Modeling MMORPG Players' Behaviour

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Abstract. *Massively Multi-player Online Role Playing Games (MMORPGs) have become rather popular type of online games which include a larger number of players who play together or against each other. In order to increase artificial intelligence of these kind of games one of prerequisites is to determine a model of different players' behaviour which would enable the creation of suitable intelligent agents that would facilitate better communication and more logical cooperation between individual players in order for them to achieve the game's goal more quickly and more efficiently. In this article a research about selected aspects of MMORPG players' behaviour is presented and its results are elaborated as a part of prerequisites for creation of appropriate intelligent agents for facilitating better cooperation between players which is described as a part of future research.*

Keywords. MMORPG, players, behaviour, intelligent agents

1 Introduction

Modern gaming world is engaging millions of players in a range of varying computer and console games which span several game genres covering numerous themes. Wide availability of the Internet allows for multi-player experience, as opposed to mostly single-player games which were available at the beginning of this millennium. Contrary to the behaviour exhibited during the single-player era, modern games introduce a strong social component to simple gaming. Nowadays many games include inevitable social component, demanding interaction and cooperation.

When playing Role-Playing Games (RPGs), players are requested to communicate with various in-game characters and interact with usually wide in-game world.

A special next level of social interaction enabled type of games are Massively Multi-player Online (MMO) games, which have become increasingly interesting and popular and have communities comprising tens of millions players. As Shim et al. state in [23], MMO games are *online spaces, providing users with comprehensive virtual universes, each with its own unique context and mechanics*. As noted by Shim et al. in [23], practically all actions of a player are captured on a server, providing useful data for analysis. MMO games supply researchers with mechanisms fostering social activities and in-game interaction with other players, allowing forming of guilds, groups (parties), corporations, etc. and working in cooperation. Each such action available in an MMO game can be logged on server side thus allowing for unmatched information collection regarding level of granularity and completeness of collected information.

2 Massively Multi-Player Online Role Playing Games

Particular game genre of the MMO games is MMORPG consisting of games involving properties of both MMO and RPG styled games. MMORPG (Massively Multi-player Online Role-Playing Games) is a genre of games which are fully developed multi-player universes with a visual and auditory world in which players create an individualistic character (avatar), as put simply in [18].

On behavioural side, according to [16], MMORPGs provide a place where interaction amongst mentioned avatars is carried out on a daily basis, creating a virtual environment for millions of users, allowing them to voluntarily immerse themselves in it.

MMORPGs represent games which call for player cooperation, dependence and interaction. Large number of players present in a game, along with game mechanics, make cooperation and teamwork a necessity when resolving a quest or trying to defeat a monster. Since many players are included in a game, variety is evident in different avatar skills, player experience and social interaction. This diversity motivates players to depend on other players and enforces teamwork.

Online nature of MMORPGs and their massiveness provide an interesting research ground for scientists, since many social patterns become observable and a multitude of data can be collected and researched. Behavioural analyses, organizational structures and various reactions can be observed in the world of MMORPGs, such as a desease-like phenomenon which

provided an excellent example of applied simulation modeling in infectious disease research, as described in [20].

3 MMORPG Player Behaviour

As mentioned by Cole and Griffiths in [16], based on research by Utz in [24], four typologies of gamers are present:

- *Role-players* - players interested in playing roles;
- *Gamers* - players interested in playing games and having adventures;
- *Virtuals* - players interested in virtualization comprising virtual partner meet-ups and virtual environment development;
- *Skeptics* - players disinterested in most aspects of MMO games refusing to identify themselves with any group of players.

Several playing motivations were discussed in [16] as well, as follows:

- curiosity, astonishment, and interest;
- cognitive stimulation;
- enjoyment of a different life style in virtual environments;
- recreational refreshment.

Many more papers were written on player behaviour concerning MMORPGs and their influence on people, e.g. that by Huffaker et al. consisting of research on social behaviour of experts in MMORPGs, detailed in [19], which concluded that in-game social interaction helps players to become more successful, although it takes time and energy at the same moment. Furthermore, players tend to send messages to higher-level experts, although experts tend to communicate with players of similar level. In the end, game experts in general appear to commonly chat with other players, remaining social creatures, even in virtual settings.

On the other hand, numerous are papers discussing player behaviour in terms of pro- and antisocial aspects, e.g. [22] and [21]. Interesting research is detailed in [17], which stands up to models which predict aggression and prosocial actions immediately following a gaming session - GAM (General Aggression Model) and GLM (General Learning Model), stating that *these theories fail to reflect the diverse nature of video games and treat all games with violent or prosocial content one-dimensionally.*

Since not every game platform, genre, and game is created equally, as per [17], and not all games within a specific genre are identical in content, no universal judgment should be made.

4 Towards Intelligent Assistant

Player behaviour in this paper is researched in order to create basis for further research in autonomous agents in role of intelligent assistants. Quality research is needed before player behaviour mapping and further analysis is conducted. Basics of research presented in this paper are differences between male and female players and the impact these differences have on players' success and achievements in an MMORPG. Therefore we shall try to provide answers to the following research questions:

- Are there more male or female players in a party? Do they group by gender?
- Players of which gender log in more often? Do players of larger or smaller parties log in more often?
- Are there quantitatively more larger or smaller parties?
- Do players of similar profiles form parties or are they diverse?
- Players of which gender are more successful according to avatar level? Are larger parties more successful according to avatar level, or are smaller parties?
- Do players without a party exist?

Intelligent assistant can be modeled only after a thorough analysis of player behaviour is conducted. The idea behind this paper is to create an intelligent assistant character which is capable of giving directions to a player's avatar based on their past experience, present state and future plans. Although such an agent is in general not needed in an RPG game, it can become useful in some other game genres. Motivation driving players in MMORPGs is a part of the whole game experience, and is built upon discovering the unknown, trying and failing, and interacting with as many elements of the game as possible.

Incorporating an agent which is well-versed in the past steps of a player, their current state and future plans (set by the given player or by the game), has the potential to lower curiosity of MMORPG players and their immersion in content of the game. On the other hand, an intelligent assistant might be precious in city-building games such as Civilization, Age of Empires, etc.

5 Data Analysis

Data used for analysis in this paper was generated by players participating in ModelMMORPG project[1],

[1] More details can be seen at `http://ai.foi.hr/modelmmorpg`

playing an enriched instance of The Mana World[2] free open source MMORPG using a customized game client which, under player's consent, logged usage data and sent it back to the project's server.

Before being used in any kind of analysis, data was first anonymized, since no user should be able to be identified when consulting the collected data. Every username in collected data was replaced by a construct user$x$, where $x \in [1, 411]$, and each user had their ID replaced with a number dissimilar to their real ID.

Similar process was undertaken for player characters (avatars): their names were changed to char$x$, where $x \in [1, 181]$, and their IDs were changed. E-mails, last login IPs and last time of playing were dropped from data ready for analysis so as to assure anonymity of all the involved players.

The game (being customized) invited players to solve Quest for the Dragon Egg, a new quest implemented during the ModelMMORPG project. This quest needed a player to start the quest with the Arch-Wizard, find the Dragon Egg item, create a Hatching Potion with the help of a witch, bring both items to the Hermit character, and thus learn how to cast spell summoning a dragon. While having the Dragon Egg item, two named helpers have to be in line of sight of the given player at all times. These constraints were developed in order to motivate players to cooperate and thus increase their chances of success.

Collected data was analyzed and answers to most of the proposed questions were discovered. Research is based on 411 users and 181 avatars. These numbers denote that not even half (44.04%) of the registered users created an avatar to be used in game, meaning they only registered, without real intention of playing the game, or encountered an obstacle of some kind. Only users who created their avatars were taken into consideration in further research conducted and presented in this paper. Since only users have their gender stored, and each avatar necessarily being of user's gender, no gender swapping observance is available, as researched in [21].

Amongst the 181 created avatars, 44 $(24, 31\%)$ are female, and 137 $(75, 69\%)$ are male. It is evident that male gamer quantitative presence is still dominant in youth population mostly comprising IT students. It is interesting to note that neither female $(27, 27\%)$ nor male $(31, 39\%)$ avatars are highly likely to become included in a group of players (called a party). Conversely, almost one third of avatars in general $(30, 39\%)$ are members of a party.

There are only 22 parties created, yet only 8 parties $(36, 36\%$ of total) include female avatars, and only 2 parties have female members only. On the other hand, male avatars are members in 20 parties $(90, 91\%$ of total), with 14 parties being male-only groups.

Although fewer in numbers, female characters visited the game more often - on average, players playing with female avatars have logged in more often (14 logins) then those playing with male avatars (13 logins). Taking into account the average number of logins per player per party, players in small (3 players and less) parties are more likely (average of 40 logins per avatar) to login than players in large (4 and more players) parties (average of 30 logins per avatar).

Table 1: Absolute and relative character attribute (strength, agility, vitality, intelligence, dexterity and luck respectively) values in the largest party

Char Name	Str	Agi	Vit	Int	Dex	Luk
Absolute values						
char34	1	1	1	48	87	1
char41	10	7	7	11	8	5
char64	1	1	1	44	97	1
char73	22	1	13	1	6	1
char74	21	6	6	8	3	8
char75	1	1	3	1	51	1
char76	5	5	5	5	69	5
char81	26	19	30	1	30	1
char99	1	1	58	1	1	33
Relative values						
char34	0,01	0,01	0,01	0,35	0,63	0,01
char41	0,21	0,15	0,15	0,23	0,17	0,10
char64	0,01	0,01	0,01	0,30	0,67	0,01
char73	0,50	0,02	0,30	0,02	0,14	0,02
char74	0,40	0,12	0,12	0,15	0,06	0,15
char75	0,02	0,02	0,05	0,02	0,88	0,02
char76	0,05	0,05	0,05	0,05	0,73	0,05
char81	0,24	0,18	0,28	0,01	0,28	0,01
char99	0,01	0,01	0,61	0,01	0,01	0,35
Avg.	0,16	0,06	0,17	0,13	0,40	0,08
Std. dev.	0,19	0,07	0,20	0,13	0,33	0,11

Classifying in the same manner, there are only 4 $(18, 18\%)$ large parties (with 4 players or more) and 18 $(81, 82\%)$ small parties (with 3 players or less). Since only 2 parties consist of exactly 3 members, it is safe to conclude that only 6 parties could safely finish the Quest for the Dragon Egg, because the questing avatar must name two helping avatars, which must be members of the same party as the questing avatar.

When comparing avatars by their attributes (six are present in The Mana World: strength, agility, vitality, intelligence, dexterity and luck), some similarities are visible amongst players who are members of the same party. It is advisable for players to form groups with diverse avatars which can successfully fight in-game obstacles, therefore three largest parties form players with various combinations of the given attributes. Example data showing just mentioned dissimilarity in a party is available in Table 1, where character attributes of players in the largest party are shown. Dissimilarity is visible in all the available attributes, since standard deviation is greater than 10%.

Every avatar in an MMORPG collects experience provided by solving a range of activities or quests in a game. When a designated amount of experience is accumulated, avatar gains a level enabling them usage of more advanced movement, abilities and interaction. It is found in this study that female avatars have achieved a higher average level (15) than male avatars (13). Maximum level achieved is almost the

[2]More details can be seen at `https://www.themanaworld.org/`

same though, yet male avatar achieved slightly higher level (64) as opposed to female avatar (63). Avatar level does not depend on size of a party, nor does maximum avatar level in a party correlate with party size.

Since not all players are bound to having fun playing a game, or some are playing a game without real interest or motivation, as mentioned in player models above, many players have not immersed themselves enough to become members of a party or to create a party of their own. Even though social component is the strongest in those players with avatars which are members of a party, and party membership brings benefits which make playing the game and progressing through it easier, less then a third ($30,39\%$) of players are members of a party. Maximum level achieved by avatars which are not members of any parties is 40, with average level being 7.

6 Discussion

Following the questions mentioned earlier, data analysis is mostly concerned with gender differences. Therefore, the most noticeable difference in analyzed data is that of quantitative gender inequality - it would seem male players are still quantitatively dominant in the field of MMORPGs. Since female players are lacking in quantity it would be expected to see them grouping with male players, for added protection and easier game progression. This idea is mostly followed by players, since only 2 out of 8 parties are female-only parties. A rather large number of male-only parties can be justified by a large number of male players when opposed to number of female players.

It is very interesting to note that female players are playing the game slightly more often, with 14 logins (1 more then 13 logins by male players), but this difference could be due to the ratio of male and female players, and their respective individual numbers of logins - male players cumulatively have a higher number of logins followed by a higher number of players, making high-numbers' influence smaller, while female characters are fewer in number, and any high oscillation is more evident in the final result.

Observed data provide useful indication of the number of players successfully solving the Quest for the Dragon Egg - party must have a minimum of 3 players if they are to be able to successfully complete the quest in question. Since only 4 parties have more than 3 players, and only 2 parties have exactly 3 members, only 6 out of 22 (27,27%) parties can complete the mentioned quest.

As is shown in Table 1, standard deviation of relative character attribute values is rather large, almost always higher than 10%, meaning dissimilar avatars group in parties. This phenomenon is usual in RPG games where players can group in parties, since diversity makes it easier to beat the game and various in-game monsters, challenges and quests.

It is very interesting noting that female avatars have higher average level than male avatars, meaning female players are more interested in achieving results as opposed to male players, which is highly unexpected. This result can be justified analogously to the results of number of logins - it might be due to the big difference in overall number of male players as opposed to the overall number of female players. Since maximum achieved levels by both female and male characters are almost the same, the fact that there are more male than female avatars makes it easier to lower average male avatar level, and vice versa, having only a few female avatars makes their average level expectedly higher.

7 Intelligent Agents

Intelligent agents can be defined as entities that are able to perceive various events or changes in their environment through their sensors and that are also able to act upon these events or changes by using their effectors. Illustration of intelligent agent functionality is shown in Fig. 1 [1].

When considering intelligent agents, various classifications can be found. Müller gives the taxonomy of intelligent agents that is based on two dimensions [2]:

- First dimension
  - Hardware agents
  - Software agents
- Second dimension
  - Autonomous agents
  - Multiagents
  - Assistant agents

Hardware agents are of physical nature and they perform some kind of physical interaction with their environment which is also of physical nature. This kind of agent uses physical sensors and effectors to perform input and output actions. Although of physical nature, these agents have some software components that provide a basis for logical control over the hardware agent. On the other hand, software agents have no physical

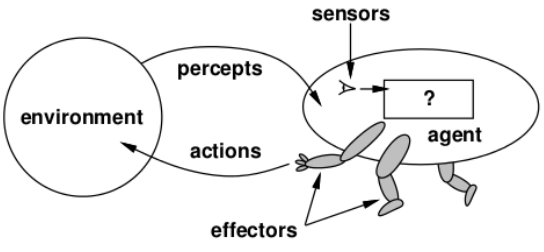

Figure 1: Functionality of intelligent agent

parts and are solely made of software components. Although of virtual nature, this kind of agents can interact with both virtual and real environments.

Autonomous agents represent agents that are able to control their own behavior in greater or lesser capacity. Multiagents are intelligent agents that are aware of other agents and have the ability to interact with these agents in collaborative manner in order to reach some specific goal. Assistant agents are mostly involved in communication with another agent which is in most cases a human agent. When taking into consideration mentioned dimensions several types of intelligent agents can be found [2]: autonomous hardware agents, autonomous software agents, hardware assistant agents, software assistant agents, hardware multiagents and software multiagents.

Autonomous hardware agents (HW-AU) are physical agents that have the ability of self-control and are used to control some kind of physical environment. Autonomous software agents (SW-AU) are virtual software agents that are able to control their own behavior and are used to control some form of virtual software environment. Hardware assistant agents (HW-AS) are physical agents that aid their users in some specific form of physical environment. Software assistant agents (SW-AS) are software based agents that are used to aid their users in some specific form of virtual software environment. Hardware multiagents (HW-MA) are agents of physical nature that communicate with other agents in order to achieve some mutual goal in more efficient way. Software multiagents (SW-MA) are software agents that communicate with other agents in a virtual environment in such a way that enables these agents to achieve some specific mutual goal.

Müller also gives a classification of intelligent agents that consists of five categories of intelligent agents [2]:

- Reactive agents
- Deliberative agents
- Interacting agents
- Layered approaches
- Others (believable agents, softbots, Internet software agents)

Reactive agents are intelligent agents that use very limited amount of input in order to produce some action. These agents are mostly based on simple situation-based rules that produce some valid action. Deliberative agents are intelligent agents that have some form of internal representation of the world and which base their decisions and actions on some form of symbolic reasoning. Interacting agents are intelligent agents that are able to interact and cooperate in order to achieve some goal. Layered approach includes structuring of intelligent agent's functionality in several layers which interact mutually in order to produce a valid overall behavior. Other intelligent agents include various types of intelligent agents such as believable agents that are able to resemble real agents from real world and real life.

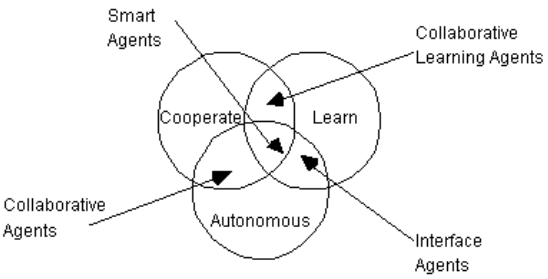

Figure 2: Nwana intelligent agents typology

Nwana has developed typology of intelligent agents that consists of the following types [3]:

- Collaborative agents
- Interface agents
- Mobile agents
- Information/Internet agents
- Reactive agents
- Hybrid agents
- Smart Agents

This typology is based on 3 basic characteristics of intelligent agents [3]: autonomy (the ability of intelligent agent to work on its own, without any guidance), cooperation (the ability of intelligent agent to interact and cooperate with other agents) and ability to learn (the ability of intelligent agent to interact with its environment, to react to this environment and to learn about it). An illustration of Nwana typology is shown in Fig. 2 [3].

Another well-known taxonomy of intelligent agents is the one given by Franklin & Graesser, shown in Table 2 [4].

Special types of intelligent agents that are able to communicate with users in a way that appears to be more sociable and that includes more of a character effect are often called intelligent assistants which can be defined as mediators of interaction and aiding agents that help their users in using some particular machine system. Conceptual model of intelligent assistant functionality is shown in Fig. 3 [15]. Frequently intelligent assistants also have some form of avatar that makes these assistants appear more similar to real human agents.

There are many examples of using intelligent agents in different areas of business, such as in [5]:

- Process Control

Table 2: Taxonomy of intelligent agents

Property	Other Names	Meaning
reactive	sensing and acting	responds in a timely fashion to changes in the environment
autonomous		exercises control over its own actions
goal-oriented	pro-active purposeful	does not simply act in response to the environment
temporally continuous		is a continuously running process
communicative	socially able	communicates with other agents, perhaps including people
learning	adaptive	changes its behavior based on its previous experience
mobile		able to transport itself from one machine to another
flexible		actions are not scripted
character		believable "personality" and emotional state

- Manufacturing
- Air Traffic Control
- Information Management
- Electronic Commerce
- Business Process Management
- Patient Monitoring
- Health Care
- Games
- Interactive Theater and Cinema

For example in electronic commerce a number of specific types of intelligent agents can be found [6]:

- Find and retrieve agents
- User agents
- Monitor surveillance agents
- Data mining agents
- Knowbots

Find and retrieve agents are the most common agents in electronic commerce. These agents are used to search the Web with the main goal of finding some desired information (best value for money, cheapest product, etc.). User agents are used to help their users in a specific work, such as planning a meeting. They are also able to learn various patterns that form different

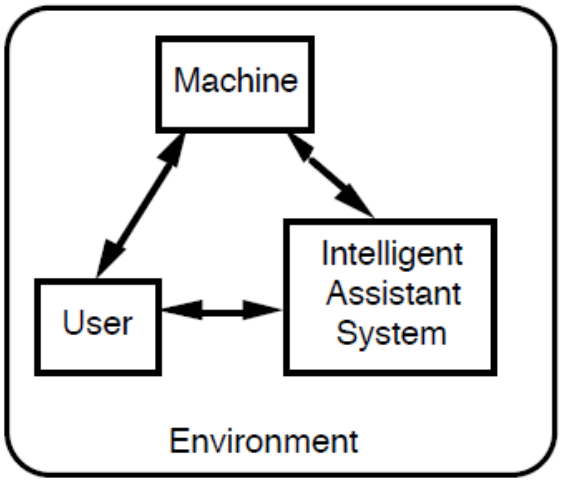

Figure 3: Functionality of intelligent agent

users' preference and are able to suggest courses of actions that correspond to these preferences. Monitoring and surveillance agents are intelligent agents that are able to perform various repetitive actions. This kind of actions include monitoring prices of various products and informing the user about changes in these prices or reporting about the occurrence of some products of interest. Data mining agents are used to gather and analyze data and predict various trends in some area of interest. Knowbots are intelligent agents that are mobile and are used to enhance various transactions and mediation processes.

Some concrete examples of intelligent agents in practice include [7; 8; 9; 10; 11; 12; 13; 14]: WEBSELL (used for aiding users in web sales), Office Assistant (used for helping office visitors and for help in management of office's schedule), CAT (Composition Analysis Tool) (used for helping users in creation of complete and consistent workflows), Triton (used for helping users in learning and usage of air travel planning system), TAC (The Architect's Collaborator) (used for helping architects in creating conceptual designs), Patient Advocate (used for patient-centered health care), PexA (used for helping in task and time management) and CAD (used for helping users in interaction with computer-aided-design system).

8 Further Research

Based on conducted analysis of players' behaviour, actions and habitual patterns, a part of future research will be design and development of an appropriate intelligent assistant that will be able to assist players in their in-game activities in the sense of suggesting various courses of action. For example, this kind of assistant would be able to suggest which skills should be developed first and which can be developed in a more prolonged manner, whether the player should join some particular party or not and which party would be the

most suitable for the player in general or to simply assist the player in creating the well-suited avatar that fits the player's profile.

This assistant would also be able to suggest the speed of acquiring items and the speed of progress that is sufficient to make player able to achieve the goals that have been set in a way that is most suited for the player and that will maximize the quality of player's in-game experience. Design and development of this kind of intelligent assistant and testing of its effectiveness in achieving better in-game experience will be one of the major parts of future research.

9 Conclusion

Computer games have been very popular source of entertainment since computers entered into mass usage. The usage of Internet has made online games popular and has changed the way in which the games are played. Games moved from mostly single-player mode to mostly multi-player way of gaming. In this kind of gaming players are asked to interact with other players and to collaborate in order to achieve the game goals. This kind of games is generally called Massively Multi-player Online (MMO) games and they include intensive social component. In this paper a research on MMORPG players' behavior and their habitual patterns, based on analysis of data gathered from players playing customized MMORPG The Mana World, has been presented and research results were discussed afterwards.

An overview of intelligent agents and intelligent assistants as a way of helping players to achieve better in-game experience has been given along with statement and elaboration of future research direction.

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