Virtual Pond Installation for Meditative Entertainment System

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Abstract

These days, the importance of interaction and media is emphasized. We will make a meditative entertainment installation with mixed reality that can provide artificial music composing using virtual "pond" and virtual "fish" swimming in the water. This project provides people with virtual environment, and people can feel nature in the city, sympathize with creatures through the music in that environment and enjoy a game with other people.

Key words: Meditative Installation, Virtual Pond, Neural-net , Artificial Music Composition

1. Introduction

It is very difficult for citizens to be close to nature in daily life. We have planed this installation to give a rest and enjoyment to these citizens who live drearily in the gray city. People can take a rest watching this installation-the figuration of nature and enjoy a game together. This installation may be installed in the theme park, a lobby or a garden of a building and a passerby will use them for their rest and enjoyment.

In this paper, we suggest a system that can give pleasure, joy, stability and inner resources to people who are tired of repetitive life in dreary city. For these purposes, this system has following functionalities.

First of all, the system is a kind of game in which whoever can participate easily and have fun. It is a MR-driven game that has an intuitional and natural interface that can make people participate in it easily on their ways to pass by. We chose 'pond in a forest' as a metaphor of nature to represent nature in a city because we think it represents nature best.

Moreover giving visual satisfaction to people through green forest and clear pond, we also give music so that people can feel acoustic comfort and stability. The bright, enjoyable and beautiful music makes people's feelings satisfied and stable. And we can generate and change the music in real time using the similarity between the flow of the music and the flow of the fish swimming in the water. In short, people can play or make music by controlling a movement of a virtual life in a virtual pond variously.

In other words, this installation is natural shape exhibition, music generator by playing with fish, gaming machine using Mixed-Reality.

2. Object

Based large aims as stated above, it are detail objects to implement the 'virtual pond' really as follow.

2-1. The intelligent music composition

According to the idea of this project giving a experience that one can soak his/her hands in water, tread water and be lost in meditation, it is the music we pursuit for the audience to make it in real-time, in a sense. That is, music is composed by various features like speed, distribution, population of fish and the audience can indirectly compose music through interacting with fish.

2-2. The game with an intuitional interface

As being seen in many VR (virtual realty) and MR (mix reality) application, the use of supplementary tool is a radical defect for forming an immersed feeling. So we must minimize the using of tools and offer a proper interface to the context of application. That is, we imagine the system which is possible to interact with installation not using specific complex process and tools, whenever one wants.

3. Virtual Pond System

We'll show the 'virtual pond' system install method and feature, equipment as follow.

3-1. Installations Description

The length of each side of the installation is about 0.8 meter long and the shape is likes rectangle form. For real trees, it looks like the pond of forest.

The installation has two modes, "exhibition" and "game" Normally it is laid as "exhibition" mode – the only interaction between visitors and fish makes the change of music. When a visitor keeps hands at same position over the surface of the 'virtual pond' in certain period, the installation has a mode shift from "exhibition" to

"game." Shortly, the mode of the installation depends on the intention of visitors.

Visitors can see the projection of "the water" from the ceiling. When the "exhibition" mode, they can make music by touching "the water" (that is creation of fish). And they can also play 'a chasing fish' game with others.

3-2. Implementation Feature

'Artificial Intelligent Music Generation' and 'Game' are the key points of implementing this installation.

First of all, speaking of AI music generation, we will develop an algorithm which can be used for creating a meditative music with a number of fish, a swimming speed of fish, and a degree of distribution of fish in virtual pond as parameters of the music generation algorithm. The purpose of this installation is to create and generation music rather than vary and modulate music. In the end, we want to express a sensitive factor of human in music. For these purpose, we use a learned composing method with artificial neural-net theory and genetic algorithm basically.

In the game mode, the audience can play the game with the unlimited number of players simultaneously in the abstractly. It is a game that the player chasing fish to have them reach the goal position as keeping away from floating matters on the surface of pond. For this goal, the player can frighten fish with his/her hands attract fish with doing a hand gesture of feeding. The virtual fish swim toward random direction like real fish in general. Also they have the instinct of banding together and taking shelter under the safe matter like a lotus leaf and avoiding danger. The fish reached final goal position can take a reward.
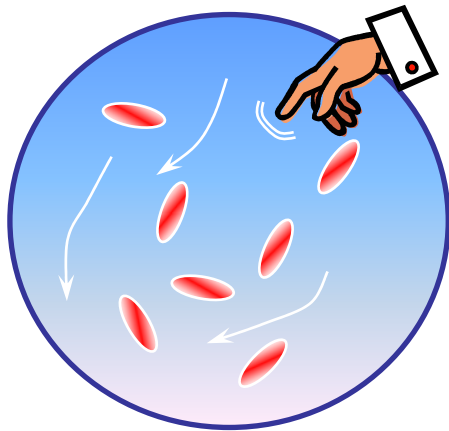

Fig. 1 Interaction between audience and system

Table 1. System Equipment

Name	Description
Pond Frame	radius : 1.8m, polystyrene, painted.
Web cam	resolution : 640 x 480.
Speaker	
Projector	
PC	P4-2.4c, 512 MB ram, Radeon9600 video card.

4. Implementation

We must develop two technical modules from a practical viewable. The one is a function to recognize hands of the audience as a system interface, another is a function to compose a music segment in real-time with the audience's input action. For these purpose, we use a vision-based image processing system with a web-cam to catch a motion of hand in addition to a properly learned neural-net model for music composition in real-time. And we implement a game which is to play with fish living in the 'virtual pond.'

4-1. Vision-based Hand Gesture Recognition

There are only two actions which is an audience's recognizable motions of hand in this project, that is fold and unfold their hand and rock their hand. One can create fish as folding and unfolding his/her hand at specific position over the surface of water, also attract fish as rocking hand at any position he/she want it to reach. In general, when the audience's hand come up to fish, it is frighten away. For these working, we capture a image of the surface of 'virtual pond' using a web-cam at regular intervals, and understand the existence of audience's hand and its motion.

To decide an existence of hand, we use a value of difference of color buffers between past screen frame and current screen frame. In detail, we choose areas where there are existences of color difference in two screen frame-past and current-, decide whether colors of area is similar to pre-defined hand colors. We adopt a Euclidian distance method to calculate a difference of colors.

Also, to decide 'a folding and unfolding', we calculate a value of difference of hand area extent between current area which is decided as hand area and past area which match with current hand area. If the value is more than a pre-defined threshold value, we can conclude there is 'a folding and unfolding' hand over that area.

Finally, to recognize rocking hand is also possible through hand area extent. In other words, we observe the change pattern of extent of hand area in regular time intervals.
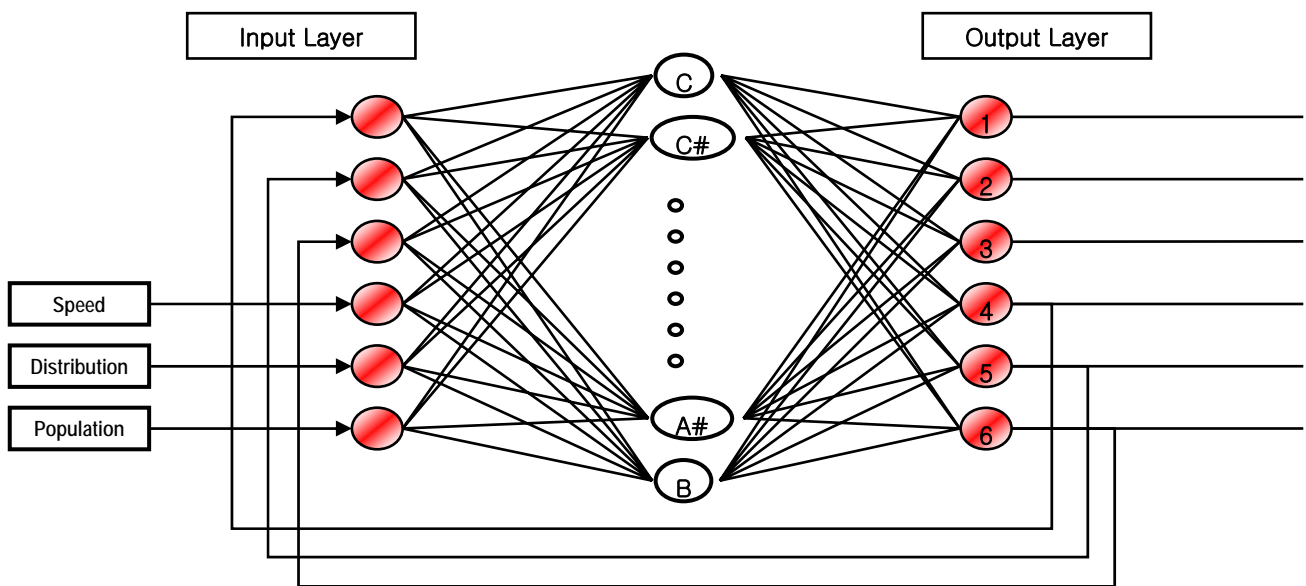
Fig. 2 A neural-net model for composing music.

4-2. 3-layer Neural-net for Composition Music

The feature of fish which is affected by the audience's action is used to extract an input parameter value for composing a music flow out from the 'virtual pond.' The more fish in the pond, the more music is created as a low-pitched sound which makes a calm and restful atmosphere. And the faster fish swim, the larger created melody range which form music. That gives the audience a vigorous and rhythmical feeling. Also, we use the extent of distribution of fish swimming in the pond to give music coherence over all. So the closer fish is each other, the more similar in ways of constructing rhythms and melodies of the whole music. In result, we can get a stable and changeless music.

We adopt an artificial neural-net model to implement these functions. This neural-net model consists of three layers – one input layer, one hidden layer, one output layer.- The input layer has six neural units. In every creating phase, we replace the fore three units' in input layer values with the values of three units in output layer for succeeding a melody of former created notes. That is, we use the feedback from the fore output result value of neural-net. The hind three units of input layer are mapped with the features of fish in the pond- swimming speed, population, distribution.- These features are dynamically taken by the action of the audience. So it makes we can use the interaction between the audience and the installation to compose music although indirectly manner. Also we use twelve units in hidden layer matched with twelve tonal pitches to strengthen a relation of connection in melody of music which is composed during the learning phase of neural-net.

We use supervised-learning method for learning neural-net with a music score of specific composer on the unit of six musical notes. Through this process, we can learn the neural-net specific style of composing.

4-3. Game

As one see swimming fish in the pond, maybe he/she have experienced hoping to play with them in vain. But most people just see a view because the real pond is too big to play with fish in it, person is afraid of sinking under the water at the slightest slip, there is not proper methods or tools to play with them.

The fish in 'virtual pond' can also stimulate person's desire something like that. In addition, because 'virtual pond' can make up for its defects as stated above, it can be effective game. Therefore we make 'a chasing fish game' keeping within bounds corresponding basic concept that 'virtual pond' is a nature-experience installation.
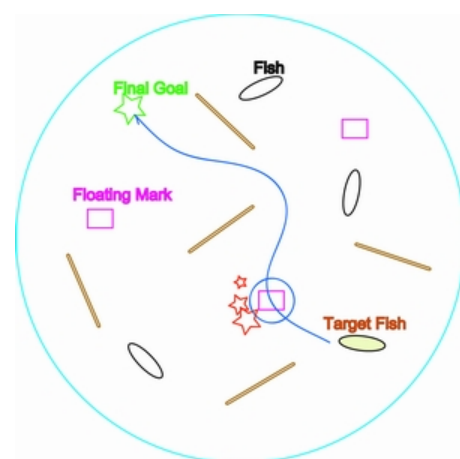

Fig. 3 A concept diagram for chasing fish

When a game begins, player must have specific fish reach a goal point. Then player can use floating matters like a sprig or a lotus. Right after a game is begun, one fish is chosen and highlighted automatically as well as

the final goal point which is a position that fish have to reach.

The audience has just to use their hands for chasing fish. In general, fish frighten and run away from hands when it is close to them and get near to hands as thinking there is some feed when it is rocked.

It is the function of floating matters to make fish get near to that objects or change their swimming course in a way of reaching a final goal point. If fish reach the goal, that can grow up correspond to time consumed.

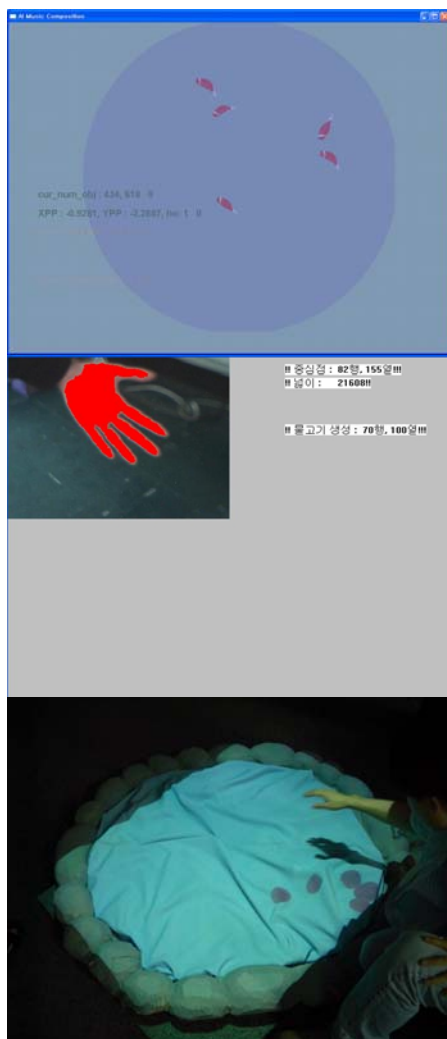## 5. Conclusion and Future work

Fig. 5 Virtual surface of water and fish, Recognizing of hand, Physical frame of installation system

Up to now, we get the acceptable result about the module of recognizing hand motion in a certain light condition and background. Especially to recognize folding and unfolding hand show high accuracy, but to recognize rocking hand show less result.

About composing music, we get the music score as a result of learning neural-net with 0.5 as a learning rate

and 0.05 as a momentum. An original musical score input is the 'After love' of 'Yiruma.' But the module which evaluates an aesthetic value of the created music is absent, so we are considering using a genetic algorithm. In the algorithm, we'll use a frequency of certain series of tonal notes in original musical score as a fitness value of genuine pool.

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