A New Look at Geography of the World

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Abstract: ***The rapid expansion of Web content has raised numerous concerns relating to reliable and meaningful information delivery. What users actually need is information that suits the task and context at hand, from a reliable knowledge source, with an assurance of information objectivity and integrity. In this respect, most of the numerous web sites that offer geographical information have, serious drawbacks: Often, advertisements are intermixed. It is hard to tell if information is slanted or censored. Facts presented are usually taken from one single source and not checked against others. Also, most information is of numeric nature. This is particularly true of databases like the one provided by the UN, the Worldbank, Wolfram Alpha, DBpedia, etc. A modest mixture of textual information and a selection of pictures are found in Factbook, Wikipedia, Britannica or Factfish, and maps are employed as in Open Street View, Google Street View, or Geonames. However, cultural or country-specific issues are never addressed. We have started what we believe is the first serious attempt to provide a site that tries to overcome some of those weaknesses in geographyoftheworld.org. Without reinventing the wheel, i.e. using information from various sources as far as copyright issues permit, we are building a site that beyond presenting numerical data we try to consolidate and verify such data and we dig deep into the hearts of countries by mentioning cultural aspects, stories typical for a certain region and a range of pictures with solid description showing the uniqueness of parts of the world.***

Index Terms: ***Data Integration, Knowledge Discovery, Geographic Server, Data Exploration***

1. INTRODUCTION

As the web is doubling in less than two years, the delivery of reliable and interactively useable information is important. In this paper we describe fairly sophisticated Webserver [30] providing general geographical information. In addition to numeric information that we try to check against various sources we also want to get across the "spirit" of countries by providing special information, pictures with ample explanations, stories typical for the country and information on culture.

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To summarize, we are trying to ensure information reliability by consolidating information (e.g. figures on various aspects of a country) by comparing numbers in different databases and taking only figures for granted if they agree in all databases examined. Otherwise we try to find out where the discrepancies come from. In many cases we are not successful and hope that the community will help.

As a start we concentrate on figures that are fairly static in time like size of countries, highest mountains, largest cities, typical (and dated pictures), stories about surprising facts or curiosities concerning a country, etc. Figures that change rapidly in time are handled by re-importing certain parts of some databases, and by tying in the community in many countries of the world, see Section 8.

We do not concentrate on figures or mere facts as such, but allow users to experiment with figures by comparing parameters both concerning countries and groups of countries. This allows determining regions of the world with particular positive or negative aspects, as required by a user's interest. We also use at least three sources for maps, one version allowing adding links to arbitrary information at any point in the map to augment and adapt maps to varying information needs.

However, the dominating feature of our server is that we do not just want to present numerical facts about countries, but a large set of typical and well-texted pictures, stories that are typical in some way (be it because of special folklore, legends, aspects of natures, interesting comparisons of figures with other countries) and emphasizing cultural aspects from Nobel prize winners to UNESCO heritage sites to National Parks.

To do this in a systematic way presents many challenges. It starts with the fact that it is not even clear what a country is. Although it sounds reasonable to take the official 193 UN countries (and we use this list as main guideline) this decision is contentious, as shown by many examples: Cyprus is considered one UN country, yet de facto it consists of a Greek and a Turkish part and some pockets of land belonging to the UK overseas territories. Most would consider Taiwan a separate country, yet China's "one country" policy has never allowed Taiwan to

become UN member state, so is only listed under territories. The status of a number of regions (like of Kosovo) of what was Yugoslavia up to 15 years ago is not clear.

The situation gets even worse once we start looking at specific numbers. The square mileage of a country is not as clearly defined as one might think: some countries (like France) exclude larger lakes and glaciers, others include the area of sea passages in archipelagos of that country (like Finland), others include large tracts of land for political reason (like Denmark the area of Greenland), etc. We have discussed such issues in previous papers, [1] and [28].

We try to clarify definitions to a high degree. In this paper, we concentrate on three issues: (1) consolidation of numbers using experts and community; (2) building a lab environment to experiment with data obtained, and (3) emphasize cultural information, stories and pictures that are archetypical for the countries involved.

Rather than treating information as static factual pieces, we try to provide an environment for exploratory insightful discovery at both the personal and community levels.

2. SOURCES OF DATA

In ensuring the validity of information we need to consider trust-worthy sources of information. For concrete base figures we use the ones listed in Factbook [9], Worldbank [10] and UN Data [11] as our main sources. Information from these sources is further checked using DBpedia, Wikipedia, Britannica, Wolfram Alpha and national sources. We believe that further progress in information consolidation will only be possible by involving the community and in particular geography institutes and other related institutions world-wide, a process that has been started with advice from geography professor and Academy Vice President Anne Buttimer at Dublin [12], see Section 8.

For maps of countries we have been using, among others, Facebook and the UN collection of Maps [13]. Concerning culture we have used information from the UNESCO heritage site [14], information on National Parks from various sites including National Geographic [6]. For famous persons we have used both sites of prestigious awards, like Nobel Prize [7], Wolff Prize [8], etc. but also lists of famous persons like Biography Online [15] and particularly the Famous Persons site [16].

As sources for pictures we have used some 8600 historic pictures from the Austro-Hungarian empire (around 1900) in the Austria-Forum picture collection [17], we have obtained many interesting pictures from the community and are particularly grateful for access to the picture archives of Gerhard Huber [18] and Hasso Hohmann [19]. Examples are thousands of pictures of high quality, some, by now, of historical value, like the about 800 pictures of Syria [20] from the year 2009, showing many UNESCO heritage sites intact before they have been heavily damaged as a consequence of the civil war in that country. Or the set of photos of Iranian architecture [21] taken over 40 years ago. We have also used pictures from Factbook, satellite images from NASA, and some from Wikipedia under Creative Common license, where applicable. The issue of stories is particularly crucial as presenting mere facts without user stories makes geography dry and not contextualized. We discuss this in detail in Section 6 of this paper. Although emerging sites like Factfish [24] do provide generic information for tourists and present much information in a video story form, they mainly serve as first impressions of a country. We believe that this service has to be expanded and should provide information beyond trivial touristic stuff. Stories are needed for each country that are either touching, funny or provide unexpected information.

3. INITIAL USES OF DATA

For each country the URL [30] provides an entry page that shows flag and emblem of the country, gives a short description and shows (via a Google plug-in) a map of the country. Below this you always find the structure shown in Figure 1.

Particular attention should be paid to the following items: “Geography” where we have tried to consolidate data (like the discrepancies of 53 UN member states when it comes to square mileage); “Maps” where we are trying to assemble a growing set of maps; “Culture” and “Special Information” (the latter called stories in many places) to be discussed in more detail in Section 6 and “Pictures” already mentioned above.”

To compare statistical figures it was necessary to normalize some of them. It may be interesting to have e.g. the number of medical doctors or Nobel Prize winners in a country, but it might be more interesting to have them per 1.000 or 1.000.000 people in the country for comparison. While USA has the largest number of Nobel Prize winners (254), per 1 million persons Saint Lucia has more (12.24) compared to 0.8 in the USA.

For each country we also have a list called “Top Ten Rankings” showing where the country ranks among the top 10 UN states. High ranking is of course not necessarily good, like High Mortality of Newborns etc. would not. Figure 2 shows the situation for Austria.

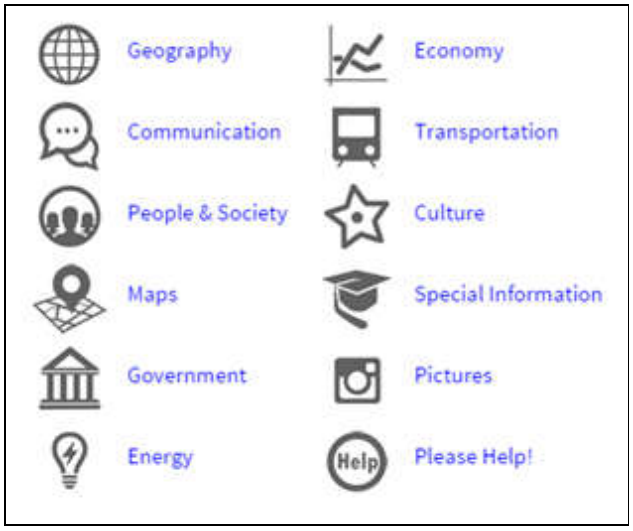

Figure 1: Structure of Information for each country and territory

Did you know that Austria is among the top 10 of the 193 UN countries in the following 12 respects.

1. Natural gas - imports per capita - cu m: 5,176 (Rank 2).
2. Median age - years: 44.0 (Rank 4).
3. Physicians density - physicians/1,000 population: 4.86 (Rank 5).
4. Electricity - imports per capita - KWh: 2,829 (Rank 5).
5. Electricity - imports - KWh: 23,260,000,000 (Rank 7).
6. Age Structure: 65 and above - %: 18.9 (Rank 8).
7. Age Structure: 55-64 years - %: 19.2 (Rank 9).
8. Electricity - exports - KWh: 20,460,000,000 (Rank 9).
9. Natural gas - exports per capita - cu m: 4,226 (Rank 9).
10. Imports per capita - $: 20,418 (Rank 10).
11. Hospital bed density - beds/1,000 population: 7.6 (Rank 10).
12. Electricity - exports per capita - KWh: 2,488 (Rank 10).

Figure 2: In 12 respects Austria is among the top 10 of the 93 member states of the UN.

Note that Austria is doing well in physicians density (Rank 5 world-wide), yet this may even be weakly connected with the dismal age structure: Austria is ranked no.8 world-wide when it comes to the percentage of persons above age 65.

All former Yugoslavian countries have high unemployment among young people, but how catastrophic the situation is can be seen in the Top Ten Rankings of Bosnia Herzegovina where 68.2% of the population between 15 and 24 years of age are unemployed!

In addition to the Top Ten Rankings also parameters for which a country is ranked among the lowest in the world are shown, revealing many interesting aspects. Here is one example: In the following 5 countries only 2.1 % or less of the population is older than 65: Uganda, Kuwait, Nauru, United Arab Emirates, and Qatar. United Arab Emirates, Kuwait, Qatar spend a very small percentage of their GNP on health, so these 3 countries do not come as surprise, but Nauru and Uganda are ranked around 30 in their expenditure on health, so why are there not more old people? Well, the island Nauru with just 21 square kilometers (most of it destroyed through phosphate mining, and no natural fresh water resources except rain and an aging desalination plant) and with less than 10.000 inhabitants it cannot be a serious candidate for statistics. Uganda with about 30 million people, yet 70% 24 years or younger, three facts explain the situation: Destructive civil wars, less than 50% of the population have access to clean water and the country where AIDS originated. However, since it is considered the main battle ground against AIDS the medical expenditure (mostly through international aid) is surprisingly high.

4. *More Advanced "Laboratory" for Working with Data*

Having data from all countries and territories of the world available it clearly makes sense to provide a "Virtual Laboratory for Exploring Countries" [22]. In this Laboratory one can check for each country an arbitrarily large subset of some 100 properties, or one can compare

properties of countries. It is probably best to explain this by means of some examples.

Figure 3 shows a comparison of Chile and India concerning population density and median age.

Rank	Country	Population density
1	India	376.1 (14)
2	Chile	22.97 (145)

Rank	Country	Median age (years)
1	Chile	33.0 (61)
2	India	27.0 (95)

Figure 3: Comparison of two countries involving two properties

Figure 3 shows among others that India is fairly densely populated (only 13 other countries are more densely populated). The mean age of 27.0 as compared to the rest of the world ranks 95 (of 193 UN countries), i.e. is fairly in the middle.
Of course we could now be interested to find out which countries have a population density still higher than India. The result is shown in Figure. 4.

Rank	Country	Population density
1	Singapore	7,988 (1)
2	Bahrain	1,729 (2)
3	Maldives	1,321 (3)
4	Malta	1,306 (4)
5	Bangladesh	1,155 (5)
6	Barbados	673.67 (6)
7	Mauritius	652.53 (7)
8	Lebanon	565.63 (8)
9	Korea, South	491.78 (9)
10	Rwanda	468.42 (10)
11	Netherlands	406.26 (11)
12	Marshall Islands	392.17 (12)
13	Israel	376.59 (13)
14	India	376.1 (14)
15	Burundi	373.55 (15)
16	Haiti	360.24 (16)

Figure 4: The 16 most densely populated countries in world

It must be clear that this offers unlimited possibilities to compare countries.

This gives rise to another obvious question: Are there countries very similar, i.e. agreeing in many properties? This question is particularly relevant if one normalizes figures (per capita, per square kilometer, etc.).

Comparing again Chile and India we find out that they only agree in one of 100 properties: their lowest point is 0 meters, i.e. both have a coast, and both no place lower than sea level.

In the Country Comparison Table [24] we are showing those pairs of countries pairs that have (of 100 important properties) between 9 and 7 properties that are similar. We count a property of two countries similar if the values differ by at most 1 %. It is interesting that no pair of countries has more than 9 similar properties and that pairs of countries with 7 or more similar properties are countries that one would intuitively think are similar, like former Yugoslavian countries. Austria is a surprising exception: It has many similarities with highly developed European countries (Italy, France, UK and Germany) but also with Bulgaria and Kazakhstan!

When countries are compared in our "laboratory" rows with similar values are highlighted red.

Our laboratory also allows aggregating countries into larger units and then comparing properties of those larger units. Note that this poses interesting questions: In some cases one has to take the sum of values (like for Nobel prizes, exports, railway lines, population and area, etc.); but the population density of conglomerate x is neither the sum nor the average of the population densities, but is the population of x divided by the area of x. In some cases averaging by population is necessary (like average birth rate or such; or else a small country with strange values may distort everything); in some cases maximum is needed (highest point) or minimum (lowest point); in some cases the value of x cannot be computed from the data: like length of borders with other conglomerates, since adding the values of all countries in x would count borders between countries within x that must not be counted. This is an interesting problem area and quite important: One does want to compare e.g. unemployment of SE European countries with unemployment in e.g. Germany, or Scandinavian countries. Again, note that some averaging by population averaging is necessary).

5. *VISUALIZATION*

Geographic databases tend to contain large sets of data, usually in the form of tables. In a few instances animation is added like in Factfish [24], a site with pleasant design and as far numerical information goes fairly sophisticated. (It does lack cultural information, stories and large sets of pictures). The figures on this site often do allow animations, like showing the population growth of a country in a graph. However, the most important part of visualizing information is to compare information, and this is not offered in Factfish.

In contrast, we have detailed population figures since 1869 (!) for all (over 2000) communities in Austria, and allow to visualize the development in arbitrary many communities simultaneously, see [26]. Figure 5 shows what this interactive visualizing of population data looks like. We can choose (either by hierarchical exploration or by search) three communities. Two of them show a steady growth, but one (in a former iron producing area) shows a dramatic drop of population. Observe that we have chosen the option "absolute", i.e. we show the actual population figures. We can switch to "index based"; see Figure 6, meaning that now the relative change compared to the values in 1869 is shown.

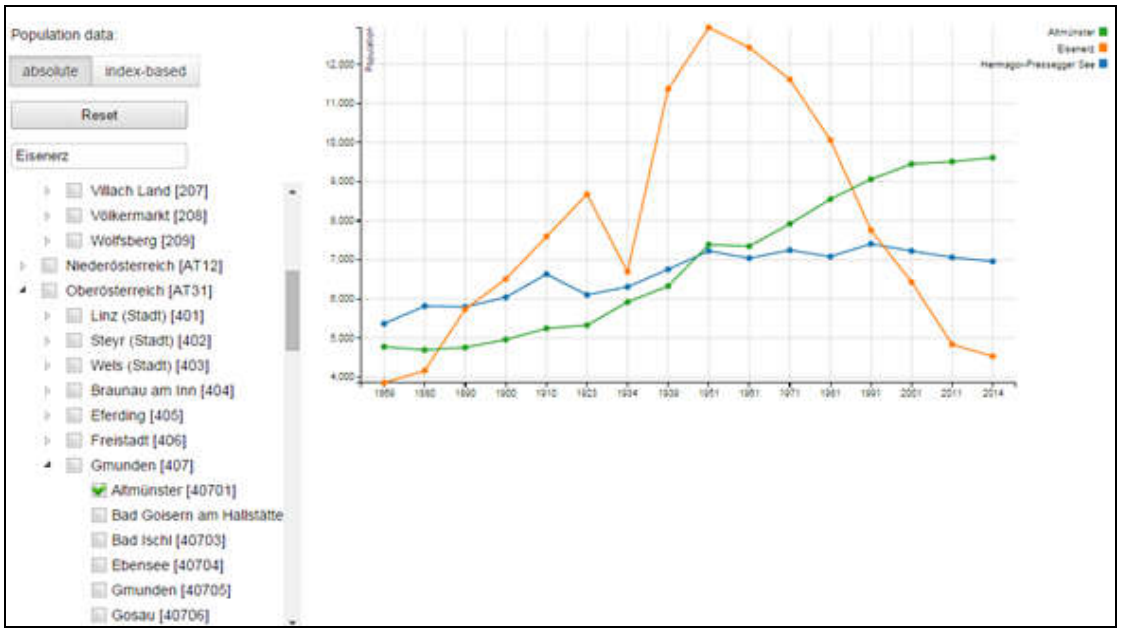

Figure 5: Visualizing population development of a number of communities in comparison

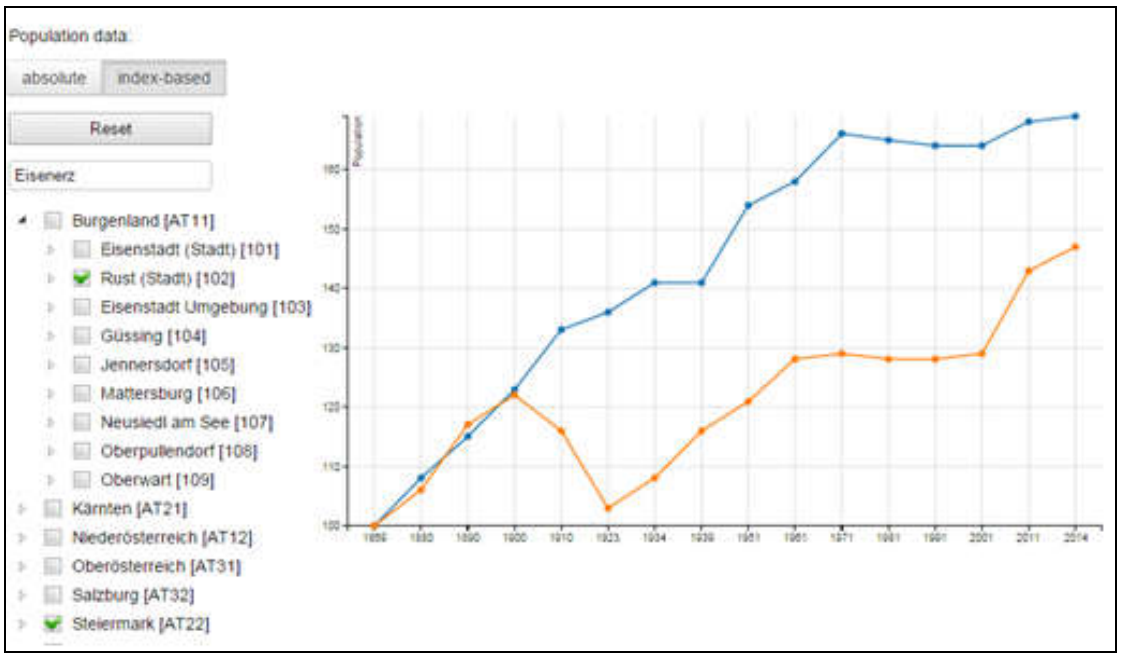

Figure 6: Comparing the rates of change rather than the actual population figures.

We have picked an Austrian province and a village in another province. The option “absolute” would show a flat line for the village at the bottom, since the village has of course a much smaller population than a province. Choosing “index based” as shown instead, it becomes apparent that the recent growth rate in the village was higher than in the province under comparison.

Based on UN data (and 2015 data from another source) we can do a similar visualization for countries of the world in [27]. To choose countries we employ a different interface. We do not provide a hierarchical structure for two reasons: one, the obvious structure by continents is not convenient, since it is often not clear which continent a country belongs to: Does Russia belong to Europe or Asia? (If we decide by population, it is Europe; if we decide by area, it is Asia.) To which continents do islands in the Pacific or Caribbean belong to? Similar cases abound. On the other hand, since the names of all countries can be shown simultaneously on the screen we decided not even to provide a search function. (Actually, this decision is doubtful, since

a country has often different names, like UK vs. Great Britain or Holland vs. Netherlands or even vs. The Netherlands).

Our visualization again allows visualizing real population figures or the population growth. After all, in absolute figures a country like Switzerland will be almost invisible when compared to China. Yet the population growth can be visually compared as is shown in Figure 7. Switzerland has been growing at a faster relative rate than China for the last 10 years!

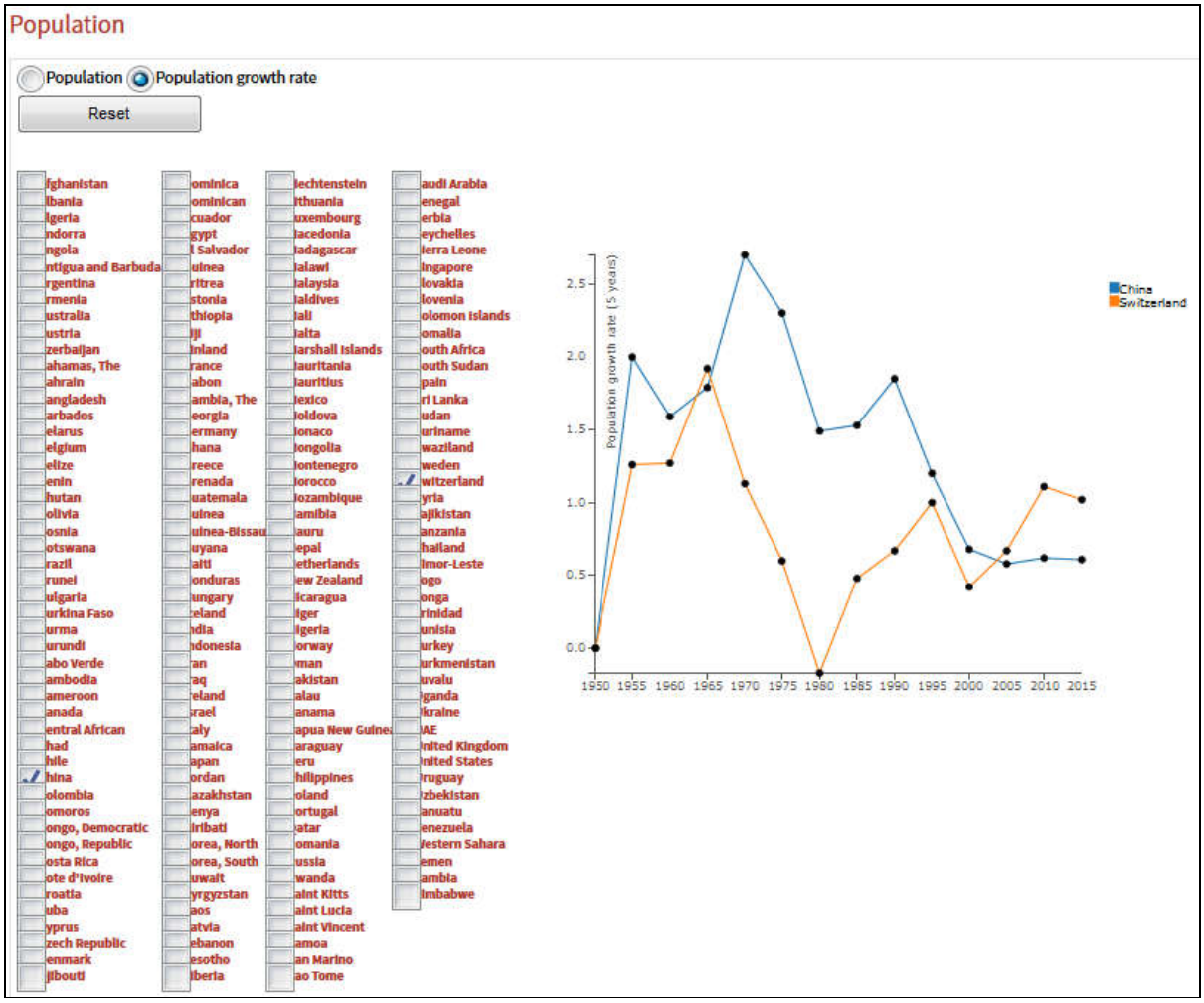

Figure 7: Comparing relative growth rates of countries

Population growth is very fascinating. Everyone knows that population growth in almost all African countries is high (6.4 children per women in Uganda!), but fewer people are aware of the dramatic consequences of some former soviet republics becoming independent: Leaving the country was suddenly possible, and turned often into a necessity because of the dramatic downturn of economy. Typical examples are e.g. Armenia and Georgia who both have lost a high percentage of their population since independence in 1990.

Using data on electricity production from the Worldbank database we can similarly compare absolute production and production changes of countries. The same technique will be applicable to other data.

It is clear that much information "hidden" in large geographical databases can be unlocked using appropriate visualization techniques.

6. *MAPS*

As mentioned earlier, we are providing at the moment three types of maps, but plan to add more as the project becomes more and more international. The first two maps are from Factbook, the third one is a vector map that shows both the country and its districts and has three special features.

It allows accessing the capital city of the country (blue marker) and by clicking it leads to the OpenStreetView with the capital city in the center. The square icons in each district/province give the name of the district.

The red markers can be placed by any person authorized to do so. A click provides whatever information was decided to be attached to the marker, i.e. can be textual, a pointer to some picture or pictures, or to some Web page(s). This is best illustrated by an example: We show the map for Germany [31] in Figure 8.

Figure 8: Germany and its districts.

A click at the red marker on the right and the lowest ones informs us that the capital city of the province Bavaria (Bayern) at issue is Munich (München). A click on the red marker straight above yields to what is shown in Figure 9:

Nuremberg (Nürnberg) is the second largest city of the state of Bavaria (Bayern), after Munich (München) its capital . Here are some typical picutures of Nürnberg .

Figure 9: Result of a click at the red marker

It is clear that providing interesting red markers cannot be done locally in Graz, but only by the community operating their own version of our geography server as explained in Section 8. Note that the heavy reliance on local help will make sure that information is indeed suitable for the local community, or for the world, if distributed, see Section 8.

7. *Culture, Stories and Pictures*

Our server is one of few geography servers that go quite a bit beyond presenting statistical data.

We have a separate section on Culture where we are in the process of collecting for each country their UNESCO heritage sites (over 1.000 world-wide and the number keeps growing), national parks, famous persons (from Nobel Prize winners to painters or composers), etc.

To further present countries not just by mere figures we want to present stories about them. Some are written by real authors see e.g. the "House of Spite" or an "Iceberg Symphony", etc. If you are curious, have a look at what is currently available under [25]!

Others are generated based on comparison of figures. As mentioned before, we listed for each country parameters, where the country is among the ones on top or among the ones at the bottom, in a world-wide comparison. We also show for each country all countries with a sizeable number of similar properties.

Still others are semi-automatically prepared: Based on figures some properties are extracted and put into a story form, just needing a bit of polishing by humans. We will come back to this in another paper when our software is sufficiently improved, but let us just hint at two different techniques for semi-automatic story creation.

A country with zero coastlines is "landlocked". Depending on the latitude it can be classified as "tropical" or such. A small country with no big elevation, a very long coastline and where tourism is a major source of GNP turns it into "a collection of fairly flat islands loved by tourists", etc.

A second approach is to search the Web for a country and analyze the texts obtained. If "mining copper" is mentioned in all or most sources, or "desalination plays a major role" and such those facts can be combined into an interesting story highlighting the most important facts of that country. Putting it differently, we are not using figures or stories from a particular source but look at many entries for a country on the Web and extract those points that occur in high percentage of the descriptions.

We use the term "semi-automatic" story creation since at this point in time the product delivered by the algorithms needs polishing and checking by humans, a typical example for human-computer collaboration.

We believe that pictures can provide valuable information about a country, including its culture, folklore, people, and more. The Web is overflowing with zillions of pictures. However, we believe that most pictures one can find either lack good descriptions of what they show and usually are rather recent. By way of example, a description "Sagrada Familia built by Gaudi" is not enough, if not more is mentioned about this building in Barcelona and its architect Gaudi. 700 pictures of Syria taken in 2009 have now historic value, since many of the famous parts of the six UNESCO heritage sites have been virtually destroyed by a conflict that is still ongoing at the time of writing. For an example see the picture in Figure 10, [32] of Palmyra, Syria, now of historical value, due to recent destructions.

It is also important to look further back. 8.600 pictures of the Austro-Hungarian Empire from around 1890 are good examples on our server. On the other hand, hundreds of pictures of various islands in the Philippines show the mixture of different ethnic groups and allows us to comprehend why frictions occur and to better understand actions of governments involved.

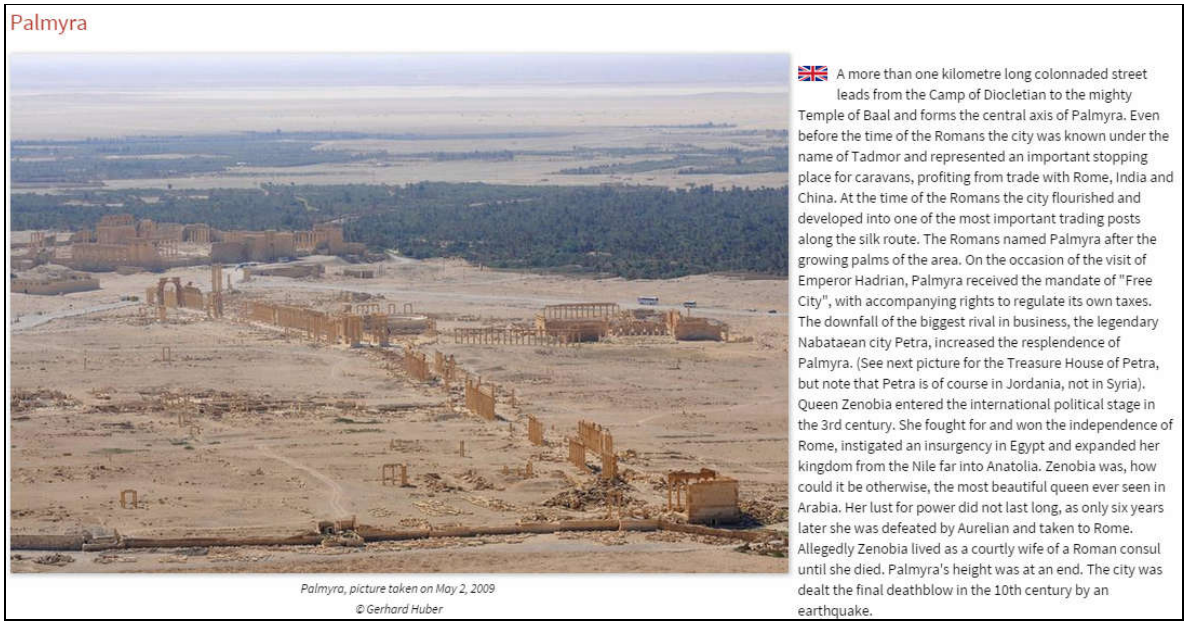

Figure 10: Palmyra, Syria

8. OUTLOOK

Reading this paper many will have wondered how we can ever expect to reach a level of acceptable completeness.

It is clear that this cannot be done by one group alone, but by tying in many groups and the community.

For this reason in addition to continue the "obvious" implementation and information gathering activities we are in the process of pursuing two important avenues. One is curation to easily incorporate material that is located outside the main server by using tools that are similar to pinterest [29] and others, yet the user can view the results without registering. This is clearly a large topic on its own. Curation on the Internet is closely linked to traditional curation of art and such, see [2] – [5]. The other avenue is to isolate the geography part of our server with a multilingual interface so it can be used in many different institutions. We call this the IGK (International Geographic Kernel server). The IGKs in this network will use sophisticated synchronization mechanisms so that information updated at one site is automatically available to all other sites.

Such a network is necessary to move what we have started forward with high speed. Due to the number of IGK nodes foreseen, we have had more than ten locations already contacting us as possible participants. The sustainability of the network does not depend on one or more specific servers and it can operate without problems even if some IGK servers are shut down for whatever reason.

It is clear that having such a network of servers will also require both algorithms and new methods to synchronize data and to assure close collaboration when implementing new features.

To be more specific, here is an example. Suppose a site is adding further information. The site may decide to make it available to all participants or only to some servers. However, the recipient may also not want to accept the change added, because it is too close advertisement, or might be politically motivated, or such. To make it unnecessary to check all incoming items manually some sophisticated heuristics will be necessary as the network of such servers grows. The first method to be implemented is this: entries in a category will have for each IGK server "a color". Red means: Ignore information coming from this server in this category. Green means: Accept information coming from this server in this category. And "Yellow" means: Check manually before accepting or rejecting.

Concerning collaboration in developing the system, one or two yearly development meetings between all those interested in adding new features or improving others will be necessary.

The IGK network has the potential to become one of the dominant sources for geographical information on a wide-area level, of course not at the fine granularity of GIS systems used in cities and countries for planning issues.

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