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Evolution of Camerawork in Automatic Comic Generation Using Interactive Genetic Algorithm with Feedbacks from the User Model

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***Abstract*—In our previous systems for automatic comic generation, camerawork parameters were determined by using an interactive genetic algorithm (IGA) with direct user feedbacks or was determined manually through an equipped user interface. The former approach periodically needs direct feedbacks, on multiple comics generated during evolution, from the user, imposing a burden on the the user. The latter approach asks the user to manually perform the camerawork setting for every frame, which lacks diversity because only one comic is produced. In this work, we propose a method that combines the above two: ask the user to manually set the camerawork for each frame, construct the user model based on the determined camerawork parameters, and use the user model, instead of the user themselves, to give feedbacks in IGA. We aim at reducing the user's burden while achieving highly satisfactory resulting comics.**

I. Introduction

Online games in recent years are equipped with the ability to output the data (log) that record a sequence of actions played by a user for replaying the user's game experience, and some of them have also a function called "machinima" to produce a movie from the recorded log. Previous work exists that represents such game experiences in the form of comics [1]. For this system, a number of methods were later developed, such as frame selection based on an interactive genetic algorithm (IGA) [2] and manual determination of camerawork via a user interface [3]. Related work to determine the camerawork in machinima exists, e.g., automatic camerawork determination [4] and interactive camerawork approach [5]. In general, an interactive approach allows more accurate shooting and more stability, compared to manual control, and more freedom in creativity compared to automatic control.

In order to resolve the issues in the above camerawork methods, mentioned in the abstract, we propose in this paper an IGA camerawork method that first creates a user model based on the user's preferences in camera setting and then uses this user model for selecting the best and worst individual in a given sub-population. The proposed method defines the subjective fitness of each individual in that sub-population based on its similarity to the best and worst individual. In addition, it defines the the objective fitness of each individual based on a popular cinematography rule Don't Cross the Line and on the exposer degree of the main character (the degree the main character is unblocked by any obstacles).

II. Proposed Method

A. User Modeling by Sub-Camera Module

This module simulates the user's game experience from the log. The user manually operates this module in order to determine the timing for snapshotting a comic frame and the camerawork parameters therein. Such information determined by the user is then recorded. In IGA, described later, the best/worst individual is the one whose parameters are closest/furthest to the parameters determined by the user at the same frame.

B. IGA

An individual in the population consists of three elements (angle, position, and shot distance) as shown in Fig. 1. Each element is quantized to have 8 patterns represented using a 3-digit binary representation. To reduce a chance in getting trapped by a local optimum, we adopt the distributed genetic algorithm (DGA) [6] in this work. In DGA, the population is divided into multiple sub-populations, and genetic operations are conducted independently in each sub-population.

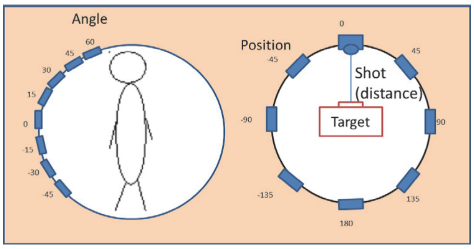

Fig. 1. Three camerawork parameters: Angle, Position, and Shot

C. Fitness

We use the fitness that is constructed by a combination of the subjective fitness and the objective fitness described below. Our aim is that of maximizing these two fitness functions, each normalized to have a value in the range $[0, 1]$. The subjective fitness Sub is defined as

$$Sub = 1 - \frac{\sum_{i=1}^{N} Euclid(Best, i) - Euclid(Worst, i)}{2N\sqrt{3}}, \quad (1)$$

where N is the number of comic frames, $Euclid(Best, i)$ and $Euclid(Worst, i)$ represent the Euclidean distance from individual i to the best and worst individual in the corresponding sub-population, respectively.

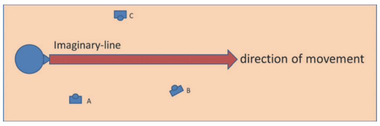

Fig. 2. Example of a case where the imaginary line is crossed and is not crossed

Next for the objective fitness, we introduce two criteria: the first one for dealing with the smoothness in the transition of camerawork parameters and the second one for dealing with the exposer degree. As for the first criterion, we divide the frames in chronological order into multiple chunks, each consisting of three frames. For each chunk, we then examine the each pair of two consecutive frames and set the smoothness of pair i, $F(i)$, to 1 if the camerawork parameters change smoothly, otherwise to 0. In the example in Fig. 2 for *camera position*, assume that the first frame has the camera position at A; if the camera in the next frame is at B, then $F = 1$; however, if the camera is at C, then $F = 0$. In this example, the camera does not cross the imaginary line in the former while crossing the line in the latter case. The objective fitness function about the smoothness Obj_1 is given by

$$Obj_1 = \frac{\sum_{i=1}^{N/3} \frac{\sum_{j=A,P,S}^{2} F_i(j)}{2}}{N/3}, \tag{2}$$

The other objective fitness Obj_2 defines the degree the main character is not blocked by any obstacles in a frame of interest. It is given as

$$Obj_2 = (The\ number\ of\ unblocked\ frames)/N \tag{3}$$

Finally, the total fitness is defined as

$$fitness = 1/2Sub + 1/4Obj_1 + 1/4Obj_2 \tag{4}$$

Figure 3 shows an example of a resulting comic, the one with the highest fitness value and the end of evolution.

III. User Evaluation

We carried out a user evaluation where 10 evaluators were asked to compare a comic generated by the proposed method, comic with randomly assigned camerawork parameters, and comic with the user-model camerawork parameters, all from their own experiences. Each evaluator first plays the game developed for this experiment using Unity[1], from which the game log is recorded. Then, the above three comics are generated accordingly and presented to the evaluator. The evaluator must rank the three comics. Table 1 shows the evaluation results, which confirm the effectiveness of the proposed method over the other two methods.

[1]http://japan.unity3d.com/

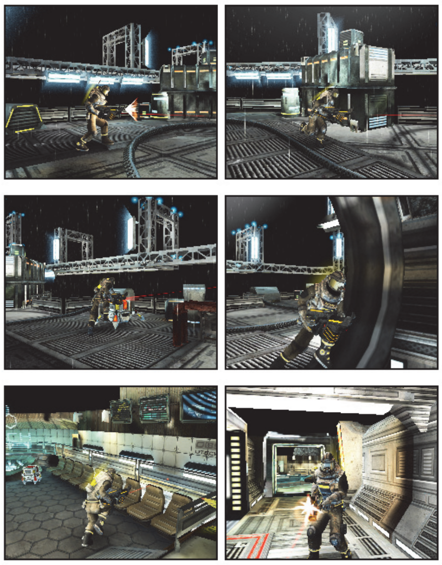

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Fig. 3. Example of a resulting comic

TABLE I. Evaluation Results

	Rank 1st	Rank 2nd	Rank 3rd
Random	2	4	4
User Model	3	2	5
Proposed Method	5	4	1

IV. Conclusions

By introducing the user model into IGA,we can reduce a burden on the user while maintaining the user's satisfaction to the generated comics. However, the proposed method still generated a comic which includes unacceptable frame, where some parts of the main character are hidden behind obstacles. We consider this is due to our mechanism for Obj_2 and therefore plan to advance the mechanism in near future.

References

[1] Ruck Thawonmas and Tomonori Shuda, "Comic Layout for Automatic Comic Generation from Game Log," IFIP International Federation for Information Processing, vol. 279/2008, pp. 105–115, 2008.

[2] Ruck Thawonmas and Yoshinori Tani, "Frame Selection Using Iterative Grammatical Evolution for Automatic Comic Generation from Game Logs," Proc. of the 2011 IEEE Conference on Computational Intelligence and Games (CIG2011), Seoul, South Korea, pp. 31–38, 2011.

[3] Ruck Thawonmas, Ko Oda, and Tomonori Shuda, "Camerawork Editor for Automatic Comic Generation from Game Log," CD-ROM Proc. of Nicograph International 2009, Kanazawa, Japan, Jun., 2009.

[4] Marc Christie, "Film Editing for Third Person Games and Machinima," Workshop on Intelligent Cinematography and Editing, 2012.

[5] Wenfeng Hu, "A Semiautomatic Control Technique for Machinima Virtual Camera ", Proc. of Computer Science and Electronics Engineering (ICCSEE), 2012, Vol. 1, pp. 112–115, 2012.

[6] Theodore C. Belding, "The Distributed Genetic Algorithm Revisited," Proc. of the 6th International Conference on Genetic Algorithms, pp. 114–121, 1995.