Exploring the future of compact disc-interactive

Patrick J. Haggerty

Follow this and additional works at: http://scholarworks.rit.edu/theses

Recommended Citation
Rochester Institute of Technology

A Thesis Submitted to the Faculty of
The College of Fine and Applied Arts
in Candidacy for the Degree of
MASTER OF FINE ARTS

Exploring the Future of Compact Disc - Interactive

By: Patrick J. Haggerty

Date: August 9, 1990
Approvals:

**Advisor:** Craig McArt  
**Date:** 9-6-90

**Associate Advisor:** Doug Cleminshaw  
**Date:** 10-9-90 SEP 10

**Associate Advisor:** James Sias  
**Date:** 9-6-90

**Special Assistant to the Dean for Graduate Affairs:**  
Philip Bonarath  
**Date:** 9/3/90

**Acting Dean, Collège of Fine and Applied Arts:** Dr. Peter Giopulos  
**Date:**

I, Patrick J. Haggerty, hereby grant permission to the Wallace Memorial Library of RIT, to reproduce my thesis in whole or in part. Any reproduction will not be for commercial use or profit.
Table of Contents

I  Introduction 1

II  Information Age - Information Media 3
   Optical Disc Technology and CD-I 3
   Marketing 7

III  Technical Explanation of CD-I 7
   Optical Discs 7
   CD-I Audio 9
   CD-I Video 9
   Video Images 11
   Visual Effects 13
   Text 15
   Processing Power 15

IV  Possible Applications 17
   Education 18
   Resource Tool 21
   Entertainment 22

V  The Portable CD-I Unit 23
   Goals 24

VI  Product Development 25
   Components 25
   Display Screens 25
   Cursor Control Device 27
   CD Drives 31
   Circuit Boards 31
   Power Supply 32
   Compatibility 32
   Sound 33
   Controls 33
   Molded Shell 35

VII  Form Exploration 36
   Analogy, Metaphor and Allusion 36
   Disc Shapes 36
   Functional Benefits of Form 39
   Color 39
   Softcase 40
   Logo 41

VIII  Conclusion 43

   Appendix A 45
   Appendix B 60
   Bibliography 62
## Illustrations

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deep and Wide Structure</td>
<td>7</td>
</tr>
<tr>
<td>Resolution Proportions</td>
<td>11</td>
</tr>
<tr>
<td>Image Planes</td>
<td>12</td>
</tr>
<tr>
<td>CLUT Animation Technique</td>
<td>13</td>
</tr>
<tr>
<td>Scrolling a Large Image</td>
<td>15</td>
</tr>
<tr>
<td>Resolution Control On an LCD Screen</td>
<td>26</td>
</tr>
<tr>
<td>Comparison of Control Response Ratios</td>
<td>29</td>
</tr>
<tr>
<td>Menu Driven Controls</td>
<td>33</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Charts</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth of Information</td>
<td>3</td>
</tr>
<tr>
<td>Audio Levels</td>
<td>17</td>
</tr>
<tr>
<td>Comparison of Various Devices on Speed and Accuracy of Cursor Positioning</td>
<td>28</td>
</tr>
</tbody>
</table>

iv
I. Introduction

The flood of modern technology has done a great deal to fill needs in our changing society. Technological advances not only improve upon the past but also create totally new methods of doing things which, in turn, revolutionize our way of life.

From a designer's standpoint, the prospect of incorporating new technology to create an entirely new product is overwhelmingly exciting. The designer is placed in the position of shaping the future. This situation should be approached with both enthusiasm and seriousness. Enthusiasm will spawn innovative concepts while seriousness will bring refined solutions.

Some of the high-tech products today lack refinement and, as a result, are unfriendly and difficult to understand. These unrefined products may be very creative, but have somehow failed to meet the needs of the user. They are lacking the user-friendliness and familiarity that successful products possess. By creating products that relate to users, confusion can be avoided.

Each new product that is designed should be a step forward; a step that can both look to the future and relate to the past. A product that looks ahead has an exciting appeal, while relating it to the past gives it a familiarity that users are comfortable with.

For my thesis I have designed a Portable Compact Disc - Interactive Unit. During the design process I have experienced the enthusiasm of designing a new and exciting product. At the same time, I have realized the need to exercise the seriousness that brings refinement. I attempted to derive a form that is exciting and new, but one that also reflects the context in which it was created.

Compact Disc-Interactive (CD-I) is a new optical disc technology that has the capability of revolutionizing the way we use information. CD-I will fill needs in homes, businesses, and institutions. It is capable of replacing traditional forms of information storage such as books and maps, in addition to creating totally new methods of using
information. With the combination of interactivity, sound, and video, CD-I will transform traditional media into something entirely new.

Considerable time and effort was spent investigating Compact Disc - Interactive because of its new and imperceptible quality. By gaining a clear understanding of CD-I's technical aspects, I could arrive at a physical solution that would be a rich expression of CD-I's character.

The first sections of this paper will explain the more general technical aspects of CD-I so that the reader might also gain an understanding of its possibilities and its character. The sections that follow will explain the design process I experienced in my creation of the Portable CD-I Unit. It will cover the analytical selection and placement of physical components, as well as the aesthetic exploration of product form.
II. Information Age - Information Media

Optical Disc Technology and CD-I

"Efforts to describe CD-I are a bit like the tale about the seven blind men and the elephant. Each man was asked to describe the elephant based on what he could feel. Each came up with a different description, but none developed a true understanding of the beast. Since no previous single system has approached the level of functional integration of CD-I, we are all, in a sense, blind men."^1

In the past 20 years there has been tremendous growth in the area of information. (see chart 1


Growth in Information

chart 1

---

^1Steven Lambert and Janet Sallis, CD-I and Interactive Videodisc Technology, (Indianapolis,IN: Howard W. Sams & Co., 1987, p.121.
In 1980, nearly 50 percent of our labor force was involved in information activities. This flood of activity has not only created the need for new and better ways of using and sharing information, but it also has spawned many new and innovative product solutions. These new and innovative solutions have greatly reduced tasks, as well as the cost to complete these tasks. Just think of the list of everyday products and services that have changed our ways of handling information: personal computers, cable television, cellular telephones, fax machines, conference calls, automatic-teller machines, photocopiers, pocket calculators, pocket televisions, ... and the list goes on.

The storing and processing of information is an area that is under constant rethinking. Our society is drowning in a sea of paper. In small scale operations, paper is a very flexible and efficient way of dealing with information. When the operation becomes large scale, however, paper becomes very inefficient. It becomes inefficient to store by filling rooms with filing cabinets full of paper. It becomes inefficient to process because every document must be found individually, by hand. Producing paper also depletes our forests of trees and wildlife so that more paper can be produced. Optical disc technology is a relatively new technology that may be able to solve many of the problems of storing and processing information.

Although optical discs have been around since the mid-1970's, they did not become commonplace to the public until 1982 when Compact Disc - Digital Audio (CD-DA) was introduced. These small 12 centimeter discs offered a sound quality never before obtainable in musical publishing. The discs themselves are very durable, accurate, and can be produced at a low cost (approximately $14./disc).

The storing of audio files is only part of what optical discs are capable of. Compact Disc-Read Only Memory (CD-ROM) is used in libraries to store large textual references, indexes, and abstracts. Interactive Videodiscs (IV) store both still and full motion video images and have been used for educational and job training purposes.
Compact Disc-Interactive (CD-I) is one of the newest optical disc technologies. It combines audio, video, and textual information, all on the same disc. These three media are then unified by a program, also stored on the disc. All together a 12cm disc has the total storage capacity of 650 Megabytes (Mb). In simple terms, that equates to:

- over 7800 video still frames or,
- 2 hours of top quality sound or,
- 17 hours of simple narration or,
- 150,000 pages of text or,
- more typically, a combination of all four under

the guidance of a computer program also on the disc.

Coupled with CD-I's amazing storage capacity is its ability to instantly access any bit of information on the disc. The information on an optical disc is stored digitally, meaning each bit of information is stored in numerical form, has its own identity, and can be accessed easily. This is contrary to traditional analog forms of storage such as phonographic records and audio tape which store information in linear form. In analog recording, each bit is dependant upon the information on either side of it.

Digitally stored information has a real time advantage over analogically stored information, in that information is randomly accessible. Random access is defined as, "Any form of storage in which the access time for any item of data is independent of the location of the data most recently obtained." This means that digitally stored information is easily accessed, and can be found regardless of any other information on the disc.

CD-I is also a Real Time Operating System (RTOS) which means, "The flow of data taken directly from the disc cannot be interrupted within the bounds of a real time

---

3Philips International, p.188.
record." More simply, any data contained on the disc can be instantly accessed in direct response to the user (Within CD-I, an instant can be anywhere from immediate, if the data is close, to no more than 2 seconds, if the laser used to read the disc has to travel across the entire disc.).

Random accessibility and CD-I's ability to operate in real time offer great opportunities for interactivity. Interactivity is being realized as a powerful learning tool. In an interactive program, as much as a 40% increase in retention can be gained over traditional passive methods. Interactivity forces the user to become involved and establish a dialogue between one's self and the program. Ideally, you want the dialogue established to be meaningful and rewarding to the user, to keep the user actively engaged in the program. With random accessibility and real time, the user can change subjects instantly if not interested. This allows the user to learn subjects in one's own order, regardless of the order established by the writer.

CD-I gives the user the interactive advantage to control the pace of the program. You can slow down by stopping, repeat anything instantly, or speed up by changing frames faster. This can eliminate the possibility of someone becoming angry or frustrated by a fast-paced program, or, the possibility of boredom and distraction in a slow-paced program.

CD-I also gives the user the ability to interactively control the level of the program. Most CD-I programs will have very deep and wide programs (see figure 1). The problem with this is how to present a deep and wide program. Usually it is approached systematically by having various levels of information. The higher levels contain general information while the deeper ones are more specific. With CD-I, you can choose to remain on a general level or dive into a deeper level instantly.

---

4Philips International, p.188.
5Philips International, p.7
Marketing

One of the marketing advantages of CD-I that gives it a better likelihood of success over other optical disc mediums is that it is internationally standardized. Standardization has proven to be a large factor in the success or failure of a new technology. For example, consider the fate of laser videodiscs in the mid-70's. Originally videodiscs were supposed to fill the market videotape now occupies, but incompatible standards caused their downfall.

International standardization enlarges and simplifies the CD-I market. It enlarges markets by making the world its consumer. It simplifies markets by allowing for only one version of player and software to be made.

One aspect that further reinforces the success of CD-I is that it's based on Compact Disc Digital Audio (CD-DA). By coupling with CD-DA, CD-I already has the tools of manufacturing, marketing and distribution channels in place. "Seldom has a new consumer technology been so spring-loaded for success."\(^6\)

\(^6\)Lambert and Sallis, p.121.
In Explaining the potential of CD-I, Dr. Bernard Luskin, president of American Interactive Media (AIM), poses that CD-I is a "focal technology", meaning that it combines several publishing industries into one publishing medium. This is unlike traditional publishing methods that disperse information.7

III. Technical Explanation of CD-I

Optical Discs

Optical discs store information in a manner similar to a conventional audio LP. Coded information is burnt into a glass master disc by a powerful laser beam from a magnetic tape master recording. The positive glass master disc is then used to produce a negative metal mold for stamping mass produced discs. The information on the disc is actually a series of pits and grooves along a spiral path, much like an LP, but much more dense, and spiraling from the inside outward.

The mass produced plastic discs are then covered with an ultra-thin layer of reflective aluminum, and overcoated with a protective, clear plastic coating. This outer layer makes the disc impervious to dirt, wear and rough handling.

To read the disc, a low powered laser beam is reflected off the disc. The reflection is passed through a series of prisms and mirrors to a photo diode which decodes the information for processing.

All optical discs share this common storage method. However, the way the information is processed can vary. CD-I players decode information by a small microprocessor within it. A CD-I player is known as an Optical Media System because it reads and decodes information on the disc. Other formats such as CD-ROM players, do

---

7Lambert and Sallis, p.121.
not have a microprocessor and require the aid of a computer to process information. This is known as an Optical Media Peripheral Device because it only has the ability to read information and cannot decode it.\textsuperscript{8}

Information on a CD-I disc is stored in tracks and sectors. All of the material from one application is stored in one track. Within this track there are many different sectors containing audio, video and text information. If the sectors contain only audio information, there can be no visual information displayed. If the sectors contain only video information, there can be no sound. Certain types of information consume more sectors than other types. A disc designer should be aware of these consumption values so storage space may be conserved.

The rate at which the disc information is processed is the most critical aspect of disc design. Audio, video and text information are all processed along one channel. This channel can only process information at a certain rate. Consequently, a bottleneck occurs along this channel when information flow is greater than the channel’s capacity. Because there is a danger of the bottleneck stopping information flow, CD-I offers several quality levels of audio, video and text. A higher quality level consumes more space in the data channel, while a lower quality level consumes less. By offering various levels, the disc designer can avoid the dangers of a bottleneck in the data channel by choosing various quality levels that will not restrict the flow of data.

**CD-I Audio**

CD-I offers three different quality levels, all of which have a stereo or mono capability. A-level (the highest), has a sound quality equivalent to the first play of a brand new, high quality audio LP. B-level is equivalent to an FM broadcast, transmitted and received under

\textsuperscript{8}Philips International, p.12.
optimum conditions. C-level is equivalent to an AM broadcast, transmitted and received under optimum conditions.

There are 16 channels of audio playback available on a disc, each with a duration of 72 minutes. Each higher level uses a greater number of channels to playback. A-level uses 8 channels for stereo sound, so, with A-level, there can be just over 2 hours of high quality sound on one disc (some space must be allotted to control data). With C-level mono occupying only one channel, there can be over 16 hours of simple narration. Or, each track could contain a different language to produce a disc over an hour long containing 16 different languages, any of which the user can select!

**CD-I Video**

As with audio, CD-I offers three levels of quality. Normal resolution is the lowest level and can create an image equivalent to a normal television broadcast. Double resolution can produce an image equivalent to a color computer monitor. High resolution is equivalent to the highest quality digital picture.

The easiest way to describe the difference in these resolutions is by proportionally comparing the number of pixels which appear in any given image. Figure 2 shows this comparison.
Originally, the benefit of being internationally standardized created some problems with compatibility. There are two main standards for television broadcasting in the world. These two standards have incompatible screen display sizes. The NTSC (National Television System Committee) standard, used in North America and Japan, uses a 525-line screen that is updated at 30 times per second. The PAL (Phase Alternation Line) system used in Britain, most of Europe, Australia, Africa and South America, uses a 625-line screen that is updated 25 times per second. CD-I overcomes this incompatibility by incorporating a decoder within the player that adapts the video signal to the type of video monitor it is linked to.\(^9\)

CD-I offers use of four image planes within a program (see figure 3). A screen image can be a combination of several of these viewing planes overlapping each other. The first image plane is transparent and contains the cursor and simple user control graphics. The second and third image plane can be full or partial screens displayed together or separately. These two planes can also be merged to create a single video image that requires twice as much data to be displayed. The fourth and final image plane acts as a backdrop when planes in the foreground are transparent and leave voids in the display area.

Video Images

CD-I is capable of three types of video images: full color animation, video stills and full motion video. Full color animation is possible through particular coding techniques and certain processing methods that only update fractions of the image, causing a reduction in the data stream. Animation can be user manipulated in applications like golf or hockey, where the user controls the animated figure to compete.

Another animation technique uses the Color Look Up Table (CLUT) which is used to define and code all the colors in a given scene. This technique gives motion to graphic objects by repeatedly changing the data in the CLUT, which, in turn, changes the color of the objects. For example, CLUT animation is possible in a sing-along sequence that displays lyrics with a bouncing ball to help the user follow along. To simulate ball
movement, a series of ball images can be overlaid together. By sequentially changing the
color of each ball from transparent to opaque, the ball will appear to move across the screen
(see figure 4).

![CLUT Animation Technique](figure 4)

Video stills will be the most common video images, used in nearly every video
application because they do not require updates which consume the data stream. Quality
will be offered in the three different levels available.

Full motion video is possible in several different ways. Full motion video, in a
traditional sense where the image is constantly updated, would create a moving image for a
total of only 4.5 minutes. Because of this, different methods of processing and storage are
used. These methods reduce the storage size and processing time of a scene with motion.
The first method of full motion video is achieved by partial updates. That is, only part of the screen (up to 13%) is updated for motion while the rest remains the same.

The second method achieves 10 frames per second on up to 50% of the screen. It achieves this larger area by employing software coding techniques. This technique puts information on the disc in code form so that it can be processed easier and faster.

A third process uses a technique called chroma key. In this technique, two image planes are utilized; a foreground and a background. The foreground image is updated regularly to show motion. The background image is very large and bleeds far off the screen. Motion is achieved in the background by using a technique called scrolling. In scrolling, the video screen moves, or scrolls, across the very large background image, updating the screen as it moves. The result is a background image that moves with the foreground figure. Scrolling is a visual effect that will be described in greater detail in the next section.

Visual Effects

The range of visual effects CD-I has to offer is great enough to achieve visual styles equal to that of television broadcasts. Special effects include cuts, wipes, fades, dissolves, granulation, and scrolling. One important aspect to keep in mind is that CD-I can be used to edit its own programs. Video images and sequences need not be finalized before being encoded on the disc because an editing program can be input to control the frame sizes and sequences.

There are two classifications for visual effects. One type achieves an effect using a single image plane, while the second type requires the use of two image planes. Single plane effects will be discussed first.
The cut is the simplest and probably the most common way of changing from one image to another. In CD-I, the cut is used for obvious screen frame changes as well as providing full motion video by sequentially cutting and updating a partial image.

Scrolling, referred to before, is another single plane effect that gives motion to a large still frame. In scrolling, a large image is processed only once, while the edit program moves across it, only displaying part of the image (see figure 5). Also, as described earlier, a two plane effect can also be used to employ full motion video.

![Scrolling a Large Image](figure 5)

A fade is where an image slowly appears or disappears by a simple variation in screen intensity. CD-I is capable of taking an image from black to full intensity in 64 levels or sequences. This is enough to achieve high quality fade-ins and fade-outs.

Mosaic effects are similar to fades. They can be used to change frames as well as other minor effects. In a mosaic change of frame, the image becomes granulated by altering the resolution of the image. The granulation builds and the image soon becomes impossible to see. Another image is resolved from a granulated state until it becomes...
clear. Mosaics can also be done with two planes where the disappearing granulations are
alternately interweaved with the next frame.

Wipes appear as if the picture were wiped off the screen by using a windshield
wiper, revealing an image behind the original. Wipes require the use of two image planes.
Wipes can be horizontal or vertical and moving in either direction.

A dissolve is another effect that requires two image planes. In reality, a dissolve is
a fade-in and fade-out occurring simultaneously. Two image planes are needed, one for
each fade.

**Text**

Text is the simplest media form to store. Up to 150,000 pages of text can be stored on a
single disc. Text can be compressed (reduced for storage) much easier than sound or
pictures. CD-I specifies a particular set of characters as a standard for compressed storage.
This set covers all Latin alphabet languages. Alternate sets of characters can be created by
traditional means of storage and processing, so CD-I is easily a multi-lingual medium.

Higher quality text and graphics can be created using alternatives in animation and
graphics. These higher quality images cannot be compressed as easily and require more
storage space.

**Processing power**

The processing power of CD-I, as mentioned before, can be limited by a the bottleneck in
the data stream. The real challenge of designing a CD-I disc will be to analyze all of the
possible combinations of audio, video, and text at a given time and select levels of quality
which will allow all medias to be presented. Chart 2 below separates the various levels of
audio to clarify the data flow percentage of each.
Video, on the other hand, does not follow the rules of a chart. Because video images are not constantly updated, video data will only occupy the data stream when images need updating. Time can allow a higher quality image to be presented with A-level stereo sound, as long as enough time is given for the data to squeeze through the remaining 50% of the data stream. So, with video image processing, the time between frames becomes a factor as well as video image quality and size. From this it's easy to see how quickly things can become complicated.

A CD-I player has two forms of temporary storage which allow for options that could enhance a player's capability. The first type of temporary storage is called system RAM (Random Access Memory). Generally, its job is to store data which comes slowly
from the disc so that it may be presented more quickly. The example in the last paragraph is a good illustration of how a video image is stored in system RAM before it is presented. System RAM only offers temporary storage of 1Mb, which is lost when the player is turned off.

Fortunately, not all of the 1Mb is used in most data processing. Any remaining RAM can be used for applying good human factors principles. Various effects such as beeps, buzzes and highlights can be incorporated into a program to give good feedback to the user.

The second form of temporary storage is called Non-Volatile Random Access Memory (NV-RAM), and can be saved even if the power supply is lost. It has the storage capacity of 8 Kilobytes (Kb). Part of the NV-RAM is used for system information. The remainder can be used for various features like note taking or page marking. For example, while researching on a reference disc, important pages can be marked and notes can be taken. These page marks and notes can be stored in NV-RAM and recalled as they are needed. NV-RAM can also be used for user preferences like text size and color. This can prove very helpful to users with poor vision.

IV. Possible Applications

Possible applications for CD-I list in great numbers. One important aspect to remember is that many traditional mediums are transformed into something entirely new when applied to CD-I. An interactive encyclopedia is one of these applications. In a CD-I encyclopedia, there is only one disc, so, shuffling through a 20 volume set is no longer a problem with CD-I. In addition, the structure and makeup of the subject matter has completely changed. The addition of sound and video not only allow the user to read, but also, hear famous musical scores or speeches.
There can be several levels of interactivity that will allow you to learn at your own pace and depth. Passive viewing can be achieved by remaining in the shallower levels of interactivity. A slide lecture of famous presidents, for example, could be a passive viewing section for browsing. Specific information can be found by keying in the subject or person you wish to learn about. So you see, an encyclopedia becomes more dynamic and friendly with CD-I, as well as becoming less expensive by using fewer materials.

The following is a list of some of the possible CD-I applications from the book, *Compact Disc - Interactive: A Designer's Overview*:

- pop music, movies plays, dance and opera
- studies of famous people and events in history and popular culture
- art and music programs which allow the user creative control
- games of observation/deduction, such as mysteries and adventures
- educational games for children, to teach learning and social skills as well as academic subjects and knowledge areas
- interactive movies and even erotica which allow the user or player to direct the action
- games of skill such as bridge or chess, or enhanced versions of board games such as Monopoly
- multi-media reference works such as encyclopedias and dictionaries
- diagnostic reference books on specialist topics from family medicine to car repair
- picture libraries and databases for amateur and professional collectors, scholars and hobbyists
- games of general knowledge, wit and experience, such as trivia and word games
- armchair travel guides and tourist books
- guides to famous places and buildings, from archaeological sites to museums
- maps, plans and navigation aids - including in-car systems
- 'surrogate travel' through fabulous places (real or imaginary)
- arcade-style games demanding hand/eye co-ordination and quick judgement
- educational material at all levels from pre-school to post graduate
- language teaching for self-tuition or institutional use
- industrial and commercial training material, both off-the-shelf and made-to-order
As you can see, CD-I has the possibility of changing the way we learn. Applications for CD-I can be grouped into three main categories; education, resource tool and entertainment.

**Education**

CD-I is an educational tool, a tool that can enhance and improve the learning process through interactivity. The use of audio-visual aids has long been known to enhance learning. Programs to teach children could help advance them faster than before, while language learning programs could bridge gaps in cultural and language differences.

Let's look at the possibility of a language learning program to better illustrate the educational power of CD-I. A program could contain animated or real sequences of common conversational scenarios such as eating at a restaurant, visiting a bank, or asking for directions. An audible conversation could be heard in one language, while translated, textual information could be scrolled along the bottom. Because of CD-I's storage capacity, several different languages could be stored on the disc and the user could choose which language is heard and which is written. This means that a German could learn English, or a Russian could learn French; an international language program all from the same disc!

An example of interactivity could be taken from a restaurant scenario. When asked what to eat, the user is given a menu to select his or her choices. One has the ability to control the program based on what is chosen. The number of options could mean that many different directions the program could go.

Also, within the animation, certain objects in scenes could be highlighted, calling them to the attention of the user. By pointing at and selecting any of these objects, a small window would instantly cover a corner of the screen. This window would prompt a audio pronunciation of the object while, at the same time, showing the object's spelling.
In addition to the vocabulary aspect, there could also be a menu of related topics scrolling alongside the animation. Related topics could offer options such as photo essays on geography or culture. These essays could vary, based on something within the exercise. Topics relating to the type of food ordered, such as geographical origin or ingredients, could scroll alongside, allowing the user to tailor one's lesson to one's interests. So the language learner has also become a cross-cultural lecturer!

**Resource Tool**

CD-I's capability as a resource tool comes from its obvious strength in storage capacity and random accessibility. "First and foremost, CD-I is a stand alone personal computer." Its massive storage capacity will enable one disc to hold many different software programs, while its quick processing speed will shorten tedious tasks. All that remains is to allow the user to have the ability to save files. This can easily be done by connecting a magnetic disc drive to the player.

Other resource tool applications will replace many of the books we own today. Multi-volume reference works that are required in many professional fields can exist on CD-I. Catalogs such as *Sweet's Catalog* and the *Thomas Register* can become CD-I discs. Many of these catalogs, requiring yearly updates, are expensive and an incredible waste of paper. CD-ROM has already started the transfer of paper media to digital media by converting multi-volume abstracts and indexes, found in libraries, to optical disc. The main problem with CD-ROM is that there are no standards for disc size and CD-ROM is only a Peripheral Optical Media, a media which requires the aid of a computer to process information. Plus, by using CD-I for these references, sound and video can also be added which may make research less strenuous. Advertisements in the *Thomas Register* and

---

10Lambert and Sallis, p.123.
Sweet's Catalog will have the capability of presenting their products better. However, a disc with several thousand television commercials could deter even the most serious professional.

**Entertainment**

CD-I is also an entertainment media. Sporting events and Travel Guides are types of programs that will introduce CD-I to the consumer market. Sports programs, like a golf game can simulate some of the most famous courses in the world. Photographic stills will show you exactly what the fairways look like while you control the animated figure to hit the ball. CD-I can also install details like, club selection or a professional's description on how to play each hole. If playing the game is more involved than you wish to get, you have the option of passively viewing a slide lecture on the history of the course.¹¹

Although entertainment may not be the noblest application of CD-I, it will be one that has a great deal of control over its success or failure. "The object of CD-I is to set the standard for the generic home information and entertainment system of the future."¹² Since the consumer market is the main thrust, applications designed for that market will have the most impact in dictating CD-I's success.

The aspect of interactivity can be questioned when applied to entertainment applications. It has been argued that consumers may not want to interact with a television monitor. After a hard day of work, they may only be in the mood for more passive forms of entertainment, or engaging in conversation with others. The truth is, it is not yet known

---

¹²Lambert and Sallis, p.119.
how consumers will receive a highly interactive device in the home. There has never been a device like CD-I offered to them. The safest route is to allow for passive viewing as well as active viewing by designing software with several levels of interactivity.

V. The Portable CD-I Unit

"If you are a videodisc designer or producer, CD-I is a specification for a pocket digital videodisc player."

The design of a Portable CD-I Unit is a direction inherent in CD-I technology. Physically, the small and dense discs lend themselves to a portable application. The player itself, being an Optical Media System, can be operated independent of any peripheral device. What remains to be done is to integrate a player (microprocessor and disc drive) with a video display, a form of audio output and a portable power source. These components would make up the bare minimum of an independent unit.

Coupled with CD-I's inherent small physical size, are the number of portable applications. Families and business persons who travel by car will no longer need folders of maps and travel guides to help them in unfamiliar areas. A travel disc can contain road maps with various levels of detail right down to pictures of buildings and landmarks alongside the road. Guides for hotels, campgrounds, restaurants and entertainment spots can give ratings and descriptions of each facility as well as showing their exact location on the map. If you are looking up old friends, the travel disc's phone book can give you phone numbers, addresses and locations without even leaving the car.

13Lambert and Sallis, p.119
In relation to road maps, a civil engineering map on disc could be used by city planners and their workers to locate utility lines and junctions in the field. Different lines could be color coded and the user could control which utility lines were displayed so that reading the map is easier. One disc could replace several large maps.

As an entertainment medium, a portable unit will allow use in any environment. A portable unit in the home can give you the flexibility of a book by allowing use in every room. A non-portable unit loses this flexibility because it is dependant on other forms of output such as a television or stereo which aren't necessarily portable.

**Goals**

The Portable CD-I Unit should be small, lightweight and easy to carry. It should be capable of presenting sound, video and text equivalent to the qualities obtainable. The unit should have an interface that is intuitively understood and comfortable to the user. The power supply should not restrict use to only certain locations or short amounts of time.

One of the traps that should be avoided is the temptation to integrate every compatible component into the unit. If CD-I is introduced as an extremely complex tool then CD-I will only succeed in perpetuating confusion and fear among consumers. Success will come by reducing the units features to pure CD-I use, while allowing for hookup to other compatible devices. This reduction will also stress portability by remaining small in size.

The physical makeup of the unit should be of realistic construction. The electronic components used should reflect present or near future developments in technology. The housing shell should be made of present day materials and utilize present day manufacturing techniques.
Aesthetically, the unit should be both exciting and visually pleasing. The form should express CD-I's dynamic character while at the same time allude to more simple and translatable artifacts to remain understandable.

VI. Product Development

Components

The following section explains the physical makeup of the Portable CD-I Unit. Where different options on various components exist, the component selected is justified on its own strengths as well as against other options. In reality, all of the physical components were researched simultaneously. However, for clarity, each component is examined individually.

Display Screens

A form of visual display will be needed. Any television set could be used. However, to allow for flexibility and freedom, a screen should be included on the unit.

There are four main types of display screens available, Cathode Ray Tubes (CRT), Electroluminescent displays (EL), Gas Plasma Displays, and Liquid Crystal Displays (LCD). Each type has its own strengths and weaknesses, and each type was weighed as it related to the Portable CD-I Unit.
CRT displays offer a relatively high quality picture in terms of resolution and color rendering capabilities. However, when weighed against aspects of portability, a CRT falls short. Its size and weight are too great to be easily carried and it consumes too much power to be powered by a small battery.

EL displays are small in size, light in weight, and picture resolution is good. However, color rendering is poor for blues and greens, and power consumption is too great for a portable application.

Gas Plasma Displays work much like EL displays. EL displays electronically excite particles in a membrane to make them glow at different hues. Gas Plasma Displays excite gases to achieve the same end. Gas Plasma Displays are small and lightweight but, like EL displays, they consume too much power for portable applications.

An LCD is the best portable solution. It is small, lightweight, and has low power consumption. It works by changing the shape or structure of a liquid crystal contained in a thin membrane. Changes in shape will cause ambient light to be absorbed in certain areas and reflected in others. This variation causes light and dark areas, much like when a magnet is passed under a sheet of paper with iron filings on top of it. Because an LCD screen refracts light, it can be viewed in very bright environments. A light emitting display, such as a CRT would lose resolution in a brightly lit environment.

In dark environments, where there is no light to refract, an LCD has the option of being back-lit, supplying both the screen and the user with a light source. Color is available in good quality, and resolution is fairly good and constantly improving.

The weakness of an LCD is in viewing angle. An LCD has only one optimum viewing angle and resolution at any other angle is poor. Because of this, a tuning device is incorporated with many LCD's. This tuning device allows people to change the optimum viewing angle to one which accommodates them. Tuning takes only a few seconds and can be changed anytime. However, due to the small range in viewing angle, the screen cannot be viewed by more than one person at a time.
Technically, tuning is achieved in the same manner a Venetian blind's louvers can be rotated to be seen through from any angle (see figure 6). The tuning knob on an LCD screen realigns the structure of the crystal so that it is reflected in the user's direction.

Screen shapes can vary greatly. I have adopted a rectangular screen that conforms to the 3x4 proportions of both the NTSC and PAL broadcasting standards. I have also chosen an LCD screen with a curved profile. This profile will reduce screen glare to a single narrow bar across the screen. Glare is further reduced by a non-glare matte finish on the screens surface. The curved screen was also chosen for functional and aesthetic considerations that will be discussed later.

**Cursor Control Device**

A cursor control device with two selection buttons will be needed as the interface control mechanism between the unit and the user.\textsuperscript{14} There are many different devices which have

been developed for cursor control. However, only a few of the most common devices fit well into a portable application.

A mouse is one of the most familiar and accurate cursor controls. However, it requires a tabletop for use as well as having a hard-wire connection that would prove awkward for traveling. A light pen is another device that would have a hard wire connection. Hard-wire connections can easily deteriorate in portable units because the cord may be misused to carry the unit.

A touch screen is a cursor control that would increase interactivity by making a cursor control device seem to disappear. A touch screen is essentially a form of electronic grid placed over the screen. Control is maintained by simply touching small windows, resembling buttons, on the screen. Finger location is instantly calculated to deduce which button was touched.

This type of interface could help take users a step closer to an invisible interface. However, with a small size screen being used, problems exist with touch screens. Tactual recognition fields for touch entry systems have been found to yield the best performance when the tactual field for controls exceeded 30mm x 30mm. When this size tactual field is applied to a small screen, the screen becomes overrun by buttons for user control. It is because of this that a touch screen has been ruled out.

A joystick or trackball are two control devices which have long been common control devices for video games. Because of consumer's familiarity with them, these two devices could be used to establish a comfortable interface that requires no explanation. A joystick and trackball also lend themselves to portable applications because they can be self-contained within the unit, requiring no loose wires for connection.

---

Of the two, a trackball is the better choice. It is faster and more accurate than a joystick. In fact, when compared with six other cursor controls, the trackball was the most accurate, and fourth in speed. (see chart 3)

<table>
<thead>
<tr>
<th>Device</th>
<th>Speed</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Touch screen</td>
<td>1 fast</td>
<td>6.5 worst</td>
</tr>
<tr>
<td>Light pen</td>
<td>2</td>
<td>6.5</td>
</tr>
<tr>
<td>Digitizing tablet</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Trackball</td>
<td>4</td>
<td>1 best</td>
</tr>
<tr>
<td>Force joystick</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Position joystick</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Keyboard</td>
<td>7 slowest</td>
<td>5</td>
</tr>
</tbody>
</table>


chart 3

The trackball I have incorporated into the unit has been positioned to be used by the fingertips of either hand (see appendix B, photo #1 ). Fingertip control will be forced due to its positioning on the unit, as well as the low control response (C/R) ratio that can be incorporated within the trackball itself.

C/R ratio is the comparison between the movement of the control device to the movement of the system response. Different C/R ratios can be described using the example of the tuning of a radio. Some radios are equipped with two tuning knobs, a gross and a fine tuning knob. A small turn on the gross tuning knob results in a substantial movement
of the needle (low C/R ratio). The fine tuning knob requires several rotations to move a small distance (high C/R ratio) (see figure 7).

\[\text{Low C/R ratio} \quad (\text{high sensitivity, high gain})\]

\[\text{High C/R ratio} \quad (\text{low sensitivity, low gain})\]


**Comparison of Control Response Ratios**

*figure 7*

In continuous controls, such as a trackball, there is initially a gross adjustment movement used to find approximate position. This gross movement is followed by a fine-adjustment movement used to find precise location. Although these two different movements are indistinguishable from each other, there is definitely a change in motor behavior.\(^\text{16}\)

A low C/R ratio in the trackball of the Portable CD-I Unit will make manipulation of the cursor fast to shorten response time. This high sensitivity will also require precise, fine-motor movements (fingertips) to make selections.

CD Drives

The disc driving mechanism for a CD-I player already exists in stores and homes throughout the world. CD-I uses the same disc drives as CD-DA discs because the two have been made compatible. In fact some companies will offer CD-I converter kits that will transform a CD-DA player into a CD-I player.

A typical in-home disc drive measures 6 x 9 x 1-1/2 inches and has a sliding door for disc loading and unloading. This is quite large for a portable unit. Portable CD-DA units have a substantially smaller driving mechanism. They can measure as small as 5-1/2 x 5-1/2 x 1/2 inches.

I have allowed a volume slightly larger than this for a self-feeding disc drive. Extra volume was allotted to allow for a disc-feeding mechanism that would eject as well as inject discs (see appendix A, drawing # 14). Self-feeding is uncommon to most portable drives. It eliminates the need for a hinged door or sliding tray that would be less durable.

Circuit Boards

Philips Electronics corporation has developed a ‘mother’ circuit board for a player that is 12 x 12 x 1/4 inches in size. This board will be reduced in size to 6 x 6 inches in 1991.17 This board can also be divided into several pieces equaling the same area. I allowed enough volume in the portable CD-I unit for three boards measuring 3 x 4 inches (see appendix A, drawing # 14).

17Ray Ashton, interview, March 1990.
Power Supply

Power supplied to the portable CD-I unit can be in the form of a rechargeable battery or wall socket. I have incorporated a standard (Panasonic Camcorder Type) rechargeable battery which powers a camcorder for over 2 hours. I have also incorporated an adaptor connection for a 9 VDC power converter. This will enable the unit to hook-up to other power sources to minimize battery consumption.

Compatibility

It is important to limit the amount of components on the unit to maximize portability and product simplicity. It is also important to allow for hook-up with compatible components to make the unit more versatile. I have incorporated hook-ups for a magnetic disc drive and a second television.

The magnetic disc drive is essential if the unit is to be used as a personal computer where the capability of saving documents is needed.

A coaxial cable hook-up with a second television will allow the unit to double as an in-home unit by connecting with a home's higher quality video monitor and stereo system. In most cases, the video monitor and stereo system in a home have already been connected for viewing stereo broadcast television programs. With this already in place, only one connection is necessary. The Portable CD-I Unit then becomes a player and cursor controller that can be used like a hard-wire remote control in the user's lap.

By allowing consumers to use the Portable CD-I Unit as both a portable and in-home unit, they need only to purchase one unit. This may help with the success of CD-I due to its projected cost of $1,500.00, which may seem expensive to the average consumer who is unaware of CD-I's capabilities.
Sound

At least two speakers are needed as audio output for the unit because of CD-I's full stereo sound capability. These small speakers should offer high quality sound, not only because of CD-I's stereo capabilities but because CD-DA discs can also be played by the unit.

Incorporating a hook-up for headphones is very important for more intimate public use of CD-I. Headphone use will also spare others from having to listen to a program with all its miscellaneous noises. This could prove vital to a school teacher's sanity if CD-I is used in the classroom.

The speakers I have incorporated are 2 inch coaxial, cone speakers. To improve durability these speakers have water-resistant mylar cones.

Controls

The display screen and trackball will allow most of the controls to be programmed into the display. Functions and features like the volume control and internal clock can be controlled through pull down menus with windows. (see figure 8)
For keying in specific information a keyboard will be included in the control menu. A window with a drawing of a keyboard would appear which would allow the user to key-in specific information using the trackball and select buttons.

There are three manual controls on the unit. The power switch controls discrete information (only two choices) and requires a discrete type of switch. Pushbuttons, toggle switches, and rotary selector switches are three examples of discrete controls. I chose a pushbutton for its low profile and for aesthetic considerations that will be discussed later.

The other two manual controls, the contrast and brightness controls, control continuous information, that is, information on a continuum. Rotary knobs, wheels, cranks and levers are four types of controls that manipulate continuous information.

The brightness and contrast controls were chosen as manual controls on the Portable CD-I Unit because they control factors of screen visibility. If these controls were programmed into the screen like the others, they would not be able to be manipulated by the user. How could you brighten the screen in a dark environment where the screen was
impossible to read? How could you improve screen resolution if the control menu was unreadable?

Knurled rotary knobs were incorporated for their small size and low profile. The knobs were placed in close proximity to the screen to insure good mapping. In early sketches, all of the manual controls looked similar in shape and created confusion as to how they were used. (see appendix B, photo #6) The final shapes were intentionally altered to differ from each other. The rotary knobs afforded rotation by being larger and having knurls, while the pushbutton remained small and smooth.

**Molded Shell**

The plastic molded shell of the unit is intended to be made of ABS (Acrylonitrile-Butadiene-Styrene). This material was chosen for its high durability. Injection molding was chosen for its extreme flexibility and versatility.

The molded shell I have designed has three parts (see appendix A, drawing #10). The first two parts enclose all of the components that make up the unit. These two parts have been given proper draft so that molding is possible.

The third part exists mainly for aesthetic reasons, although it does serve as an enclosure for the trackball. This piece is molded separately and is attached to the top piece.
VII. Form Exploration

"As microelectronics have dematerialized technology and given it an intelligent presence it never had before, designers are forced to confront meaning rather than simply package machinery in the most efficient way."¹⁸

Analogy, Metaphor and Allusion

Form was explored for the Portable CD-I Unit on the basis of CD-I's character and the implications of CD-I on present society. If CD-I is successful after its introduction, it has the possibility of greatly changing the printed word as we know it. CD-I, with its dense storage and low manufacturing cost, could replace many of our books and alter many traditional paper markets and their products. CD-I will also transform these traditional products into something more than their former existence.

It is appropriate to allude to these traditional forms of information storage in giving shape to this new product. By paying homage, we show the richness of our changing culture as well as establishing a comfortable context in which consumers can understand this new and different technology.

Through my exploration of form I refer to many forms of traditional paper storage. Book, magazine, spiral notebook and paper are all images which can be identified in the drawings. In early stages this reference is more literal and fails to transform itself into its new definition. Through abstraction, I was able to derive references which allude to, rather than clearly state their meaning.

One of the earliest concepts was the use of layered paper imagery. The ridged profile of a bound stack of paper was used in many of my forms to allude to traditional analog information storage. This suggested CD-I's relationship to paper documents.

In early forms, the pages appear flat like that of a normal book. In later forms, however, the pages are altered in a subtle S-shaped curve that achieves a more exciting look and expresses the dynamic altering CD-I will have on paper information storage. The parting line was also chosen to go in-line with the S-curved profile for emphasis.

The many different ways that paper can be manipulated were used for ways of revealing controls and displays. Folds, cuts and tears were used to show the removal of a layer of paper to reveal a screen, or a trackball. This concept is highlighted in the sketches where several possibilities are illustrated. The final form treats the top surface as if it were a die-cut piece of paper. Cuts made in the surface leave voids which reveal electronic controls from within the unit. The top overlay surface was given a rough texture and its edges were rounded. The rough textured surfaces helps hide signs of wear and dirt, like scratches and fingerprints. Where the overlay piece appeared die-cut, the surface and edge were at right angles and the edge was made smooth and glossy. This aids in illustrating the die-cut concept by making the surface appear as if it were cut with a hot knife. Also, by remaining smooth and glossy, the "die-cut" edges remain moldable. A textured edge surface at near right angles to the top surface cannot be released from a mold, however, a glossy and smooth edge can.

**Disc Shapes**

The contrast of rectangular shapes and curved shapes was used to express the dynamic change CD-I may have on traditional information medias. In early forms, disc shapes fail to be integrated into the unit and have a "stuck on" appearance. In the final unit, the disc shapes are subtracted from, rather than added to, the overlay piece. These shapes are also
integrated with the unit's controls. By doing this, the disc shapes become an integral part of the form.

The edges of various surfaces on the unit were given full 180 degree radii. These radii provide both a softness of form and contribute to the layering affect by leaving gaps on the edges between layers (see appendix A, drawing # 14).

Of the disc shapes, the shape of the disc drive was the most difficult to resolve. Early shapes representing the disc drive were either overstated and visually dominated, or they were understated and failed to become an integral part of the unit (see appendix A). Originally, the disc drive was to have a door, but a self-feeding mechanism was added for durability. The disc is inserted into a slot which grasps the disc and feeds it into the player. To eject the disc, the user selects the eject control on the screen menu.

The final form was an attempt at defining the disc drive intuitively through affordance. Affordance refers to the fundamental properties that determine just how something can be used. In the final form, the receding arc on the overlaying surface leaves a gap for inserting the disc, while the bottom arc reaches out to accept the disc. (see appendix B, photo # 5)

The battery was a component that in earlier drawings was cylindrically shaped and looked much like the binder of a spiral notebook. This shape, however, was dropped for a standard camcorder battery, mainly because the cylindrical battery was too large and visually overpowered the unit. It also made the inclusion of hook-ups difficult because it occupied a large surface area on the player, an area that is the most logical place for hook-ups (see appendix A).

---

Functional Benefits of Form

The curved profile adds to the functionality of the unit. The S-shaped profile is a logical shape for a curved screen which will reduce glare. It provides a comfortable surface for the hand to rest on during operation and it raises the bottom surface so that speakers can be placed on the bottom. Sound is reflected off the object the unit rests on. Bottom placement also resolves problems of fitting the speakers in the player and it also reduces any visual clutter that may have resulted if the speakers were placed on the top.

Shapes of controls were chosen so that they related to each other. The pushbuttons for the trackball were placed on a radius from the center of the trackball and given soft corners and edges. The power switch and headphone jack are shaped to relate to the trackball. The rotational contrast and brightness knobs were given an angular look to differ from the pushbuttons, while at the same time they retain the same circular and domed shape the other controls have. (see appendix A, photo #6)

Placement for these controls was originally in two locations but was resolved to one for simplicity (see appendix A). The arc that the controls rest along was originally on the right side of the unit but it was later moved to the left side to balance the dark grey top surface.

Color

Neutral colors were targeted for the unit due to the variety of markets CD-I will address. Specialty models for children or rugged use were considered as second generation products and were not considered. Two grey values were chosen to contrast with each other and accent the layered concept. The textures for these two values were also contrasted. The dark grey surfaces have a rough texture while the light grey surfaces are smooth and
glossy. The bottom dark grey section was originally light grey but later was made dark, to 'float' the center, light grey section.

An accent color was chosen to highlight key elements in the unit. Lighter colors were targeted for their freshness and softness. Pale yellows, pinks and pale blues were some of the options. Yellows were eliminated because of their popularity in sports products. Blues were chosen over pinks because of their conservative or neutral nature. Although it is not a key functional element, the parting line was colored blue to accent the curved lines of the unit (see appendix B, photo #2).

**Softcase**

The transporting of the unit was explored much differently in early stages. The unit was treated as its own self-contained hardcase that hinged or slid open and closed. The unit could be operated in the open position. While in the closed position, vital components were protected from the elements. The unit was also given a handle for safe transporting.

In the later stages of designing, a total rethinking of portability was made. I wondered if a self-contained hardcase was a valid way of protecting such an expensive device. I also saw dangers in having moving parts that created weak joints and protrusions that could be broken easily.

I decided that a unit with a low profile and no moving parts would be a better solution. The low profile unit would have no handle but would be small enough in size to be carried in the hand, from room to room. For carrying outdoors, I decided to design a softcase; an additional case made of durable fabric and padding. Instead of protecting only the vital components, the entire unit would be protected.

The final case is equipped with a handle and shoulder strap for carrying as well as a pocket for storing extra discs. It is also important for the unit to be operated without being removed from the case. Wasted time spent fumbling with removing the unit from the
case could easily result in the unit being dropped. Inside the case are velcro straps that attach to loops molded into the base pan of the unit (see appendix B, photo #9). By strapping the unit in, the case and unit are secured together, allowing the unit to be operated by folding back the main flap. If hook-ups are necessary, a velcro flap under the handle will allow wires to be connected easily. By simply repositioning the case on your body, the shoulder strap can be used to operate the unit comfortably while standing (see appendix B, photo #8).

Materials chosen for the soft case were chosen for their durability, cost, and style. Durable and waterproof, Cordura Nylon makes up the outer shell that is filled with inexpensive polyethylene foam. Hardware accessories like the Fastex buckles and the YKK zippers were chosen for their quality and material composition. Nylon webbing straps are extremely strong and the Lycra coated neoprene pads were chosen for their comfort and vivid color. The colors were all chosen to remain consistent with the unit.

**Logo**

Ideas for a logo came about as a natural outcrop of the design process. As I was thinking of how to three-dimensionally represent CD-I, ideas for a graphic, two-dimensional representation came naturally. The strongest mental images were logos that graphically described interactivity. A logo was developed that enhanced the word "interactive." This logo could be used in conjunction with the already familiar "Compact Disc" logo.

The word was divided into two parts, "inter" and "active" and attempts were made to make them graphically interact. Early ideas were worked out on tracing paper, however, none were very interesting and few were readable. (see appendix A, drawing #13) From that point, a computer was used to develop possibilities. The computer was a great aid because of its speed and accuracy. Variations on an idea took only seconds to reproduce, while if done by hand, would take hours. Ironically, the final solution was not thought of
while working on the computer. In fact, it could not be produced with the available software.

The word part "inter" was split into two halves, a top and bottom, and "active" was inserted in between. A serif font was chosen for "inter" so that letter shapes were more distinguishable. An italic font was chosen for "active" to show action. The two fonts were contrasted in black and white and placed on the grey background of the unit. (see appendix B, photo #5) The contrasting light and dark letters and mixing of word parts was an attempt to cause vibration between the two images, visually causing interaction.
VIII. Conclusion

The Portable Compact Disc - Interactive Unit is a realistic attempt at a near-future product. The first CD-I players will probably be in-home players or CD-I conversion kits for CD-DA players. The design of the portable unit is intended to accentuate the inherent qualities within CD-I, both in its physically portable size and its many uses in portable applications. The unit was also designed to create a multi-media system that preserves some of the flexible qualities of paper and paper publishing mediums.

On the whole, I feel that most of the goals set, were accomplished. The portable unit is small and easy to carry. I have chosen components that are capable of presenting CD-I in its true sense. By being a near-future product, I also assumed that further advances in technology can only improve these components. Most importantly, I feel the unit achieves somewhat of a balance between being intuitively familiar and excitingly novel.

There is, however, always room for improvement. Like all designers, my training has forced me to become self-critical. Being self-critical, in simple terms, means that a project is never finished.

The main weakness I see, is in the union between the softcase and the unit. After the great effort spent deriving an interesting form, the softcase hides it. An effort was made to shape the case with the same profile as the unit. However, the materials used were not able to define such a subtle curve.

The softcase could also have been more functionally integrated with the unit. Small pull-off windows, revealing controls, would have been a better solution than the one large flap. Physically, the unit would be better protected.

The reason the two components are not integrated as well as they could have been, lies in the fact that they were not designed hand-in-hand, each one having the other in mind. The softcase solution came after decisions were already made on the unit. The
result was that controls and displays were not grouped tightly together, to create small surface areas of controls, that would lend themselves to pull-off windows.

A minor weakness of the unit is that it should been given a hard-wire connection for a keyboard. The typing of large documents is nearly impossible with a menu-driven keyboard. A keyboard connection would allow the unit to become a word processor as well.

The next generation of CD-I players will become more versatile and complex. They will have the capability of communicating with even more devices, bridging gaps in incompatibility. Also, the software available for CD-I may find totally new applications for CD-I. These new applications may require a new type of player to be designed due to the environment or way, in which, the player is used.

Presently, CD-I is just being introduced to the institutional market. Institutional prototypes have been introduced that look similar to a computer, having box and front panel construction.

As I have said before, the success or failure of CD-I lies in the consumer market. Consumer market introduction is likely to occur sometime in 1991. Software designed for this market will make or break CD-I. There has been unending speculation as to whether or not the public is ready for such a powerful medium, speculation that consumers won't want to interact with their televisions. Only time will tell.
Appendix A
Bibliography


Backo, John, Philips Consumer Electronics Corporation, Director of Industrial Design. Telephone interview by author. March 1990. Knoxville, TN.


