Designing Interfaces for Elastic Displays Using Workshop and Prototyping Methods

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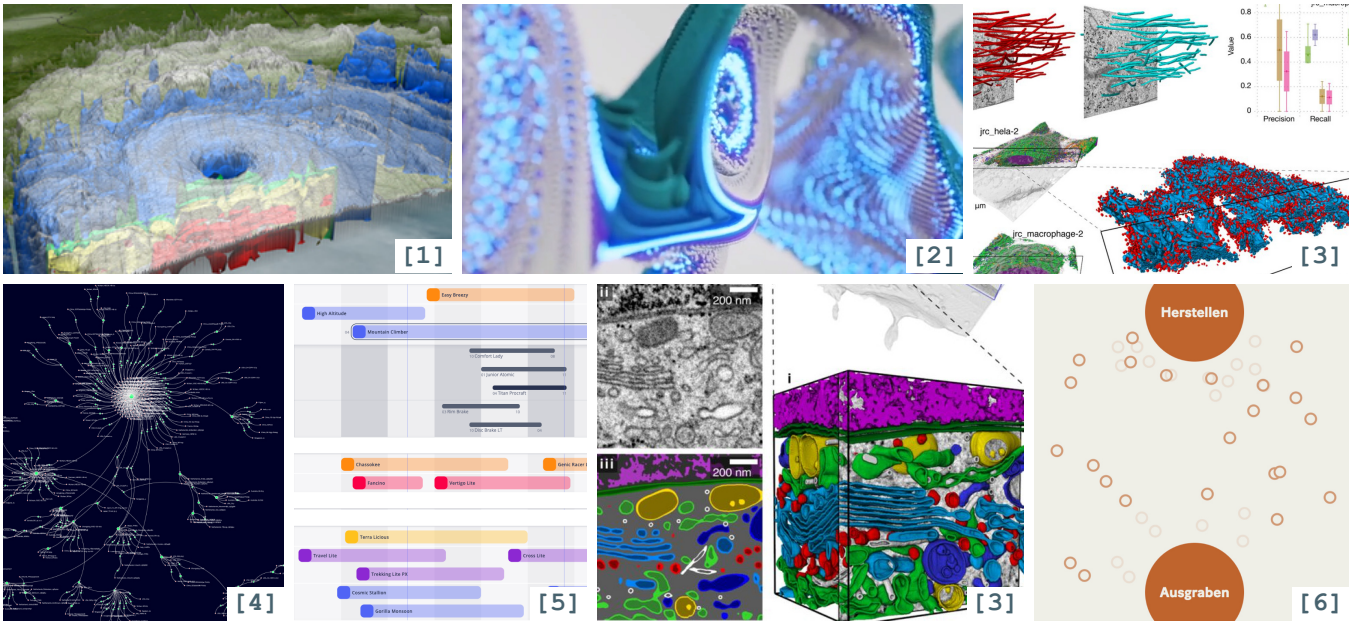

Figure 1: Moodboard with inspirational material of existing data visualization interfaces used for specifying the concrete application domain in the preparation phase. [1],[2],[3],[4],[5],[6]

ABSTRACT

Any design endeavor requires practitioners to engage in divergent thinking (cp. Double Diamond Model). Numerous creativity techniques and methods exist to support the design process and give structure in order to converge a wide variety of ideas into suitable candidates for prototyping and testing. Designing for specific, tangible interaction technologies requires a careful framing of the selected methods.

Over the course of 10 years, our research group has gained experience in designing and developing applications for elastic displays. In this pictorial paper, we illustrate methods and intermediate results for a concrete application design. Due to the Covid19 pandemic, we made extensive use of the collaborative whiteboard application miro. We designed a way to visualize, explore, and evaluate clustering algorithms in the domain of machine learning using an elastic display. Finally, we present follow- up techniques for prototyping the concepts and ideas.

CCS CONCEPTS

• **Human-centered computing** → *Interaction design process and methods*; *HCI theory, concepts and models.*

KEYWORDS

elastic display, interaction design, design methodology, design thinking, user centered design

1 PREPARATION: CREATING A SCHEDULE

Our design process was part of a research project between a company and a University of Applied Sciences. The goal was to involve as many experts from design and software development as possible to yield the best ideas. However, we found it very beneficial to alternate between the number of participants. Workshops with more than three participants produced many intermediate results that were condensed by fewer colleagues afterwards as input for

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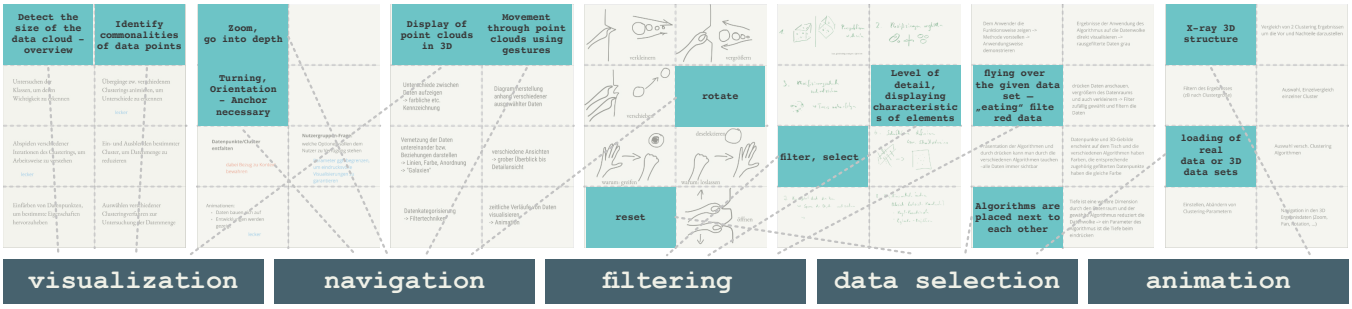

Figure 2: Categorized and grouped ideas resulting from the "Crazy 8" method used in Workshop I.

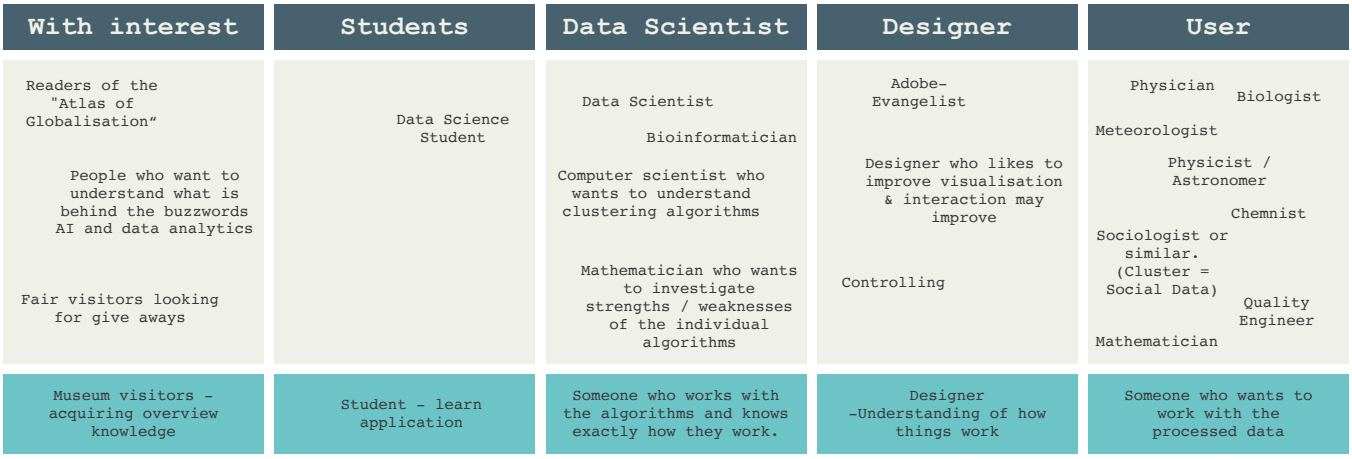

Figure 3: User segments created in Workshop II.

the next extensive workshop. Due to organizational issues such as limited time resources and remote work, each workshop was restrained to a duration of max 2 hours. The process shown in this pictorial paper spanned approximately two months. Two persons were responsible for preparing the schedule and initial contents required for the workshops.

Initially, the subject area was roughly characterized as "Big Data Exploration". An important first step was to boil down the scope and prepare precise questions. As a result, the application domain was specified and necessary details for a basic understanding were researched. The preparing team also provided some initial inspirations (see 1) and presented different existing solutions on traditional user interfaces. The idea was to point at specific issues that could be solved by leveraging the possibilities of the elastic display. All material was collected in a miro[1] virtual whiteboard.

2 WORKSHOP I: BROADENING THE VIEW

The first workshop had seven participants and the main focus was to foster divergent thinking according to the double diamond model [7],[8]. The input from the preparation phase included information on the topic and the technological setup of the elastic display. The application domain of clustering algorithms was opened up, considering different possible applications, visualizations, and interactions. For the initial question: "How to handle clustered data from machine learning on the elastic display?", each participant produced textual and sketched ideas according to the "Crazy 8" method [9] on the miro whiteboard (see 2). After the workshop, the manifold ideas of this workshop were grouped and categorized into the aspects of: navigation, animation, data selection, visualization, and filtering. These cleaned up outcome served as input for the next workshop.

3 WORKSHOP II: GETTING A GRASP ON USERS

In the second virtual workshop using the Miro whiteboard, a focus group of three participants converged the ideas and analysed user segments (see 3). This workshop also included a brainstorming phase based on the prior results. Again, the focus was broadened in a first step by collecting inspirational material for possible user groups (see 4).

In the second step, the ideas were condensed into three suitable user groups covering a variety of aspects from the original user segments: meteorologists, medical experts, and biologists. Personas for these user groups were completed individually by the three workshop participants as follow-up work after the workshop (see 5).

[1]https://miro.com

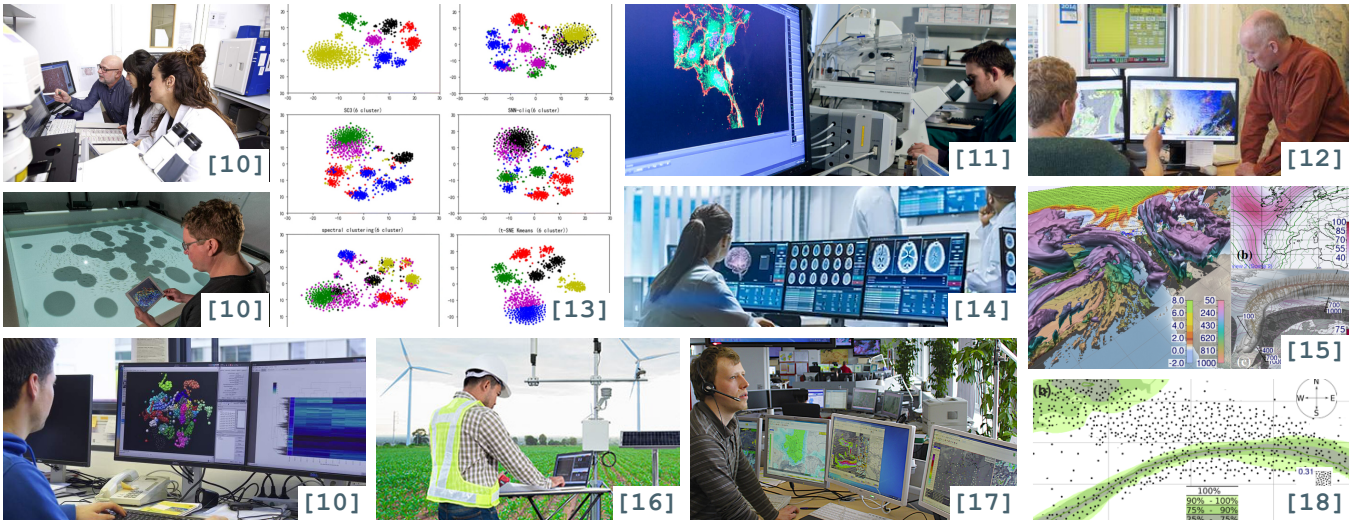

Figure 4: Collecting inspirational material for specifying user groups. [10], [11], [12], [13], [14], [15], [16], [17], [18]

Figure 5: Personas for three user segments: meteorologists, medical experts, and biologists. [19], [20], [21]

Moreover, an initial story map was created as preparation for the third workshop.

4 WORKSHOP III: CREATING A STORY

With five participants, the categorized ideas and the user requirements identified in the previous workshops were collected in a story map on the Miro whiteboard containing an “enter”, “exploring”, and “leaving” phase (see 3).

We considered the pain points of our personas in regard of the tasks from the different associated disciplines: biology, medicine, and meteorology. Our story map also served to prioritize functions in order to define a minimal viable product (MVP), keeping additional ideas in a separate lane as future extensions (see 6).

5 WORKSHOP IV: DEFINE THE INTERACTIONS

The fourth workshop with three participants was devoted to brainstorming the interaction concept necessary to realize the functionality defined in the story map. This workshop was performed at an actual elastic display in a table setup with the goal to identify intuitive interaction metaphors. An important issue was to find out discrepancies, redundancies, and conflicts in the proposed gesture

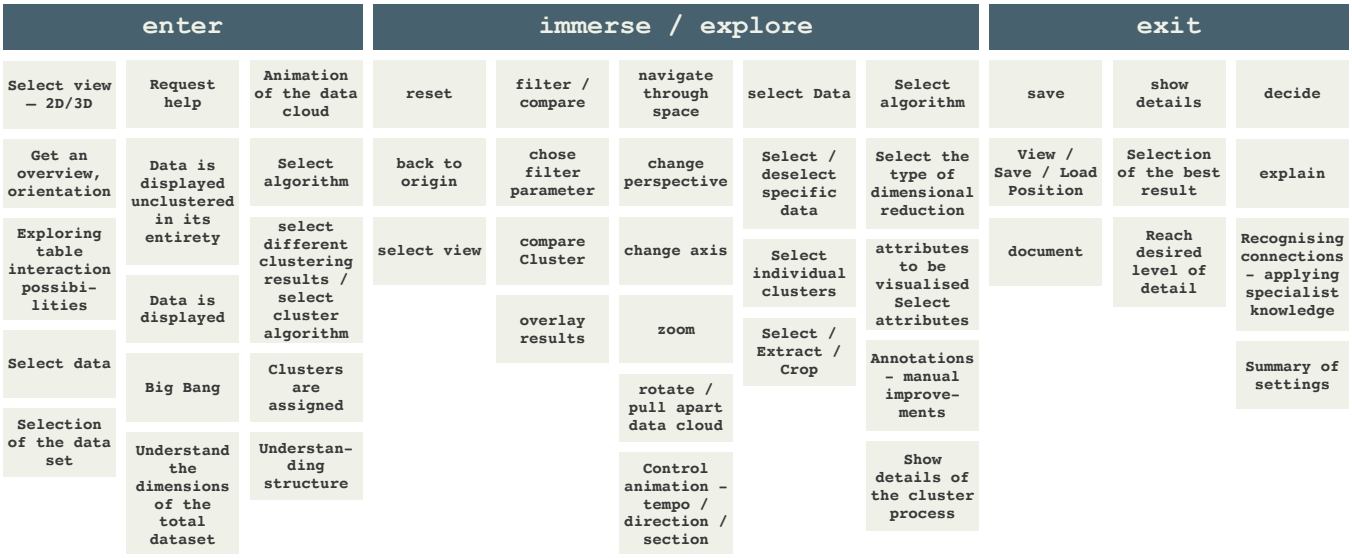

Figure 6: User Journey containing categorized user requirements as input for Workshop III.

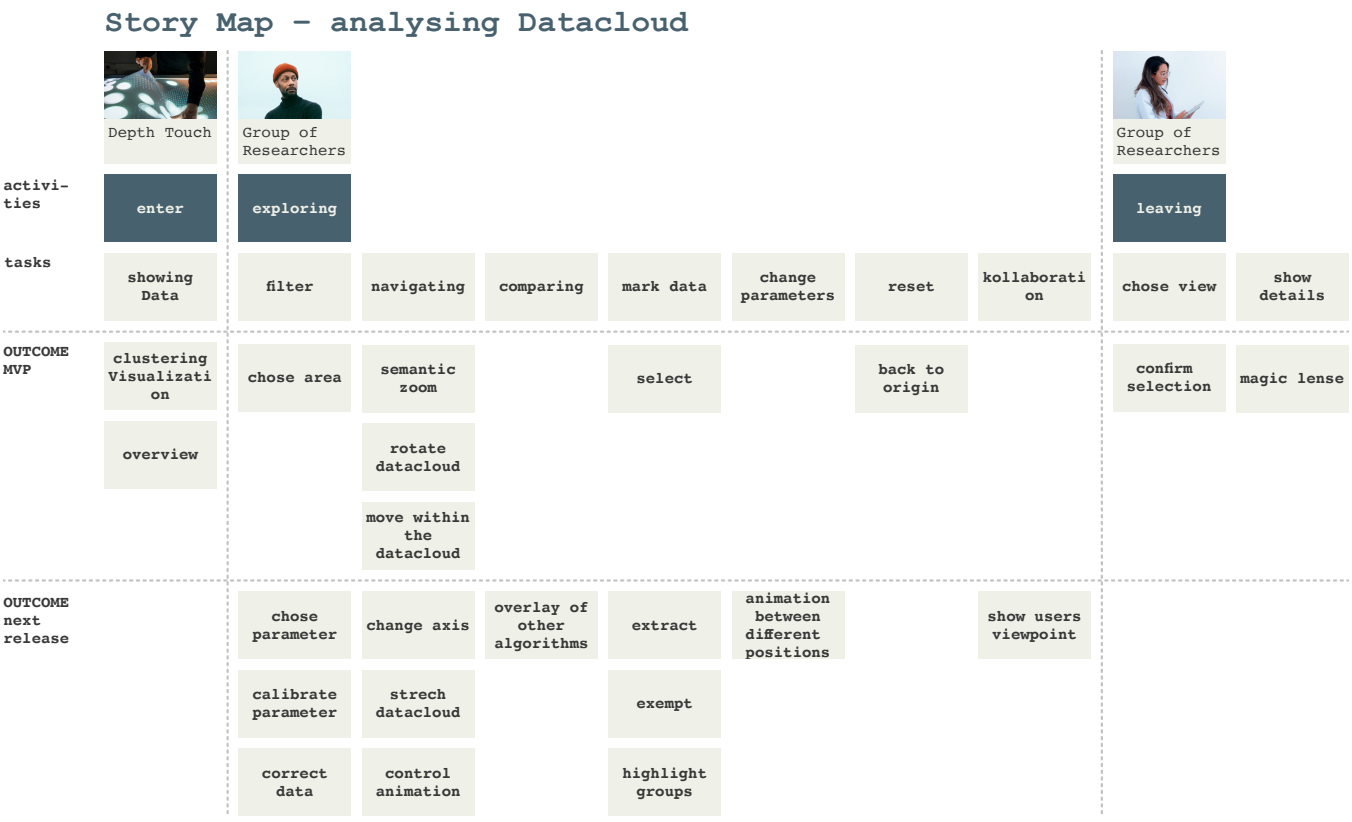

Figure 7: Resulting Story Map containing the MVP-feature set, grouped into the user requirement categories and extended features as additional lane on the bottom.

set. In order to document the results for all team members in the miro whiteboard, stop motion videos were produced. Two persons were responsible for the consolidation of the ideas. Gestures were

Figure 8: Three different gesture sets for elastic displays covering the function defined in the user story map.

named and grouped and possible technological issues were identified. Conflicts and ambiguities were checked and gesture sets and variants were specified in order to eliminate the necessity of mode changes where possible. As a result, a gesture matrix including three possible versions of the interaction concept was created for further prototyping and testing (see 8).

6 PROTOTYPING: CONTINUE THE WORK

For more detailed prototyping, project members can individually refine the interaction concept even without permanent access to an actual elastic display (e.g. due to remote work). Such a mock up still provides a feeling for elasticity, handling, and the interaction possibilities of an elastic display. A plain wool fabric can be simply fixed to a picture or other wooden frame (see 9). As shown in the fourth workshop, the stop motion technique can document interactions, even using other lo-fi elements such as cutouts.

Another prototyping method that we tested was the virtual reconstruction of an elastic display. This can be used to simulate and experience the actual use of an elastic display in a certain work situation (see 10). The restrictions imposed by the current tracking hardware and mechanical setup can avoid making mistakes such as using areas near to the edge of the elastic display, which cannot be depressed as well as in the middle.

Finally, we are also working on a gesture recorder and emulator to be used in later interface design steps to converge the ideas from our design workshops into feasible solutions.

7 REFLECTIONS

In this pictorial, we presented a structured overview of a workshop-based approach for the development of user interaction methods for elastics displays. This approach was illustrated by an application to visualize, explore, and evaluate big data clusters. From grouping ideas in a first workshop using a creative ideation method (Crazy 8), we identified user segments and personas in a follow-up workshop. Based on this user research, a user journey, a story map, and finally concrete interaction methods were prototyped in the last two workshops.

We especially addressed the careful documentation of all design steps, which was achieved using the collaborative whiteboard application Miro due to the corona pandemic. In our experience, this documentation presents a great challenge and needs considerable resources. However, the wealth of different and new ideas from the workshops allows for a careful selection of the best solutions. Although this user-centered design process is not entirely new, our pictorial provides a clear example for novel interfaces based on elastic displays. We are confident that our approach is suitable for future interaction technologies such as other shape-changing interfaces.

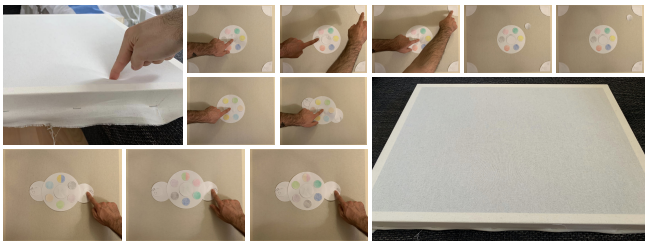

Figure 9: Physical mockup for testing gestures on an elastic display and produce stop motion sequences for visualizing gestures and interface elements.

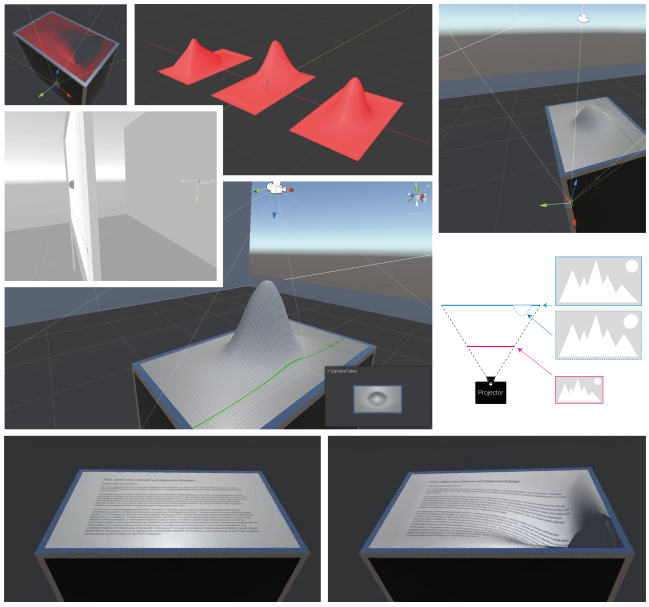

Figure 10: Experimental environment to analyse behaviour of Elastic Displays, especially in regard to projection and readability issues.

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