Automatic Mapping Between Gameplay And Aesthetics RPG Character Attributes Through Fuzzy System

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Abstract

Role-Playing Games (RPG) are widely popular, and the idea of living in a parallel virtual world has attracted players for decades. Currently, as RPGs come in several flavors, such as tabletop RPG and eletronic media, one feature is paramount: character customization, in which the player has the ability to choose gameplay (and sometimes visual) character attributes. However, when a player decides his favorite values for gameplay attributes (such as strength or dexterity), the 3D character he sees has no correlation with these attributes. In this work, we propose a system that can automatically map from gameplay attributes to character aesthetics by using fuzzy system, which knowledge base is derived from players' knowledge. Besides detailing the technique, we present a complete user experiment that includes from rules definition to validation of results.

Keywords:: RPG, Fuzzy System, Character Creation

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1 Introduction

Role-Playing Games (RPG) are a very popular genre, and the idea of taking part of a parallel world is attractive to many people, both in traditional form (tabletop RPG), live-action, or in eletronic media. To enhance the immersion, the player generally is presented with the possibility to customize his own characters, choosing abilities, clothes, appearance, etc. [Feil and Scattergood 2005]. In fact, the power of customizing a character is considered the most important feature to get a player involved in an RPG [Tychsen et al. 2006].

Tabletop RPG players may customize theirs characters in several ways, being one of them the definition of gameplay attributes, also known as statistics or traits. These gameplay attributes of a character are often described as pure textual information (such as "strength 7" or "dodge 4"), without any visual representation of an avatar based on these characteristics. In the other hand, in eletronic RPGs, the player usually may also define some appearance attributes of the character, such as height, belly width and arm size. But these are aesthetics attributes, and if the player wants to know, based solely on his 3D modeled character, how much strength and dodge his character has, there's no guaranteed coherence between aesthetics and gameplay attributes.

For the human being, it is normal to describe the environment using natural language, through perceptions which are intrinsically imprecise [Zadeh 2008]. So, if we ask a player to describe how a 3D model of a character with "strength 10" (in a range from 0 to 10) should look like, it is expected that we receive an answer such as "the character will have big arms" than something like "the character will have an arm with 15 units of radius". To build a system to aid players in modeling 3D avatars, we need to simulate the human ability to reason and take rational decisions in an environment filled with such imprecise informations.

In this work, we present a method to automatically map a character's gameplay attributes to aesthetics parameters and vice versa. We take advantage of the feasability of fuzzy logic rules [Zadeh 1975] as elements of RPG character creation and definition. The system's knowledge is built within an interactive technique we devised to gather information from specialist users. We also ran an experiment with game players in which a 3D avatar had its aesthetics parameters automatically set based on the fuzzy system.

1.1 Contributions

This paper presents the following novel aspects to procedural character creation:

- A dual method to map from gameplay attributes to aesthetic attributes and vice versa. This conversion is executed by a fuzzy-logic system based on specialists knowledge;
- An automatic system that can be plugged in an electronic RPG. The player chooses his desired gameplay attributes, and the system configures a cohese 3D model;
- An interative technique to collect information from RPG specilialists, and create the fuzzy rules;
- A user experiment about fuzzification and defuzzification of character's attributes. Knowledge of several players is used to build the fuzzy sets.

The rest of this paper is organized as follows: Section 2 discusses related work on procedural content generation and the use of fuzzy systems in games. Section 3 explains our character creation model. Section 4 details our fuzzy system for the proposed method of dual mapping for attributes. Section 5 shows how we generate the IF-THEN fuzzy rules, while Section 6 presents experiments and results. Finally, Section 7 ends up with conclusions, limitations and ideas for future work.

2 Related Works

Well-defined characters are the basis for a successful Role-Playing Game. The player has a character as an open door to a virtual world, and without this character that impersonates the player's desires, immersion becomes hearder to achieve [Lankoski 2004]. For a better gaming experience, the player needs to recognize his character as a extension of his mind, and a way to do this is personalizing his traits, appearance, history and so on. The custom virtual character will be an interesting and a stronger link between the player and the game [Vanhatupa 2011; Tychsen et al. 2008].

Given that character customization is such an important aspect of an RPG, our automatic system does not intend to change what the player wants for his character, but our system is designed to convert automatically the personalization from one type of attribute to the other: from custom gameplay attributes to an equivalent custom 3D avatar. We didn't find in literature tools or papers proposing goals similiar to our main goal, convertion between different types of character's attributes. Nevertheles, our proposal may be seen as a joint work between procedural content generation and fuzzy systems, so in the next subsections we describe some previous works in each of these fields.

2.1 Procedural Content Generation

Procedural Content Generation (PCG) is a term used to describe techniques and algorithms that automatically generate game content [Togelius et al. 2011]. These techniques can also offer to the user some form of parametric controls as a way to manage the entry values and get different results. The work of Mark Hendrikx [Hendrikx et al. 2013] was the first detailed survey in the PCG field, where the authors propose a six-layered taxonomy to describe each strand of game content creation, as follows:

- **Game Bits:** These elements generally don't make all users happy when viewed as a single piece, but together are essential parts of the game. This include vegation, textures, sound and etc. Karl Sims [Sims 1991] develops in his work a set of evolutionary techniques to generate complex textures, allowing interactions from users as a way to guide the process. Some advanced combination can be seen in the work of Bernd Lintermann [Lintermann and Deussen 1999], where a combination of rule-based systems and geometric modeling are proposed to generate fast and complex types of plants. Our work fits on this field, because we intend to automatically generate character's attributes based in some other attributes, so these new generated traits can be used inside the game, customizing NPCs (Non-Player Characters), for example;

- **Game Space:** It is the place where game happens and the player can interact with items of game bits. Two major subdivions of this are indoor and outdoor maps. The work of Smelik [Smelik and Tutenel 2010] puts together several procedural techniques to interactively create a 3D world, even for non-specialist users. Ian Parberry [Parberry 2014] propose the use of spatial analysis of real elevation data to create, procedurally, more realistic terrains;

- **Game Systems:** These are systems that model and simulate a diversity of behaviors, they intend to make games more believable and realistic, instead of monotonous and predictable. Some examples are complex systems to simulate animals and ecosystems, urban environments with cities, people, weather and so on. Basil Weber [Weber et al. 2009] proposes a system that can simulate a whole urban city model over time;

- **Game Scenarios:** Game scenarios characterize the way as a game will unfold, and how will be the sequence of game events proposed to the player. Game scenarios can be strutucted like puzzles, stories and game levels. Joshua Taylor [Taylor and Parberry 2011] proposes an algorithm to generate levels of the Japanese puzzle Sokoban, with guarantee of a solvable instance. Julian Togelius [Togelius et al. 2007] and his team developed an evolutionary algorithm to generate better racing tracks based on a particular human player;

- **Game Design:** It is made up of game's rules and goals. A game is a specific instance of game design, this instance holds what a player can do and what a player has to do. The paper of Nathan Sorenson [Sorenson et al. 2011] proposes a model to estimate the entertainment value of game levels design, and uses this information to generate new fun levels of the game;

- **Derived Content:** It is all the content that is created outside the game universe, like news and player rankings in blog or television broadcasts. Chia-Jung Chan [Chan et al. 2009] presents a system to automatically generate comics using players's actions inside game world, and Yun-Guyng Cheong [Cheong et al. 2008] describes a system that use game logs as input for generating visualization of the summarized actions in the game session.

2.2 Fuzzy Systems in Games

As in real life, games produce lots of imprecise data, not perfect measures, which are still good enough to process into useful information about the player, game, strategies and much more. This data, given its imprecise nature, can be faceted using fuzzy systems. The use of fuzzy decision trees, for example, can be seen in the work of Onisawa and Yano [Onisawa and Yano 2006], where this technique is applied to a system with the intent to simulate a bot that uses strategies like human players in the game of poker.

The widely known game rock-paper-scissors receive an automated judgment by the use of fuzzy *c*-means [Matsumoto et al. 2012], a type of algorithm used for clusterization, instead of applying some complex image processing. The paper of Xiangfeng Luo [Luo et al. 2009] proposes an improved fuzzy cognitive map to develop game-based learning systems. Peter Loh [Loh and Prakash 2009] reveal competitive perfomance of fuzzy moving target search among other algorithms that equip bots with the possibility of tracking human player locations, and Peter Li [Li et al. 2011] apply a fuzzy-measure-based technique as tool to help the multi-criteria problem of selecting units in a real time strategy game.

3 RPG Character Model

Our character model represents which attributes will be considered by the system. This model then can be used to gather information from specialists to build the knowledge base. Our system purposes a map between gameplay and aesthetics attributes, so the character model consists of these two types. Figure 3 illustrates our model and in the next subsections each attribute type is described in more detail.

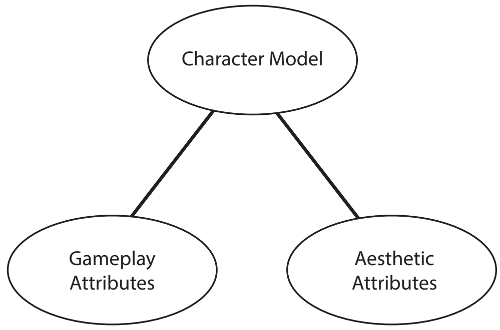

Figure 1: *Character model with two sets of attributes: gameplay and aesthetics.*

3.1 Gameplay attributes

These are non-visual attributes that give information about the character. Each game and context has its own types of characteristcs to describe it. For instance, the six gameplay attributes used in one of the most popular tabletop RPGs, Dungeons and Drangons [Heinsoo et al. 2008], are:

- **Strength:** Physical power;
- **Constitution:** Health, stamina, vital force;
- **Dexterity:** Hand-eye coordination, agility, reflexes, balance;
- **Intelligence:** Ability to learn and to reason;
- **Wisdow:** Common sense, perception, self-discipline;
- **Charisma:** Force of personality, persuasiveness, leadership.

For our experimentation, we have chosen two of these attributes: *strength* and *dexterity*. We picked theses two attributes because they are also commonly associated with aesthetics attributes. As as clarification, any other combination of chacteristics could be used, as long as an specialist is able create fuzzy rules to map between them.

3.2 Aesthetic attributes

Aesthetic attributes represent the character's visual information, in which are included all the attributes that can give some details about appearence, skin color, clothes and so on. To control these aspects, we are using the UMA (Unity Multipurpose Avatar) framework [Ribeiro 2014], a tool for procedural content generation that provides procedural controls to several parts of a full-body 3D avatar. For example, in a human body avatar we can manipulate: body height, head size, arm length and waist. This tool also alows the use of custom assets such as clothes to be used together with the generated 3D avatars.

For our experiments, we simplified some of the existing controls in UMA into three aesthetic attributes: breasts, belly and legs. Figure 2 illustrates which other body parts are also influenced by these aesthetic attributes:

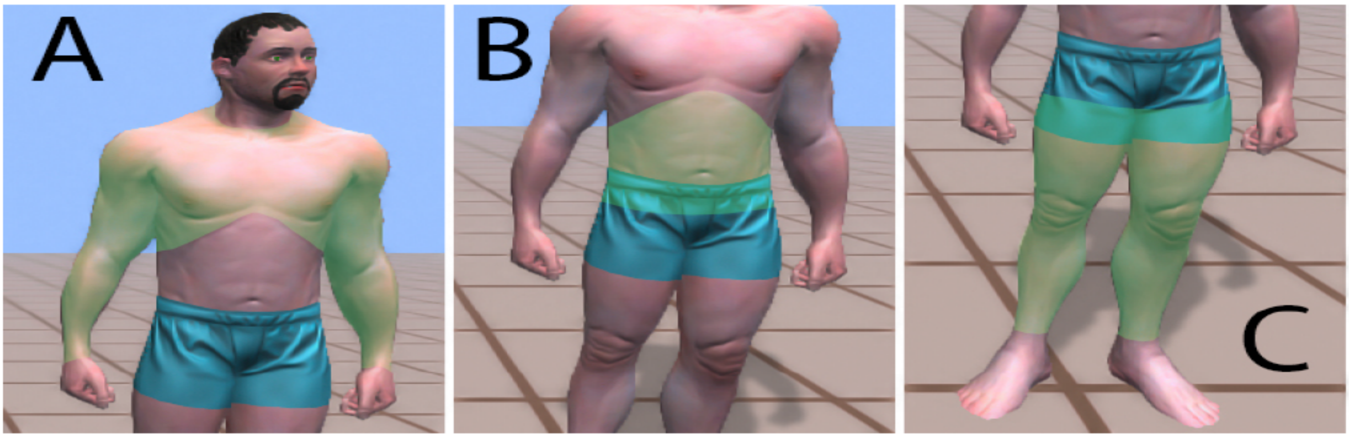

Figure 2: *Human body parts influenced by the aesthetics attributes.*

- **A - Breasts:** It influences the top part of the body, like body breasts, arm width and arm length;
- **B - Belly:** It influences the middle part of the body, like belly and waist;
- **C - Legs:** It influences the bottom part of the body, like legs width and legs length.

4 Fuzzy System for Character Creation

The knowledge of human being is like a cloud of thoughts, perceptions and ideas that don't have a clear border. Because of this, a perfect mathematical model is unfeasible to be defined for some tasks. A lot of work has been developed to express this brain information in the computer science field, and one of them is known by his practicality and simplicity, fuzzy systems [Rojas et al. 2000]. Fuzzy systems owe their popularity to the ability of representing complex relations through linguistics terms, essential piece of natural language.

Our technique is based on a fuzzy rule-based system, and the jFuzzyLogic library [Cingolani and Alcala-Fdez 2012; Cingolani and Alcalá-Fdez 2013] was used to design the fuzzy logic controllers according to the fuzzy control language (FCL) standard. Figure 3 shows the main parts of our fuzzy system structure: fuzzification, rulebase, database, inference system, defuzzification.

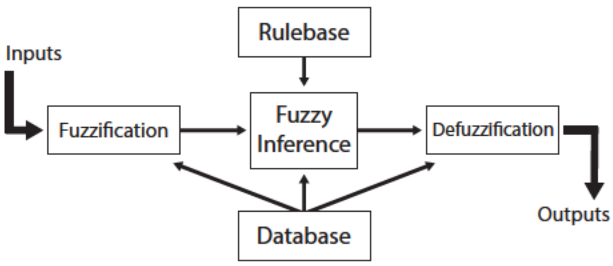

Figure 3: *Fuzzy system structure.*

4.1 Database

In the database, the membership functions associated to each fuzzy set are kept. A membership function gives to each element-fuzzy set pair a membership grade ranging from zero to one, where zero indicates no relationship between the element and the fuzzy set, and one indicates a maximum relationship. This is different from a classical set where an element's membership must be false or true only, not a value. Specifying and detailing membership functions and its parameters is an essential part in the fuzzy inference process [Chen and Wang 1999].

The database also contains the domain range of each variable, input or output, to be used together with the membership functions. Each game can have its own variables range. The strength attribute, for example, may vary from 0 to 5 in a game, while in other may vary from 10 to 100. Because of this, we decided to make a more generic approach to our current system, which is illustrated by Figure 4 and detailed as follows:

- **Variables (Input and Output):** Each variable will have a fixed domain ranging from 0 to 10;
- **Membership functions for gameplay attributes:** Gameplay attributes will have three linguistic terms, in simple triangular shape, corresponding to the expressions low, moderate and high;
- **Membership functions for aesthetics attributes:** Aesthetic attributes will also have three linguistic terms, in triangular shape, corresponding to the expressions little, moderate and big.

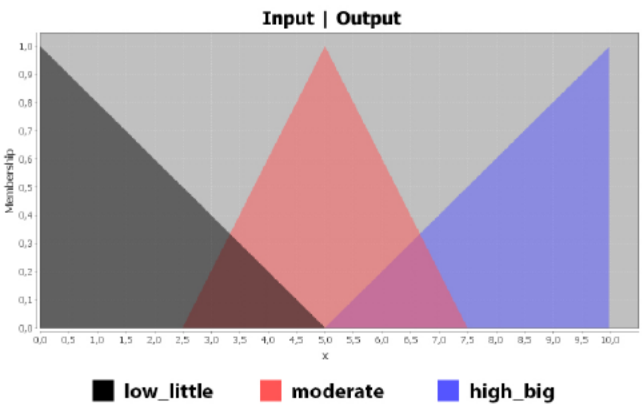

Figure 4: *Membership function configuration for input/output variables.*

Information about which are input and output variables are taken from our character model. When the goal of the system is to convert from A to B, the input will be A and the output will be B. For example, to convert from gameplay attributes to aesthetic attributes, the inputs are gameplay attributes (strength, dexterity, etc) defined in character model and the outputs are the aesthetic ones (breasts, belly, etc).

4.2 Fuzzification and Defuzzification

Fuzzification and defuzzification are the first and last part of the fuzzy system, respectively. In fuzzification, inputs are transformed from precise (numerical) values to linguistic terms through application of membership functions. For example, if strength attribute value was 7, this value will be converted to each linguistic term described in gameplay membership function, as in Table 1:

Linguistic term	Membership value
low	0.0
moderate	0.2
high	0.4

Table 1: *Examples of resultant membership values after fuzzification of the strength attribute with value 7.*

Defuzzification does the opposite of fuzzification, converting from fuzzy values to an exact numeric value. To get these numeric values from a fuzzy system, several different methods are proposed to solve defuzzification: centroid method, weighted average method and max membership principle are knowns examples in literature [Hellendoorn and Thomas 1993]. The centroid method, also known as center of gravity (COG), was chosen for it is the most accurate and commonly used [Tahriri et al. 2014]. COG method can be formulated as in equation 1:

$$Z^* = \frac{\int \mu_L(z)\, z\, \mathrm{d}z}{\int \mu_L(z)\, \mathrm{d}z} \quad (1)$$

Where:

Z^*: Defuzzified output

z: Domain value

$\mu_L(z)$: Membership value of z in the fuzzy set associated with linguistic term L

4.3 Fuzzy Inference and Rulebase

One of the most common ways to represent human knowledge in a fuzzy system is the use of IF-THEN rules [Ross 2010]. These rules express a way to infer a conclusive fact based on a hypothesis fact. An example can be seen in Table 2.

Rule model:	**IF hypothesis THEN conclusion**
Rule example:	IF strength IS high THEN arm IS big

Table 2: *Rule model and a rule example.*

In our system, specialists' knowledge is used to generate a rulebase, and after the rules are created, it is possible to do the inference process and calculate, for example (Table 2), how big will the character's arms ("arm IS big") be given how high the value of his strength ("strength IS high") is. An interative approach was used to get this specialists' knowledge, and this approach will be detailed in next section. As an additional information, the following configurations were applied to our fuzzy system:

Method	Operator
AND's T-Norm	MIN
Implication	MIN
Aggregation	MAX
Defuzzification	COG

Table 3: *Configuration used in the fuzzy system.*

5 Fuzzification Rules

To create our fuzzy system's rulebase, we developed an interactive application that gathers all necessary information from the specialists. To collect this information, automatically generated questions are asked and the answers are recorded for a future processing phase (subsection 5.1). Each question asked is based on a possible hypothesis fact that mixes input variables and linguistic terms, and all possible questions are asked. An example is shown in Table 4, supposing 'strength' and 'dexterity' gameplay attributes as input variables, and only 'low' and 'high' as linguistic terms.

#	Question
1	strength IS low AND dexterity IS low
2	strength IS low AND dexterity IS high
3	strength IS high AND dexterity IS low
4	strength IS high AND dexterity IS high

Table 4: *An example of all possible questions for a scenario with two input variables and two linguistic terms.*

These questions are softly modified when asked to the specialist, depending of which goal was chosen for the mapping system. In case of gameplay to aesthetic attributes, questions are asked as "Model a character with the following attributes: strength high and dexterity low", and the user response is a visual configuration of sliders. Each slider controls the influence of a single aesthetic value, as can be seen in Figure 5. In the opposite case, aesthetic to gameplay attributes, it is almost the same as before, but instead of asking for aesthetic informations the system presents to the specialist a preset 3D avatar and asks for gameplay values to be set on sliders that resemble that avatar.

5.1 Processing phase

The goal of the processing phase is to build an IF-THEN rule for each question asked to the specialists. As sliders have a free movement inside the variable's domain range, a single answer from a specialist is a set of V float values from the sliders' configuration, where V is the number of output variables. So, to combine responses of all specialists a mean value is taken, as in equation 2.

$$X_{qv} = \frac{\sum_{i=1}^{s} A_{qv}(S_i)}{s} \quad (2)$$

Where:

X_{qv}: Resultant value for question q and output variable v

s: Number of specialists

S_i: Specialist i

A_{qv}: Value given by specialist i to output variable v in question q

To every X_{qv}, there must be a liguistic term associated, and after identifying all these terms it is possible to construct the entire rulebase. To discover which linguistic term to use, we fuzzify X_{qv} in all possible terms defined for output variable v, then we take the linguistic term with the higher membership value. Table 4 can be extended to Table 5, showing an example of how a rulebase can be, supposing an unique output variable 'arm' with three linguistic terms defined: 'little', 'moderate' and 'big'.

Figure 5: *Example of view to collect specialist's responses.*

#	Rule
1	str IS low AND dex IS low **THEN arm IS little**
2	str IS low AND dex IS high **THEN arm IS little**
3	str IS high AND dex IS low **THEN arm IS moderate**
4	str IS high AND dex IS high **THEN arm IS big**

Table 5: *A possible complete rulebase based on example questions defined in Table 4.*

6 Experiment and results

An experiment was conducted with five game players, with the goal to generate a rulebase to support conversion from gameplay attributes to aesthetic attributes. To each player, an explanation about the attributes used in our character model was presented based on section 3's content. As our character model has two gameplay attributes (which are input variables in the experiment) and three linguistic terms, the number of all possible questions is nine, so all players answered nine questions which are similar to Figure 5. The questions presented are shown in Table 6 and the responses for each player is in Tables 7, 8 and 9. Each cell of a response tables has the pattern: "**breasts value** | **belly value** | **legs value**";

#	Question
1	strength IS low AND dexterity IS low
2	strength IS low AND dexterity IS moderate
3	strength IS low AND dexterity IS high
4	strength IS moderate AND dexterity IS low
5	strength IS moderate AND dexterity IS moderate
6	strength IS moderate AND dexterity IS high
7	strength IS high AND dexterity IS low
8	strength IS high AND dexterity IS moderate
9	strength IS high AND dexterity IS high

Table 6: *Questions asked to each game player.*

#	Question 1	Question 2	Question 3
1	3.85 | 3.40 | 3.40	5.08 | 3.15 | 4.62	5.50 | 2.34 | 4.85
2	1.67 | 8.41 | 1.64	1.67 | 4.75 | 4.70	1.67 | 0.71 | 3.70
3	2.84 | 2.84 | 2.18	4.94 | 4.41 | 4.76	4.81 | 4.76 | 4.64
4	0.00 | 10.0 | 0.00	0.00 | 10.0 | 0.00	0.00 | 0.00 | 6.37
5	2.52 | 4.30 | 2.92	2.74 | 2.87 | 2.92	4.27 | 2.24 | 4.67

Table 7: *Players' response to questions 1, 2 and 3.*

#	Question 4	Question 5	Question 6
1	4.85 | 2.34 | 4.85	4.85 | 3.47 | 4.85	5.95 | 2.17 | 6.83
2	5.10 | 5.13 | 1.17	5.10 | 4.95 | 4.90	5.10 | 0.86 | 6.00
3	5.71 | 3.91 | 3.61	5.46 | 4.69 | 5.21	5.71 | 0.55 | 5.49
4	4.96 | 0.00 | 6.37	5.04 | 0.00 | 8.42	6.17 | 0.00 | 10.0
5	6.08 | 3.77 | 6.03	5.65 | 2.74 | 4.77	4.95 | 5.08 | 4.15

Table 8: *Players' response to questions 4, 5 and 6.*

#	Question 7	Question 8	Question 9
1	5.95 | 2.17 | 5.23	5.95 | 4.30 | 5.23	6.80 | 4.30 | 7.66
2	8.38 | 6.70 | 1.39	8.38 | 5.05 | 5.05	8.38 | 0.00 | 6.53
3	6.32 | 0.00 | 4.61	6.32 | 3.31 | 6.24	7.27 | 2.41 | 6.84
4	10.0 | 10.0 | 1.65	10.0 | 4.94 | 6.94	10.0 | 0.00 | 10.0
5	8.21 | 4.42 | 7.51	7.41 | 3.95 | 6.13	8.48 | 3.25 | 7.78

Table 9: *Players' response to questions 7, 8 and 9.*

Following equation 2, all mean values were calculated and the linguistic term associated to each X_{qv} was determined. Table 10 shows the result of this operation, and Table 11 shows the final FCL rules derived from this experiment.

Output Attribute	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	Q 7	Q 8	Q 9
Breasts	2.18 - L	2.89 - L	3.25 - L	5.34 - M	5.22 - M	5.58 - M	7.77 - B	7.61 - B	8.19 - B
Legs	2.03 - L	3.40 - M	4.85 - M	4.41 - M	5.63 - M	6.49 - M	4.08 - M	5.92 - M	7.76 - B
Belly	5.79 - M	5.04 - M	2.01 - L	3.03 - L	3.17 - L	1.73 - L	4.66 - M	4.31 - M	1.99 - L

Table 10: *Resultant mean value and liguistic term for each output attribute in all questions. Legend is: L - Little, M - Moderate and B - Big.*

FCL Rule
RULE 1 : IF strength is low AND dexterity is low THEN breasts is little, legs is little, belly is moderate;
RULE 2 : IF strength is low AND dexterity is moderate THEN breasts is little, legs is moderate, belly is moderate;
RULE 3 : IF strength is low AND dexterity is high THEN breasts is little, legs is moderate, belly is little;
RULE 4 : IF strength is moderate AND dexterity is low THEN breasts is moderate, legs is moderate, belly is little;
RULE 5 : IF strength is moderate AND dexterity is moderate THEN breasts is moderate, legs is moderate, belly is little;
RULE 6 : IF strength is moderate AND dexterity is high THEN breasts is moderate, legs is moderate, belly is little;
RULE 7 : IF strength is high AND dexterity is low THEN breasts is big, legs is moderate, belly is moderate;
RULE 8 : IF strength is high AND dexterity is moderate THEN breasts is big, legs is moderate, belly is moderate;
RULE 9 : IF strength is high AND dexterity is high THEN breasts is big, legs is big, belly is little;

Table 11: *Rulebase created with experiment's information.*

After creation of the rulebase, our fuzzy system is capable of converting from the gameplay attributes to the aesthetic attributes chosen as our character model. To illustrate the technique's use, two 3D avatar models were generated using Table 12's input information. The visual result of this generated models can be seen in Figure 6.

Model	Strength	Dexterity
Left	1	2
Right	9	8

Table 12: *Input information used to generate Figure 6.*

Figure 6: *Two 3D models generated by the fuzzy system.*

7 Conclusion and Future Work

As a conclusion for this paper, we consider fuzzy systems as a feasible approach to automatically map between two different types of RPG character's attributes, such as gameplay to aesthetics. The results of our experiment show a 3D avatar (right 3D model in Figure 6) with more physical power (big arms and breasts) and better agility and balance (tinier belly and long legs) when compared to the other 3D avatar (left 3D model of Figure 6) generated based on lower values for 'strength' and 'dexterity'. We also list some current limitations of our proposal:

- **Rulebase generation:** To create a complete rulebase it is necessary combine all input variables and linguistic terms, this combination may generate a huge number of questions, which might become infeasible to be asked to a specialist;
- **Number of input and output variables:** The number of variables can confuse the specialist's actions. In our experiment, the number of inputs are two and outputs are three, but in a scenario with more variables it will be a hard task pick the right values;
- **Game player experience:** Each player can have his own game experience and preferences, and also different definition of strength, dexterity, intelligence and so on.

Thiese limitation may be seen as a guide to a future work, with which we conclude this paper by showing what we intend to develop as improvements:

- **Distributed rulebase acquisition:** by 'distributed' we mean questions split among several specialits, reducing time and ammount of work to each player. Another possible improvement is dividing the number of variables to make questions easier to be answered;
- **Experiments with well-defined groups of players:** A well-defined group of players is a group where all participants have similar game experience, thus responses tends be more correlated;
- **Clothes and character's acessories:** Adding clothes and other accessories can expand the scope of aesthetic attributes, giving more power of customization;

- **Female gender and different race types:** The experiment realized has only male gender and an unique type of 3D model template, we want to incorporate female characters and other race types, enhacing the knowledge acquisition;
- **Framework:** As final improvement, we intend to publish our system as a framework and share it with other researchers and game developers. This framework will be highly customizable, with the possility to change: fuzzy system's configurations, attributes of character model, 3D avatar template, clothes and acessories.

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