Developing a system for suggesting alternative ways of visualizing data

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Data visualization can be powerful with regards to perceptive advantages and effective communications. It amplifies cognition and helps users to carry out tasks more effectively [1, 2]. Despite its advantages, cartographers and DataViz designers still have this gap for some *incorrect* decisions in picking diagrams and map types. Moreover, they are sometimes unaware of the *alternative* visualization options that appear with data transformation. With an example of SDG indicators framework, we can demonstrate how a recommender system can be designed in order to bring *alternative* and advised data visualization options to the users.

BACKGROUND

Data visualization deals with the translation of qualitative, quantitative, and spatio-temporal data into a correspondingly appropriate visual representation that might be relevant to its users. Considering the recommender system for data visualization, it is important to select a focus among the aforementioned aspects of data visualization (e.g., software usage recommendations, graphic design decisions, pipeline optimization). By selecting the focus, it is possible to design the recommender system by means of following methodologies [4]:

Data-driven system (involves artificial intelligence and machine learning to advise visualizations or decisions); **Expert knowledge-based system** (uses sets of logical rules, forming a knowledge representation of the visual artifacts with assigned characteristics)**; Hybrid system** (use a combination of two aforementioned approaches).

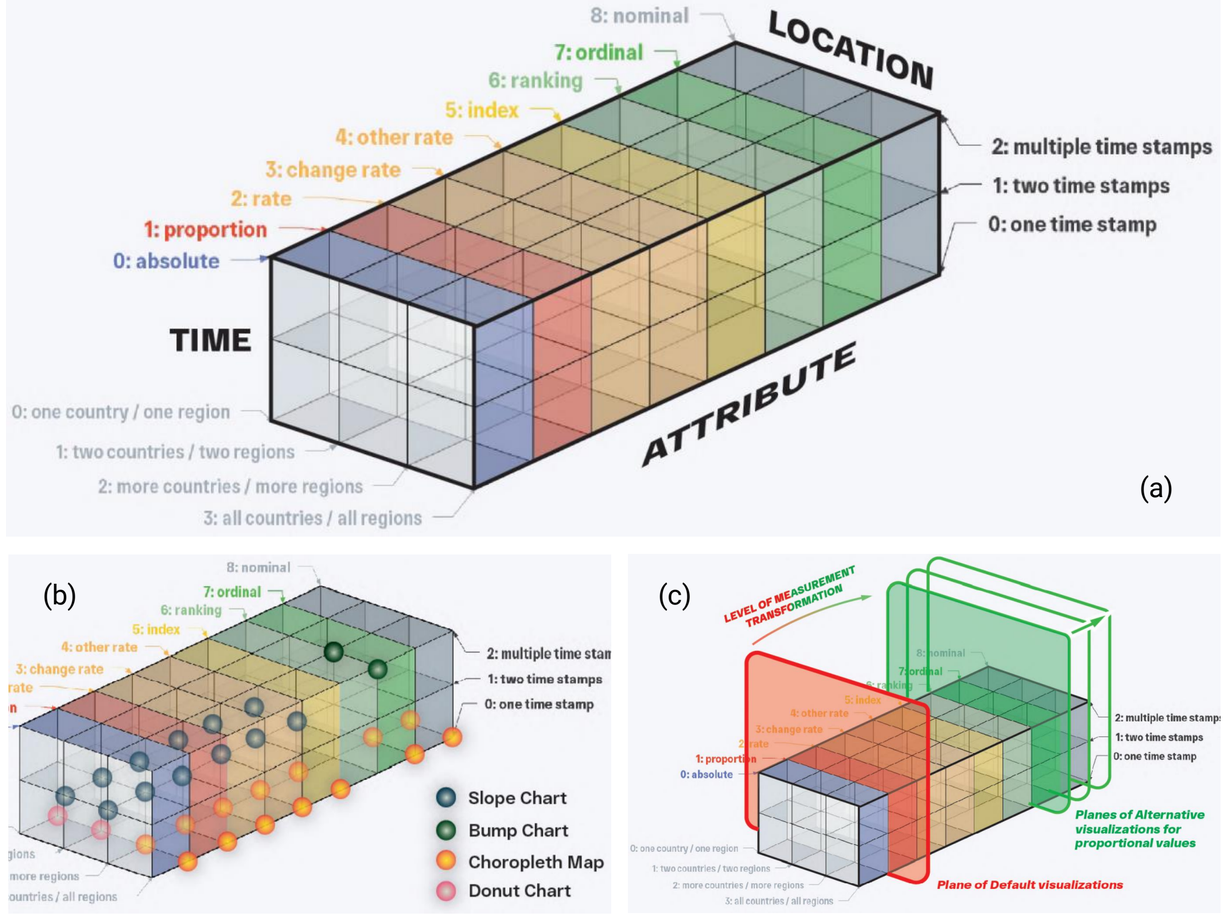

Fig. 1. (a) conceptual realization of recommender through ATL matrix, (b) location of some data visualization options in the matrix, (c) data transformation option example with proportional values

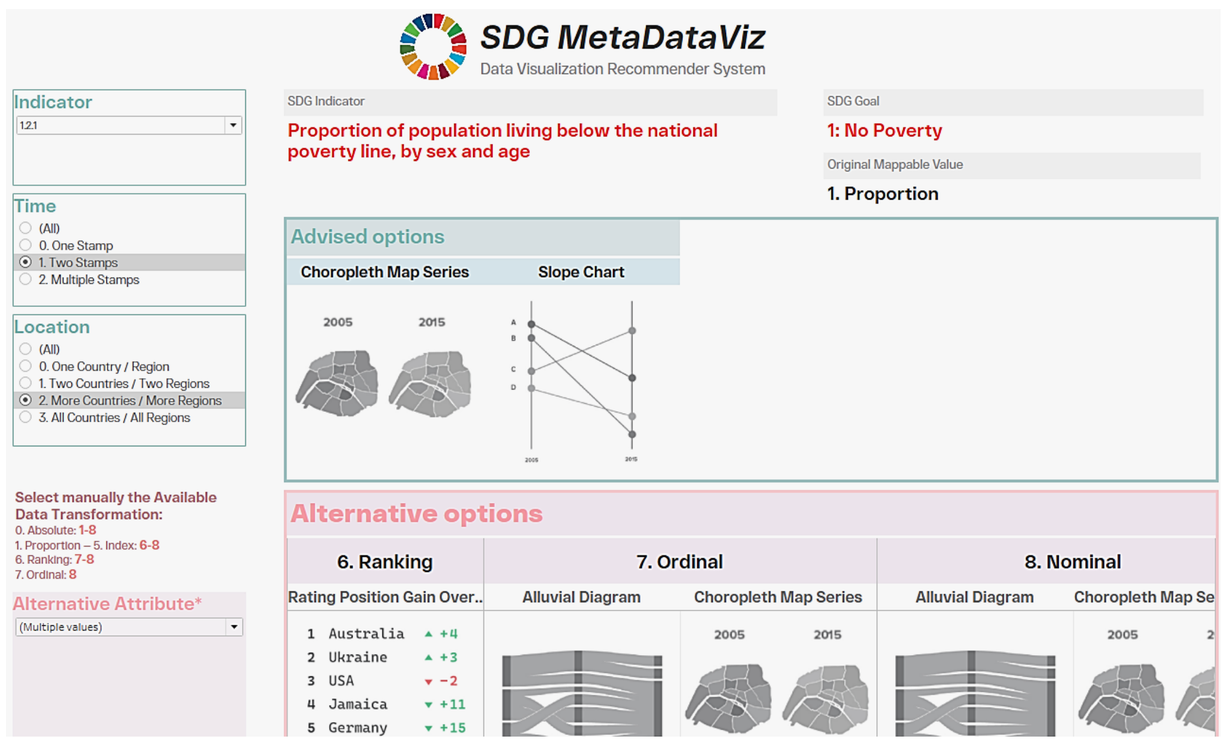

Fig. 2. SDG MetadataViz dashboard designed in Tableau, demonstrative prototype of recommender system

SDGS

The Sustainable Development Goals (SDGs) by the United Nations represents a particular topic for cartography and data visualization. For the proper analysis and better understanding of SDG concepts, data visualizations and maps come with support, offering insights at multiple scales and displays. The existed collaborative research on SDGs allowed to focus on SDG indicators data representation that can be used for a recommender system of indicators visualization [3].

METHODOLOGY

It was decided to focus on an implementation of expert knowledge-based recommender system due to multiple constraints. The geospatial data representation of SDG indicators can be narrowed down to the shaping parameters of attribute, location and time (ATL). Moreover, each indicator contains inherent level of measurement (ratio, ordinal, nominal) and corresponding mappable value (e.g., absolute value, proportion, index, etc.). They can be used as a main reference for a recommender system.

Additionally, there are some defined options for data transformation (e.g., proportional values can be transformed into ranking, ordinal and nominal values, etc.). By classifying the parameters of time and location into simply distinguished categories, it becomes visible to discern the data visualization recommendations as dependencies on these ATL parameters (Figure 1, a).

The matrix should be considered as a compilation of intersecting planes (e.g. plane of two-time stamps visualizations, the plane of ranking visualizations, etc.) that narrow down the data visualization options to the user depending on the input ATL parameters and located data visualization types (Figure 1, b). Finally, there is a data transformation, which brings the *alternative* data visualization options (Figure 1, c). By transforming the level of measurement, the message of the map or visualization gets simplified, involving levels and categories instead of numbers [2].

RESULTS & CONCLUSIONS

The key practical realization of the study is realized in the prototype (Figure 2). It allows to see the advised and *alternative* data visualization options depending on the selected indicator, time and location parameters. Moreover, there were multiple illustrations and maps designed for the thesis in order to demonstrate the validation of the system and data transformation effect on the visual output. The selected matrix methodology implies that some of dataviz aspects were considered to partially assist in the SDG visualization design process. It is useful to expand the research involving data-driven approach and adding more parameters.

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