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Designing a Senior Friendly Interface for a Personalized 3D Narrative Simulation

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ABSTRACT

Caring for people with Alzheimer disease can be demanding. As an attempt to help caregivers to improve their interaction with people with Alzheimer disease, we are developing a personalized simulation allowing caregivers to practice problematic situations they encounter in their daily life. The strong level of personalization and the large number of interaction choices make it challenging to design interaction mechanisms that are usable for targeted end-users. After several stages of design and evaluation, we propose an interface that supports the strong dynamic interaction during the game, it is integrated into the 3D environment and is simple to be used even by players with limited computer skills.

CCS CONCEPTS

• **Human-centered computing** → **Graphical user interfaces**.

KEYWORDS

human-computer interaction, dynamic interfaces, personalization, narrative simulation, serious game, training, caregiving

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1 CONTEXT

The care for people with Alzheimer disease can be a challenge and demanding. It is estimated that approximately 44 million people live worldwide with Alzheimer disease and that one to four family members act as caregiver for each individual with Alzheimer disease. Compared to caregivers of people without dementia, caregivers of people with Alzheimer disease present substantial emotional, financial, and physical difficulties [6]. The constant modification of the patient behavior due to the illness, the unpredictability of the behavior, as well as the uniqueness of each situation makes it very difficult to adopt a single strategy and requires constant adaptation. As a consequence, caregivers often get exhausted, psychologically and physically. Several interventions exist to teach professional and informal caregivers how to deal with daily life situations, but most of them provide generic strategies that are complicated to transfer into the real life setting of the caregivers [5]. Based on this limitation we propose to develop a personalized narrative simulation aiming at practicing realistic problematic situations that caregivers encounter in their daily lives.

The simulation or serious game consists of a 3D Interactive Drama where the players play their own role and where the reactions of the patient are procedurally simulated. The goal for the player is to support the patient in accomplishing one or several specific daily life activities that are usually problematic to perform such as having a meal, brushing teeth, putting clothes on, etc. The player has the choice between a large numbers of actions, verbal or physical, to which the virtual patient react, based on a psychological model.

2 NARRATIVE TECHNOLOGY

In order to provide the user with more choice and variability than traditional serious games, the narrative simulation is based on a Narrative Engine that generates on-the-fly characters' actions [8]. It takes as input many parameters that allow personalizing the user experience. These parameters deal, on the one hand, with the behavior of the patient through a choice of eight neuropsychiatric

symptoms associated with the illness. These can be combined, and reflect whether the patient is, for example, apathetic, aggressive or has a tendency for wandering. On the other hand the typical attitude of the caregiver is also taken into consideration. The need for personalization is one of our main motivations for using generative technology.

The player's task, acting as caregiver, is to get the patient to achieve a set of tasks related to daily activities. A set of caregiver attitude has been modelled when communicating with the patient. Each attitude is expressed via specific narrative acts (Suggest, Ask, Complain, etc.). For example, a caregiver with a 'case manager' attitude, will tend to use the 'IdentifyWhyAfterRefusal' narrative act. Therefore, the player's possible actions are a mixture of intention (which task the player wants the patient to do) and the way of communicating it (narrative act). Both characters can also perform concrete/physical actions: the patient can perform actions to reach a given goal (e.g. eat the meal), or other actions, such as cuddle the cat; the caregiver can also perform concrete actions, such as read a magazine. The action selection algorithm takes into account the personalization parameters to select the correct patient action, as well as the list of available narrative acts and actions. Story coherence is maintained by the linear nature of the underlying task structure and therefore the narrative engine does not embed techniques such as planning or agent architecture. Nevertheless, the system is rich enough to provide more variability and choice than traditional narrative games used for training.

3 METHODOLOGY

Game design, including UI design, is usually an iterative process, as it is difficult to fully envision the gaming experience in advance. Our application is even more challenging, because no games exist that attempt to make 3D games usable by seniors (and non-gamers), and that incorporate the interactive narrative challenge of giving more choices to the player, at the same time. Therefore, our methodology involved a large number of iterations before reaching a satisfying user interface.

The process started by identifying and refining the core constraints associated to the game (Section 4). Then, inspired by existing interaction systems in existing dialog-based games [1], we went through 16 iterations of design and evaluation stages, including paper and non-interactive versions of the game.

4 CONSTRAINT IDENTIFICATION

The following four major constraints were identified:

- **Target users:** Our primary target group is informal caregivers. This population includes a large group of people over 60 who may suffer from light deficiencies that require specific attention [3]. Also, they have limited experience in video games, compared to young generations and may not be familiar with current game-interaction conventions. Other target users include the general younger population, still aged 40-60 (formal caregivers, children of patients), who may be computer literate but who in the vast majority of cases have little experience with gaming.
- **3D visualization:** As hinted, the final product takes the form of a game in 3D. The reasoning for this lies outside the scope

of this paper, but includes a need to dynamically represent a large variety of situations. With this choice comes the typical difficulties associated with 3D environments (camera management, occlusions, etc.).

- **Dynamic actions during the game:** Due to the generative nature of the underlying narrative engine, that provides the high level of personalization, the resulting interactive situations are rich but not fully predictable. As a result, the designers may not easily foresee all possible configurations of choice and scene-composition. The interface must be flexible enough to fit with these many varieties (e.g. many or few choices, short or long texts, etc.).
- **Quantity of choices [7]:** And finally, given the dynamic property as well as the complexity of the caregiving situation, the user is often faced with more choices than usually provided in similar serious games.

The combination of these constraints is particularly challenging. For example, the 3D visualization constraint combined with the dynamic actions may raise specific issues such as how camera movements interfere with click on game elements.

5 MAIN DESIGN DECISIONS

From the initial analysis of the constraints we made the following design decisions:

- There are many design options available related to how to present choices to the user, involving, for instance whether the options are embedded into the world or laid on top of it, how options are staged, how time-related constraints are inserted, etc. [2]. We made the initial design decision that possible options would be explicitly proposed to the player, in contrast to approaches where the user choice is inferred from a natural interaction interface. The latter suffers from technical limitations, and therefore tend to lead attention on the interface itself (is this the way I should express myself to be understood?) rather than on the content (is this the appropriate choice in the given situation?). Diverting attention in this way would be particularly irrelevant for senior users.
- It is usually expected that a 3D world allows some form of exploration. However, for our target users, this was not a good option. Standard navigation schemes in commercial games are not suited to users with no previous experience with such games. Simplified ways of exploration could be considered, but we decided to entirely avoid the issue by disabling free navigation entirely. In a non-narrative context, a similar decision was made in the game "Le village aux oiseaux", a 3D rail shooter for senior users [4].
- A third decision consisted of structuring options by narrative acts (action types, see Section 2), so that the player is more prone to reflect on these action types and strategies.

Then, by successively testing the prototypes, we added the following design decisions:

- Since the choices are dynamic, as well as the first-level menus to access them (the narrative acts), it revealed necessary to make it clear that the interaction options changed dynamically, by some sort of animation.

- Directly clicking within the 3D environment to initiate the action selection process revealed finally the best option, in terms of usability. So the user would click on the patient to interact with her, click on object to interact with them, even if we want to maintain the above-mentioned restriction regarding user navigation.

6 DETAILED DESCRIPTION

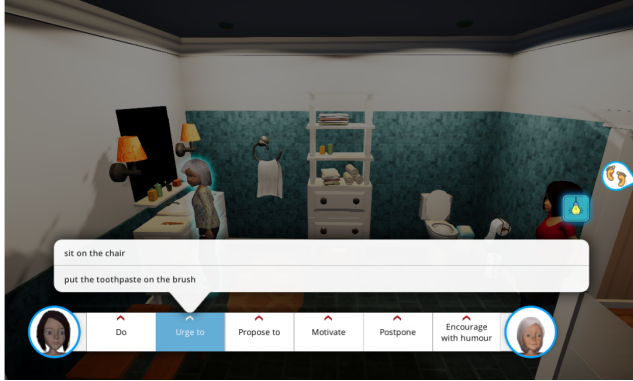


Figure 1: Screenshot of the latest user interface of the simulation

The goal of this section is to describe the final outcome of the iterative process. Although designed for a particular application, the proposed user-interface is useful for any senior friendly narrative 3D game with a moderate to large number of interaction choice, and in particular, a lot of dialogue.

6.1 Action Mapping

First, the visualisation module receives a number of options that correspond to possible actions, from a narrative controller. Each of these actions must be associated with a "hook" used to select this action in the 3D environment. This hook can be either a Non-Player Character, an object, or a 3D position when no object can be associated (see the case of changing rooms). If the latter, a replacement icon is placed at the 3D position (Figure 2, center).

6.2 Highlighting and Occlusion

Each game object which contains options is highlighted with a blue outline. If the element is partially occluded by another object, only the visible part can be used for selection. If the element is too obscured, an icon replaces the highlight (Figure 3, left). The camera determines obscurity by recognizing if a series of points on the object are hidden from view. When 50% are hidden (percentage can be adjusted), the icon replaces it.

Whenever the player's pointer is on a clickable element or icon, the name of the element is displayed in a label at the bottom center of the screen. Clicking on the element or the icon will show the options menu for that hook, with the corresponding options.

6.3 Off-screen Management

Whenever a hook is off-screen and contains options, an icon looking like an arrow is added to the screen to the side, on the left or on the right, depending on the position of the element. The icon will point in the direction of the off-screen element (Figure 2, left).

These arrows are placed at the height corresponding to the height of the hidden object. This, together with the arrow, provides exact information about the actual direction of the object. If the latter is directly above or below the camera's view, the pointer migrates to the top or bottom corner and points inwards in the correct direction.



Figure 2: The iconography as they represent elements in the game. Left icons: off-screen objects. Central icons: replacement (top) or obstructed (bottom) icons. Right icons: active but non clickable objects — in red. The blue spot indicates that the referred object emits a dialog

6.4 Representation of Dialogue and Sound

This section is only relevant for interfaces that do not use voices or text-to-speech technology but text written on screen. Following the comics' conventions, character dialogue is represented as bubbles pointing to the character's head or icon. Inside a conversation, several utterances would pile vertically, from the top to the bottom, following the chronological order of the exchange. Note that objects may also use the same mechanism when they emit sounds, like a clock ringing, a dog barking, etc.

Given the other, selectable, function of the iconography already present on the scene, a couple of measures had to be taken to avoid confusion about when an object can be clicked:

- The dialogue will attach itself to a physically present object in the scene. The highlight has no relevance to the bubbles.
- If a hook with an icon (replacement, obscured, or out-of-view) is already present, the dialogue will attach itself to it. The colour of the selectable icon is then blue.
- If a hook has no options and no dialogue, its icon is not shown.
- If a hook has no options, but has dialogue, the dialogue forces the appearance of the icon. The icon will then turn red to indicate that no options are associated with it (Figure 2, right).
- Since the arrows of the text-bubble point to the side of the icon it is attached to, but not at the object, a text bubble might mistakenly be pointing at an icon close to the icon speaking. To avoid confusion, when an icon has text attached, a blue



Figure 3: Sequence of interaction

circle will pulse in the upper right or left corner to indicate that all dialogues close to it, belong to it.

6.5 First-level Menu

The first-level menu is a horizontal bar overlaying the bottom of the 3D world, that appears only when a game element or icon has been clicked (Bottom bar - Figure 1). It contains a round icon at the left showing the player character, several menu items, corresponding to the options and categories of options associated with the selected element and finally a round icon at the right, showing the selected element. The number of items in the menu is dynamic, according to the variable number of options available. The more items, the smaller the item's cell. Within each cell, three lines are available to name the item. When an object or icon with options is clicked, the bar animates into the scene, folding out from the icon.

The first level of the menu contains two modes based on what each cell represents:

- All options are part of the same narrative act, or menu group: The options will be directly displayed in the first-level menu, and selectable from there. No fold-out will occur, as each cell is a raw option.
- The options on the hook are part of more than one option group: The cells will represent the group, and fold out as described in the Second-level menu.

6.6 Second-level Menu

The second level menu appears as a large bubble coming from the selected cell in the first-level menu (Figure 1). It contains as many lines as there are available options for that group. Once a line is selected, the second-level menu folds vertically into the first-level menu bar, and then the first menu bar folds horizontally, back into the icon, and disappears. The same animation is gone through in case the players clicks outside the menu, to make it disappear.

6.7 Interaction Chain

Given the above, the entire interaction chain therefore goes as follows (Figure 3): Click on an in-game element or icon → A horizontal menu bar appears. In the horizontal bar, choose a first-level element (narrative act for the patient's options) → If the element was an action, close the menu and perform it. If the element was a menu, open the second level menu → In this menu, click on an item to choose an action. The menu closes and the action is performed. At any point in the menu one can click outside it, and it will close.

The options will refresh after each option selected, as all options are recalculated. The menu will close-and re-open (animation) if the menu changes while it is open.

7 DISCUSSION AND CONCLUSION

Based on an iterative design approach, we have established an effective user interface to select actions in an interactive and narrative 3D environment. This interface differs from many traditional games, since it does not allow for free spatial exploration in the world. Instead, movements are only a consequence of user-initiated or computer-initiated narrative actions. Action selection is still based on clicking on elements that are concerned by the action, a standard approach in games. These constraints has led to design an icon management system, to deal with visually inaccessible game elements, either hidden or off-screen.

Although the last evaluation did not reveal a big flaw in the design, the iterations are ongoing. Future versions of the UI will include more guidance.

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