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Navigation aspects in CD-i;
an exploration

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# Abstract

The events that occur to users that navigate through the contents of a CD-i title contribute to the feeling that they get about that title and probably also about the medium CD-i. Therefore it is important to understand the mechanisms that play a role in the process of navigation. This report is the result of an exploration of navigation aspects in CD-i titles. Based on the experience with a number of titles a few important aspects are discerned.

The first important aspect of navigation is the way the information of a title is organized. This can be described by means of an information structure. Here a simple notation method is used to describe the information structure on a global level (macro structure) as well as the locally used structures (micro structure) that allow the user to access the information that is on a disk.

Feed forward and feed back are two other aspects that play an important role. A number of mechanisms and tools are discussed that support these aspects and that can give the user confidence about the results of his actions. In combination with a good internal representation of the information structure they will offer the user a reliable environment to work or to play in.

Finally a user must get the feeling of being in control. It is important that a user, having the right information and drawing the right conclusions from that, must be able to achieve his goal without too many obstacles. A few mechanisms that support the feeling of being in control are discussed.

This report must be considered to be the start of more detailed investigations on the subject of navigation in CD-i titles. Beside thorough title analyses experiments with users are planned to find out how they develop a navigation strategy and to determine what aspects of the interaction annoys them or on the contrary pleases them.

# Content

# 1. Introduction

Since the first introduction of the medium CD-i, many titles have been produced and are used by a large audience. Many people are enthusiastic about the medium, but playing and working with CD-i titles can also result in a lot of frustration. A number of factors contribute to the experience that users get from a title. A large contribution to this experience is of course determined by the contents of a title itself. However, other factors like the appropriateness of the input device, response times and the ease of navigating in the contents of a title must not be underestimated. It appears that navigation problems contribute greatly to feelings of discomfort. Other media already induced research on this topic (van Nes and Tromp 1979, van Nes 1980, Engel et al. 1983). Now a start is made to understand the problems that people have with finding their way in CD-i titles.

The first step in recognizing the factors that play a role in navigation on CD-i, is by enjoying and getting frustrated yourself. A number of titles of various kinds were used as test material and the experiences with these titles were noted down. The data mainly consists of remarks about things that caught the attention in a positive or a negative way. For a few titles the more laborious job of drawing a representation of the information structure was performed.

A method to describe the information structure can be found in section 2. The positive and negative remarks resulted in the determination of a number of mechanisms that are relevant for the navigation between elements in the information structure. These mechanisms are discussed in section 3. How these mechanisms should be used is expressed in a set of guidelines that can be found in section 4. Finally, in section 5, some general conclusions are drawn.

Many examples are used to illustrate the aspects that are discussed. Some titles are referred to more frequently than others. This doesn't mean that they are worse or better than other titles or that other titles don't make the same errors. It does ensure that knowledge of the most frequently used titles enables the reader to share the experience of most examples. A list of the titles that are referred to in this report is given in appendix A.

# 2. Navigation and information structures

In essence the basis of most titles is formed by pieces of information. A good organization of the information in an information structure can help a user to get an overview of the contents of a title. We will therefore start with a description of navigation and information structures. In this description a number of terms are introduced, from which some may have a different meaning in another context. The terms we want to emphasize are written in italics and can also be found in alphabetical order with a brief description in appendix B.

## 2.1 User and system

CD-i is about the interaction between a user and a system. The *user* can be any person who is playing or working with CD-i, as a leisure activity in a home environment, an education tool, a professional application, etc. The CD-i *system* can be described as the combination of the CD-i player, a CD-i title, an input device and a TV-set. The interaction between user and system is based on the information contents and interaction options that are provided by the CD-i title. The user can enter his input for the interaction by means of the input device and receives output from the TV-set.

The input device provides besides a positioning control mechanism (joystick, trackball, graphical tablet, etc.) at least two buttons: button 1 and button 2, further referred to as *buttons*. The TV images can contain regions that give a pre-defined reaction if they are selected (with help of the positioning control mechanism) and activated (with a button press). These active regions, often called buttons, will here further be referred to as *hotspots*. Beside this more or less standard usage of positioning control mechanism and buttons all kinds of other exotic interaction patterns can be supported with the input device.

## 2.2 Navigation aspects

The goal of the user is to enjoy the contents of the title, being stories, games, exercises, etc. These contents can be presented automatically by the system, like in a guided tour, but it is also possible for the user to select the information himself. Beside the information contents the title provides software to interpret the input from the pointing device and to navigate through the available information.

*Navigation* can be described as knowing where you are, where you want to go and how you can get there. This description implies that there are locations, to be at or to go to, and that there are paths to travel from one location to another. In CD-i we discern units of information, being the equivalent of the locations and control mechanisms, being the paths to go from one unit of information to another. The term *unit of information* will be used to denote the smallest accessible piece of the information contents of the title. A *control mechanism* is the actual implementation of a path. It can have many appearances, like a menu screen, a 'goto'-hotspot, a click of the mouse, etc.

A *position* indicates the current status of the title, being in a piece of information or somewhere in a path. It is possible to regard a path as the whole of transitions needed to go from one position in a title to another one. In that case it includes menu's, control configurations, etc. However in this context we use the term *path* for a single transition between two consecutive positions.

## 2.3 Organisation of information

The units of information are normally organized in a structure, further referred to as *information structure*. The PIMA-guidelines (see Blake et al.) discuss 4 generic types of organizational structures: linear, cyclic, hierarchical and hyper-connected. These structures are illustrated in fig 1.
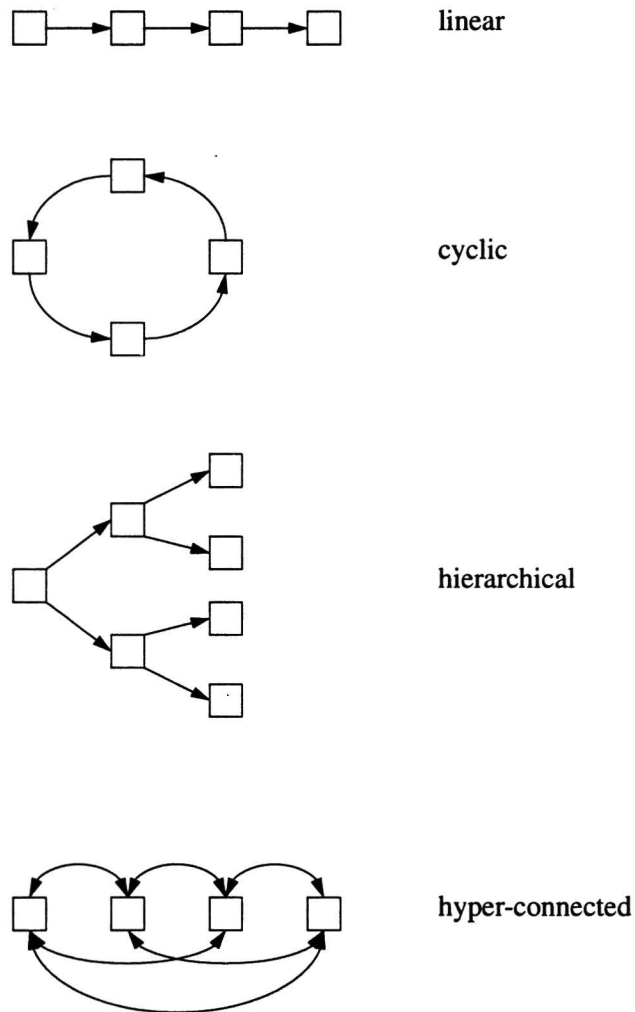


**Fig. 1:** Four types of organizational structures.The rectangles denote units of information and the arrows denote the direction of the transition from one unit of information to another.

A coarse information structure can be used to give a global overview of a title. This structure includes the menu's that can be used to access the information that is available in the title as well as (hyper-)links between pieces of information. We will further refer to this overview as the *macro (information) structure*. The pieces of information contain a time component: a movie or a soundtrack is played, pictures are shown etc.

The time component in the pieces of information induces the need for control functions like skip, fast forward, replay, pause, etc. These functions are supplied in a number of micro structures that are superimposed on the macro structure. The *micro structures* are used to handle the transitions between pieces of information on a local level. It includes the local control mechanisms and their effects. Examples of local control mechanisms are: the click of a button on the input device, hot spots that accomplish transitions between information items, etc. A set of hot spots that can be used to control the output flow of the title will further be referred to as a *control configuration*. A control configuration can operate on a global level (macro structure), on a local level (micro structure) or on both.

An elaborate description of an information structure is made for the title Time/Life photography. The title uses a hierarchical structure to go to the themes or the workshops and a hyperconnected structure to access the workshops from the themes. Furthermore the information units of a theme are organized linearly. The macro structure of Time/Life photography reveals one control mechanism viz. the menu screens. A schematic drawing of the macro structure of Time/Life photography is presented in figure 2.

Figure 3 represents two micro structures that are used in Time/Life photography. In the micro structures more control mechanisms become visible, in this case the click of a button on the input device, control configurations that accomplish transitions between information items and the activation of the main menu. In the micro structure we see that pieces of information that are presented in the macro structure as one item, may consist of more units of information.

This representation of an information structure can form the base to characterise the navigation strategies that users develop to find their way in a title. The navigation patterns that are used can reveal whether a user is browsing, searching or is getting lost in a title (Canter et al. 1985). For more technical purposes this method of representing an information structure will not be extensive enough. There a more elaborate model will be necessary to describe complex timing aspects and relations between the various media that are available. The Amsterdam Hypermedia Model (Hardman et al. 1994) is an example of a model that takes these aspects into account. Another example of the notation of timing aspects can be found in the description of a Hypermedia Journal (Brondmo and Davenport 1989).
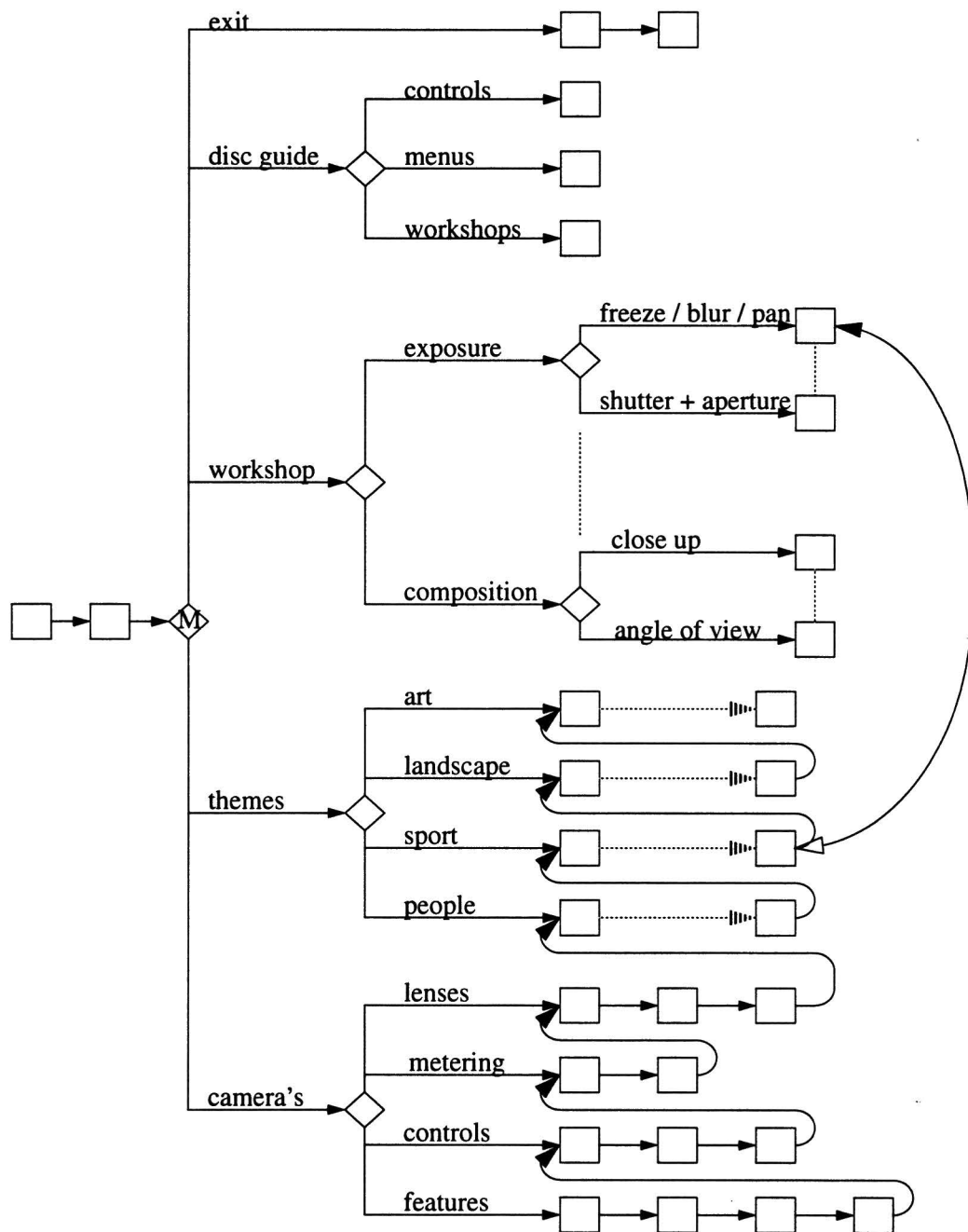
**Fig. 2:** The main information structure of Time/Life photography. Rectangles denote information: they have a time component that proceeds from left to right, diamonds denote a menu, with M=main menu, and the arrows denote the direction of the transition from one information item to another. The two-way arrow represents a hyperlink between two units of information. The open head indicates that the transition in that direction only is available to return from the transition in the direction of the filled arrow. The dashed lines indicate that there are more context-like elements, that are not drawn in this overview.

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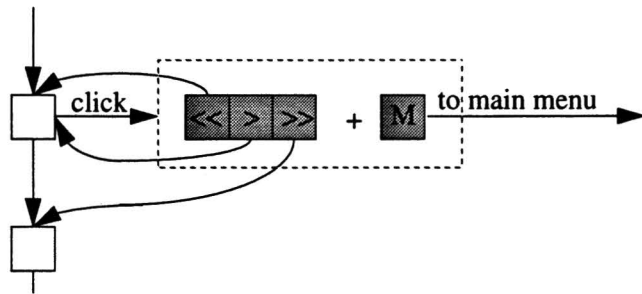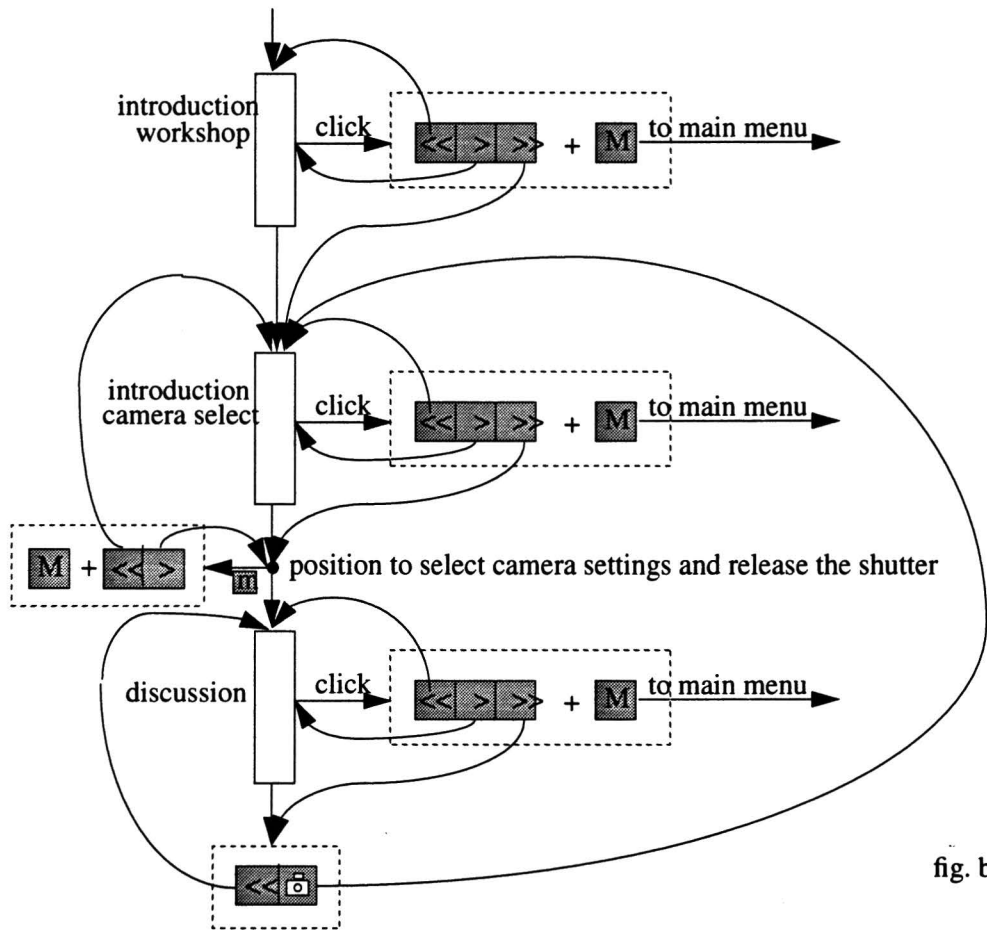
**Fig. 3:** Two micro structures that are used in Time/Life photography: a is a structure that is valid for any unit of information of the title; b is the structure that is used for most of the workshops. The open rectangles denote units of information; they have a time component, time progressing from top to bottom. The arrows denote the direction of the transition from one unit of information to another (or to itself). The dashed boxes contain the control configurations that become available after clicking a button of the input device or that are induced by the title itself. The hotspots that are part of the control configurations are coloured grey.
Note: the transitions induced by a click or by the m-hotspot (goto main menu) are optional. If they are not used the title will progress according to the top-to-bottom timeline. Furthermore, the clicks can occur at any vertical position (time) on a unit of information.

# 3. Navigation tools

Navigation is about finding your way in the information structure with the available units of information. To support the user in the process of navigation there is a wide range of navigation tools, from the organization of the information on the disk, to the button presses on the pointing device. Navigation is aided by good feed forward as well as feed back mechanisms: these mechanisms concern the contents of a title as well as the available navigation tools. Furthermore, it is important for the user to have the feeling of being in control during the whole process of navigation.

In this section a number of navigation tools are discussed that are crucial in the design of a good title.

## 3.1 Navigation structure

The navigation structure can be defined as the sum of the information structures (macro and micro) and the possibilities to travel around in this structure. The most important parts of the navigation structure are:

- the information structure
  The organization of the units of information in an information structure greatly affects the ease of navigation in a title. It is important to find the optimum between the accessibility of information and the complexity to do this for the user. Some examples illustrate the role of the information structure.

  ```
  -  In Time/Life photography the usage of menu's is combined with
     hyper-links and linear sequences. Although the linear struc-
     tures contribute to a simple macro structure, they can be an-
     noying  if  the  user  wants  to  see  a  specific  piece  of
     information somewhere in the middle of a sequence. An extra
     menu layer can solve this problem, but also adds to the com-
     plexity of the structure (see fig. 4). Strangely enough this
     extra layer was indeed used to access the workshops where it
     was not employed for the themes.
  -  In the Renaissance Gallery hyper-links are used to connect the
     three galleries: 'reference', 'art' and 'music' (see fig. 5).
     Being in one gallery, a hotspot labelled with an unclear icon
     results in the transition to another gallery. The user has no
     idea which gallery this will be. If it is not the right one he
     must activate that hotspot again, which results in the transi-
     tion to the third gallery. It is also possible to return to
     the main menu and select the gallery wanted. Then the user
     knows what he is doing. Here the hyper-links only add complex-
     ity to the structure, that does not result in an easier access
     of the information.
  ```
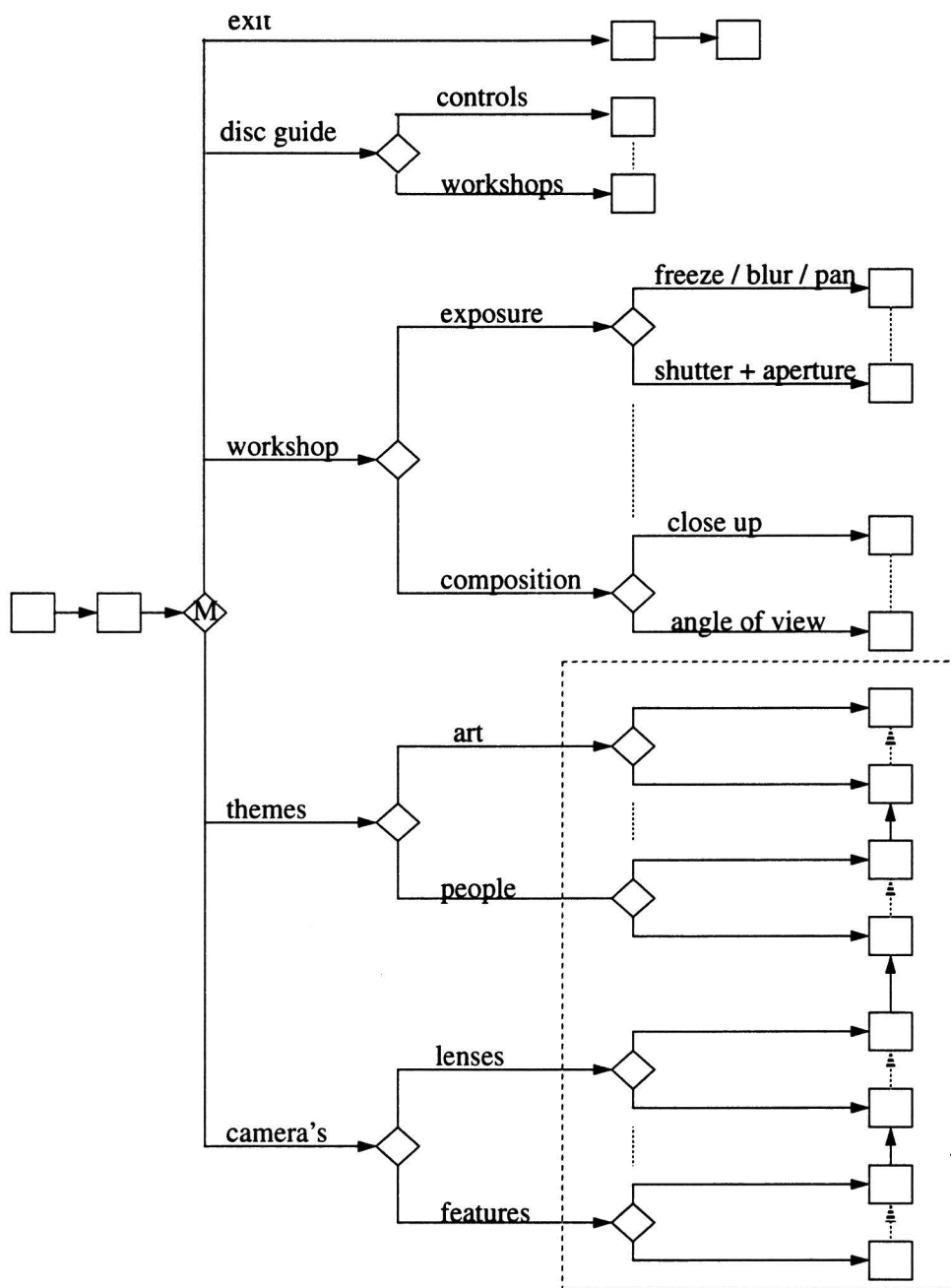
**Fig. 4:** The dashed box indicates the difference between this figure and fig. 2. It shows the addition of an extra menu layer in the Time/Life photography information structure for the sections camera's and themes. As can been seen this depth of menu layers was already available for the workshop.
Rectangles denote information, diamonds denote a menu, with M=main menu, and the arrows denote the direction of the transition from one information item to another. The dashed lines indicate that there are more context-like elements, that are not drawn in this overview.
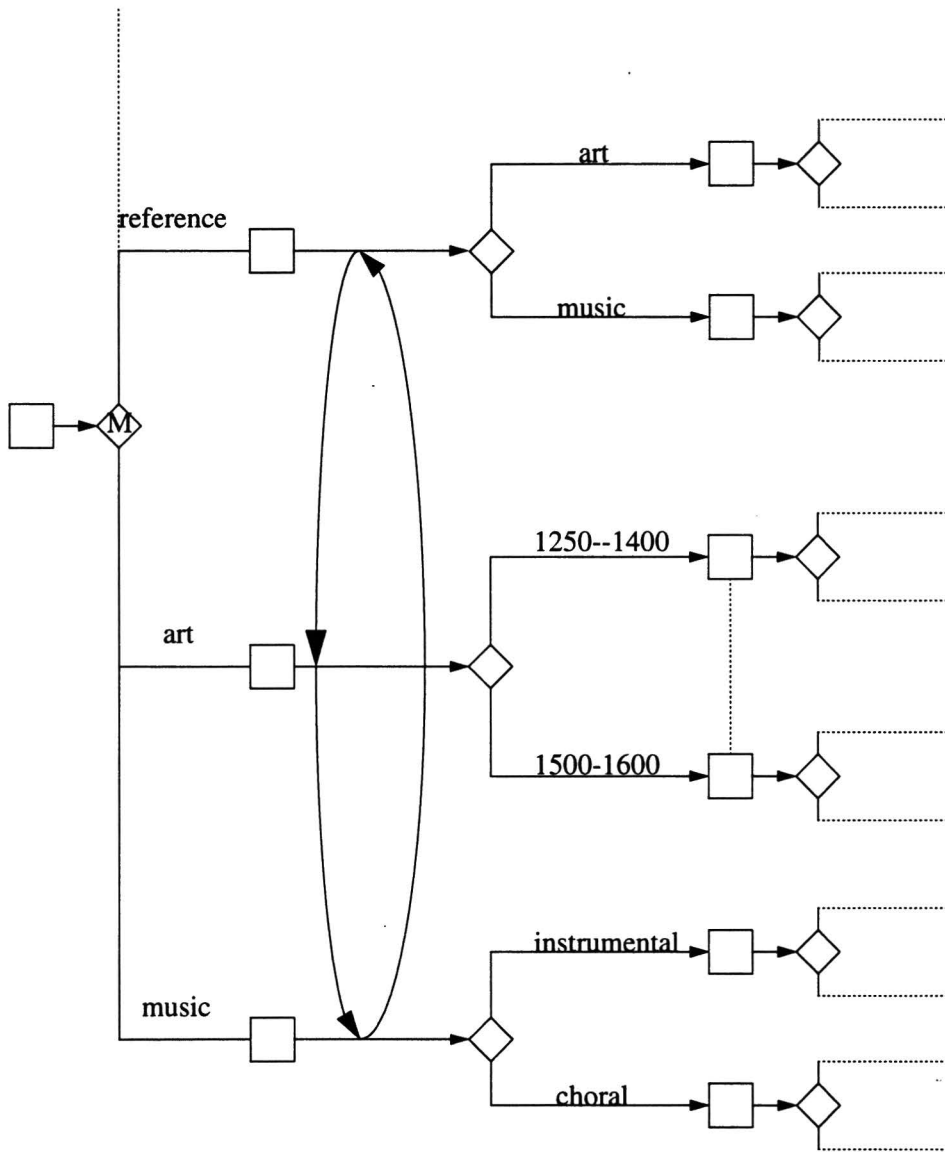
**Fig. 5:** Part of the main information structure of the Renaissance Gallery showing the hyper-link construction that is used to go from one gallery to another.
Rectangles denote information, diamonds denote a menu and the arrows denote the direction of the transition from one information item to another. The information structure is not fully represented here. The dashed lines indicate that there are more (context-like) elements, that are not drawn in this overview.

- feed back about the actual position in the information structure
One of the complaints of users is that they get lost in CD-i titles. After passing a few menu's and the usage of one or more hyper-links the user mostly loses track of his explorations and returns to the main menu to start over again. The main menu is then used as a 'reset' mechanism to give the user a new starting point in the title. It is also possible to give the user 'clues' about his position in the title.

  - In Sesame Street there remains a part of the background visible when the title zooms in on specific items like a telephone, television, radio, etc. It is always clear where you are at that moment.
  - If a user enters the menu screen of Time/Life photography the options that are selected at that moment can be discerned from the other options by a different colour. This way it is possible to show simultaneously the available options and the selection that the user made from these options.

- control configurations
The control configurations are available at the level of the micro structures. They are local tools to go from one unit of information to another. The functionality that is needed locally can be very specific, but care should be taken that there are not too many different control configurations in a title. It is very useful to have one generic control configuration that operates on most places in the title.

  - The main control configuration of Time/Life photography consists of the hotspots 'repeat', 'continue', 'skip' and 'goto-main-menu'. This is the configuration that pops up when the presentation of information is stopped by a click of the mouse. In the workshops other control configurations are used that are also standardized as much as possible. The user is very quickly familiar with these standard control configurations.
  - Renaissance Gallery uses standard control configurations for each layer in the hierarchical structure. Although there is not one main control configuration, the use of identical configurations in similar situations is very helpful for the user to know what navigation options are at his disposal at that moment.

- help facilities
Help facilities can also be considered to be a part of the navigation structure. They must provide information about the actions that a user can take in that specific situation. The absolute minimum is information about how the available options should be operated. Preferably there should also be information about what the user can expect after a certain action or even suggestions about what he can do in the given situation. If a user got stuck in a part of a game it can be worthwhile to give hints on how to solve the situation. Furthermore, it is important that help facilities can be recognized easily as such.

```
-   The Wacky World of Miniature Golf provides no help facility in
    the main menu (the hall of the clubhouse). The help informa-
    tion however is available in the practice hole that provides
    an explanation of the buttons and an option to practice. Dur-
    ing the games there is no help at all available.
```

## 3.2 Feed forward

A user will plan his actions with a goal in mind: he wants to find a piece of information, play a game or just wants to provoke any reaction from the system. He develops a strategy on base of what he expects to be the results of his actions. There are a number of mechanisms that help the user to create an image (mental model) of the operation of the system and the content of a title. In an extended version of the Layered Protocols Model, describing user-system communication this is defined as E-feedback: the need to know what information the system *expects* to receive from the user (Engel and Haakma 1993). The system provides feed forward before the user enters his input. The feed forward mechanisms are available on various levels (layers) of operation, from the shape of a hotspot to information about the contents of a title.

*   guided tours
    A mechanism that is often used to give a user an impression of the potential of a title is the guided tour. A guided tour can give the user a rough idea of what he can expect of a title. Basically it should reflect the macro information structure. It is not necessary to give detailed information but it is important to present all main features that are available to avoid that a user is unaware of parts of the things that can be done with a title. Further it must be avoided to create expectations that cannot be fulfilled by the title.

*   overview of the contents of a title
    A good overview of the contents of a title helps the user to develop his strategy to find information. This overview needs not to be extensive, but it must avoid that 1. the user is looking for information that is not there and 2. that the user knows in which part of the title he might find the information he wants.

    ```
    -   In the menu screen of Time/Life photography it is possible to
        get an overview of the items that can be found on the disk.
        Although not all items are presented at the same time, the
        user can get in a short time an impression of the information
        that is available.
    ```

*   suggestion of the systems reaction
    There are many ways to suggest how the system will react after a user action, e.g. the arrangement of information according to a number of categories, the comment of a voice: "If you press button 1 ...", etc. If these suggestions are not in agreement with the actual reaction of the system, this can be very annoying to the user.

    ```
    -   In the disc guide function of Time/Life photography an expla-
        nation of the usage of controls is given. A voice explains
        that "moving your joystick, moves the cursor..", but at that
        moment the user has no control over the cursor. To select an
        icon the user is invited to press either button, but pressing
        a button of the input device results in the occurrence of a
        control configuration that only provides a function to skip
    ```

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the rest of the explanation. If the user wants to continue to watch the explanations he has to start the whole procedure up again using the main menu.

- consistency of control mechanisms
Consistency is a very strong feed-forward mechanism. If the location of a hot spot, the lay-out of control configurations or the structure of menu's are consistent through a whole title or maybe even between similar titles, they can help the user enormously to anticipate on their function. If the functionality of control configurations changes across conditions the user has to re-orientate each time in what part or layer of the information structure he actually is and must keep focusing on the control mechanisms instead of on the contents of the title.

  - Time/Life photography has something like a main control configuration that pops up if you click on a button of the input device. The configuration offers the functions 'repeat', 'continue', 'skip' and 'goto-main-menu'. The lay-out of the configuration is always the same and the hot spots are always located at the same position of the screen. The user knows what he can expect.
  - All the Fun at the Fair also has a main control configuration. However if the user enters the book on Treasure Island he suddenly is confronted with other functions. Although this situation indeed needs other functions this sudden change of lay-out and functionality is quite confusing.
  - Another inconsistency in All the Fun at the Fair is the usage of an OK-function. Sometimes, after the title is paused, pressing OK results in the continuation of the situation. In other cases pressing OK brings the user back to the overview of the fair (main menu).

- metaphors
Good metaphors can give the user valuable information about what can be expected from the title as a whole. It can be very valuable to use the same metaphor throughout a whole title. However this must only be done if all situations lend itself to the usage of that metaphor.

  - Renaissance Gallery uses the metaphor of a museum. For the paintings this works well, for the music this metaphor has less meaning. In the museum there are separate entries to the time periods. When you are at the level of the paintings themselves the museum metaphor is no longer used. You can view the paintings one by one, from one painter to the next, from one time period to the next one. There is no extra feed back if another time period is entered and the user finds himself in a completely different era than he choose for. However, the museum metaphor can help the user here to orientate himself by showing an entrance if a next time period is entered.

- icons
A good icon can inform the user about the functionality that is hidden behind it. Icons that represent different functions must have a clearly distinct appearance.

```
- In the main control configuration of the title Tim en Beer one
  of the hotspots is labelled with an icon of Tim en Beer.
  Pressing this hotspot brings the user back to the main en-
  trance of the hospital. A very nice feature of Tim and Beer is
  the fact that every picture in this title can be transformed
  into a jigsaw puzzle. However if the title is in a 'jigsaw
  situation' there is a hotspot that looks very much like the
  Tim en Beer hotspot in the main control configuration. Only
  this time the function of the hotspot is to break off the jig-
  saw session and return to the last situation in the story.
```

- pre-positioning of the cursor
  Positioning of the cursor can be used to help the user to select the most appropriate action
  under the given condition e.g. after a pause the cursor can be positioned in the appropriate
  position to continue. Then cursor pre-positioning serves as a real navigation tool as it guides
  the user. If there is no obvious continuation of actions the cursor can be placed nearby the
  current hot spots to avoid that the user has to make long cursor movements. However, in this
  latter case, cursor pre-positioning mainly serves efficiency and is not a real navigation tool.

```
- If a new situation is started up in the English course Language
  Director the cursor many times is off the screen. Then the
  user even first has to search for the cursor before he can
  start to move it in the direction he wants.
```

## 3.3 Feedback

After an action of the user, the system should respond with a reaction that makes sense to the
user. In the extended version of the Layered Protocols Model this is defined as I-feedback:
feedback on the system's *interpretation* of the input of the user (Engel and Haakma 1993). I-
feedback is supplied after the user's input is completed. It gives the user the feeling that he is
really interacting with the system. In relation to navigation there are a number of feedback
mechanisms of importance.

- information content
  The information content of what is presented after an action of the user is a very important
  feed-back mechanism. It shows clearly whether or not the user has arrived at the point that
  he had in mind. Of course this is not always valid. The user might have had a wrong idea of
  what he could expect at a certain location. Then he navigated correctly to that place but he
  didn't get what he wanted. In that case the feed-forward mechanisms might have failed. It is
  also possible that a title specifically is designed to surprise the user with unexpected situa-
  tions.

- hand-cursor coordination
  The translation of the movements of (the hand of) the user into the movements of the cursor
  must be intuitively correct. Title contents play here an important role. Games that require
  speed need another approach than titles that need accuracy. This means that different titles
  benefit from different types of input devices. Speed control requires a joy-stick while accu-
  racy (position control) is better served with a track-ball or mouse. Also the motor skills of
  the user play a role. Small children are best of with the roller-controller, that needs larger ex-
  cursions of the ball to get the same cursor movements as e.g. the normal track-ball gives.

> - Dark Castle gives the user the option to enter his name before
>   a game is started. To do this the user must select letters
>   from an alphabet. With the mini joystick, the standard remote
>   control, it is very difficult to point accurately at the want-
>   ed letters. Using a track-ball would be more convenient. How-
>   ever a track-ball is absolutely unsuited for the rest of the
>   game.

- messages from the system
  A user action should result in a perceptible reaction of the system. If a transition to another position requires more input actions of the user, each step should cause a reflection of the current status (that may be somewhere in between two different situations). Often the information contents itself gives enough information about the status of the system, however, also invalid actions from the user require some sort of feedback. Messages from the system can then give information to the user on what went wrong, or maybe even better, they can advise him on how to continue.

- response time of the system
  Different situations impose different restrictions on response times of the system. If a user thinks he performs a simple action, the system must response quickly. However, for tasks that seem to be more complex much longer response times are accepted and even expected by the user. Here also title content is of importance. Action games need quick responses while educational or informative titles are less demanding on response times. If response times do not match the expectations of a user he may become confused or even annoyed.

  > - It is easy to point out titles that react slowly. Everybody who
  >   has seen a number of titles knows a few. So far we did not en-
  >   counter titles that responded too fast.

## 3.4 Feeling of being in control

The intention of CD-i is to let the user manipulate the system and not the other way around. Sometimes this will take a lot of training (games), but essentially the user must be in control. The navigation structure and the feed forward and feedback mechanisms can be of great help to support a smooth navigation. They also help to give the user a feeling of being in control. Yet there are some other aspects that contribute to this feeling.

- freedom to make decisions
  If a user has a goal it must be possible to reach this goal as straight forward as possible. The implicates that there must be as few as possible 'forced actions' in the path. Examples of 'forced actions' are: watching a story that cannot be interrupted, not being able to finish a session that is no longer interesting, being forced to go through a large number of menu layers, etc.

  > - In Tim en Beer there are a number of decision points in the
  >   story that offer two alternative options (Tim goes into the
  >   operation room or goes looking for Beer). At those decision
  >   points only one of the options can be selected actively. The
  >   title then continues immediately with the selected option. To

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'select' the other option you just wait until some time-out
period has passed, after which the title automatically contin-
ues with that option.
```

- 'pause', 'restart' and 'repeat' options
  Any time during the interaction between user and system the user must be able to pause the action of the system and to continue as he wishes. An option to repeat the most recent output of the system would also be very convenient.

  ```
      - In All the Fun at the Fair it is not possible to pause during
        a story. Pushing a button of the input device results in skip-
        ping the rest of the unit of information that is presented at
        that moment.
      - The Reference part of Renaissance Gallery also lacks the op-
        tion to pause the output of the system. It is not possible to
        stop the flow of titles of books that are listed or to break
        off stories that are told. If a user wants to note down an in-
        teresting book title or remark he hardly has the time to do
        so. Pushing a button of the input device results in skipping
        the rest of the reference information that is presented at
        that moment.
  ```

- actions of the system itself
  It is very annoying if the system takes action by itself. If there is a period without any inter-action the system should not continue automatically after a certain amount of time. In such a case a warning might be an appropriate action of the system, but this is not always necessar-ily the case. In cases that a system should also work without interaction (e.g. as information point in a showroom) automatic action of the system is acceptable.

  ```
      - In Tim en Beer the story is automatically resumed after a cer-
        tain period without interaction. This even is the case if the
        title explicitly is put in a pause mode. So if the user isn't
        able to pay attention to the system for a (short) while the
        story has continued and the user probably has lost track.
  ```

- effect of practice
  Interaction patterns that are hard to control, e.g. in games, are tempting the user to gain con-trol by practising a lot. Care must be taken that a fair amount of practice can result in a fair amount of gaining a feeling of being in control. The skills of the target group users should be taken into account.

# 4. Derived do's and don'ts

In the discussion of the navigation aspects given above, a number of rules of thumb are implicitly presented to the reader. Here they are presented once more in a more explicit form using the same order of presentation as in section 3.

## 4.1 Navigation structure

- the information structure
Make an information structure complex enough to enable easy access to all information units. However avoid too complex structures that only will confuse the user. For the usage of hyperlinks this means:

  - use hyperlinks for frequently used transitions (short-cuts)
  - use hyperlinks for items that are classified under different heads, but that are closely related to each other

- feed back about the actual position in the information structure
Use clues to give the user information about his actual position or give him the opportunity to ask for clues (like overview maps, history paths, a return option, menu's, etc.)

- control configurations
Use a coarse (global) navigation mechanism to reach a certain section of a title and then continue with a fine (local) mechanism that can be more specific for the current situation. The coarse mechanism should be available at any position in the title.

- help facilities
Supply at any appropriate position in the title help facilities that give information about the available options at that moment. It is not enough to give only information about how to act, but also about what the user can expect after a certain action. In some cases it can be appropriate to give the user hints on what to do.

## 4.2 Feed forward

- guided tours
Guided tours best can be used to give a rough overview of the contents of a title. Instructions on the usage of the disk should be available in the help facilities.

- overview of the contents of the title
Provide a short overview in at most a few screens that can be scanned interactively to help the user to develop an internal representation of the structure of a title.

- suggestion of the systems reaction
Don't suggest interaction possibilities that are not actually offered at that moment.

- consistency of control mechanisms
Consistency is a very strong mechanism to make a user feel familiar with a title. Therefore take the effort to find control configurations that can be activated and used at any position in a title.

- metaphors
  Use metaphors that apply to the largest part of the title. If a metaphor only can hold for one or two levels in a hierarchical structure then it probably isn't suited for the contents of that title. On the other hand, it is possible that the metaphor isn't exploited fully in that case.

- icons
  Icons must be self-explanatory and well distinguishable. Avoid the usage of icons that look similar, especially if they are used in different sections of a title and cannot be directly compared with each other.

- pre-positioning of the cursor
  Just think of the option to do something with the position of the cursor when screen content changes. Placement of the cursor near a new set of hotspots avoids unnecessary long distance movements for the user and can guide him towards the most likely selections.

## 4.3 Feed back

- information content
  It is not always necessary to give explicit feed back information to the user. Often the content of what is presented is enough and very adequate feed back information itself.

- hand-cursor coordination
  Movements of the hand (via the positioning mechanism of the input device) and the movements of the cursor must be very closely related to each other. Large and fast hand excursions must produce large and fast cursor movements. Time delays must be avoided. For some titles it might be advised to use a specific type of input device.

- messages from the system
  Provide the user after each action with a perceptible reaction of the system. In case the user gives invalid input, the system must give information on what went wrong and advise the user on how to continue.

- response time of the system
  More about response time rules can be found in the PIMA guidelines (see Blake et al.).

## 4.4 Feeling of being in control

- freedom to make decisions
  Avoid as much as possible passive selection of an alternative. Give enough alternatives to select from actively to make it possible for the user to go straight to his target.

- 'pause', 'restart' and 'repeat' options
  Supply 'pause', 'restart' and 'repeat' options at any place in a title. Avoid that an unintended button press of the user results in the skipping of information.

- actions of the system itself
  Only permit the system to make its own decision if there is a very good reason to do so.

- effect of practice

  Practice must pay. It is important to adapt the level (difficulty) of interaction to the motor skills of the target group. It may be a challenge to gain a higher level of interaction by practice (especially in games), but there always must be the possibility for interaction even with lower motor skills.

# 5. Concluding remarks

Navigation can be described as knowing where you are, where you want to go and how you can get there. It is greatly determined by the combination of information structures (on a global and a local level: macro and micro structures) and a number of mechanisms mainly concerning feed forward and feedback. Structures and mechanisms can all be looked upon as tools that support the process of navigating in the contents of a title.

A start is made to find a convenient way to describe navigation aspects of titles. The basis for this description is formed by existing titles and the way they manifest themselves to a user. For a more thorough description it will be necessary to perform a systematic title analysis of a number of different title categories, such as games, informative titles, titles for children, etc.

So far the description of navigation aspects only concerns addressing the information that is available in a title. This can be considered to be a task-oriented usage of the medium. New titles more and more try to incorporate real interaction between user and system, allowing the user to add his own knowledge or creativity to the title's assets. Especially in the leisure type titles this results in a totally different analysis of user interface aspects, where beside factors like effectiveness, efficiency and satisfaction also the factor pleasure plays an important role.

# 6. References

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## Appendix A: List of titles

List of titles that are used in the examples (figures and text) and the number of times they are referred to.

| Title name | nr. of references |
|---|---|
| 1. Time/Life photography | 9 |
| 2. Renaissance Gallery | 5 |
| 3. All the Fun at the Fair | 3 |
| 4. Tim en Beer | 3 |
| 5. Sesame Street Letters/Numbers | 1 |
| 6. Language Director, English | 1 |
| 7. Dark Castle | 1 |
| 8. Wacky World of Miniature Golf | 1 |

## Appendix B: Glossary

This glossary gives an overview in alphabetical order of the terminology that is introduced in chapter 2.

- *button*
  Component of the input device.

- *control configuration*
  Set of hotspots on the screen by which the user can control the flow of information (for example 'skip', 'repeat' or 'continue').

- *control mechanisms*
  All kind of means to cause the transition from one unit of information to another. Examples of control mechanisms are: menu's, 'goto'-hotspots, control configurations, clicking the mouse, etc.

- *hotspot*
  A region on the TV screen that gives a pre-defined reaction if it is selected and activated.

- *information structure*
  Organisation of the units of information in a title. An information structure can for example be linear, cyclic, hierarchical or hyper-connected, or a combination of these structures.

- *macro structure*
  The global outline of the information in a title, including menu's that explain the accessibility of information and (hyper-)links between pieces of information.

- *micro structure*
  Local organisation of and transitions between units of information. The description of this structure includes the local control configurations and their effects.

- *navigation*
  The process of finding your way between the pieces of information in a title.

- *path*
  The transition between two consecutive positions.

- *position*
  The actual status of the system, which can be either in (the presentation of) a piece of information or somewhere in a path (in a menu, activating hotspots, etc.).

- *system*
  The combination of a CD-i player, a CD-i title and a pointing device.

- *unit of information*
  The smallest piece of information that can be accessed from another place (position) of the title.

- *user*
  The person that is playing or working with a CD-i title.