The Rembrandt Watermark Project Compact Disk

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Creation of a multimedia title with a limited budget, and staff places constraints on a project that at times, seem insurmountable. As Ben Dubrovsky states in his article on well designed multimedia, "Constraints are not hindrances. Rather, they should be considered the means of setting the bounds of your design and focusing on what can be done.1 Working within this paradigm, the goals of the project were to deliver a usable program with a simple user interface that performed within the scope of the project designer's level of expertise. Faced with creating a compact disk with a two-person project team, it was clear that the program could not be created with the same level of intricacy as would be produced by a professional company. However, with clear goals and a thorough understanding of a method of presentation that would best convey the message, the team built upon its experiences to create a product that met all expectations.

The creation of a compact disk was initiated as part of the research conducted by Shelley Fletcher, Head of Paper Conservation at the National Gallery and Nancy Ash, former paper conservator at the Gallery. Their project was to record and catalogue the watermarks associated with prints made by Rembrandt van Rijn (1606-1669.)

Watermarks indicate the manufacturer of a sheet of paper They are a part of the mold used in the paper making process. Molds are composed of a woven metal screen, bounded by a rectangular wooden frame. A thin wire shaped into a design is attached to the surface of screen to create the watermark. Watery paper pulp is captured by the mold. The water drains out through the screen leaving the pulp in the mold. The drained pulp is removed from the mold and pressed between sheets of felt. The watermark is caused by the shaped wire displacing some of the paper pulp resulting in a thin area. This difference in density is detectable by holding the sheet up to bright light. Accurate recording of the watermark pattern is achieved by taking advantage of the varying density of the paper. A plastic plate containing radioactive material is placed on top of the paper containing the watermark and a piece is x-ray film is placed beneath. The resulting exposure and development of the x-ray film reveals the shape of the watermark since the radiation from the plate passes more easily through the paper where it is thinner.

1 Ben Dubrovsky, "Well Made Multimedia, How to Design Multimedia that Works, In Theory, In Practice," Digital Video June, 1995, p. 38.

The watermark radiographs were created using prints from the National Gallery's collection as well as other institutions that maintain substantial holdings of Rembrandt's prints. Watermarks were sorted and catalogued by design features and correlated with the subject of the prints and their states of printing. With this information prints can be traced to their paper sources. Anomalies or posthumous printing of Rembrandt's works can be easily identified since paper know to be manufactured after Rembrandt's death has been used with his printing plates. Further, Rembrandt's working methods regarding paper selection for various prints can be charted. This information shared with the scholarly community is valuable to understanding Rembrandt's working methods. A book illustrating the watermark radiographs and their descriptions along with information on associated prints would be published as a result of the research.

A decade of work has gone into production of the catalogue. Painstaking referencing of the prints and their states have been made. The conservation division has been eager to share their knowledge with scholars and print collectors interested in Rembrandt's prints.

Watermarks in Rembrandt's prints are organized by visual characteristics. Watermarks with similar shapes are grouped together. Thought of as a family, each general type of watermark is a parent. Watermarks with the same basic characteristics , but containing slight alterations are called variants. Variants are the children of the parents. Variants may also have children called subvariants. Subvariants are slightly different from the variants but are closely related to the design found in the variant.

The user of the book can examine a watermark on a print they posses and look for a watermark type (parent) that generally matches their own. Upon finding a type match, they can find the variant that more closely resembles their watermark. Subvariants can be examined to find a match that is exact. Information on the history and use of the watermark is available to the reader. In addition, a reference to prints that contain the same watermarks are documented in the book.

The idea of generating a compact disk came from a projected use of the book. The authors desired to have users compare their watermark images with full-scale watermark radiographs printed in the book. Watermarks found on prints are difficult to compare with an image printed in a book. Ideally, users would overlay the watermark from their print on top of the image in the book and use a light table to provide backlit illumination for the overlay. Since both the book and the print are nearly opaque, they are not easily suited for examination by transmitted light. Further, the book is printed on both sides of the page so that images interfere with each other as light is transmitted through the paper. Finally, the watermark on the print may appear in an awkward position so that overlaying it with an image in the book is impossible.

The primary goals of the compact disk are to present the watermark image in a way that assists users in selecting a catalogued watermark that is the closest match to their print's watermark. Since a number of variations exist, identifying exactly the same watermark requires matching very subtle details. The CD allows users to print an image of the selected watermark from the database for overlay and

comparison. Printing of the watermark could be done on light weight paper or transparent laser printer film to maximize image clarity. The CD would be thought of as an extension of the book and serve a target population that has access to computer equipment and the need to research prints.

The developers understood early in the production of the CD that both publications have limited audiences. As a means of attracting a broader range of users, a number of added features on papermaking and Rembrandt's life were added to the CD.

With a quote for development cost of a CD of this type in the range of $175,000 to $200,000 it was soon realized that other projects had a higher level of priority. A small number of multi-media presentations had already been completed by the division. Building on that experience, it was agreed that the Rembrandt watermark CD would be created within the conservation division.

The division had already made a commitment to purchase computer equipment for a variety of image processing tasks related to research on infrared reflectography. The capabilities of the equipment were proven as the result of experience with using video and digital photography for the documentation of the condition of works of art. Working with digital images over a two year period, a number of basic equipment choices and incremental upgrades were made. The configuration at the start of the project was a Macintosh, Quadra 840 AV 16/500 with an E-Machines 19 inch monitor and E-Machines 24 bit graphics card. A Umax flat bed scanner was used to capture the watermark images from the x-radiographic film.

Software used to prepare the CD was Adobe Photoshop™, Illustrator™, Premiere™, Macromedia Director™, WordPerfect™, SoundEdit 16™, Debabelizer™, and Planet Color™.

With limited memory and disk drive capacity on the Quadra, an upgrade was initiated to change to a Power Macintosh 8100 AV 40/500. Purchase of a 2.6 GB hard disk to handle the large number of raw and processed images and the full contents of the CD was added. A monitor that provided multiple screen resolutions was purchased so that all of the components of the multimedia authoring software could be viewed simultaneously on the screen.

While the equipment budget was adequate, no additional staff were allocated to the project. The design staff consisted of one person to carry out the programming, design, planning and administrative functions and an additional staff member to scan images, design screens, and organize materials for entry into the authoring program. The author of the watermark book would oversee the content and manner of presentation of the material and serve as authoritative source for all of the components of the project.

As in other museums, each member of the production team has many other responsibilities. It was difficult to block out segments of time to devote to production of the CD. The team did not have research support. Funds, staff, or time were not made available to develop sections of the CD on papermaking and the artists' life. From the outset, it was decided that simplicity and brevity would dictate the development of these sections. One of the greatest inhibitors to the project was being able to reserve substantial periods of uninterrupted time for production of the CD.

Early in the project, a number of programming issues needed to be solved. This work consumed several weeks of effort. Progress was incremental as lines of code were composed and checked for errors. Upon returning to the areas of great programming difficulties, after moving on to other issues, a period of time was spent relearning the functions of the code. Careful notes and programming remarks were kept to document the solutions to problems. This minimized the reaclimation time considerably.

The design strategy for the CD paralleled many of the features of the watermark book. However, a deliberate effort was made to refrain from making the CD an electronic version of the book. The nature of interactive media prompted the design team to view the use of the CD as a reference that users would approach in different ways. The target audience was determined to be museum curators, print collectors and dealers who would have different type of queries about Rembrandt's prints. Key to the design would be the interweaving of these users needs so that a unified approach would be created. A critical decision was made not to have 3 separate tracks for the CD.

The design contains a starting point explaining watermarks and instructions for using the CD. This is followed by images of the basic watermark types. Each watermark type is a starting point to explore and define a corresponding match to the user's watermark. After the basic watermark type is selected, the viewer can choose to see detailed information about the watermark and move to select a close match from a choice of variants. The variants define a group of watermarks with similar characteristics. Each one is slightly different, reflecting the subtle changes that occur in watermarks over time as these wire shapes are remade for new paper molds, are altered by damage through usage, or copied by other paper manufacturers. These variants are grouped together with those of similar design. Variants that have slight deviations are termed subvariants. They "fine tune" the user's selection of watermark that is the closest match. With the number of levels of selection, the design of the CD had to maintain clarity and distinctiveness of selection categories so that the user would not become confused.

The linear nature of books and the instant visual feedback provided as to the page or section of the book the reader is browsing, assures that the user cannot get easily lost. Since the viewer of a CD can move in a non-linear manner, the ability to become disoriented is far greater. Emphasis on clear navigational marks that point to the users location and direction are critical to the success of the design. Most users can retain a mental layout of a simple hierarchical structure for each scene in a presentation. A relational model poses far greater complexity. Tracking information down a complex hierarchy with multiple crossovers into other hierarchies is extremely difficult to comprehend. The watermark CD's format created an added burden as the variants and subvariants look similar and the method of

presentation is visually identical. While the design team is familiar with the navigational structure of the project, the distinction between screens can be easily blurred. This problem was overcome by using icons that highlight the location of the viewer within the hierarchy.

With a small project development staff, all of the tasks necessary to completing the CD were accomplished without outside expertise. The first difficulty was to capture all of the beta radiographs. The black and white images were all on transparency film and of fairly low contrast. Several images had to be manipulated extensively to make them usable. All of the radiographs were adjusted in contrast to clearly indicate the watermark lines and the chain and laid lines of the mold. Each scan was saved as a PICT file and checked to maintain the one-to-one size relationship with the original.

A problem appeared early in the development of the project. Using small versions of watermarks as buttons to assist the user in selecting the type to explore proved to be unintelligible. The 640 x 480 pixel screen resolution was not large enough to illustrate details on small images. This screen resolution was chosen to allow the greatest number of computers to run the CD. Tracings of the watermark images in black on a white background was the solution to the readability problem.

A variety of compression schemes were explored to minimize the size of individual elements in the CD. JPEG was the most successful method for reducing file size. However, when the image was imported into the authoring software, it was slightly larger than its original size. The most successful method of file size reduction was to compress the scanned images to 8 bit indexed color images. The black and white watermark scans were initially captured as 24 bit entities so that they could be conditioned properly for maximum readability. A limited number of color palettes were created. Images were mapped to these palettes to reduce size and create uniformity. Color fidelity was not critical in most instances within the watermark CD as many of the images were black and white.

Programming the presentation was entirely self-taught. Without funds for training, the methods of creating non-linear, multimedia presentations had to be learned by example and practice. Most of the CD was fairly routine. Navigation buttons and the programming necessary to make the scene shift to the proper location was the extent of the programming skill required. The more complex routines focused on automating tasks so that routine navigational requests made by the user could be processed without repetitive lines of programming code. Much of the code was written, tested and refined on small modular applications that minimized the variables and complexity of interaction. The debugged, working code was transferred to the watermark authoring software and tested again.

Most of the multimedia presentations made by the staff before the start of the watermark assignment had little programming code. Most had no more than 80 elements and 50 scenes. Early in the planning stages of the project it was determined that the scope of the CD would be far greater than any other venture already completed. Initial estimates targeted 40 watermark types for inclusion in the catalogue.

Each watermark type has an average of 5 variants and 5 subvariants. There is one block of text for each watermark type, 2 for each variant and 1 for each subvariant. The total number of images and associated text is 1,040. Navigational buttons total 485. The images, buttons and sounds in the sections on papermaking and Rembrandt's life add 80 images, 40 buttons and sound files. The approximate total for all of the elements in the CD is 1,680.

In order to compensate for the small project staff where the separate components of the CD would be divided and managed by a design team, the complete project was handled by two people. A common method was adapted to track the components of the project. Using the film industry standard, the storyboard, each part of the CD was devised on paper. Since each screen represents a separate scene of the CD, all of the elements needed for the scene are drawn and annotated in a frame of the tracking system. Single sheets 8.5 x 11 inch paper outlined each frame, its position related to adjoining frames, navigational buttons, script references, sketches of the position of elements in the scene, and instructional notes. This method was time consuming but valuable in tracking the location of elements and programming commands. The authoring software, while powerful, masked many of the navigational instructions used by the program. Scripts attached to buttons were hidden under layers of commands. The paper documentation assisted in organizing the directions for all of the elements in the CD.

During the initial discussion phase of the project, much time was spent creating mock-up views of screens for the CD. The placement of navigational buttons, text and images helped the designers and the author of the watermark book plan the direction and content of the program. As the design progressed, the visualizations were animated so that the buttons were active. The size of navigation buttons, icons, images, and text placement were all tested and approved before moving ahead to other parts of the project. Many issues were resolved long before they were heavily embedded in the design structure and more difficult to rework.

Using printouts of the scenes in the design visualizations, the program was tested with individual familiar with watermarks and those not associated with the project. Testing eliminated the inherent problem of the staff's lack of objectivity in interpreting design functions and navigational elements of the CD. The basic concept of the CD was explained to the test subjects. Users were asked about the layout and specific questions focused on how they thought navigational buttons would function, where a button activation would take them, where the program was leading them, what their location was within the program, the clarity of the presentations, and fulfillment of the goals explained in the beginning of the test. If respondents consistently misinterpreted the content, notes were made and visual or programming changes followed. New test participants were chosen and tests of problem areas were repeated to see if changes corrected the difficulties. As the prototype program was assembled, the same type of testing was performed. These tests were critical to the development of the CD. Without test subjects, the final product could have been released with numerous flaws.

The creation of the watermark CD demanded a great amount of time and skill. The concentrated effort of two people would have to compensate for a much larger group of multimedia designers that are usually part of a CD project. The cost savings in equipment and personnel were tremendous. The size of the hardware and software budget would be considerable with a large development staff. Much of the equipment for the conservation division CD was already purchased for other tasks, If equipment had to be purchased to start the CD mastering project its cost, less the software, in 1995 would range from $8,000 to $14,000. With a compromise in processing speed, a system could be purchased for slightly less than $8,000. Savings may be obtainable by having outside vendors perform some of the image processing tasks. Use of images captured on Photo CD developed by Kodak offers an alternative to purchasing a scanner.

Salary expenses for existing staff members may be factored into the cost of a CD. In certain instances, it could be viewed as a productive endeavor that furthers the mission of the institution. However, in a small museum operation, the attention taken away from other projects can amount to a considerable sum over the time needed to develop a CD. This might be offset by the potential for revenue generation from the CD.

Important to creating a high quality presentation is an understanding of the message being conveyed in the CD. Important factors in CD development are knowledge of the capabilities of the authoring software, the expertise of the museum staff, and capitalization on the strengths of a small production staff. Instead of allowing the size of the development team to be constraining, designers have the flexibility to use the tools and programming elements to explore the scope of the subject matter. A small work team has the added advantage of being able to work closely with each other. Misunderstanding of the scope of the project is diminished because communication within a small development team is easily accomplished. A committed group of designers, familiar with the subject material and the authoring software can work to the highest level of their expertise. Overly ambitious designs that inherently have a high percentage of potential flaws are minimized since a small staff may be reluctant to design complicated programs.

The design of the Rembrandt watermark CD took advantage of the research performed to organize the watermarks, fashion an interface to access and match the images, inform the user about the history and characteristics of the watermark, and create a printable, full scale image of the watermarks for comparative purposes. This simple, direct approach was accomplished with a limited budget and design team. These constraints motivated the staff to produce a product that has characteristics equal to project budgets many times its size.

Watermark Identification in Rembrandt's Etchings (WIRE) Project: Porting Instruction Manual. K Ferreira. A House. Rembrandt's Watermarks, Past, Present, and Future: Erik Hinterding in Conversation with Andrew C. Weislogel. E Hinterding. What Is an Original Print?Â The Rembrandt Watermark Project Compact Disk. Conference Paper. Jan 1995.