Using KiriPhys to Show Expanding Carbon Emissions

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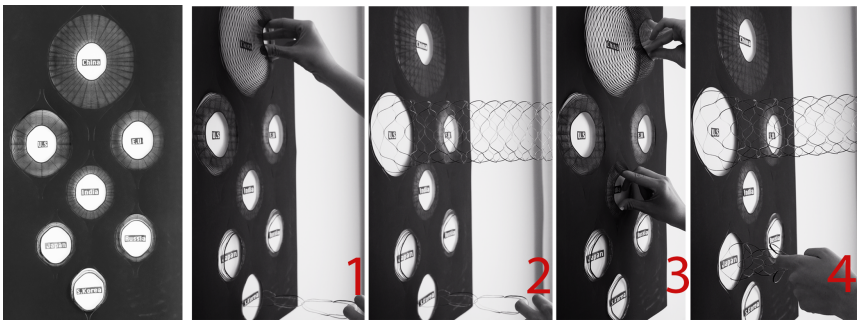

Figure 1: Using KiriPhys to show carbon emission: Left image shows the front view of the geographic regions with the highest carbon emissions. The other views show interaction revealing cross-country comparisons.

Abstract

We present an interactive carbon emission data physicalization based on the Kirigami technique. Leveraging the interaction and data representation possibilities of Kirigami, we physicalize total and per capita carbon emission in a way that reflects the data set relationships: Total emission divided by population is equal to emission per capita.

Index Terms: Human-centered computing—Visualization—Visualization techniques—;

1 Introduction

There is a well-known gap between what experts know about data and what the general public understands. This gap is particularly critical regarding climate change data which requires public awareness and feelings of responsibility. To close this gap, we need to make crucial climate-related information easily accessible to the public in a tangible, understandable format. Physical data representation or physicalization, which is defined as "a physical artifact whose geometry or material properties encode data" [2] has been shown to be engaging, emotionally rewarding, and relatively easy way to create understandable representations compared to digital visualizations. Motivated by the promising advantages of physicalization, we decided to physicalize CO2 emission data, which is the most dominant greenhouse gas produced by human activities. We retrieved the total CO2 emission and per capita CO2 emission of China, the United States, the European Union, India, Japan, Russia, and South Korea since they are the top 7 largest emitters in the world in 2018 accounting for 66.6 percent of the world's total emission [3].

To make a comparison of countries' emissions and per capita responsibilities, emissions in terms of CO2 per person have to be taken into consideration, as for instance, China also has the world's largest population. Therefore we physicalize both absolute and per capita emissions, two crucial indicators of a country's performance and useful units to make cross-country comparisons.

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To illustrate these indicators and their relationship in a logical way, we physicalized CO2 per capita as the result of the total CO2 amount divided by population. To this end, we implemented a physicalization technique that offers both dependent and independent variables data. Therefore we can show the absolute CO2 emission and population with two independent variables and the CO2 emission per capita with the resulting dependent variable.

2 Describing CO2 Emissions KiriPhys

KiriPhys, a physicalization technique based on kirigami techniques, offers the potential of combining independent and dependent variables as well as novel tangible interaction possibilities. In this technique, applying data-driven cut loops on a 2D paper turns the paper into an expandable 3D structure. The expansion properties like size and density follow the applied cut line properties. For a full explanation of the technique, please refer Daneshzand et al. [1].

The CO2 Kiriphys we have designed has seven cut patterns in a form inspired by leaf shape. The inner loop size is identical for all countries. Then, one loop is added for every 200 tonnes of CO2 emission. This results in larger cut patterns for countries that emit more CO2. Therefore, a viewer can quickly observe and compare the sizes of the outer loops of several countries to get a ballpark estimate of the differences and can also retrieve precise values by counting the number of loops upon closer examination. The population of each country is mapped to the density of texture in each cut pattern. Therefore, the larger population results in denser expansion and vice versa. Given that the total emission is mapped to the number of loops and population is mapped to the number of anchor points the resulting amount of expansion of the cut pattern represents the emission per capita for that country (see Figure 1).

References

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