Creating Multiplayer Ubiquitous Games using an adaptive narration model based on a user's model

Stéphane Natkin
Centre d'Etude et de Recherche en Informatique du Conservatoire National des Arts et Métiers
292 Rue St Martin FR-75141 Paris Cedex 03
natkin@cnam.fr

Chen Yan
France Telecom Recherche & Développement
4 Rue du Clos Courtel BP 91226
35512 Cesson Sévigné Cedex France
chen.yan@orange-ftgroup.com

Sylvie Jumpertz
France Telecom Recherche & Développement
4 Rue du Clos Courtel BP 91226
35512 Cesson Sévigné Cedex France
sylvie.jumpertz@orange-ftgroup.com

Bernard Marquet
France Telecom Recherche & Développement
4 Rue du Clos Courtel BP 91226
35512 Cesson Sévigné Cedex France
bernard.marquet@orange-ftgroup.com

ABSTRACT
Mixed reality technology and ubiquitous computing allow the user-centred design to provide an adaptable and personal content at any time and in any context. In this paper, we present a method to develop Multiplayer Ubiquitous Games (MUG). Our approach is using a narrative mechanism correlated to a user's model, which stimulates the user's physical interaction with the real world and his social interaction with other users. We refine the information of user's model in three classes: user by himself, user as a player and user as an avatar. User's social characteristics and personality traits are featured in the game by using the big-five-factors model. A decision process proposes quests to the player according to his profile and a narration scheme.

Author Keywords
Multiplayer, ubiquitous, mixed reality, narration model, user's model

1. INTRODUCTION

An increasing complexity of relationships between the real world and the virtual world is arising in next generation games [4]. For example, there have already been several attempts to use real-time events (sports, variety shows, and even political events) broadcast through media such as radio and TV as the background of a game played on an interactive TV set. It is also well known that Massively Multiplayer Online Games (MMOGs, such as *World of Warcraft*, Blizzard, 2004) have complex economic systems and that some of the virtual goods produced can be sold on the real market, which has a direct impact on the real economy [5].

All of these games develop new types of user interactions with the game system. In the near future, this type of interaction will not be limited to Human-Computer Interaction (HCI), but will be expanded to the real world through Real-world Gaming-system Interaction (RGI). This is the new requirement for the design of Multiplayer Ubiquitous Game (MUG). MUG system includes interactions between the real world and the virtual world with the user being present in both worlds, and it may have at least one of the following properties:

- Proactive: the game interacts with the player's life at uncontrolled times, for example, through email and phone.
- Social: the game leads to social interactions between the players.
- Ubiquitous: the game interacts with the player at non dedicated locations through non dedicated objects or concepts of real life.
- Mobile: the gameplay relies on the player's physical mobility.

The essence of a gameplay is to be designed according to the point of view of a potential user [13]. This user is implicitly or explicitly coded in the game. All games, and, more generally, all entertainment applications include a model of the user. In single player games, it starts from a rough classification of the target players and a limited memory of player's actions during the game. In multiplayer games the model contains social attributes and behaviours. In multiplayer ubiquitous games, the model must be cognitive, social and related to the history and to the current situation of the player in both the virtual and real worlds. A MUG system must be flexible and adaptable to be able to respond to these complex and uncertain relations between the real world and the game world, and between the player and the real world.

In our previous studies [14, 15] we analyzed and classified mixed reality applications and the complex relationships

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they create between the real and virtual worlds. In [16] we proposed a reactive framework including three types of user model and related narration schemes. In this paper, in section two we first analyze the feedback loops of a user-oriented MUG system. In the third and fourth sections we present the structure of the user's model and the social model based on the Big-five theory. In the fifth section, we elaborate the narration model and its adaptive relations with the user's model. The last section includes an illustration of these concepts using a simple example.

2. STRUCTURE OF MUG SYSTEM: FEEDBACK LOOPS

Concerned by this study, the Real World (RW) is the user's physical environment when he is involved in the dedicated applications. It contains all the contextual information needed to interpret the meaning of the virtual world within the user's physical and social context.

A virtual world (VW) is an imaginary space composed of virtual objects governed by simulated physical laws, where the user is represented and where he experiments with the sense of immersion and presence. We define two types of virtual objects:

- An Image Virtual Object (IVO) is the image of a real object. It may also include some estimates of real world variables. For example, a user can be identified as a cursor, a car or a character in the virtual space.

- A Purely Virtual Object (PVO) is an object that has no match in the RW. For example, Non Player Character (NPC), items and locations exist only in the game.

In our context, the notion "mixed reality" has the following meaning: the real objects and virtual objects can co-exist and interact in the gaming environment. Some real elements of the RW can take part in shaping the gaming experience, and the game objects of the VW could also bring new meanings to the real objects and influence the RW state. An experimental example is Human Pacman [6]. It's an outdoor mixed reality role-playing game. In this game, the RW includes two players, their physical movements, the cookie's ingredients (physical real boxes) and their locations, and the geographical characteristics of the outdoor area, which are all Explicitly represented Real Objects (EROs) in the system. The VW is composed of the players' representations as "pacman", "ghost" and "helper" plus their virtual locations (IVOs), and a fantasy VW map (PVOs).

The relation between the RW and VW can be understood as a reactive system. The RW information is collected and identified by a RW model in the system, which includes a user's model with user's data directly from the user, and also represents data from other RW phenomenon such as the weather, the location of the user's car or the results of a football championship. Figure 1 shows three main feedback loops of a MUG system integrated with three models: RW model, Player model and VW model.

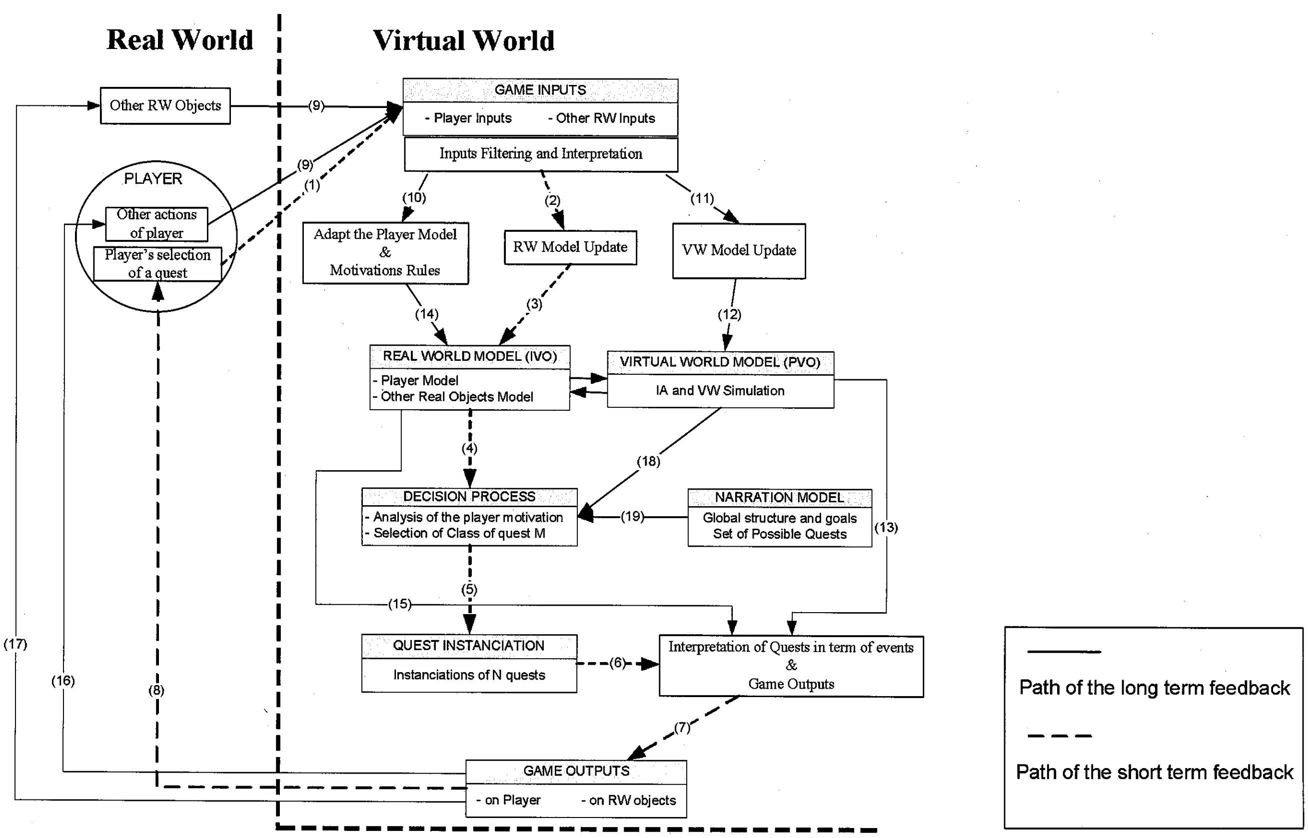

Figure 1: Feedback loops of a MUG system

The main game loop is represented by the following sequence of entities:

1,9: Inputs from the player and the RW

2,3,10,14,11,12: Updating the RW and VW model

13,15,7,16,17: Output and the corresponding interactions from the game to the RW

The short term feedback loop selects a set of quests M and recommends them to the player, who chooses one of them. The selection of the potential quests M is based on the user's model and the corresponding motivation scheme. This is represented by the dotted line sequence of entities (1 to 8).

The long term feedback loop reflects the adaptive nature of the user's model: According to the quest selected by the user, the model is dynamically adapted to reflect the user's current motivations. This is represented by the sequence of entities 1, 10, 14, 15, 7, 8.

3. PREVIOUS STUDIES ON THE PLAYER MODEL

A user model represents the set of information needed to predict some users' behaviours under a set of possible stimulations. The user model contains some evaluations of the physical situation, and also some psychological and social parameters deduced from existing cognitive and sociological models. On the basis of the user model, a system can provide the user with services or information fitting the user's specific need. It can also form the compatible interaction and adaptive interface to the user's specific context.

In digital game research, the idea of a player model came from the analysis of player behaviours in Massively Multiplayer Online Role-Playing Games (MMORPGs). Players with similar motivations can be grouped into the same "Player types" [1]: achievers, explorers, socializers and killers. Bartle has improved his original model with a three-axis representation able to take into account the evolution of the "player's type", according to the situation of the player in a narration scheme [2]. Following Bartle's categorized method, many researchers have put forward new player categories, by obtaining values from after-game player surveys or observations of in-game player-activities logs in order to identify player types or to predict player motivations in the game [8, 12, 20, 21].

User's out-game information has been considered in educational games or learning systems. An intelligent tutor could benefit from the user's model to adjust its instruction and to decide the type of content for different learners. [3] suggests a player model in a compute-based educational tutoring system. The player model includes a macro level such as gender and cognitive style and a micro level which contains in-game player-behaviour data such as response time and errors. [7] proposes a probabilistic model that takes the environmental variables of the interaction, the user's emotional state, personality traits and bodily expressions into account in order to generate the best interventions during the user's interaction with educational games. In [18], the user model is considerably stereotyped from a social and individual point of view. A three-level user model is described: *"user modeling, which includes a profile of an individual user; user clustering, which is based on similarities between user profiles and forming a user cluster using some form of automated technique; and community modelling, which includes a profile about the social group as a whole, not as the sum or the average of its individual member's profiles"*. These three levels of knowledge can be used simultaneously in multi-user application to control social and individual influence of the content.

However, in MMOG's design, user's out-game information or his personality traits are few processed in the system. Research focusing on the relationship between the personality of the player and his choices or performances in MMOGs is limited. As we can see, the user's activity space embedded with computing and information systems becomes ubiquitous and proactive. Our point of view is to consider the interaction between the real and the virtual world in a mixed reality mode, and the possible user actions in both universes. In this mode, the player may change between types over time and he may also be influenced by the real world. Therefore the user characteristic information outside of the game like gender, age or personality.... will in a very great degree influence his decisions or his behaviours both in the game and in the real environment. [19] uses Social Cognitive Theory and Action Theory to analyse a set of behaviour indicators (personal, social or control) to divide and refine Bartle's four motivation types of player. However, they are difficult to operationalize for the design of MUG system.

In the classical classifications of human personality, known as the Big-five theory or the Five-Factor Model (FFM), [17] uses five dimensions to describe and identify human psychology: the Need for stability (N), The Extraversion (E), The Originality (O), The Accommodation (A) and The Consolidation (C). According to Table 1, a human's personality is defined through five normal distributions of scores of these dimensions. A rough approximation uses three levels on each dimension. For example a personality can be specified by a pattern such as $N-, E=, O+, A-, C+$. This model has been discussed and improved. From our point of view, the main interest is its operation ability: it has been used in several fields, for example for personnel's profession selection. The personality profile is determined using a survey based on a questionnaire.

Table 1: Personality factors in FFM [17].

Dimension / Level	–	=	+
Need for stability (N)	Resilient (N-)	Responsive (N=)	Reactive (N+)
Extraversion (E)	Introvert (E-)	Ambivert (E=)	Extravert (E+)
Originality (O)	Preserver (O-)	Moderate (O=)	Explorer (O+)
Accommodation (A)	Challenger (A-)	Negotiator (A=)	Adaptor (A+)
Consolidation (C)	Flexible (C-)	Balanced (C=)	Focussed (C+)

4. USER'S MODEL

4.1. Generic, Localized, Personalized Models

As stated previously, the user model represents the set of information needed to predict some user behaviours under a set of possible stimulations. In our context, the user model and the stimulations are used by a narration engine to control the evolution of the game. The user model will take into account the general motivations of the users, and also the skill of the user in relation to the various challenges he must face. This is a type of "easy to start, hard to master" learning curves for the user.

Therefore, the user's model depends on a set of parameters that can either be statically defined by the game designer or dynamically adjusted by the changes of user's states. This data may be more or less personalized, which leads to three levels of parameters in the user model: generic, localized or personalized [16]. In this paper we recall the main definitions.

A generic parameter is a general hypothesis about the player, a location of all users on the game map and statistics of players' actions. It does not distinguish one player from another. For example it is a statistic about the players' community (e.g. 65% Male, 35% Female, 34-years-old mean age, occidental).

A second level of parameters includes some real-time data related to the user's location. In this case, the user has an identifier and his current location is a user-state variable of the model. This information is interpreted by the game through other known contextual variables of the real world. For example, the game may know, from the location of the user and a map of the real world that the player is in a cafeteria. Most location-based mobile games, like *Mogi* (Newtgame, 2003) and *Botfighter2* (AliveMobile, 2000) use implicitly a Location Model (the contextual information surrounding the player) to analyze events in the real world, to detect the distance between players and virtual objects in order to manage personal exchanges between players according to their proximity.

Personalized parameters define state variables about each user. Some of these variables are already used in classical games: for example, various kinds of challenges according to the skill level of the user. However, in mixed reality environments much more detailed data can be used: civil status, personal habits, social relationships...

Of course if data is known on a personal basis, it can be computed from a generic point of view. For example if we know each user's exact location we can compute the distribution of locations. The reverse is obviously false. If the provider stores the exact age of each player it is a personalized parameter. If for technical or privacy reasons the age is only stored as a statistic (mean, deviation, distribution…) it is a generic parameter. If, at a given time, we know the exact names of the players who are interacting, it is personalized data. If we only know that three players are together in the same room, it is a localized parameter.

According to [16], a user model only based on generic parameters is called a Generic Model (GM). A model that includes both generic and localized parameters is called a Localized Model (LM), and if the model includes at least a personalized parameter it is called a Personalized Model (PM).

4.2. Structure of the User's Model

In this part, we will describe which kinds of player information is collected and identified by the user's model. We have to consider the player's knowledge from several different points of view. It is important to understand that the behaviour of the user in his everyday life is different from his behaviour as a player. For example, from a classical psychological point of view, a human personality changes infrequently, but the player's behaviour in the game (as he is playing) may change from one turn to the next. There is not a simple mapping between the player characteristics and his avatar's feature or its evolution. It is well known that old pappies want to be little girls in the game. This leads us to consider at least three groups of data:

- We may know some data about the user "by himself", i.e. which is not related with game practice. Most of this data can only be obtained through a deliberate answer to an investigation.
- The second group collects the knowledge about the user defined as a player. It includes some exact information corresponding to the player's basic choices: the type of account, the type of avatar chosen, etc. It includes also statistical data gathered by the game engine: accounting data, social relation during the game… At last some real time data are also managed during the play: his physical location, his use of the various interfaces between the RW and the VW.
- The third group is already partly implemented in almost all existing games. It defines the status of the player's avatar in the game from both a statistical and real time point of view.

Table 2 shows a classification of this data and the relationship to the level of the user model. In this table, if a piece of certain data is classified as P, it is data from a personalized model. L stands as Localized and G as Generic.

These different types of information are not used in the same way. Statistical information about the user by himself can be correlated to very general social models. For example the proportion between "fighting quests" and "socialization quests" may be bound to the ratio between males and females or to the distribution of the players' ages. However, if this information is known on a personal basis, it can be used in a much more subtle way. It has been observed that the relationships between players in the game have an influence on the relation in real life [11]. And the converse is also true, the choice of a competitive or cooperative quest can be interpreted in more depth if the system knows that the players involved are friends or are married.

The data about the user as a player can be used, for example, to adapt quests either to general preferences (global data) or to individual choices. According to the value of the corresponding parameters, the system may construct a game level composed of a great number of complicated, long quests or short mini-games. The physical location of these quests may also be chosen according to the same process.

Table 2: Structure of the user's model

Subclass	Static exact	Statistical	Real Time Exact	Real Time Estimated	Example
			User by himself		
Civil status	P	G			Age
	P	G			Gender
	P	G			Profession
	P	G			Country/ State/Town
Social Relation	P	G			Friend of other player
	P	G			Wife or Husband of another player
	P	G			Profile of the related player
Preferences	P	G			Leisure
	P	G			Consumption habits...
			User as player		
Accounting		P or G			Time since first account
		P or G			Time spent playing
		P or G			Frequencies of play times
		P or G			Mean duration of a turn
Choice Selected by the player	P	G			Type of account
	P	G			Type of Avatar
Statistics about Physical Interactions		L			Distribution of the time of play in each location
		L			Type of location visited during the game
		P or G			Distribution of the type of interface used
		P or G			Ergonomics data (Interface used)
	P	G			Trace of physical interactions
Real Time Interactions			P	G	Playing or not
			L		Localisation
			P	G	Type of interactive device used/available
			L		Relative position to other players
			P or L		Interaction with other players
			User as an Avatar		
Standard information	P				Name
	P				Graphic representation
	P				Level
	P				Abilities
			P		Location in the VW
			P		Status in the game
			P		Trace in the game
Social model in the game				P or G	Sociability (group, guild...)
				P or G	Motivation (FFM profile)

4.3. The Social Model

In the sequel of this section we discuss mainly the social model of the player in the game. Our needs, in terms of a model, are related to the trend of player's social features but are more focused on the automatic generation of narration and gameplay schemes. These needs can be summarized as follow:

- The goal of the model is not to understand the personality of the user broadly, but to deduce his interests as a player and therefore offer him an adapted scenario scheme. In particular, in contrast to the real personality of the user, its virtual personality in the game may evolve very quickly [2].
- The user sociability model must not only be descriptive, but also operational: we must be able to deduce some simple rules to decide which type of quest can relate the social state of the player to the global narration needs.
- The model must be adaptive: we must be able to build a feedback loop that improves the model according to the player choices and actions.
- The model must be sufficiently flexible and responsive to classify the user in smooth and changing categories.
- As the model will monitor a narration system according to the supposed player's need, we must allow the user to change his mood and alter the sociability model. For example, using Bartle's classification, the system may deduce that he is mainly a "socialiser" and so generally offer him some "social" quests. But this week he wants to be a warrior...

The simplest way to reach these goals would be to define the user's model as a set of weighted possible types of quest. For example in an MMORPG the following types of quests could be considered: Search for NPC or other players, Hire some efficient teams, Fight against enemies or monsters, Conquer areas, Explore new territories, Discover characteristics of an object or a place, etc. Each time the player chooses a quest in a given set, the weight of this set increases. The quests are randomly chosen according to the distribution of weights. But this model relies too much on the definition of quest, which may vary even in a given game. We may also consider building a player model based on Bartle's classification and relate the classification to the type of quest. For example Killers should prefer to conquer area or to kill a monster rather than to hire a team. However, in all these cases the user model, from our point of view, is related to just one type of game: MMORPG.

We build the user's social model in the game on the basis of the Five Factor Model (FFM). At a given time the player's social model, called the user profile, is defined as a vector M of 5 frequencies:

$$M = (MN, ME, MO, MA, MC) \text{ where } -1 \leq Mi \leq 1 .$$

The initial values are computed using the FFM test principle. The player is invited to fill a form which is used to set the initial values of the user model parameter and which includes a FFM test. The profile changes according to a feedback loop related to the player choices in the game. The technical aspects of this process are introduced in the next section. The goal is to relate the profile of the user to the profile of game quests. It does not matter if the psychology profile is correct or if the nature of the quest is fully translated. The only goal is to suggest interesting quests to the player. Thus, we want the player not only to remain in control of the interpretation of his actions during the game, but also to be able to directly alter his profile through a simple editing interface. This allows him to choose a type of behaviour in the game and change this behaviour according to his progress.

5. NARRATION MODEL

5.1. General Principles

We define an interactive narration model as a mechanism which generates narrative schemes correlated to the user's profile. As a guide model, these narrative schemes orient the definite quests pre-scripted by the game designer which can be translated into actions in the real world. In general this principle is called emergent narrative. In the context of mixed reality, it means that the narrative emerges from the user's physical actions or natural activities in the gaming space. The ultimate goal of this mechanism is to give an interest (event) to different players either in their individual experience or in their social experience during the game.

Quest system is a traditional storytelling technique used in various genres of games. According to the [10]'s terminology, a *quest* is defined by three main characteristics:

- A goal, for example, find a secrete code.
- Obstacles, which are opposed to the achievement of the goal, such as the existence of a secret passage to access codes.
- A resolution method, which makes it possible to cross the obstacles, for example the activation of a mechanism that opens a secret passage.

MMORPG usually uses a quest system, which is an extensive database of pre-scripted quests. The set of quests is designed to fulfil some narrative structure and also to develop the structure of the virtual world providing each player with the kind of experience he is interested in. Generally in MMORPGs, all of the available quests are open to each player who decides to choose one of them, according to his experience and environment. In MUG the same principles can not be directly used, for several reasons: the player is involved in the real world leading to time and space constraints, he has to physically meet other players, the duration of a turn is limited, he may use mobile devices as an interface which changes the ability to control the execution of the quest .... So a MUG such as *Botfighter2* uses a very simple and linear narration scheme using the same quest (or type of quest) for all players at a given type (killers). We try to define a quest system which has the same properties as the MMORPG quest database and which can be used in MUG.

This model must have the following properties:

- Coherent with a narrative scheme;
- Adaptable to the evolution of the state of the real world;
- Controllable in time and space;
- Able to be carried out using the ubiquitous and pro-active computing environment of the game;
- Adaptable to the player characteristics and motivation;
- Providing a variable and renewable experience to the player.

We assume that the game is composed of rounds or levels which have to be executed in a given time. *Botfighter2* uses quests which must be played in less than one week, *Majestic* (Anim-X, 2001) uses one-month episodes.

A round is generated according to the following steps:

a) Choice by the designers of a narrative structure. This structure is a set of events which are supposed to occur according to time and space constraints. This narrative structure is associated with a set of classes of quests.
b) Proposition of a subset of quests classes to each player according to his model and the current progression of the game.
c) Choice by the player about his class of quest.
d) Instantiation of the class of quest according to the RW and VW situations.
e) Execution of the quest as a sequence of commands to game output devices.

In this paper we do not discuss the formal representation of the narration model. It follows the maze technique of level design [13]: virtual objects have to be distributed in the space according to the chosen path and goals, and quests are submitted to the players at given points in the game's evolution. We have proposed a timed Petri Net model which can be adapted to this use [9]. In [16] three levels of narration models are proposed according to the knowledge level of the user model. A Global narration Model (Gl) proposes quests according to a storyline that does not distinguish players' identities, contexts or histories. The Context-oriented narration Model (Co) distinguishes different real circumstances to trigger different scenarios. A Character-based narration Model (Ch) provides personalized stimulation according to an individualized cognitive or social model. This classification may be used as the basis of the instantiation of quests in a given situation and according to the data available in the user model.

The next section is dedicated to the relationship between the user's model and the choice of quests.

5.2. The Adaptive Scheme

The allocation of quests and the instantiations of quests rely on the user's model. Each class of quest is associated with a FFM profile, a vector $Q = (QN, QE, QO, QA, QC)$ where $-1 \leq Q \leq 1$. A distance $d(x, y)$ in $\Re^5$ is used; it can be either the Cartesian distance or a distance function used for classification (such as the Malahobis distance). The game selects a set of classes in the neighbourhood of the user's profile (according to d) and another quest class is randomly chosen. This second proposition is comparable to a mutant in genetic algorithms: it allows a diversification of the player's choice. It can also be combined with narrative constraint to ensure some qualities of the gameplay. Then each selected class is instantiated using the user model: choice of the location, of the group of players involved in a given mission or with who will probably meet during the game...

The list of the constructed quests is proposed to the player. He selects one quest and starts playing. Let Q be the profile associated with the chosen quest, the new profile of the player M' is given by an exponential smoothing:

$$M' = \alpha M + (1-\alpha)Q \text{ where } 0 \leq \alpha \leq 1$$

The choice of α determines the speed of adaptation. If $\alpha = 1$, the user profile is not changed; if $\alpha = 0$, the user profile becomes equal to the quest class profile.

6. EXAMPLE: ALICE AND BOB MOVIE GAME

This method can be illustrated by using the simple example of a new MUG game: Bob and Alice Game (BAG).

Assume that this MUG is played in a town divided in two areas: *Montmartre* and *les Champs Elysées*. The game is played by one-day turns. The player belongs to either the Red or the Blue team. Players are using geo-localized mobiles as the game interface. The main classes of quests are classified according to the main gameplay experience in the four classes related to Bartle's classification:

- **S**cheme of **D**estruction (SD). This type of quest is for killers. It leads groups of opposing players in the same place with conflicting goals. For example conquer the same territory, protect/destroy a virtual object, protect/destroy an exploration group. This causes a battle between teams, using for example the Bluetooth connexion as a weapon.

- Scheme of **E**xploration (SE). The core of the experience is to discover new areas and unknown aspects of the game. The quest is based on puzzles whose clues are distributed in time and space.

- Scheme of **S**ocial **I**nteraction (SS). The third class develops physical cooperation interactions between players. This class of quest is (like in MMORPG) based on goals which can only be solved by forming the strong cooperation between players. Cooperation can of course involve a player on the same team but also players on opposite teams.

- Scheme of **C**reation (SC). The fourth scheme involves the player in the achievement of an "important" task: create a virtual (a new virtual building in the real town) or real object (a video recording of the game).

More complex classes of quests can be defined as a mix of the previous basic classes.

A typical example of a "one day" MUG narrative scheme could be as follows. First, in each area of the town, players are involved in a SD scheme and a SE scheme. For example, asking the Blue player located in *Montmartre*, to solve a puzzle and the Red player to conquer the same area. Choosing the symmetric scheme in the area of *les Champs Elysées*, this will lead to two battles in both *Montmartre* and *les Champs Elysées*. Then asking both teams to meet in the same place with solutions to the puzzles. These solutions are keys to play a set of arcade mini games (SD, SS according to the arcade game). In parallel some of the players have to send some small videos of the game evolution (SC). The Editors of each team receive the videos, scores and other elements of the game. At the end of the day each team has to produce a video of the day turn. These videos are both shown in the arcade game area and on a TV show (SC and SS). The best video wins a prize. The quests profiles may be similar to the following table:

Table 3: Classes of quest according to schemes

	N	E	O	A	C	Example of classes of quest
SD	0	0	+1	-1	+1	Defeat the opposing players located in a given area
SE	+1	0	+1	-1	+1	Solve the puzzle in a given area
SS	+1	+1	0	0	-1	Find Blue players with the solution to a puzzle and Red players with the solution to an other puzzle and combine solutions as a clue to an other quest
SC	-1	0	+1	0	+1	Collect images from other players and edit a movie

Assume that the profile of a player called Alice is $MAlice = (0.5,1,0,0,-0.5)$. Using the Cartesian distance we get $d(SD,M) = 2.35$; $d(SE,M) = 2.35$; $d(SS,M) = 0.71$; $d(SC,M) = 2.55$

Therefore the system selects the SS class and, for example, chooses the SD class randomly.

Assume that the system knows, from the model of Alice, that: 1) she is located in the *Montmartre* area, 2) Alice is playing for the Blue team 3) that Alice's boy friend (Bob) is playing for the Red team today.

Therefore the following quests are proposed to Alice:

- Find a Blue player with the solution to the puzzle dedicated to *Montmartre* area and a Red player with the solution to the puzzle dedicated to *les Champs Elysées* area and combine these solutions to access to the arcade game area
- Defeat the Red players located in *Montmartre* area

Assume that $\alpha = 0.8$

If Alice chooses the SS quest, her profile changes to:

$$M' = 0.8M + 0.2SS = (0.6,1,0,0,-0.6)$$

If Alice chose the SD quest her profile changes to:

$$M' = 0.8M + 0.2SD = (0.4,0.8,0.2,-0.2,-0.2)$$

Assume that Bob has a the following profile

$$MBob = (1,0,0.5,-0.5,1)$$

The quest "Solve the puzzle in *les Champs Elysées* area" will be proposed to Bob, so Alice and Bob can meet to combine their solutions to the Blue and Red puzzles.

7. CONCLUSION

This paper investigated some basic problems in the design of MUG: the nature of the feed back loops which relate the RW and the VW, the types of information covered by the notion of player's model, and the method to correlate the player's model to the gameplay in general and to the narrative structure in particular. To each of these problematics we propose an operational answer. Nevertheless, many problems are still open, in particular, the coherence between the adaptive scheme and the narration. We believe that there is no general answer to this question, which must be considered in the scope of each game or each type of games. We have chosen to experiment our scheme in the framework of a game developed by students at the Graduate School of Games and Interactive Media (ENJMIN). The game *Nippon Salary Racing Championship* (NSRC) is based on a cartoon type of races in a virtual world environment. This experiment will be the next step in our research.

REFERENCES

1. Bartle, R. A. "Hearts, Clubs, Diamonds, Spades: Players Who Suit MUDs". 1996, Available: http://mud.co.uk/richard/hcds.htm

2. Bartle, R. A. "Virtual Worlds: Why People Play". In: *Massively Multiplayer Game Development 2*, Thor Alexander (ed.), Charles River Media, Hingham MA. 2005, pp. 3-18.

3. Beal, C. et al. "Intelligent modeling of the User in Interactive entertainment". In AAAI Spring Symposium on Artificial Intelligence and Interactive Entertainment, 2002.

4. Björk, S., Holopainen, J., Ljungstrand, P. & Åkesson K-P. "Designing Ubiquitous Computing Games", A Report from a Workshop Exploring Ubiquitous Computing Entertainment in Personal and Ubiquitous Computing, (Jan, 2002), Volume 6, Issue 5-6, pp. 443-458.

5. Chan, D. "Negotiating Intra-Asian Games Networks: On Cultural Proximity, East Asian Games Design, and Chinese Farmers". In "Gaming Networks", *Fibre Culture*, Issue 8, 2006.

6. Cheok, A.D. et al. "Human Pacman: A mobile entertainment system with ubiquitous computing and tangible interaction over a wide outdoor area". The 17th Annual Human Computer Interaction Conference (England, Sept. 2003), Springer-Verlag LNCS press.

7. Conati, C. "Probabilistic Assessment of User Emotions During the Interaction with Educational Games". In the 8th International Conference on User Modeling, Sonthofen, Germany, 2001.

8. Foo, C. Y. & Koivisto, E. M. I. "Grief Player Motivations", in Other Players Conference on multiplayer phenomena, Copenhagen, December 6-8, 2004.

9. Grünvogel, S. M., Vega, L. and Natkin, S. "A new Methodology for Spatiotemporal Game Design". In: Proc of the Fifth Game-On International Conference on Computer Games: Artificial Intelligence, Design and Education *CGAIDE'2004*, pp. 109-113.

10. Guardiola, E. *Ecrire pour le jeu: Techniques scénaristiques du jeu informatique et vidéo*. Ed. Dixit, 2000.

11. Gustavo, M. and Talmud, I. "The Quality of Online and Offline Relationships, the role of multiplexity and duration". In *The Information Society*, 2006.

12. Lazarro, N. "Why We Play Games: Four keys to more emotion without story". *XeoDesign White paper* (2004), http://www.xeodesign.com/xeodesign_whyweplaygames.pdf

13. Natkin, S. *Video Games & Interactive Media, A glimpse at new Digital Entertainment*. AK Peters Ed, Wesley MA, USA, March 2006.

14. Natkin, S. and Yan, C. "Analysis of Correspondences between Real and Virtual Worlds in General Public Applications". In *Proc of Computer Graphics, Imaging and Visualization* CGIV05 (Beijing, July, 2005), IEEE, pp. 223-231.

15. Natkin, S. and Yan, C. "A Typology of the Relationships between Real and Virtual Worlds". In the 7th International Conference on Computer Games: AI, Animation, Mobile, Educational and Serious Games *CGAMES 05* (Angouleme, France, November 2005), IEEE, pp. 223-231.

16. Natkin, S. and Yan, C. "User Model in Multiplayer Mixed Reality Entertainment Applications". In International Conference on Advances in Computer Entertainment Technology ACE'06 (California, USA, June, 2006), ACM SIGCHI press.

17. Pierce J. H. and Jane M. H. "The Five Factor Model: An Introduction to the Five-Factor Model of Personality". Center for Applied Cognitive Studies (CentACS), Charlotte, North Carolina, 2003. Available: http://www.childrenofmillennium.org/eugenics/pages/articles/bigfive.htm

18. Saari, T., Ravaja, N., Kallinen, K. and Turpeinen, M. "Emotional Regulation System for Emotionally Adapted Games". Future Play 2006, London, Ont.

19. Shaw, P., Ward, J.G. and Weber, R. "Player Types and Game Qualities: A Model to Predict Video Game Playing". Future Play (October, 2005), Michigan State University, http://www.futureplay.org/papers/paper-161_shaw.pdf

20. Steinkuehler, C. "Situated Identities as Styles of Play in Massively Multiplayer Online Games". In "Cognition & Learning in Massively Multiplayer Online Games: A Critical Approach", *Doctoral Dissertation* of University of Wisconsin, 2005, Chapter 3.

21. Yee N. "Motivations of Play in MMORPGs: Results from a Factor Analytic Approach". The Daedalus Project 2005, http://www.nickyee.com/daedalus/motivations.pdf