BLIND DRAWING: INVESTIGATION INTO SCREEN LOCATION TRACKING FOR COMPUTER AIDED INTERACTIVE DRAWING

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Abstract

One of the main problems faced by blind learners is lack of drawing technologies that support images and diagram drawing without the help of a sighted support worker. Even though some technologies have been experimented in the past, blind learners have not been keen on tactile drawing due to: the difficulty of the drawing task, the length of time taken to complete a simple task and the inefficiency of the drawing experience. This paper presents a blind drawing technology that introduces a drawing technique with screen navigation, sectioning and sizing. This will provide blind learner with an interactive drawing environment, which will improve the understanding of a concept or, a subject matter. It will contribute to the improvement of the overall quality of learning and drawing experience by mapping their mind images into objects and spatial information. This technique promotes an interactive and easy drawing environment to build objects, associations, layout information by zooming, navigation, and grouping. It will lead to future possibilities such as 3D world modelling, printing and multisensory integration of inputs and output methods.

Introduction

The aim of this project is to investigate techniques, tools and technologies, which assist children and adults with Microphthalmia (small eyes) and Anophthalmia (no eyes) in creative processes. Blindness is inability to see anything. A blind person cannot see anything at all and are in totally darkness. Partially sighted people have limited vision. About 39 million are blind and 246 million have low vision according to World Health Organisation 2013.

Motivation and Problems

I was inspired to start this project when I taught a blind student of computing who demonstrated considerable ability in the comprehension and expression of knowledge and ideas, but found the use of diagrams and images challenging. This experience inspired me to seek to develop a technique, which will help blind and partially sighted learners to develop and build diagrammatic "images" to help them learn and communicate visual ideas.

Research shows that most blind learners often seek the help of a support worker to draw pictures or diagrams or, they avoid drawing because they find it difficult to believe that they would be able to create pictures or diagrams without the guidance from a sighted person and would not even make an attempt. Hence, expressing imaginative thinking through Computers is limited. Therefore, the need of a self-reliant blind drawing technique and technology is highly valued among blind communities. The question is not whether it is useful for a blind person to draw at all because they cannot see. Instead the focus questions should be: what sort of an object layout a blind person could easily conceive and convey? What sort of a navigation system would build a sense of object layout easily? What sort of a space arrangement could navigation be done easily?

Several studies have introduced Grids for easy navigation and finding the accurate places of maps in an unknown environment. The game technologies such as IF(Interactive Friction) games is purely based on text and command language for user input tracking, voice feedback for interaction and a screen compass for object searches. IF gaming technology has been popular among blind game players for decades. Hence, this study investigates compass and grid based location-tracking approaches together with interactive friction gaming communication style to develop the user's concept of drawing. This method of drawing does not need the help of a support worker, does not take enormous amount of time to complete a task and is not expensive to use. The method is intuitive, interactive, and easy to learn and has functions for error detection and correction.

Background

Vision is made up of multidimensional channels combining the senses to produce a composite, which we call "visualization". While blind people may not have access to the specific visual channels, they may have alternative access via their other senses to enable them to *fill in the gaps*. The difficulty is in explaining how that process converts into what sighted people know as object relationships. There are several experimental tools for blind drawing and editing semantic diagrams.

Kamel, Landay have introduced IC2D product that divides the screen in to 9 navigable smaller workspace [3]. There are pallets for users to select shapes, types and colours. In order to make more precise selections each of the nine cells is then divided into further nine cells, which in turn dived in-to 9 more cells. Annotations are given for meaningful semantics so that the user can build an accurate mental image. System "Kevin" [1] enables users to read, edit and create diagrams using N2 chart. This system does not keep track of screen layout information but retrains the mandatory information needed for a simple DFD diagram. System PLUMB [4] uses *Linked lists* and *Heaps algorithms* to store data in a data structure and to access them in a sequential manner. When the user selects "insert node" a new node is inserted to the existing link list, which would be, acknowledge to the user. Some systems explore the different levels of the UML diagrams, its hierarchic, floor plan and spatial information that has a special emphasis on semantically annotating the data, which results in interoperability of systems of intranet and internet.

A good drawing enables the user to remember and access the floor plan, retrieve the objects in the floor plan and join them and make sense of them. Peripheral localization becomes more difficult for older adults and blind people. If a message is conveyed by voice, it has to be short and easy-to-understand due to the possibility of exceeding working-memory-capacity. However if the information is too simple there is less benefit from multiple modalities. Thus processing load, disorientation and redundancy effect has to be removed for good engagement or learning. Therefore distributing the information load across multiple channels is advantageous.

Questions such as, "what technique a computer tool needs, to build up an unknown environment? Does going through a virtual environment generate a cognitive map for a blind person? Does a computer generated picture map give a clear reflection of a blind users' mental image?" are not fully explored by main software providers.

Proposed Solution

Blind Drawing Technology and System

The screen is divided in to 9 memorable locations such as north, south, east west, north-west, and northeast southeast, south-west. (See Figure 1: Division of the computer screen and line drawings) A compass on the interface will take the user to the intended location. The screen changes its granularity by a zoom-in and zoom-out technique. When zoom-in is executed, the current location is sub dived into another nine smaller locations. Inputs invoke the primitive objects, locations and operations. Audio feedback is given for conformation and verification. A set of keywords is used to form the language for producing art. Once established, we will explore extending the facility to extend 3D drawing and printing.

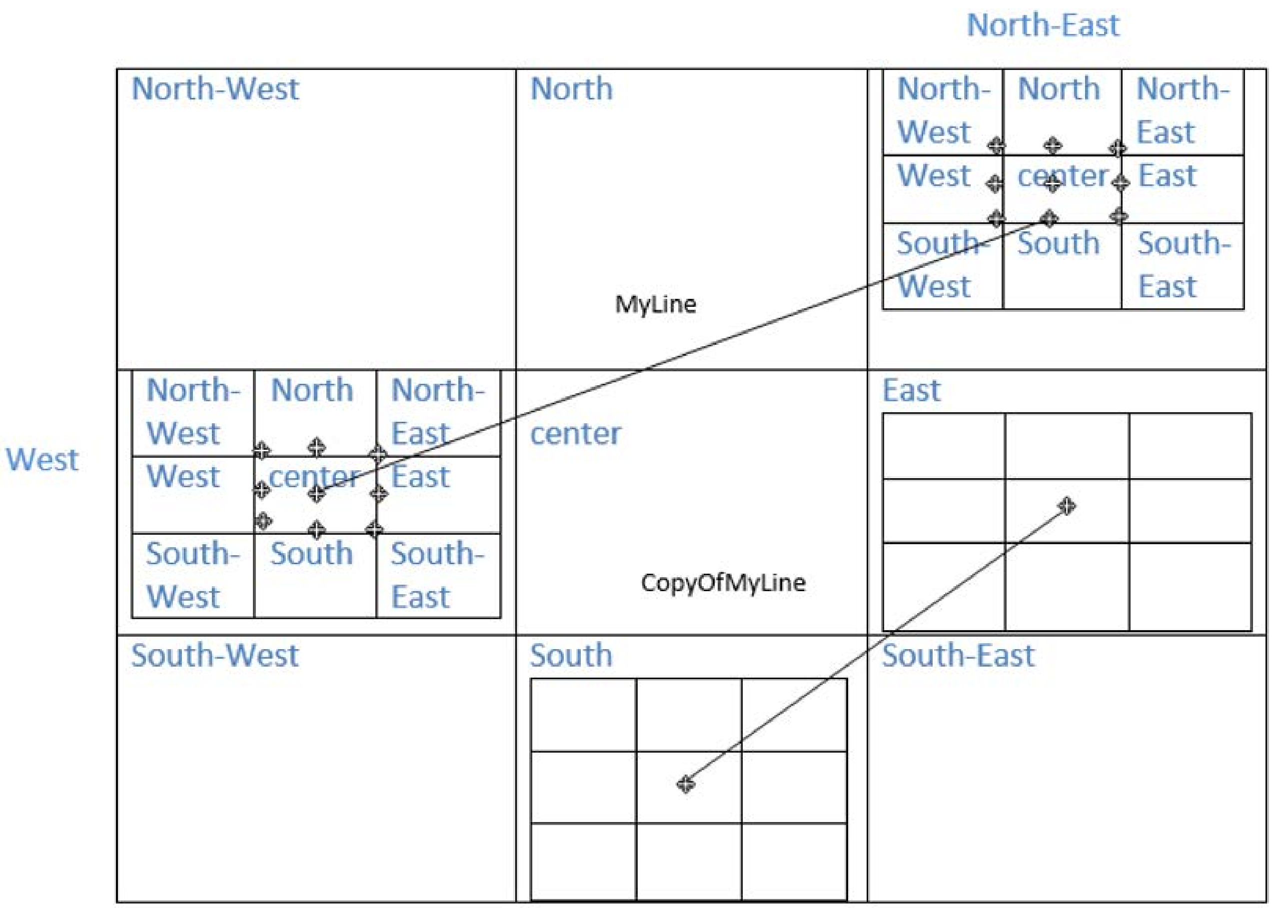

Figure 1. Division of the computer screen and line drawings

Proposed Researched Methodology

My sample population will be selected from the MACS charity (UK's national charity for children born without eyes or with underdeveloped eyes.) and also visually impaired learners from LeSoCo further education College UK. However, this experiment could be extended to the RNIB, UK and beyond the UK. Data and fact finding has already started using questionnaires, interviews and direct observations to gather evidence on the blind user's preferred methods computer Navigation, communication, location tracking and drawing. Iterative development methodology will be used to gather feedback and remodel the technique. During the testing phase, gender, age and vision, will also be taken in to consideration. I will be using quantitative and qualitative methods of data gathering and analysing outcomes throughout the project. The technique will be evaluated using complexity, ease of use, easiness to learn, reliability, efficiency and fitness-for-purpose criteria.

Current Stage of Research

To date, I researched tools, techniques, and range of technologies available for blind drawing and I have conducted interviews, observations and teaching during the data gathering. I am currently devising a middle-tier "language" for the proposed blind drawing technique that will be experimented with a programming tool such as Java.

Acknowledgments

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About the Author:

Sandra Fernando has ten years' experience in the software industry and as a teacher of IT and is now beginning a PhD investigating the development of a computer aided drawing tool for blind learners. Sandra was inspired by MACS (Micro and Anophthalmic Children's Society) member, Toby Ott, who she came across while teaching at Lewisham and Southwark College.