Using *MoneyColor* to Represent Financial Data

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Abstract

One form of information visualization is called *ambient display*. It is defined as the use of aesthetically pleasing displays of information which sit on the periphery of a user's attention (Manko, Dey, Hsieh, Kientz, Lederer and Ames 2003).

Financial visualization is the practice of making large financial datasets into images .

In this paper, we describe a research project which uses watercolor images to represent the real-time changes in stock price and volume.

Keywords: ambient display, financial data, *Moneycolor*

1 Introduction

Ambient display is derived from the concept of *ubiquitous computing*, which was first mentioned by Wiser (1991). Wiser believes that computing resources should be distributed throughout our everyday environment, rather than being confined to a desktop workstation. A partial answer can be found in *ambient display* which implements information display into people's everyday environment.

Great progress has been achieved in the design of ambient displays. The typical approach to implement ambient display is to modify traditional wall-hung art to act as the function of decoration architectural space.

Our project uses watercolor images as ambient media to represent dynamic stock price and volume information. Our aim is twofold:

- Provide a smart visual decoration
- Represent the real-time stock information

1.1 Ambient display

Normally, ambient display resides in the environment of the user rather than on the screen of a desktop computer. It has the ambitious goal of presenting information without distracting or burdening the user.

Obviously, it is quite difficult to achieve that goal. To convey information, we aim to use *calm technology* (Mark&Brown 1995), which based on the movement of human eyes shifts between the centre and the periphery of users' attention. However compared to the ambitious goal mentioned above, it still has a long way to go.

There are two main limitations which block the development of ambient displays. One follows technical limitations for ambient display. Current technology can only display dynamically updated data on a high-resolution wall. In the near future, if display technology can show information on any surface-such as curtains, windows, tables or even clothing-then we can completely break through this technical limitation and incorporate ambient displays into everyday environments. The second limitation is in human understanding of ambient display. Even if the technology required for ambient display is available, people still need better ways to interpret and understand this new kind of display.

There has been much research in ambient display. These include:

- *Sideshow* , which uses a sidebar on the windows desktop to provide regularly updated peripheral awareness of a broad range of information from virtually any accessible web site or database (Cadiz, venolia, Jancke and Gupta, 2002) (See Figure 1);

- *BusTraffic*, inspired by Mondrian, creates an informative art installation to represent the real-time local bus traffic conditions (Skog, Ljungblad and Holmquist, 2003) (See Figure 2);

- *InfoCanvas*, uses a beach scene to represent multiple real-time information (Plaue, Miller, Stasko 2004) (See Figure 3).

Figure 1. Ambient display in *Sideshow*

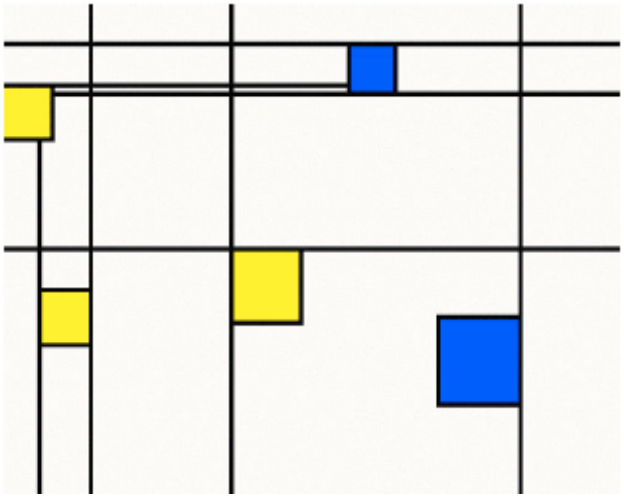

Figure 2. Ambient display in *BusTraffic*

Figure 3. Ambient display in *InfoCanvas*

1.2 Financial Visualization

Normally, financial visualization encounters two main research challenges. One is financial complexity. Usually, the size of financial data is huge and often multi-dimensional. Furthermore, it may have an extremely complex financial model. The second challenge is visual ambiguity. There is no obvious correspondence between abstract data and a spatial coordinate. It is necessary for us to constitute a formal criterion to guide this kind of mapping.

The common method of displaying financial data is to use 2D or 3D charts. Sometimes, these kinds of charts are very difficult to understand for people with a non-financial background (see Figure 4). In this project, we use dynamically changing watercolor images to represent real-time financial data of stock information. We especially focus on stock price and stock volume information.

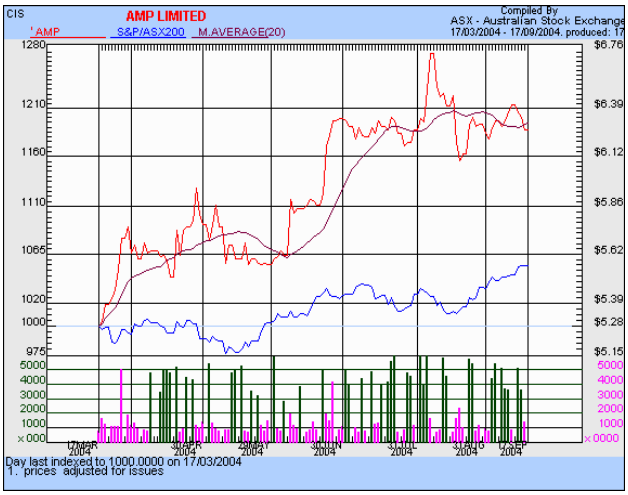

Figure 4. 2D financial chart

2 MoneyColor

In this section, we describe our ambient display system called *MoneyColor*.

There are three symbols in this system. The color of sky represents trading time, the number of mountains visible represents stock price and number of trees visible represents stock volume. In Figure 5, the image represents the trade for AMP at 10:50 on August 28, 2003.

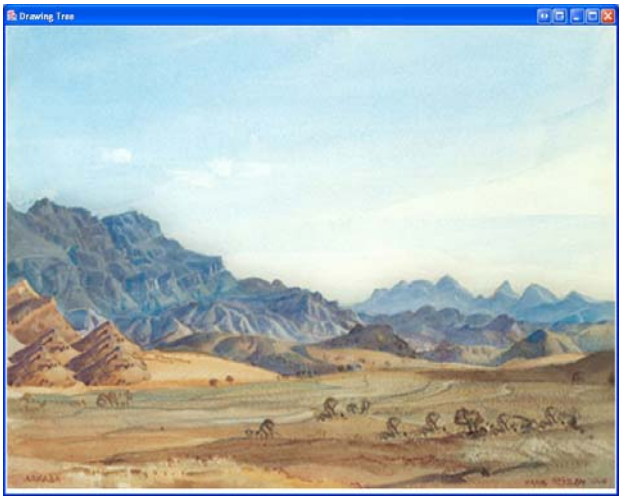

Figure 5. 10:50 on 28/8/2003 the state of AMP stock

The state of AMP at 9:10 and 15:20 on the same day is represented in Figure 6 and 7.

Figure 6. 9:10 on 28/8/2003 the state of AMP stock

In this project, we limit the AMP stock price change rate is within negative 10% to 10%. If the stock price change rate is outside this range, we will regard it as 10%. Because the stock price will not change too much within one day, it is enough to represent the stock price change range.

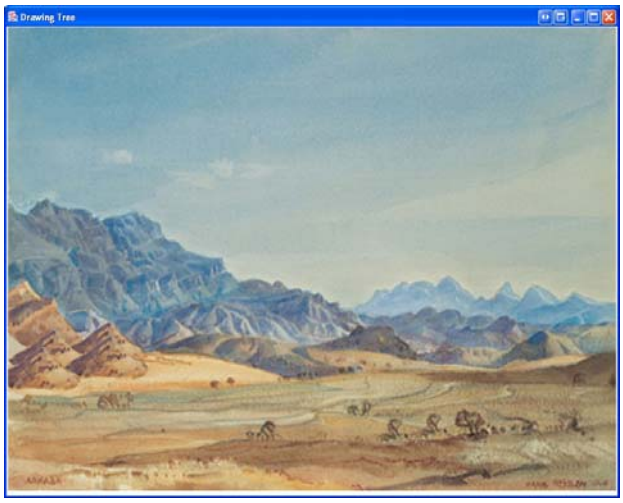

Figure 7. 15:20 on 28/8/2003 the state of AMP stock

Also, we set the watercolor image to change once every minute. Stock price for a specified stock will not offer too much change within one minute. Because of this, we often have to magnify the stock price change rate in visualization effects.

We use a special display in which the border of the monitor is covered by an old-fashioned picture frame (see figure 8). We hang it on the wall to allow it not only decorate architecture space but also represent information which is closely linked to people.

Figure 8. ambient *MoneyColor* frame

3 Why use *MoneyColor*

Our *MoneyColor* display can provide a number of advantages over traditional financial visualizations.

Firstly, *MoneyColor* can lead important information, such as stock data, into people's everyday environment. Our normal method is inspired from traditional wall hung art to hang the display on the wall and achieve the function of decoration architecture space.

If we follow the trend of the development in information visualization, it is clear that future environments for people will have information everywhere. Computers can control light emitted by the windows, tables, and curtains to carry information, also even clothing. Thus, we can use all these surfaces to carry information. All in all, everything in people's environment will be able to convey and represent information.

Secondly, *MoneyColor* can also represent a continuously updated overview of the complex stock information.

However, stock price is affected by various factors and it does not make any sense to consider a single price at any one moment. The continuously updated overview over time can give you a general stock trend then help you make an informed decision.

Thirdly, from aesthetic view, our aim is to let people feel that *MoneyColor* is an artwork.

People use artwork to decorate the environment and show personal taste. Our ambient *MoneyColor* display meets this requirement and also conveys important information into everybody environment.

4 Discussion

Ambient display research is still in the initial stage. There are many factors which limit the development of ambient display such as those mentioned above. We also need to consider the factors below.

4.1 Animated versus Static

Ambient display is a peripheral display which has two requirements. One requirement is to display information without distracting users; the other is to convey information which includes real-time or non-real-time information.

Static images meet the requirement of ambient display not to attract people's attention but they may not meet the other requirement to convey information. Animation conveys information but it draws people's attention (Sekuler & Blake 1994).

Our aim is to meet both requirements in ambient displays; thus, how to design an appropriate ambient display becomes a challenging problem.

4.2 Image change rate versus data update rate

Our *MoneyColor* system uses real-time stock data as data source and uses an image as *ambient media*; this was first explored by Ishii (Ishii&Ullmer 1997). It leads to two issues: how fast is the image change rate and how quick is the data update rate?

It is clear that we cannot change the image too fast because rapid movement would draw users' attention so that the display would no longer be peripheral to their environment. However, we cannot allow delays that are too long between subsequent image updates. Otherwise, the users may miss out on important information. In situations where it is crucial that the information shown is up to date we say that the data source is *time critical.*

In our application, real-time stock data is a very time critical data source. This means that we should keep the data update rate high enough to capture all significant changes. For non-time critical data, the data update rate can be low (such as weather forecast information) but it also need to be associated with image change rate.

4.3 Ambient display versus Art display

Ambient display is inspired from art to make a special display device to hang it on the wall and get the function of decoration of architecture space. But the radical purpose of ambient display is to explore new ways of introducing information displays in the everyday environment (Holmquist&Skog 2003). Thus ambient display is not the same as art.

We can partly use art display evaluation criteria to evaluate ambient display but on the whole, evaluation criteria must be derived from information display.

5 Future Work

As this study is still in progress, there is still much to be done.

5.1 Evaluation

There have been many studies in ambient display but few focus on evaluation. This is because evaluation of ambient displays can be costly, difficult and time consuming. However, evaluation is a key aspect in designing ambient displays. Without evaluation, it is difficult to determine which displays are effective and why they are effective. Without this information, it is difficult to improve on existing work .

Our evaluation will involve two parts: One for the hardware; the other for the software.

The hardware part is to build a movable ambient display panel and put it in the entrance foyer of a business office. Within that panel, we will embed one PC, monitor and camera. The PC is responsible for running the visualization program and processing data, the monitor is responsible for displaying watercolor images and the camera is for video recording.

The software part will include our *MoneyColor* program and design evaluation method.

6 Conclusion

Ambient display research involves two parts. One is the design of the ambient display; the other is the evaluation of the ambient display. In this paper, we describe an example of how to design an ambient display.

Evaluation is another important part and we plan to address it in future work.

7 Conclusion

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