An Evaluation and Design of a Digital Fish Book Based on the Visitor Research

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ABSTRACT: The Large Coral Reef Tank in the Tropical Marine Life section of the Port of Nagoya Public Aquarium displays about 3,000 fish from 150 species. Fish nameplates are located inside the aquarium, but the large variety of different kinds of fish complicate identifying each one of them. Therefore, we propose a mobile digital fish book display that simplifies intuitive searches for fish, even for beginners. This study was conducted using three different types of surveys of aquarium visitors: visitor behavior, fish identifiability, and fish features. The results of the first survey indicate that about 60% of the visitors actively searched for fish while they were standing in front of the tank, signifying a relatively high degree of interest in such searches. The results of the second survey identified which types of fish were most often searched for to determine the priority of search rankings. The third survey determined what part of the fish visitors looked at and what features the visitors identified using the following search terms: size, color, pattern, and shape of the tail fin. I designed a digital fish book using these elements. I conducted a demonstration experiment and achieved a high search rate and received favorable feedback. In the future, we will improve this search function both in relation to the fish in the Large Coral Reef Tank section and marine life outside the aquarium.

INTRODUCTION

One of Japan's largest aquariums is the Port of Nagoya Public Aquarium, which provides knowledge about the ecology and evolution of various ocean creatures. This aquarium is divided into north and south buildings. In the north building, such cetaceans as killer whales, belugas, and dolphins are featured around the theme of the evolution of life. The south building houses various sea creatures from a variety of countries from Japan to Antarctica. In this research, we focused on the Tropical Marine Life section in the south building. The Large Coral Reef Tank in the Tropical Marine Life section, which was remodeled in 2015, currently displays about 3,000 fish from 150 species (Fig. 1).

Fig. 1. Large Coral Reef Tank.

The aquarium's fish tank contains many species, such as huge fish (Humphead wrasse (*Cheilinus undulatus*) etc.), colorful fish (Yellow-brown wrasse (*Thalassoma lutescens*) etc.),

uniquely patterned fish (Blackbelly triggerfish (*Rhinecanthus verrucosus*) etc.), and distinctively shaped fish (Bluespine unicornfish (*Naso unicornis*) etc.). Since many visitors want to know the names of such fish, three types of fish boards have been installed around the fish tanks: both analog and digital fish name boards as well as a digital fish database. However, few visitors search for fish with them because such navigation is difficult for beginners. Therefore, a tool is needed that simplifies the investigation of fish names.

In this research, we developed a Digital Fish Book with which fish beginners can easily and intuitively search and propose a system design based on visitor surveys.

PURPOSE OF RESEARCH

The biggest feature of our proposed Digital Fish Book is that it simplifies searching for visitors who are unfamiliar with fish. Below we list the disadvantages of a fish database or a fish name board in aquariums (Fig. 2).

Fig. 2. Analog fish board and digital fish database.

(1) Common fish databases often search by name, classification (e.g., perciformes: pomacentridae), and group (e.g., butterflyfish

species). Beginners often have difficulty utilizing such databases.

(2) Many fish have similar colors and shapes. However, because only a limited number of fish name boards can be introduced, one kind of fish cannot be found while comparing similar fish.

(3) Because the fish name board cannot be moved, it is impossible to compare the fish in the fish name board with those the visitors are looking at.

Therefore, in this research, we developed a Digital Fish Book that has the following characteristics:

(1) It can search based on fish features (size, color, shape) that even beginners can understand, avoiding keyword searches based on such scientific jargon as name, classification, and group.

(2) When searching for fish, a list of similar fish is displayed with the search results to facilitate searches for similar fish while comparing.

(3) Since it allows fish searches in front of the tank, the application's (iOS, Android) format is used by mobile phones.

In this research, based on these features, we investigated which fish features the visitors were interested in and those that can be distinguished and based our design on the result.

SURVEYS OF AQUARIUM VISITORS

We conducted four types of visitor surveys (Fig. 3).

1) Visitor behavior survey
(1) Purpose:
We clarified the target of this system and the characteristics of the visitor behaviors.
(2) Survey date:
May 20, 27, July 15, 2016

(3) Survey method:
We video-taped the tank with a fixed-point camera for three days. We analyzed such visitor behaviors as staying time, pointing at fish, and taking pictures (fish, tank, visitors themselves) and scored the behaviors (survey: 1,796 groups).
(4) Result:
60% of the visitors are interested in fish. They talked about the fish, pointed at them, and watched them swimming in the tank. The

remaining 40% include those with more interest or more knowledge in fish as well as those who are not interested in fish.

Fig. 3. Visitor surveys.

2) Visitor attention survey about various kinds of fish
(1) Purpose:
We investigated the different kinds of fish that visitors are interested in to clarify why they focus on particular fish.
(2) Survey date: March 28, 2016
(3) Survey method:
In front of the tank, we recorded the characteristics of the fish in which the visitors expressed interest and analyzed the reasons (survey: six visitors, about 3 to 5 hours per person.)
(4) Result:
Such characteristics as color and pattern received much attention. Furthermore, we clarified that people who are unfamiliar with fish have difficulty describing three or more features of fish.

3) Survey of visitor interest in fish
(1) Purpose:
We concretely identified what fish the visitors are interested in.
(2) Survey date:
May 20, 2016
(3) Survey method:
We asked 60 visitors about fish characteristics based on such items on check sheets as color, shape, pattern, size, movement, etc.
(4) Result:
Many visitors were interested in such big fish as Bowmouth guitarfish (*Rhina ancylostoma*) or such fish that resemble movie characters as Palette surgeonfish (*Paracanthurus hepatus*). Overall, the range of fish in which visitors show interest is limited.

4) Survey of language used by visitors to describe fish

(1) Purpose:

We clarified the language used by visitors to describe the characteristics of fish.

(2) Survey date:

May 27, 2016

(3) Survey method:

We showed visitors photographs of 16 kinds of fish, such as Blackbelly triggerfish (*Rhinecanthus verrucosus*), and clarified how they expressed their characteristics (Fig. 4) (survey: 27 visitors).

(4) Result:

Visitors expressed four types of fish characteristics: size, color, pattern, and tail shape.

Fig. 4. Photographs.

SYSTEM DESIGN BASED ON VISITOR SURVEYS

Based on the results of our visitor surveys, we designed the following Digital Fish Book, which is a system for mobile phone applications for Android and iOS.

(1) The visitors searched for fish by actively observing them and selecting search items.

(2) We designed three search items. (Actually, since three search results cannot accurately extract, we set it to four items.)

(3) We placed a popular fish in the corner of the top page. Visitors can see it immediately without searching.

(4) We set up four search items: size, color, pattern, and tail fin shape.

The Digital Fish Book design is shown in Fig. 5.

Fig. 5. Digital Fish Book.

The following are the fish search words.

Table 1. Search words.

Item	Search words
Size	oversized, large, medium, small, unknown
Color	16 colors, including white, red, and blue
Pattern	none, horizontal, horizontal stripes, vertical, vertical stripes, diagonal, diagonal stripe, mesh, spotted, other
Tail fin shape	line, fanned, bifurcated, up and down, single, unknown

Search words were given one by one by looking at pictures of fish. 195 kinds were registered in the Digital Fish Book database.

EVALUATION AND IMPROVEMENT

Three system developers tried to search for ten distinctive fish such as Blotched foxface (*Siganus unimaculatus*) at the front of the tank. The search rate was 43%.
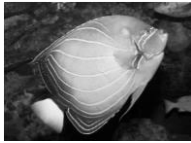
Possible causes for the low search rate include

failing to correctly set the color keywords and incorrectly observing the tail fin shape.

Search words were initially given using fish pictures taken by the Port of Nagoya Public Aquarium. However, when comparing such

photographs to the actual fish in the tank, the colors may appear different due to the influence of light or changes to the tail fin shape during swimming. Therefore, keywording based not only on scientific correctness but also appearance was done for each fish in the tank (Table 2).

Table 2. Search words of fish.

	Blue ring angelfish (Pomacanthus annularis)	Blotched foxface (Siganus unimaculatus)
Size	large, medium	large, medium
Color	yellow, purple, blue, brown, white	yellow, black, white
Pattern	diagonal stripes, other	horizontal, horizontal stripes, diagonal stripe, spotted
Tail fin shape	lined, fanned	lined, bifurcated, fanned

By correcting the keywords for ten fish, we improved the correct answer rate to 100%. When the search was conducted for fish other than these ten species, the correct answer rate was 88%.

EVALUATION BY VISITORS

We used our Digital Fish Book for visitor evaluations. Its details are as follows.

(1) Purpose:
We examined the search rate by visitors and evaluated the usability of our Digital Fish Book.
(2) Survey date:
July 10, 13, 17, 21, 2018
(3) Survey method:
Visitors searched for two fish using the Digital Fish Book and then responded to questionnaires about its usability or enjoyment (survey: 106 people).

(4) Result:
The following are the ages of the visitors who completed surveys: 21% in their 10s, 42% in their 20s, 18% in their 30s, 6% in their 40s, 8% in their 50s, and 5% in their 60s. The search rate of the visitors was 73.3%. The survey results did not differ by age.

Table 3 shows the Digital Fish Book evaluation, which is indicated by the averages of the five stages.

Table 3. Evaluation of Digital Fish Book

Question	Average
Was the Digital Fish Book easy to use?	4.1
Was it easy to see? (usability)	4.2
Did you enjoy using it?	4.2
Did it increase your interest in fish?	4.2

We obtained the following comments from users:

·Since the buttons and icons are small, selecting them was difficult.
·Since the font size was too small, it was hard to read.
·The design of the fish size button was especially difficult to understand.
·The re-search navigation was too complicated.

Future work will implement a more user-friendly design.

CONCLUSION

We developed and evaluated a Digital Fish Book based on visitor surveys that focused on the parts of interest in fish features and what features can distinguish them. Then we designed an original search method and a keywording system. We will continue to evaluate our Digital Fish Book by improving its correct answer rate and increasing its usability.

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