

# Towards Accessible Charts for Blind and Partially Sighted People

Christin Engel, David Gollasch, Meinhardt Branig, Gerhard Weber

TU Dresden, Faculty of Computer Science, Chair of Human-Computer Interaction

## Abstract

Perception of charts is a challenging task for blind and visually impaired people. Nevertheless, charts are an important tool to analyse data. Appropriate output media are required to make data analysis more accessible. We propose a semantic preserving workflow as well as tooling requirements to integrate the generation process of accessible charts. Towards getting there, we present our current prototypical state and specify further steps.

## 1 Introduction

Following the BITV guidelines (BMJV, 2016) making non-textual information accessible means to offer alternative verbal descriptions. For rather complex graphics, in particular charts such as bar or line charts, these descriptions are not sufficient to cover the whole visual content of the graphic. That hinders blind/visually impaired people to interpret visualised data on their own.

Given this problem, enabling blind/visually impaired people to access charts by means of various modalities (e. g. tangible and auditive representations) may improve the accessibility of those graphics and address several use cases. Hence, we propose a feasible workflow to implement a chart interpreter serving the required output to realise different modalities and show a first prototypical approach leading in that direction. Our research question, though, is to identify *what it takes to make charts fully accessible for blind and partially sighted people*.

## 2 Related Work

Existing approaches to *verbally describe charts* often lack in general applicability due to a focus on only a few and less complex chart types, such as line or bar charts (Ault et al., 2002; Demir et al., 2008, 2012; Moraes et al., 2013). Other approaches such as from Ferres et al. (2007) or Morash et al. (2015) lack gathering the interpretation of the visualised data (high-level content,

e. g. symmetry and clustering). *Tactile charts* offer an additional modality and may be more efficient to analyse data. Projects such as those from Watanabe et al. (2012) and Ladner et al. (2005) focus on enhancing the production process of tactile charts. Other approaches provide access to charts e. g. by the use of sonification (Franklin and Roberts, 2003).

The majority of research approaches focus on translating visual charts into non-visual representations (especially verbal, auditive, tactile, force). Our approach provides access to charts as well as high-level content. We offer an abstract representation of charts containing structural, semantic and style information to automate the generation of multimodal accessible charts. To reach this goal we follow a semantic preserving approach like Goncu (2009) and Fredj and Duce (2007) proposed.

### 3 Envisaged Automated Workflow

There are at least two facets of accessibility regarding charts: Firstly, an existing chart should be readable for all sighted, blind and partially sighted people. Secondly, the creation of those charts should be an accessible process as well. Thus, we state the following requirements:

- The data input tooling (e. g. Excel) has to be accessible and usable for our target user group.
- The chart creation comprises the generation of an ordinary visual chart (for sighted users).
- A wide range of different chart types and adaptable layouts should be supported.
- The graphics has to allow a multimodal (e. g. visual, auditive, tactile, verbal) output.
- The generation of accessible charts should be simple and mostly-automated yet customisable as well as highly flexible.

To match these requirements, we propose the implementation of an interpreter that picks up the semantic properties from a created chart of a given (already accessible) diagramming tool (e. g. Excel) and provides an interchange format as output comprising the required chart information for multiple different modalities. Figure 1 embeds this interpreter (there called *App*) into a processing sequence.

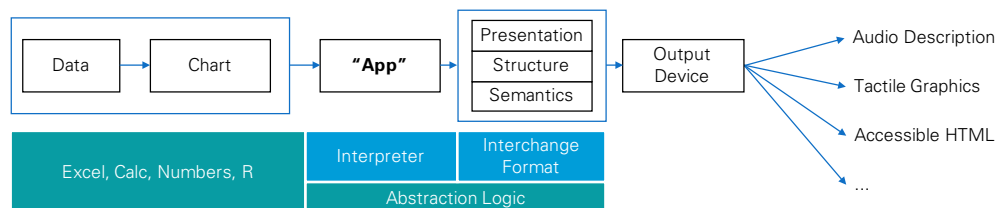


Figure 1: Anticipated Workflow

Our contribution will be the implementation of the *Abstraction Logic* with the mentioned interchange format as output. This interpreter requires access to the data and chart, making it tooling-specific. The interchange format should be universally readable, comprising a visual and textual chart representation. The visual representation will contain all style properties which are needed to generate a tactile output. The textual representation will contain formal chart characteristics including an automatically generated interpretation of visual data characteristics.

## 4 Current Prototype

Our prototype is implemented as an accessible Excel plugin with functionality that can be triggered manually. Once triggered, the plugin captures the created chart (cf. Figure 2, left screenshot) and allows a fully-automated generation of a verbal chart description. The text generation based on templates that can be customised by the author (cf. Figure 2, right screenshot). Our tool supports different chart types, such as scatter plots, area and radar charts, thus, is not limited to just simple-structured data visualisations. Furthermore, the verbalisation may include different kinds of analysed chart information. For instance, we support outputting labels (title and axis information) as well as extrema. The generated output is an accessible HTML-based verbalisation of the selected chart.

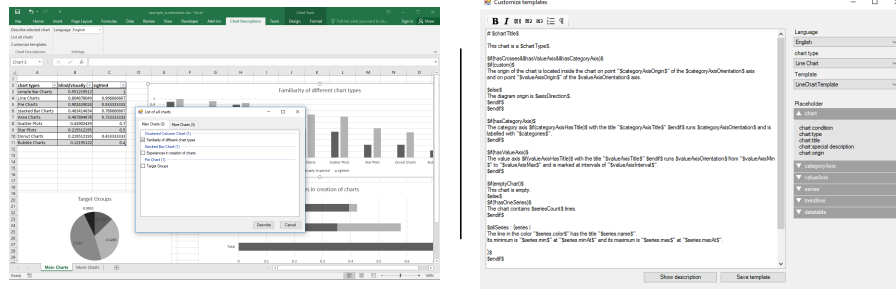


Figure 2: Current state of workflow implementation as prototype. Selection of the spreadsheet's chart (left), customisation of the verbalisation to export (right).

## 5 Conclusion and Future Work

Our prototype state a starting point towards an integrated tooling to support visually impaired and blind people to create and explore charts to analyse data on their own. Therefore, a universally applicable interchange format, preferably based on an easily parsable XML structure has to be constructed. The interchange format should contain semantic information that allows the adaption of the chart for different modalities. In an exemplary workflow, we use it to create accessible audio-tactile charts based on given charts from Excel or other diagramming tools, such as Calc, Numbers or R. There are still some research questions to investigate. Which information is needed and should be stored in the interchange format to cover a wide range of

modalities, use cases and chart types? What modalities are feasible and should be combined to work with non-visual charts? And how to integrate the creation of accessible charts into existing workflows? Our approach enables blind and visually impaired users to not only access and work with charts created by sighted users but create them on their own as well. We think that also other target groups may benefit from this approach.

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