A Study on Crowd Simulation Effects through Marker-Based Multi-Object Augmentation

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Abstract

We have carried out research on high-speed crowd simulation effects through marker-based multi-object augmentation as the basis for a crowd scene processing system that can produce natural movement of a crowd with less resources and operation. When applied to 3D AR images, this method is expected to achieve high efficiency with less mobile resources.

Keywords: *Augmented Reality, Crowd Simulation, Multi-Object..*

1. Introduction

A crowd of moving people or animals is frequently observed in daily life and such a scene in which a number of people appear at the same time is called a crowd scene (or a mob scene) [1]. In 3D images a crowd scene is important because it is a part of daily life. A crowd scene is essential to a scenario and increases reality. And AR can be applied to a crowd scene for commercial purposes [2].

A large number of people appear in a crowd scene but the scene is used in a limited manner. And if we employ a common method to produce the scene, it would take a lot of time and efforts. Additionally, those in a crowd scene are not major characters and, therefore, the scene should be created with less time and resources with a different method.

Hence, we have carried out research on high-speed crowd simulation effects through marker-based multi-object augmentation as the basis for a crowd scene processing system that can produce natural movement of a crowd with less resources and operation.

2. Related Researches

2.1. Marker Detection and Copy

In order to recognize a marker, we selected one of edge points of a tag area within a marker, extracted an edge point farthest away from the selected point using Pythagoras' theorem, and extracted a total of 4 edge points in the same way [3].

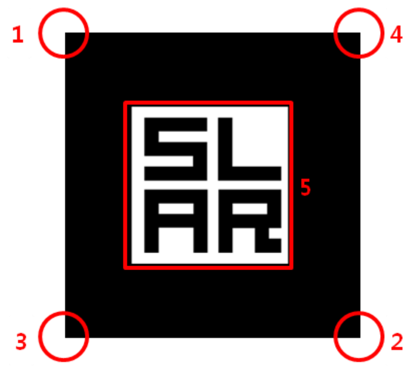

Figure 1. ROI of Marker

Using the 4 extracted points, we extracted marker ROI (Region of interest) for the tag area of the marker[4]. And the formula is as follows.

$$\begin{aligned} RectArea &= \frac{1}{2}(x_1y_2 - x_2y_1 + x_2y_3 - x_3y_2 + \ldots + x_ny_1 - x_1y_n) \\ &= \frac{1}{2}x_1(y_2 - y_n) + x_2(y_3 - y_1) + \ldots + x_n(y_1 - y_{n-1}) \end{aligned} \quad (1)$$

Finally, we detected and copied the marker using PPHT(Progressive Probabilistic Hough Transform)[5] .

2.2. Removal of Overlapped Marker Area

In order to remove an overlapped marker area, we created a circle area surrounding the marker by finding out the center of the marker [6]. The following scene was produced by creating the center for the marker first recognized by a camera, creating a circle area with a radius of the distance between the center and the farthest vertex, and completing marker area controlling.

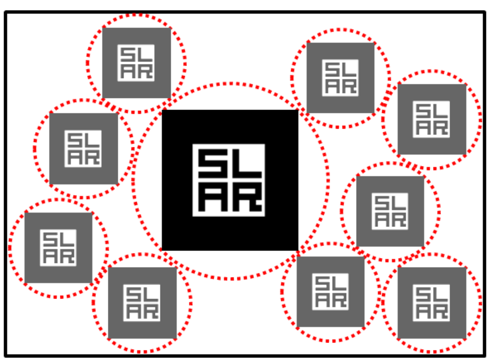

Figure 2. Output of Completed Marker Area Controlling

In this study, we attempted to produce crowd simulation effects by moving each object to a position designated by a user, augmenting an object on a copied marker area.

3. Suggested Crowd Simulation Effects

3.1. Creation and Arrangement of Objects

Because a crowd is created only within an area selected by a user, when an object is arranged, it is necessary to make sure that the location is within the area. To that end, we detected and copied a marker in a scene through related studies so as to detect and create a circle area. In this way, we examined a collision with existing objects and, if a collision occurred after an object was augmented, the scene was divided into a grid and each point was examined in order to find out one where a collision would not occur. The following figure depicts this process.

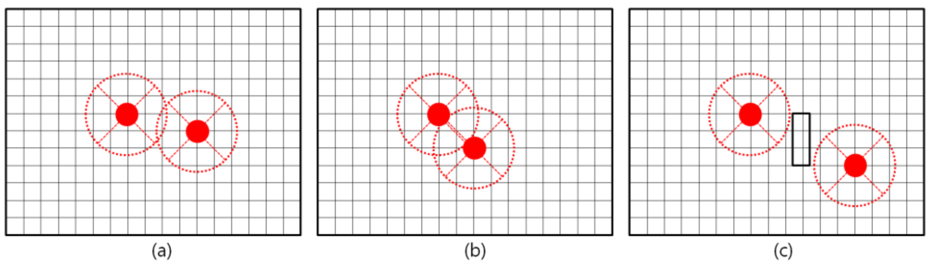

Figure 3. Evasion of Object Collision

In Figure 3(a) no area collision occurred from the outer area to the center of an object. However, in Figure 3(b) there is a collision from the outer area to the center of an each object. In this case, therefore, we applied an evasion algorithm so that the outer area of each object can be a block away as depicted in 3(c).

3.2. Moving of Objects

As to the moving of an object, an object may move according to a given route, a route selected by a user, or a destination. In this research, we considered cases of a route selected by a user and a destination. In both cases, a user needs to decide basic routes, which can be easily done by Storyboard of Microsoft Expression Blend. Also, adjustment can be made by a user in real-time so that application of the same crowd simulation effect to various images does not create the same scenes, which guarantees a general use and efficiency.

3.3. Detection and Evasion of Objects Collision

We examined a collision between objects by using a boundary circle including each object. Here, there are two methods of collision evasion: a method of changing the direction of an object and a method of stopping a moving object for a moment. First, we calculated Angle θ that a collision would not occur when a collision occurred between two objects. This is depicted by the following figure.

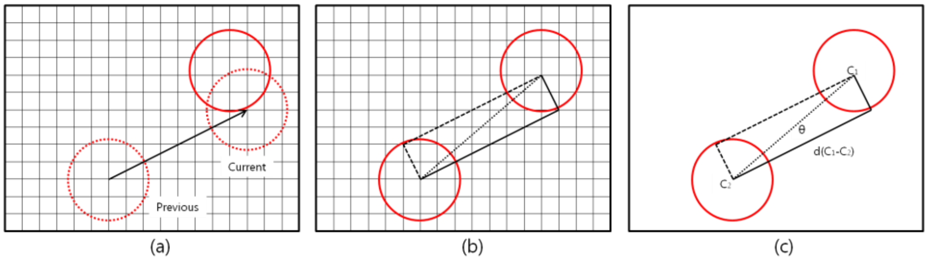

Figure 4. Evasion of Collision for Moving Objects

In case θ does not exceed limits, the value is applied and, if exceeding limits, the value is not applied.

3.4. Marker-based Object Crowd Simulation

As depicted in Figure 5(a), basic routes for the augmented 3D objects on the marker were designated by a user though Storyboard. However, if a collision is expected, two numbers of cases should be given in order to avoid the collision. Therefore, augmented objects on the marker produce crowd simulation effects according to each route designated in an image. Figure 5(b) shows a 3D object in five crowds moving according to a given route. Even if an object is added to a crowd, it has the same movement value and collision evasion value, causing no problem for producing crowd simulation effects.

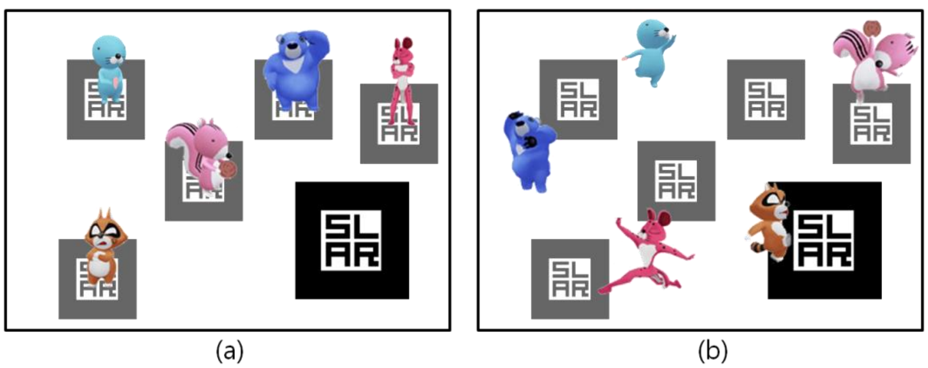

Figure 5. Application of the Crowd Simulation Effects

4. Conclusion

In this study we suggested high-speed crowd simulation effects through marker-based multi-object augmentation in order to produce the effects with less time and resources. When applied to 3D AR images, this method is expected to achieve high efficiency with less mobile resources.

Nevertheless, this study is limited in that geographical features were not taken into account. When AR is arranged in an image, no object should be overlapped with geographical features in the image. To that end, we need to figure out the height of the geography that an object is located and develop a technology that can automatically read the data. In the future, therefore, we need to carry out research on technologies of detecting obstacles in an image and avoiding them.

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References

[1] Azuma Ronald T.: A Survey of Augmented Reality, Teleoperators and Virtual Environments Vol. 6, No. 4, 355--385 (1997)

[2] Gabor Sziebig: Achieving total immersion: technology trends behind augmented reality-a survey, Proceedings of the 9th WSEAS international conference on Simulation, Modelling and Optimization, 458--463 (2009)

[3] Sungmo J., Seoksoo K.: A Study on M2M-based AR Multiple Objects Loading Technology using PPHT, the 12th WSEAS International Conference on AUTOMATIC CONTROL, MODELLING & SIMULATION, Cantania, Italy, 420--424 (2010)

[4] Huesman, RH: A new fast algorithm for the evaluation of regions of interest and statistical uncertainty in computed tomography, Physics in Medicine and Biology, Vol.29, pp.543 (1984)

[5] C. Galambos, J. Kittler; J. Matas: Progressive Probabilistic Hough Transform for Line Detection, cvpr vol. 1, IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR'99), Vol.1, pp.1554 (1999)

[6] Sungmo J., Jae-gu S., Dae-Joon H., Jae Y. A., Seoksoo K.: A Study on Software-based Sensing Technology for Multiple Object Control in AR Video, SENSORS, Vol.10, Issue 11, 9857--9871 (2010)

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