IMPROVING TARGETING FEEDBACK FOR USERS WITH LOW VISIBILITY USING VISUAL REDUNDANT FEEDBACK

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DECLARATION

No portion of the work referred to in this report has been submitted in support of an application for another degree or qualification of this or any other university or institution of higher learning.

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GLOSSARY

PDA. Personal Digital Assistant.

User with low visibility. User using PDA with a typical screen size of 160x160 pixels.

Target object. A target object can be a dialog window or widget such as a button, icon or drop-down menu selection on the screen. In the experiment, it is a button (a common size of 30x12 pixels) on a PDA.

Screen size. The area of a mobile computing device. In the experiment, we study screen sizes of 160x160 pixels, 240x240 pixels, 320x320 pixels, 400x400 pixels and 480x480 pixels.

Default display resolution. Default display resolution set for normal font size in Microsoft 2000/XP is 96 dpi. Large font size (125% normal size) is set at 120 dpi.

Resolution. The resolution used in the experiment is 40 pixels per cm. This is close to the default display resolution set at normal font size of 96 dpi (approximately 38 pixels per cm).

Typical screen size. Screen size of 160x160 pixels found on most PDAs.
**Targeting feedback.** The return of information about the result of a process or activity to locate, move, acquire (or any combination of the three actions) an object for the purpose of pointing or selecting an object on a two-dimensional plane.

**Redundant feedback.** Any other form of feedback provided beyond the basic level of visual feedback to support targeting tasks. This assistive information has been primarily visual, but can also be auditory or tactile.
ABSTRACT

A key problem with mobile computing devices is the limited screen space, which cannot be physically made larger to allow the devices to be able to fit into the hand or pocket for mobility. A small screen can become cluttered with information, resulting in devices that are hard to use, with objects that is difficult to identify and select. A solution to overcome this is to increase the object size when the pointer moves near it. The paper describes an experiment to study the optimal growth rate to apply to a target object to enhance the targeting of graphically augmented buttons on mobile computing devices. Experiment results indicated that graphically augmented buttons improved the targeting of a typical sized button on a PDA of typical screen size and that the optimal growth rate is approximately 27%. The optimal growth rate increases in correlation with the display screen size. This study produced a linear equation that models the optimal growth rate for screen sizes of mobile computing devices.
ABSTRAK

CHAPTER 1: INTRODUCTION

Since the introduction of graphical user interface (GUI), a pointing device has evolved from an alternative input method to an inevitable tool. A pointing device such as the mouse, digitising pen or stylus is used to target screen objects on a two-dimensional plane. Most graphical user interfaces involve manipulation of screen objects with a pointing device. The core activity in these manipulations is targeting – the act of moving the pointer towards a target object on the screen. An object can be an application window or a widget such as button, scroll bar, menu and drop-down selection. In this paper, we investigate the problem of making targeting tasks easier for users of mobile computing devices. A key problem with mobile computing devices is the limited screen space. This leads to a small screen that can become cluttered with objects that are difficult to identify and select. Our approach to overcome this problem is to simplify targeting by increasing the object size when the pointer moves near it. In particular, we consider visual redundant feedback that indicates when the pointer enters or leaves a target.

1.1 Background

Targeting consists of locating, moving, acquiring or any combination of the three actions (Fraser & Gutwin, 2000a). Locating involves finding the pointer on the screen when its location is not known. The user must first locate the pointer to start the targeting task. Moving requires the user to bring the
pointer from its original location to the vicinity of the target object, while keeping it in view, as it travels across the screen.

Acquiring requires the user to position the pointer accurately at the target object, and then performs an action to select it. This part of targeting requires greatest precision and acute vision; and this is the focus of our work.

1.2 Problem Statement

A key problem with mobile computing devices is the limited screen space, which cannot be physically made larger to allow the devices to be able to fit into the hand or pocket for mobility. A small screen can become cluttered with information, resulting in devices that are hard to use, with objects that are difficult to identify and select.

1.3 Objectives

A solution to overcome this problem is to simplify targeting by increasing the object size when the pointer moves near it. In particular, we consider visual redundant feedback that indicates when the pointer enters or leaves a target.

The main objective is to study the effectiveness of visual redundant feedback by growing the target when the pointer is near the target object on a mobile computing device. This visual redundant feedback is expected to make the task of targeting objects using a pointer easier by reducing the elapsed time to acquire a target on a mobile computing device.
The experiments will find the optimal growth rate given a typical button size on a PDA or other mobile computing device with screen size ranging from 160x160 pixels to 480x480 pixels. The data collected from the experiment results are to be analysed and to build a model to represent the optimal growth rate against the screen size to determine the values (optimal growth rates) for other screen sizes.

1.4 Scope of Study

This study will focus on improving the visibility of PDA users with small screen display area, typically 160x160 pixels, by increasing the size of target object whenever the pointer is over it. Typical screen size of a handheld PDA device in the market at the time of writing is 160x160 pixels. The experiment result may also provide some insights on the optimal growth rate for the objects displayed on the screen. This study will focus on using the button as the target object on the screen. This study presents an initial work to investigate whether growing of target objects on PDA can improve its targeting feedback. The experiment study is later expanded to examine the effect of different screen sizes on the corresponding optimal growth rate. Screen sizes under investigation are 160x160 pixels, 240x240 pixels, 320x320 pixels, 400x400 pixels and 480x480 pixels, which are applicable for mobile computing devices ranging from PDA to tablet PCs. A model shall be build based on the results from the experiment and later to be expanded to predict the optimal growth rate for larger display sizes.
The proposed redundant feedback using visual feedback is expected to make the task of targeting objects using a pointer easier for low visibility users. The following sections describe the experiment that will be carried out to demonstrate how our hypothesis that redundant feedback using visual feedback is expected to make the task of targeting faster and more accurate using a mouse as a pointing device. Response time of targeting task is expected to be significantly faster when the proposed redundant feedback is used.

Users with low visibility are people viewing display screen (on a computer monitor or mobile device) at a reduced vision but adequate to operate the applications. This group of users could be people with impaired vision or people with normal eyesight viewing computer screen from a distance or in a low visibility environment. Some combinations of background and text colours can also cause difficulty in visibility perception for people with normal eyesight, therefore making the environment a low visibility environment as well (Bergman & Johnson, 1995). A busy display screen with lots of possible target objects cramped in a small screen space could result in low visibility for its users too. This situation also applies for users of small mobile devices with information cluttered in a small and limited display area, such as Personal Digital Assistants (PDAs), mobile telephones and handheld computers.
1.5 Significance

The research study identifies the optimal growth rates for a typical button on different screen sizes applicable to mobile computing devices. This research also contributes to construct a model that represents the optimal growth rate against the screen size of a mobile computing device, where larger screen size requires larger optimal growth rate for effective visual redundant feedback.

1.6 Research Methodology

Literature reviews are conducted on areas related to the effectiveness of different redundant feedback methods, particularly on mobile computing devices. These include visual, audio and tactile redundant feedbacks.

Two groups of participants are involved in the study. Data collected from the first group will be used to determine the optimal growth rates for different typical screen sizes of mobile computing devices. The same set of data is later analysed and used to build the model that describes the relationship between the optimal growth rate and the screen size. The second group of participants will perform the same set of experiments and data collected from this group will be used to confirm the optimal growth rate across different screen sizes and the model.

A custom application is developed to model a mobile device screen and collect data from the experiment. The data collected are analysed with appropriate statistical tools and tests to further interpret the experiment results to build a
model that represents the optimal growth rate against the screen sizes of mobile computing devices.

Details of literature reviews, experiment methodology, experiment results, experiment analysis and building of the model are explained in the following chapters.

1.7 Outline of Dissertation

This outline gives a brief introduction of the chapters in this dissertation.

Chapter 2 provides a detailed review on the existing redundant feedbacks and other techniques used to overcome the problem of limited space on mobile computing devices.

Chapter 3 explains the experiment methodology used to perform the experiments and data collection methods used in this study.

Chapter 4 explains the experiment results of data collected from the experiments. It also shows that Fitts' Law can model targeting tasks studied in this experiment.

Chapter 5 explains the paired directional t-test on the data collected from the experiment results. It describes the comparison of optimal growth rate obtained from the analysis of experiment results against the optimal growth rate deduced from the model. The optimal growth rate deduced from the
model is further compared the optimal growth rate from the analysis of experiment results from another group of participants.

Chapter 6 presents the accomplishment, contributions and further works of this research study.
CHAPTER 2: LITERATURE REVIEW

This chapter gives an overview of the existing redundant feedbacks used in other related studies and techniques used to overcome the problem of limited space on mobile computing devices. This chapter also describes Fitts' Law and its application in similar studies related to selection tasks on computer interface using various pointing devices. There are several redundant feedback methods to provide additional targeting feedback, as described in the following sections:

2.1 Visual Redundant Feedback

Operating systems developers have provided utilities to assist users to locate the pointer by increasing the size of the pointer itself. This feature was introduced into Microsoft's operating system since the release of Microsoft Windows 95/98/Me/NT4.0 (Microsoft Corp, 2003). The Microsoft Windows Alternative Mouse Pointers are easy-to-see mouse pointer schemes designed to work with the operating system environment. These pointer schemes can be helpful for laptop computer users and some users with low vision.

Pointing device manufacturers also provide applications to help track the pointer location. Microsoft's Intellipoint Sonar application (that comes with the mouse) locates the pointer by having large circles that shrinks down to focus on the pointer's location (Microsoft Corp, 2004). Other third-party application such as the Xeyes (Packard, 1988) is available on X-Windows