Constructing Interactive Visualizations with iVoLVER

Gonzalo Gabriel Méndez
Miguel A. Nacenta
University of St Andrews, UK
ggm@st-andrews.ac.uk
mans@st-andrews.ac.uk

Abstract
iVoLVER, the Interactive Visual Language for Visualization Extraction and Reconstruction, is a web-based pen and touch system that graphically supports the construction of interactive visualizations and allows the extraction of data from different types of digital artifacts and photographs. Together, these features enable the creation of visualizations from data that is not structured in traditional formats without the need of textual programming. This demonstration shows how iVoLVER visualizations are constructed and illustrates an interactive example that can be used in teaching and educational contexts.

Figure 1: Using iVoLVER to extract data from two different images. The extracted data is used in the construction of an interactive visualization on a multi-touch display.

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Introduction
An increasing number of technologies currently allow the construction of visualizations without requiring textual programming. Notable examples include commercial systems such as MS Excel and Tableau1, research prototypes like

1http://www.tableau.com/products/desktop
DataMeadow [2] and LARK [4], and tools oriented to promote information awareness and data literacy, such as Many Eyes [5] and Gapminder\(^2\). These systems avoid the need for programming skills that could be outside a user's domain of expertise. However, most of them only support visualization of formal structured data sources, that is, they operate on database-like documents where information is organized in records of variables and associated values. Nowadays, however, we are exposed to—and surrounded by—data that exists in forms that are not necessarily structured or already in digital formats. Photographs, vector images, and web pages, are a few examples of digital artifacts that can contain useful input for visualizations.

iVoLVER seeks to redress the gap described above in the design space of infovis authoring tools, providing a visual programming environment where data can be extracted from different sources (bitmap charts, web pages, photographs, SVGs, CSV files) and then used to compose new interactive visualizations. This is enabled by a visual language implemented within the iVoLVER tool, which is described in detail in [3]. The system addresses the following audiences: domain experts that are non-programmers and need to visualize data, and experts who need to interact with data that is not in a structured form.

The rest of the document briefly describes the main paradigm for the creation of information visualizations in iVoLVER, which is what attendees will be able to experience during the interactive demonstration. During the demonstration we will seek to engage with possible users of the tool, with interaction and information visualization experts, and to explore and discuss other possible applications of the tool (e.g., in infovis education).

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\(^2\)http://www.gapminder.org
Figure 4: Construction process of a visualization to create an interactive model of the rotation of the earth around the sun. Two built-in functions (a \( \sin \) and a \( \cos \)) position the earth mark around a locator element on top of which an additional mark representing the sun has been placed. User's gestures and interactions are shown in green. See the Visualization Example section for a detailed description.
ported through Extractors, which make values from their associated sources available to other components in the canvas through specialized routines (e.g., image processing algorithms). Combination, aggregation, and transformation of data are possible through widgets that take inputs and provide outputs via reading and writing ports. Interactivity is achieved with widgets that support user manipulation and whose output can be used to produce animations.

Visualization Example
The main goal of our tool is to enable construction of visualizations from data extracted from non-structured sources. The interactive demonstration allows us to demonstrate the scenarios of the main paper [3], but in this section we use an additional educational scenario (e.g., a teacher explaining rotation and trigonometry—Figure 4) because it illustrates a wide range of iVoLVER’s interactive features.

We first create a mark from an SVG file to represent the earth and define a reference system to position it by connecting it to a Locator (Figure 4.A). The mark’s position properties become accessible by expanding its associated locator via a double tap gesture (Figure 4.B). We then add a sine function, adjust it to output values in the range $[-300, 300]$, and use its output to set the earth’s $x$ coordinate (Figure 4.C). Similarly, we use a cosine function (with output range $[-200, 200]$) to control its $y$ position. We then use a Slider that outputs values in the interval $[0, 360]$ to generate the input angle of our functions (Figure 4.D). This step allows us to control the animation interactively. The final construction is shown in Figure 4.E, where the slider’s play button has been pressed to automatically rotate the earth around a second SVG mark representing the sun that appears on top of the locator. This small example shows how iVoLVR can help create relatively complex animated visual representations exclusively through touch gestures.

Conclusion
This demonstration showcases iVoLVER, a tool that enables the creation of visualizations from multiple sources of data. The demonstration is addressed to a broad audience, from possible users to experts in infovis and interaction with interest in iVoLVER’s features, design and implementation.

References