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.

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.

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.

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