

# A State Transition Approach to Understanding Users' Interactions

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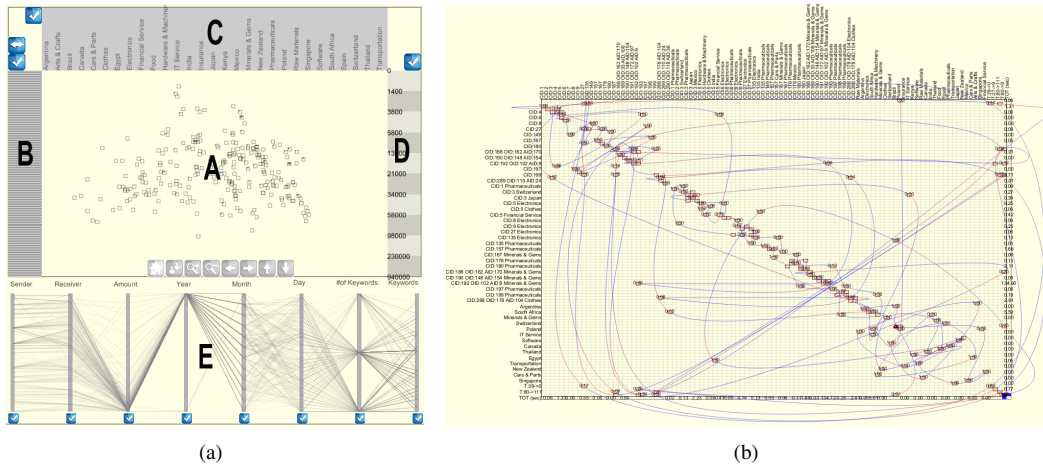


Figure 1: Overview of InteractionViz. It consists of two windows as a Relation Window (a) and a Transition Window (b). The Relation Window consists of multiple coordinated views to show the relationships among keywords, accounts, and transactions. Experts' findings on transactions are represented in the Relation Window and their overall semantic-level interactions (i.e. keywords, accounts, and transactions) are displayed in the Transition Window by following a state transition approach.

## ABSTRACT

Understanding users' interactions is considered as one of the important research topics in visual analytics. Although numerous empirical user studies have been performed to understand a user's interaction, a limited study has been successful in connecting the user's interaction to his/her reasoning. In this paper, we present an approach of understanding experts' interactive analysis by connecting their interactions to conclusions (i.e. findings) through a state transition approach.

## 1 INTRODUCTION

Although many useful visualization applications have been designed, how much the designed systems are useful in solving analytical questions is regarded as a research challenge. In the visualization community, researchers discussed to find possible research directions in understanding users' interactions by connecting to their reasonings [1]. From the discussion, one of the promising research directions was to use an eye-tracking device, with which an user's interaction can be analyzed by tracking one's visually processed visual elements. Although this is a quite promising approach in understanding users' interactions, how to connect the user's interaction to her reasoning and how to analyze the captured eye-tracking data is still unknown. In contrary to this approach, we performed an expert evaluation to see how user interactions encode

experts' reasoning [3]. From the study, we found that by examining financial analysts' interactions (semantic-level interactions), about up to 79% of their findings can be recovered through the use of a visual analytical tool. This indicates that the user's interaction logs (e.g. semantic-level interactions such as keywords, accounts, and transactions) are somewhat connected to one's reasoning behind the analysis process. In addition, we observed that financial analysts have different opinions on each financial transaction as suspicious, unsuspecting, and inconclusive. Although they have different ideas and sometimes contradict each other on determining each transaction, we found that finding the evidence how they ended up with their conclusions is difficult.

In this paper, we propose an approach to understand the analysts' interactions. To extract their interactions and discover the reasoning behind the analysis processes, we used a state transition approach by creating a state transition matrix (i.e. Markov Chain [5]). In here, each user-created interaction is regarded as a state. Depending on the number of semantic information, a  $m \times m$  transition matrix is generated by referencing the overall user's interactions. With this transition matrix, the user's reasoning can be recovered. This paper begins with describing the designed visual analytics system, then moves to explaining how the user's interactions can be analyzed by connecting them to her reasoning through the system.

## 2 SYSTEM DESIGN

In our previous study [3, 4], we performed an experts' user study based on a well-known financial visual analytics system (called WireVis [2]). From the study, we observed that financial analysts have different opinions on each financial transaction as suspicious, unsuspecting, and inconclusive. Since their decisions are often based on experiences, it is difficult to understand how they concluded with their decisions. To understand how they ended up with different conclusions, we designed a system (called InteractionViz)

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