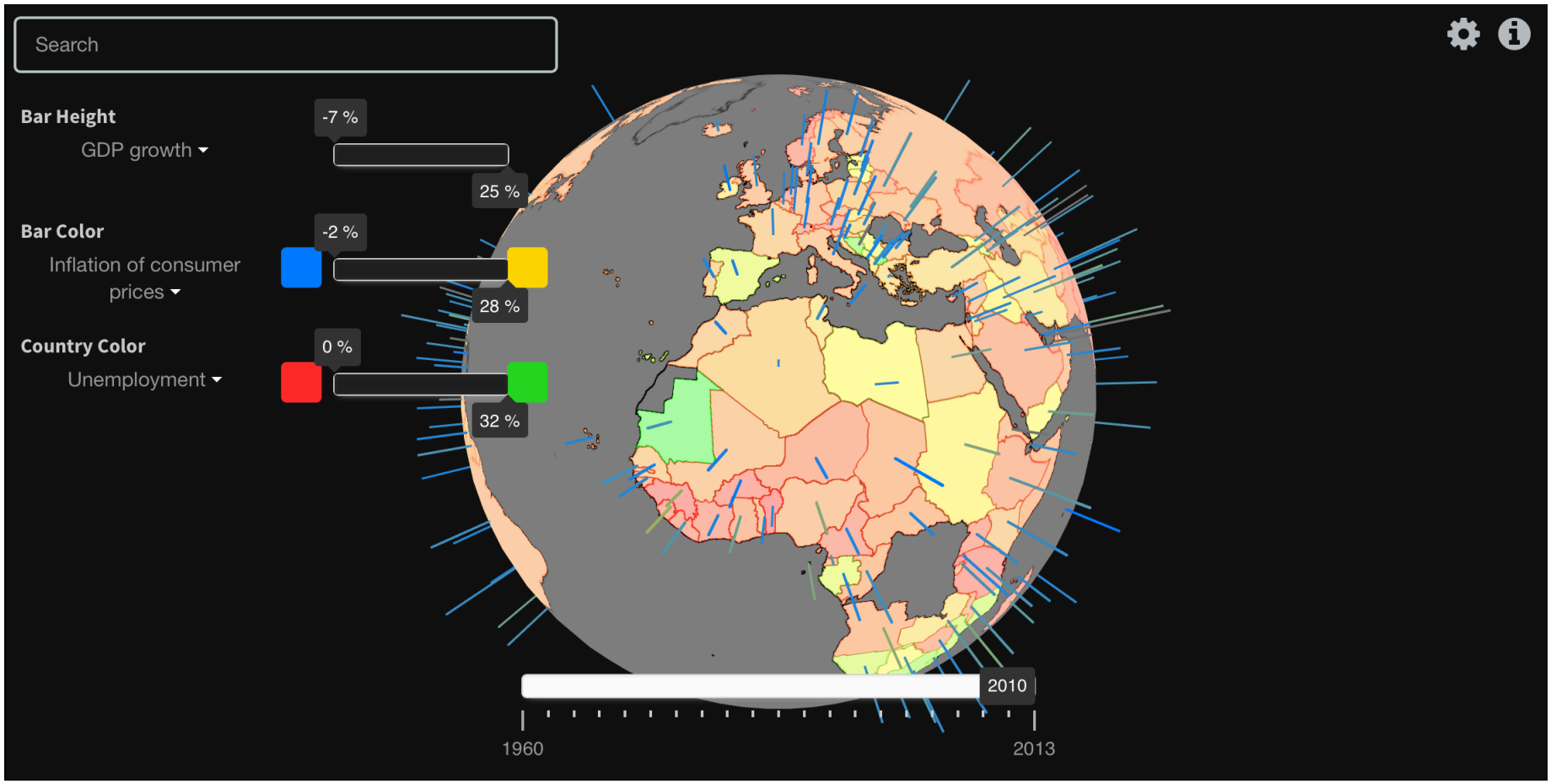
- the proposed model iterates on the state-of-the-art by:
  - improving the visual exploration of multiple data indicators simultaneously;
  - eases the interaction with the tool;
- filtering allows a clearer observation of smaller samples;
- most negative points have been corrected in the latest releases;

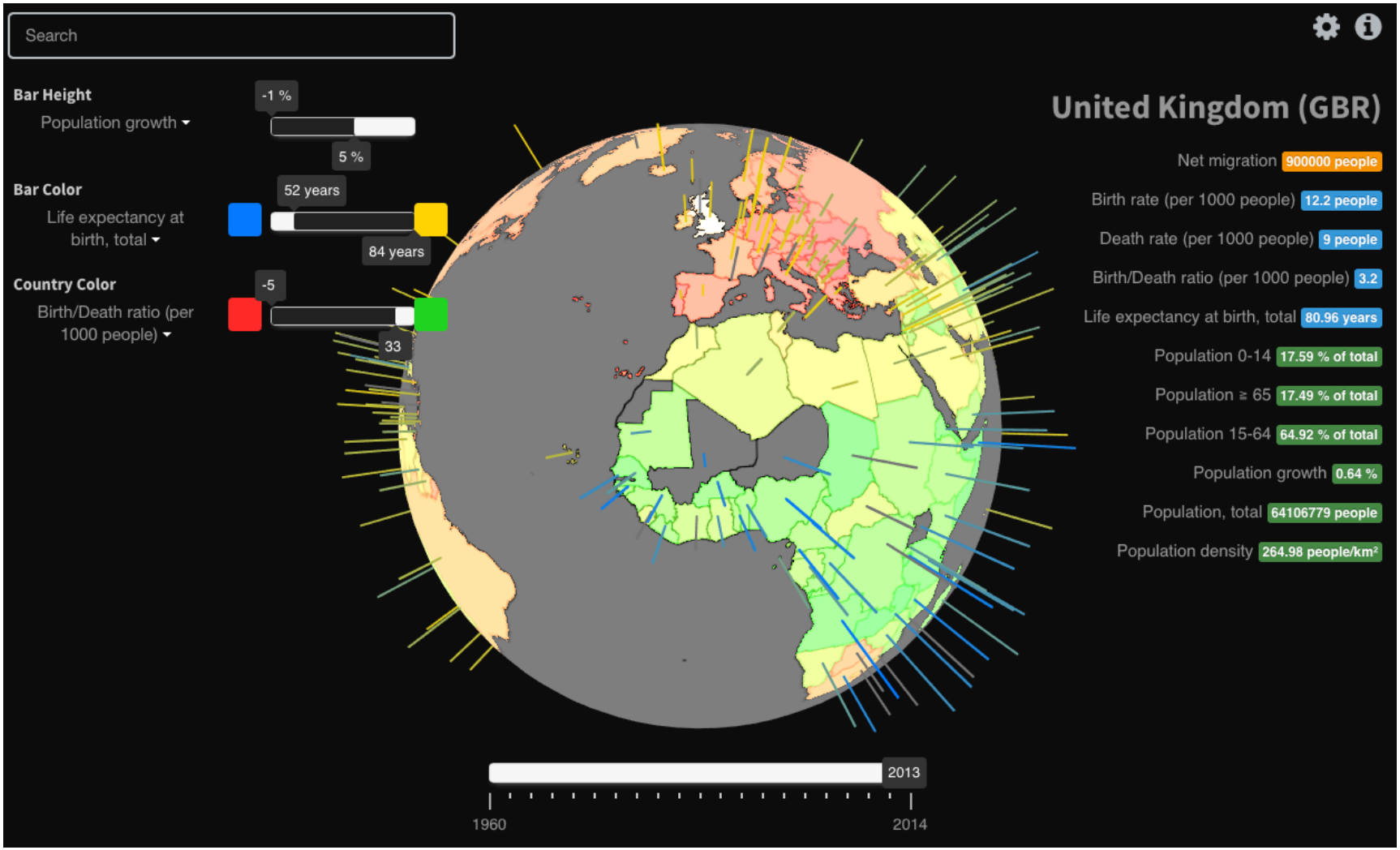
Conclusions and Future Work

- model to detect patterns and data correlations over time;
- there is potential to extend it outside the demographical data spectrum;

- **https://github.com/edduarte/living-globe**


Search
Bar Height
Population growth
-1 %
9 %
Bar Color
Life expectancy at birth, total
46 years
84 years
Country Color
Birth/Death ratio (per 1000 people)
-5
39
2013
1960
2014


Search
Bar Height
GDP growth
-7 %
25 %
Bar Color
Inflation of consumer prices
-2 %
28 %
Country Color
Unemployment
0 %
32 %
2010
1960
2013

http://edduarte.com/living-globe

http://edduarte.com/talks/hcii2016/