이동평균 배경제거 기반의 물고기 모션 검출을 통한 음악 생성

Music Generation from Motion of Fish based on Running Averaging Background Subtraction Method

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Abstract

This paper describes about a technique of generating music from the natural motion of fish which are detected via the running averaging background subtraction method. The motion of the fish will create musical notes on a background frame which will be analyzed and played by a music playing module that is proposed in this paper called "PhysicX". This module is also capable of interacting with the fishes. in the tank.

I. Introduction

Visual and auditory association have always intrigued us humans. One of the attempts to combine the two is to use image to compose music by setting the vertical axis of the image to represent musical notes and the horizontal axis to represent time [1]. It is also observed that arranging the musical notes in a special order in an image can produce music with better dynamics [2]. This paper is another attempt made to realize this concept by introducing motion as well into the music generating technique.

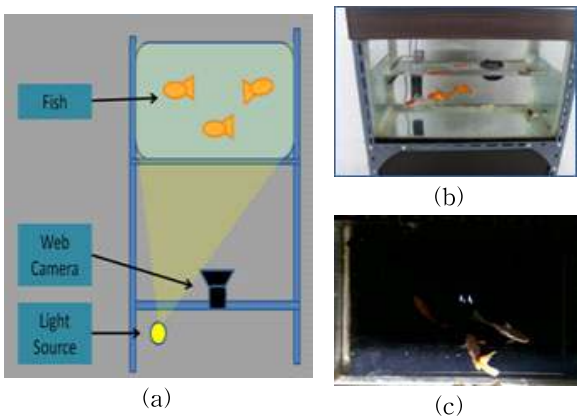

Fig 1. (a) The side view of the aquarium. (b) The aquarium used in this project. (c) The view capture by the camera at the bottom of the aquarium.

II. Equipment and Settings

The aquarium shown in Fig. 1 (a) consists of fishes, a light source, and a camera. The aquarium used must have a clear bottom part as shown in Fig, 1 (b) so that the fishes can be detected by the camera placed at the bottom of the aquarium. The camera is placed there because it is the most ideal location in the sense that it can capture the movement of the fish without much distortion from the splashing of water due to the movement of the fish itself. The image captured by the camera is shown in Fig. 1 (c).

III. Detection of Fish

A technique called the running averaging background subtraction is used to detect the fish. This technique takes the current frame of a video and subtract it with a background frame which is a weighted average of the previous frames with more weights given to the most recent frames. The result of this subtraction will create non-zero values, which are called foreground objects and the frame that saves these values is called the foreground frame. The foreground frame is threshold into a binary image and is processed with a morphological erosion filter to remove unwanted noises. This filtered foreground binary image can be used as a mask to extract the location of the fish from the original frame as shown in Fig, 2.

IV. Music Playing Module

1. Scan Line

The music playing module consists of several elements. There are the background, the detected fish, and a scan line. The background is divided into several sections horizontally. Each section will be assigned with a specific musical note.

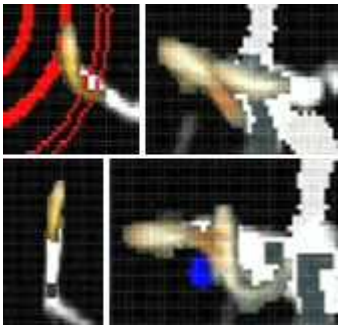

Fig 2. Shows several examples of the fish extracted from the original image by using the foreground mask

The scan line in Fig. 3 is a vertical line that moves from the left of the screen all the way to the right of the screen periodically. This line is responsible for scanning the location of the notes to be played. Whenever the scan line meets the detected fish, the note that is assigned on the section covered by the fish will be played.

In order to generate more notes to be played, a trailing end is added to the detected fish to create more coverage. This will not only help to create a longer melody but it can also help to give an effect of a shadow following the detected fish.

2. Physic X

After some experimentation, it is observed that the music played by the scan line lacks of rhythm and creates a non-natural sounding melody. Therefore, another method of playing the notes is added to the program. The basic idea for this new method is to create a set of moving pixels(a ball) with all the physical properties of a bouncing ball and thus the code name "PhysicX".

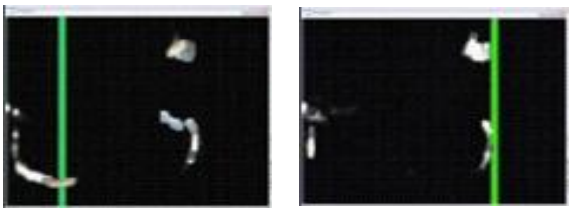

Fig 3. Shows the scan line that is moving from left to right. Any non-zero pixel that it meets will play a note assigned to that location.

This ball bounces when it hits the border or the detected fish and its trail. Every time it hits something, a ring will expand outwards from the center of the ball. The radius of the ring will continue to increase until the ball hits another object. The ring now acts as the scan line earlier and plays the notes that are assigned on the background that are covered by the detected fish.

The ring scans for detected fish from the top of the ring all the way down to the bottom. Only the outmost ring functions as a scan line while the inner rings are created to give the effect of an expanding wave. The idea of this expanding ring was inspired by the water waves that are created when a round object drops into a still water. Fig 4 shows the effect of multiple expanding rings which was created when the yellow ball collide with non-zero pixels. As the ring expands and hits the trail left by the fish, a series of musical note is played to create melody.

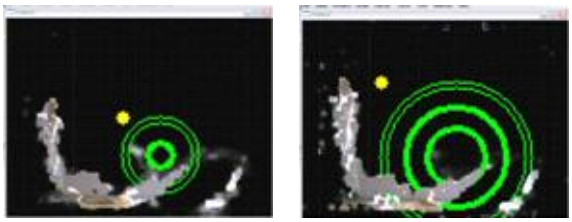

Fig 4. Shows the expanding ring that was created when the ball hit the non-zero pixels(detected fish).

V. Conclusion

This paper have shown a new technique of generating music from a visual system by introducing the motion of fish to the music generation process. The ability of the proposed music generation module to scan a wide area of the image proved to be effective in playing the musical notes composed by the fish motions. Future works will focus more on musical note placements and to introduce human interaction into the music generating process as well.

Reference

[1] V. Lesbros, "From Images to Sounds: A Dual Representation", Computer Music Journal, 20, pp.55-69, 1996.

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[3] "Zen Waves- A Digital Garden", MIT , http://www.youtube.com/watch?v=_H4WnZ5D_LQ, Feb 2006.