# Agents from reality

Kazuhiro Asai, Atsushi Hattori, Katsuya Yamashita, Takashi Nishimoto,
Yoshifumi Kitamura, and Fumio Kishino

Graduate School of Infomation Science and Technology, Osaka University,
2-1 Yamadaoka, Suita, 565-0871 Osaka, Japan
{asai, a-hattori, katsuya, nishimoto.takashi, kitamura,
kishino}@ist.osaka-u.ac.jp
http://www-human.ist.osaka-u.ac.jp/

**Abstract.** A fish tank is established in a cyberspace based on a real world in which autonomous fish agents, generated from images captured in an actual world, swim. The behavior of each fish is determined by an emotional model that reflects personality according to encountered events and user interactions.

## 1 Introduction

Environment of the earth is one of the most vital themes in these days. Therefore, computer simulations of natural ecological systems have an increasingly important role in various fields. Moreover, sophisticated interactive simulation systems are expected to be established for the purpose of assessment of the environment, enlightenment or education of the theme, and expandion of the range of the research field, and so on.

We are exploring a novel approach to interactive ecosystem simulation, carefully addressing the fragile balance and tradeoff between the autonomy of the simulated ecosystem and the freedom of user interaction. In this paper, a fishtank in a cyberspace is described. Goldfish swimming in a tank is used as an example and an interactive simulation system of an ecosystem is established.

## 2 System

Our project establishes a fish tank in a cyberspace based on video images taken from the real world.

### 2.1 Outline

Each fish in a fish tank in cyberspace is an autonomous agent generated from images of real fish from the real world. All fish motions, shapes, and textures are extracted from live video of real fish from a tank by using an image processing technique,

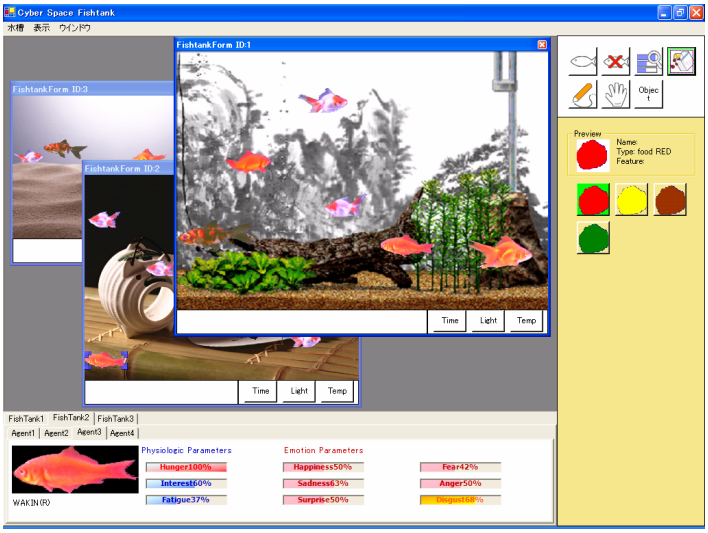


**Figure 1:** The interface of Cyberspace fish tank.

which is then applied to the fish agents. The behavior of each autonomous fish agent is determined by an emotional model with fuzzy logic. Here, the emotions of each agent are generated and based on individual personality and physiological parameters of the agent, which vary according to encountered events and user interactions. After an agent's behavior is determined, a sequence of video images that most matches the determined behavior is retrieved from a database in which a variety of video clips of real fish behavior are stored. Then the retrieved images are applied to the fish agent.

By using a mouse or other adequate interaction device, users can interact with fish agents to perform such interactions as feeding, copying, deleting, dragging, and so on. Users can also customize the fish tank by changing its brightness, temperature, water quality, time transition, and so on (Fig. 1).

## 2.2 Configuration

The basic flow is as follows: a camera is used to extract living individual objects present in the real world by image processing techniques, and these extracted objects are presented in real time in a computer-generated virtual space. Each living individual has virtual sensors such as temperature, olfactory, and visual sensors. For example, the visual sensor is used to discover the status of the other living individuals, and the visual and olfactory sensors are used to discover the availability of food. Each living individual agent is provided with six types of behavior patterns (searching, eating, sleeping, approaching, avoiding, and escaping).

When the behavior of each agent is determined, suitable behavior is called up from a wide variety of scene video examples of this living individual in a pre-prepared database, and this is displayed in the virtual space after performing any video editing that may be required.

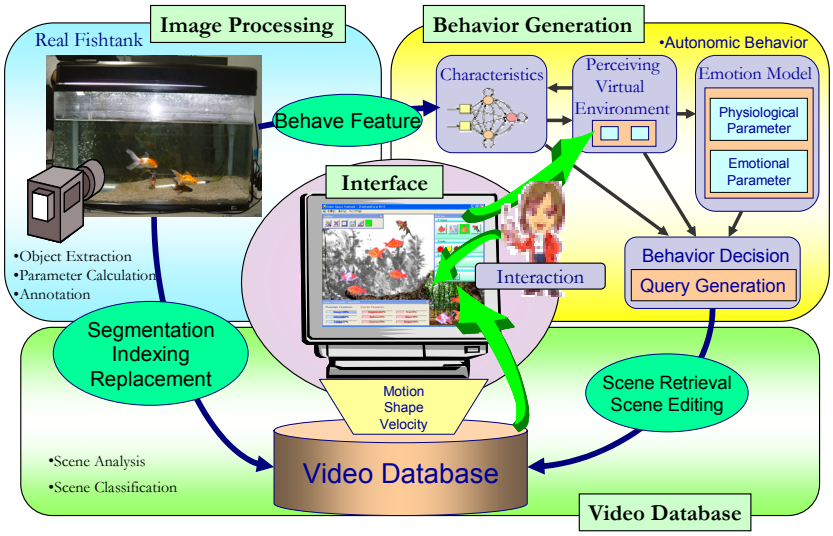


**Figure 2**: System overview.

Figure 2 shows the configuration of a system configured as an application example. As an example, consider an application where the video objects are goldfish inside a fish tank, and each goldfish is an individual living agents. A database is preloaded with scenes consisting of several tens of frames depicting a goldfish swimming in various different directions at different speeds and with different postures, inclinations, and so on. This database is indexed using information such as the direction and speed of the goldfish, its posture, inclination and so on is added on a per-scene or per-frame basis. When the behavior of a fish has been determined, a search is applied to the index information of this video database to call up a suitable scene for the behavior of the goldfish, and this is displayed in the virtual space after applying any video editing that may be necessary.

## 3 Method

Core technical innovations of the system are the following:

1. Image Processing: accurate extraction and tracing of target fish from roughly installed cameras (Fig. 3).
2. Behavior Generation: behavior of each autonomous agent is determined by an emotional model with fuzzy logic.
3. Video Database: automatic generation/maintenance of a video database and automatic editing of retrieved video clips based on context.
4. User Interface: presentation of a cyberspace fish tank and an interactive environment with autonomous fish agents.

(a) input image (b) extracted fish (c) contour (d) trajectory

**Figure 3:** A sequence of video image processing to extract goldfish.

## 4 Conclusion

The users will enjoy a cyberspace fish tank generated from video images taken from the real world through interactions using such devices as a mouse. If multiple fish tanks are simultaneously established, attendees can compare fish growth situations in different fish tanks under a variety of conditions.

Various approaches to generate virtual fist tank have been presented (e. g., [1]), however, in our work fish agents are generated from real video images taken in real space. Moreover, since the behavior of each fish agent is determined by an emotional model with fuzzy logic, our work shows a variety of behaviors. Images representing fish agent behavior are retrieved from a video database and displayed after appropriate special effects are added. The video image processing techniques [2] and motion graphs [3] were very helpful. We use similar video image processing techniques in feature based extraction and classification of real fish and smooth connection of video frames taken of real fish.

An ecosystem in a cyberspace is one of the goals of our project. A cyberspace ecosystem is established based on a real environment; however, the ecosystem is interactive, and each creature in the ecosystem exists autonomously and has an individual personality. Such a novel approach to interactive ecosystem simulation carefully addresses the fragile balance and tradeoff between the autonomy of the simulated ecosystem and the freedom of user interaction. This project will be useful for future computer simulations of natural ecological systems (not only zoological but botanical environments) for the purposes of science, education, and relaxation.

## References


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