Touch2Annotate - Generating Better Annotations with Less Human Effort on Multi-touch Interfaces

Yang Chen
University of North Carolina at Charlotte
9201 University City Blvd
Charlotte, NC 28223 USA
ychen61@uncc.edu

Jing Yang
University of North Carolina at Charlotte
9201 University City Blvd
Charlotte, NC 28223 USA
jyang13@uncc.edu

Scott Barlowe
University of North Carolina at Charlotte
9201 University City Blvd
Charlotte, NC 28223 USA
sabarlow@uncc.edu

Dong H. Jeong
University of North Carolina at Charlotte
9201 University City Blvd
Charlotte, NC 28223 USA
dhjeong@uncc.edu

CHI 2010, April 10–15, 2010, Atlanta, Georgia, USA.
ACM 978-1-60558-930-5/10/04.

Abstract
Annotation is essential for effective visual sense making. For multidimensional data, most existing annotation approaches require users to manually type notes to record the semantic meaning of their findings. They require high effort from multi-touch interface users since these users often experience low typing speeds and high typing errors. To lower the typing effort and improve the quality of the generated annotations, we propose a new approach that semi-automatically generates annotations with rich semantic meanings on multidimensional visualizations. A working prototype of this approach, named *Touch2Annotate*, has been implemented and used on a tabletop. We present a scenario of using *Touch2Annotate* to demonstrate its effectiveness.

Keywords
Annotation, Information visualization, Multi-touch interface, Taxonomy

ACM Classification Keywords
H5.2. Information interfaces and presentation: User Interfaces. I3.6.

General Terms
Design

Introduction

There is a burst of interest in designing and developing information visualization applications on multi-touch systems, such as tabletops [7] and small portable devices [3]. These applications offer great opportunities for supporting effective visual analytics by providing possibilities such as face-to-face collaborative analysis and direct touch interactions.

When users visually explore data on multi-touch interfaces, new interactions that are different from traditional ones are often desired. In this paper, we focus on a new annotation approach for multidimensional visualizations. Annotation refers to the process that users externalize their findings, such as clusters, outliers, or correlation, on top of the visualization. By annotating the findings users attach semantic meanings to them so that they can be analyzed, evaluated, reused, and exchanged for visual sense making. In existing approaches, users are usually required to manually input notes to record the semantic meaning of a finding about multidimensional data [6]. This proposes a challenge to multi-touch interface users since they often experience low typing speeds and high typing errors [4]. The tremendous typing needs for annotation distract multi-touch interface users from the visual exploration process being conducted.

We argue that to effectively make sense of multidimensional data on multi-touch systems, annotation approaches must mitigate the typing interactions to lower the overall effort required. Meanwhile, the annotations generated should have intuitive semantic meanings to enable effective evidence evaluation, exchange, and reuse.

Toward this goal, we propose a novel "typing-free" annotation approach that semi-automatically generates annotations with rich semantic meanings on multidimensional visualizations. The core components of this approach are annotation templates which can be either pre-defined for the most popular types of findings, or interactively created by users. During the annotation process, users simply highlight data to be annotated and select an annotation template according to the type of the finding to be annotated. The system will then automatically fetch information to generate a descriptive annotation for the finding using the template. A fully working prototype of the proposed approach, named *Touch2Annotate*, has been implemented. A scenario is provided to demonstrate the usage of *Touch2Annotate* on a tabletop system.

Basic Ideas

To address the challenge of automatic annotation, we need to better understand how people manually generate annotations for their findings. Toward this goal, we interviewed 16 domain experts from a variety of research fields [2]. In the interviews, we asked the experts to provide specific findings they discovered from the multidimensional data in their domain applications and describe the essential information they used to annotate those findings. We analyzed the interview results and distilled two key observations.

First, we observed that several types of findings were repeatedly reported by the participants although they used different visualization tools and were from different research domains. For example, experts in GIS, biologic, and financial analysis all claimed that they were interested in detecting and recording outliers in their data. It seemed that findings could be categorized. A user study we conducted with more finding samples and users (see [2] for more details) confirmed that the majority of findings from multidimensional data fall into less than 12 categories despite the application domains and visualization tools used. In addition, our experiment [2] showed that people could reach common sense on the categorization and perform the classification efficiently.

Our second observation was that the same set of information is often used to annotate the same type of findings. For example, the dataset name, the average value of the data items, and a quality indicator such as the radius of the cluster, were used to annotate clusters by multiple experts. We divide the information into two groups: (1) context information (such as the dataset name); and (2) content information (such as the type name "cluster" in the example, the average values, the quality indicators, and subjective evaluations). It seemed that well-descriptive annotations can be automatically generated for a type of findings once we know what context and content information needs to be recorded for this type of findings.

Based on above observations, we propose a semi-automatic annotation approach for multi-touch systems. The core components of the approach are annotation templates constructed based on a taxonomy that categorizes findings and characterizes their context and content information. An annotation template is associated with a category of findings in the taxonomy or a user defined category. It notifies the system which context and content information needs to be retrieved from the data and how to generate a semantic rich descriptive annotation when annotating this type of findings. When users find a pattern of interest, they simply select the data of interest and pick an annotation template. The system will then automatically fetch necessary information to generate a descriptive annotation according to the template.

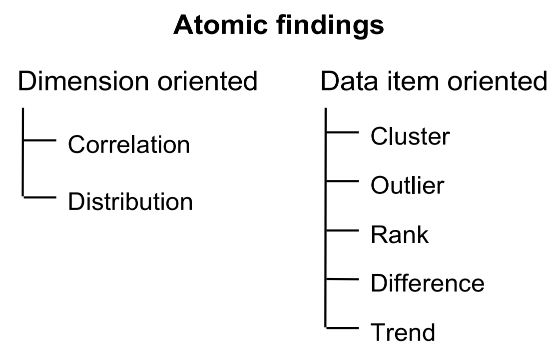

Figure 1. Frequently used atomic finding categories.

The finding taxonomy we use is a variation of the taxonomy in our previous work [2]. Findings are first classified into atomic findings and compound findings. Atomic findings directly respond to low-level analytics tasks [1]. For annotation convenience, we divide them into two groups, namely data item-oriented findings and dimension-oriented findings. Data item-oriented findings, such as data item clusters, outliers, and ranks, are patterns about data items. Dimension-oriented findings refer to patterns about dimensions, such as dimension correlations and data distribution in dimensions. We pre-define annotation templates for seven categories (see Figure 1) that were the most frequently posted [2] on Many-eyes [8]. Please refer to [2] for their content and context information. A compound finding is a finding including other findings, such as a comparison of two clusters. It consists of pointers to the related findings and user typed comments. The annotations for atomic findings can be automatically generated while users need to manually type notes for compound findings. If the pre-defined annotation templates do not fulfill the needs of the users, they can interactively modify an existing template or create a new template to define their own way to describe a certain category of findings.

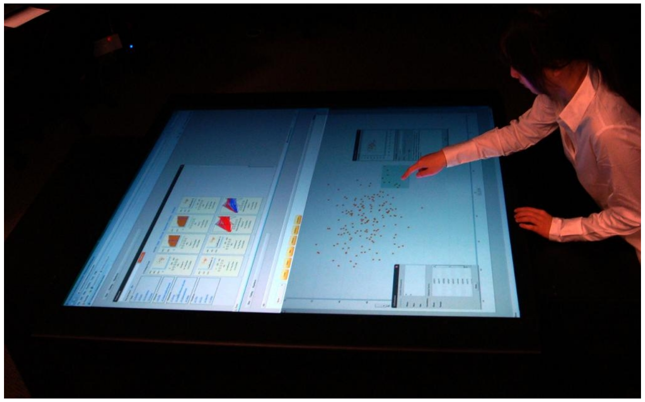

Figure 2. An analyst is using *Touch2Annotate* on a tabletop.

Touch2Annotate

A fully working prototype of the proposed annotation approach, named *Touch2Annotate*, has been implemented and used on a multiple-touch interface. *Touch2Annotate* provides multiple coordinated multidimensional visualizations and allows users to interactively explore the data for finding and annotating patterns of interest. It was developed with Flash AS3 for a multi-touch tabletop designed at the Renaissance Computing Institute (RENCI) [5] with a 62" diagonal work surface (42 x 46). Figure 2 shows that an analyst is using *Touch2Annotate* on the tabletop.

System Interface

Touch2Annotate provides several visualizations, including scatterplots and parallel coordinates, for visualizing multidimensional data. Multidimensional brushes and dimension selection tools are provided on these visualizations so that users can interactively select data items and dimensions of interest. On the top of the visualizations, there is a list of touchable buttons for activating annotation templates. Each button corresponds to a template and can be interactively added or removed from the list. Users can customize the list so that it only contains the buttons they need. To generate an annotation, a user selects the data of interest and touches the button of the desired template. The annotation will be automatically generated and an annotation window will be popped up in which the user can examine and modify the automatically generated annotation (Figure 3). The annotation contains a title, a thumbnail, and a set of sentences. The title is automatically generated and indicates the type of the finding. It can be modified by the user. The thumbnail captures the screenshot of the visualization at the moment when the finding is annotated to help the user recall the finding. The sentences describe the context and content information of the finding using natural language. The keywords in the sentence, such as the dataset name, are automatically highlighted and hyperlinked so that users can easily access related findings sharing the same keywords.

When users are not satisfied with the automatically generated annotations, they can customize the annotations through two approaches. First, they can interactively modify existing templates or create new templates through a template editing window (see

Figure 4 for an example). In the template editing window, a list of content/context information is provided. Users can use touch-drag-drop interactions to add items in the list to a template or to remove information from the template. Second, users can directly modify generated annotations. Figure 3 (c) shows that a user is dragging some statistical information of the dataset from an information window to add it into the annotation.

Scenario

Figure 3 shows a scenario where a user annotates an outlier using *Touch2Annotate*. First, the user visualizes the scatterplot of two dimensions and finds an outlier (Figure 3(a)). She selects the outlier by drawing a rectangular boundary on it using her hands (Figure 3 (a-1)). Second, she touches the button labeled "Outlier" (Figure 3 (b-2)) to generate an annotation (Figure 3 (b-3)). After reviewing the generated descriptive annotation, the user wants to add the average value of the dimension “Health behavior” to the annotation. To do this, she opens the information window (Figure 3 (c-4)), and drags that item into the annotation (Figure 3 (c-5)). Now, the average value of the dimension is in the annotation. The final annotation is shown in Figure 3 (d).

Discussion

This scenario shows that with *Touch2Annotate*, users can generate annotations with little human effort on a multi-touch interface. This is achieved due to two reasons: First, our approach generates the annotation without requiring users to type words or sentences. Users only need to perform some simple touching interactions that are easy to be performed on multi-touch interfaces. Second, our approach allows users to customize annotation templates and modify annotations with simple drag and drop interactions, without text typing.

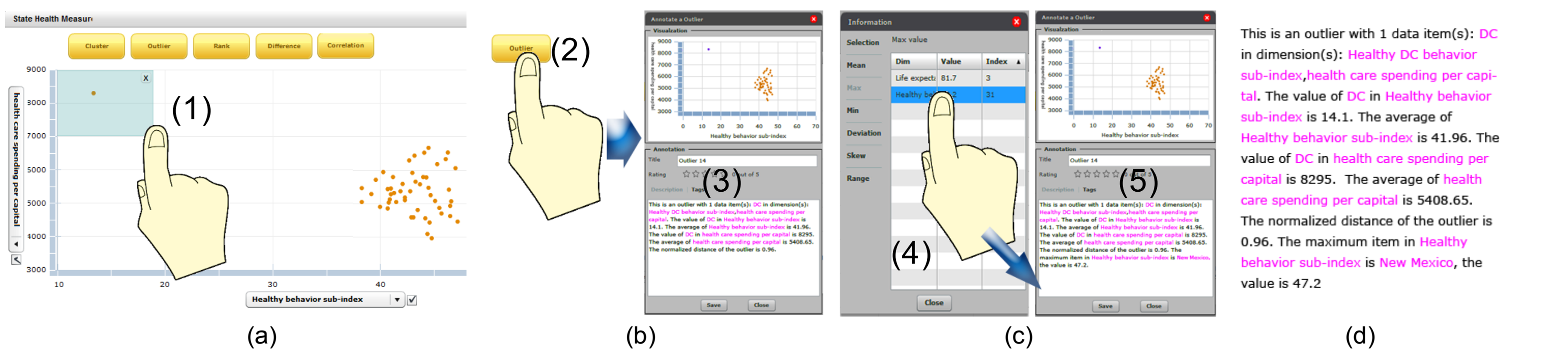

Figure 3. To annotate an outlier with *Touch2Annotate* involves three steps: (a) to select dimensions and data items of the outlier; (b) to select the “outlier” template. The annotation is automatically generated by the system according to the template and the selected dimensions and data items; and (c) to review the annotation and interactively modify it based on annotation needs. The generated descriptive annotation is shown in (d).

Meanwhile, the pre-defined templates constructed based on the taxonomy and the fact that users can interactively modify the templates ensure that the generated annotations can be semantic-rich, formal, and well-descriptive, without missing important context and content information.

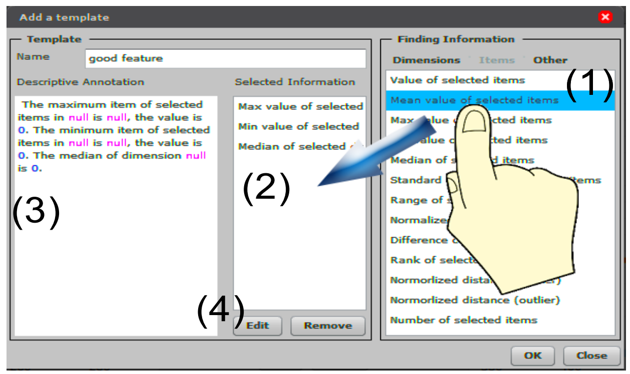

Figure 4. Editing a template. To add information to the template, users can touch an item in the information list (1), and drag and drop it to the selected list (2). The preview of the descriptive annotation is shown in (3). Users can click the "edit" button (4) to trigger a window where the way to describe the selected information can be customized.

Conclusion and Future Work

In this paper, we proposed a "typing free" annotation approach for multi-touch systems. Our approach generates high quality annotations with reduced typing effort on multidimensional visualizations. In the future, we plan to conduct formal user studies to systematically evaluate the effectiveness and efficiency of our approach. We will also develop other finding management approaches, such as finding retrieval and browsing functions for multi-touch systems.

Reference

[1] Amar, R., and Stasko, J. Low-level components of analytic activity in information visualization. *In proc. of IEEE InfoVis*, 2004, 141-147.

[2] Chen, Y., Yang, J., and Ribarsky, W. Toward effective insight management in visual analytics systems. *In proc. of IEEE PacificVis*, 2009, 49-56.

[3] Hao, J., and Zhang, K. A mobile interface for hierarchical information visualization and navigation. *In proc. of IEEE ISCE,* 2007, 1-7.

[4] Hirche, J., Bomark, P., Bauer, M., and Solyga P. Adaptive interface for text input on large-scale interactive surfaces. *In proc. of TABLETOP*, 2006, 153-156.

[5] Renaissance computing institute, 2009.

http://www.renci.org

[6] Shrinivasan, Y., and Van Wijk, J. Support the analytical reasoning process in information visualization. *In proc. of ACM CHI,* 2008, 1237-1246.

[7] Tobiasz, M., Isenberg, P., and Carpendale, S. Lark: coordinating co-located collaboration with information visualization. *In proc. of IEEE InfoVis*, 2009, 1065-1072.

[8] Viegas, F., Wattenberg, M., Van Ham, F., and Kriss, J. Many eyes: a site for visualization at internet scale. *In proc. of IEEE InfoVis*, 2007, 1121-1128.