Research Article

The IoT Solution to Archive and Play the Digital Library of Kamishibai

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ABSTRACT

We innovate an IoT solution to archive and play the digital library of Kamishibai. Kamishibai is a form of Japanese picture story show. The solution has two aspects. The one is a regional vitalization to know cultural history of the residential area, and the other is an educational platform to design the programming education by using NFC device. In this paper, we report the experimental results to build a display and sound system to play the digital library of Kamishibai.

1. Introduction

Advances in information and communication technology have certainly improved the convenience of our lives. The household ownership ratio for smartphones such as iPhone and Android is 79.2%, and the grand total of mobile device ownership ratio is 95.7%. Overall, the percentage of Internet users from 13 to 59 years old exceeds 93% [1]. The role of Information Communication Technology (ICT) in tourism has become very important for the countryside vitalization. Here are some examples. At Tateyama-cho in Toyama Prefecture, various type of promotion are moved ahead for the global branding of the Tateyama Kurobe Alpine Route, in which mountains at altitude of 3,000m are high up [2]. In the Murodo Area located at the altitude 2,450m, an optical fiber cable has been laid and Wi-Fi Internet access become more convenient for the tourist. Live feed at the gazebo of Kurobe Dam by using web camera is delivered, and the tourist information such as a time table of the cable car and manners of national park usage, *etc.* is shown at the stations by using digital signage [3]. At Hiroshima City in Hiroshima Prefecture, the peace tourism around the Atomic Bomb Dome and Peace Memorial Park is promoted, so that the number of foreign tourists has been increasing year by year, since when Barack Obama has visited at the Peace Memorial Park. In that case, the fact that almost half of them return to cities such as Kobe City, Osaka City, and Kyoto City on a day trip is came out according to an analysis of tourist information of Hiroshima Free Wi-Fi users. Therefore, a round trip to various areas in Hiroshima Prefecture such as Miyajima island, Kure City, and Edajima City, *etc.* is planned to encourage tourists to stay in the prefecture [4]. Especially, through the stamp rally such as "Hiroshima Red Passport" is held from August 31st to December 25th, 2019. Stamp rally means going to different locations to collect stamps on a card. If you take part in the stamp rally, you can win prizes according to the

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number of stamps you collect! [5] In Nagasaki City at Nagasaki Prefecture, the "Miracle Nagasaki Project" is being promoted to explore further appeal points of Nagasaki City and consider a new style of tourism, and the Wi-Fi Internet service has been provided to improve the convenience of tourists [6]. As an approach to barrier-free access to sightseeing facilities and spots, barrier-free information such as sidewalks (road steps, obstacles, *etc.*) is automatically collected based on the various sensors attached to a general wheelchair. The collected information is visualized on images and maps as the barrier-free street view web application [7],[8].

Though these tourism services based on ICT will be an urgent issue in Japan, where the Tokyo Olympics are close at hand, the perspective after the Tokyo Olympics is also important. Making the further leap forward as the tourism-oriented country, it is important to create new tourism services based on flexible thinking. Considering tourism services as "things", users are "tourists", and tourism that users enjoy is "experiences". Tourism functions in case that "things", "tourists", and "experiences" engage together, and tourism cannot uphold without the interaction between "things", "tourists", and "experiences". Even in view of the current state of community-based new tourism, it is obvious that new kinds of tourism results from the regional activity. Tourism cannot be uphold without vitalizing the regional community.

Now, let's get into the main subject in this paper. What is the most important element among "things", "tourists", and "experiences"? It is perfectly obvious. The answer is "tourists". Tourists use "things" and obtain "experiences", and share "experiences" with another. Tourism must be centered on tourists. There are three essence for creating a new community-based tourism. The first is the innovation in tourism. The second is the sustainability in tourism. The last is the educational enhancement in regional community. Here, we make an emphasis on the last, and plan to organize a workshop which enhances the awareness of regional culture. How can we enhance the awareness of regional culture? Isn't it "accumulation of regional culture", "learning of regional culture", and "creation of new values"? In this paper, we apply Kamishibai to accumulating and learning of regional culture, and employ ICT to create new values. Kamishibai is a form of Japanese traditional picture story show and is a kind of play that a performer tells story while switching several sheets of pictures. In

Omihachiman City at Shiga Prefecture, the guides belong to tourism association produce and play Kamishibai. They conducts demonstrations of Kamishibai at elementary schools, so that the students can acquire knowledge of Omihachiman's history such as culture, planning town, and Omi merchants [9]. Kamishibai is utilized in programming workshops for junior high school students. In the workshops, the students create Kamishibai by using Scratch, a programming language [10]. In this study, we design a framework of traditional culture and ICT by blending Kamishibai and IoT, and build a display and sound system of Kamishibai experimentally. We report the experimental results to build a display and sound system to play the digital library of Kamishibai.

In Section 2, we describe the outline of the display and sound system of Kamishibai, and in Section 3, report the experimental results to build the system. In Section 4, we describe the conclusion.

2. Display and Sound System of Kamishibai

2.1. *What is Kamishibai?*

Kamishibai is a form of Japanese traditional picture story show. The beginning of Kamishibai is said to be a performance by the unemployed people in parks and at street corners where the children gathers during World Depression in 1929. Unemployed people set a miniature stage-like device on a carrier of bicycle and tells the story by switching the sheets of pictures. They sell the cheap candy in order to gather children. The performer communicates with children to create a lively atmosphere. The impeccable interval of switching pictures deepens the concentration in the story. Kamishibai is getting noticed as an educational tool for children.

2.2 *Development Environment of Display and Sound System*

In our system, Kamishibai consists of several sheets of picture made by using drawing tools, and they are placed on a Web server. Each picture is coded as a web site by using HTML5 and is displayed on a monitor by switching each NFC tag in which URL information of each picture is written. In this study, we made each sheet of picture by using free illustrations. The story of Kamishibai is "Momotaro", famous Japanese fairy tales. Our "Momotaro" consists of 12 sheets of pictures, so that the numbers of NFC tags to switch each sheet of pictures

is 12. We also construct sound system by using raspberry pi 3 Model B and the "PaSoRi" RC-S380/S. NFC tag has a unique ID for every tag, we read and identify the ID, make sounds according to the picture story. The code to read and identify ID is written in Python.

2.3 *Architecture of Display and Sound System*

We explain the architecture of display and sound system to play the digital library of Kamishibai in Fig.1.
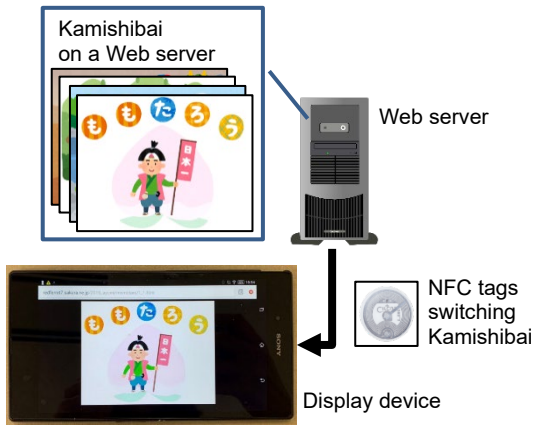

Fig. 1: Architecture of Display System.

Kamishibai consists of several sheets of picture on a Web server and is displayed on a device by switching the NFC tags in which URL information of each picture is written.

Here we show the observe side of display system in Fig.2 and the reverse side of display system in Fig.3. As shown in Fig.2, we use android device to display Kamishibai and the device is affixed to cardboard with double-sided tape.
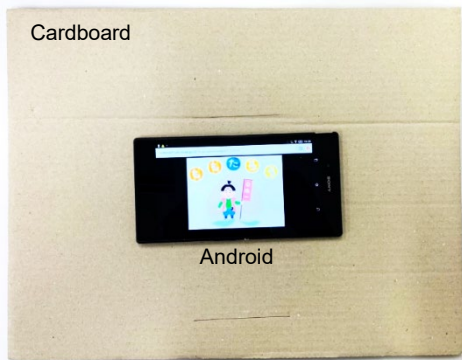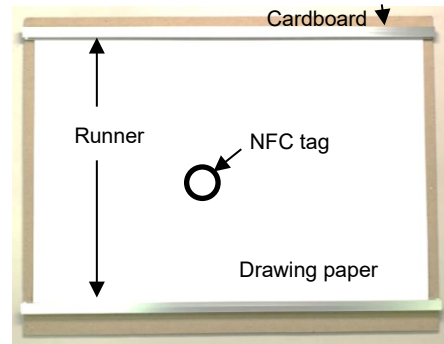

Fig. 2: Observe Side of Display System.

Fig. 3: Reverse Side of Display System.

3. Experimental Results to Build Display and Sound System

3.1. *Positional Relationship between NFC tag and NFC Reader*

3.1.1. *Thickness of Cardboard*

Between NFC tag and NFC reader, there is a cardboard and its thickness is $412g/m^2$. We check whether read error is occurred or not according to the cardboard. We repeat the three sets of sliding 12 sheets of drawing paper, there is no read error and we can perform the full story of "Momotaro" by three times.

3.1.2. *Position of NFC tag against NFC Reader*

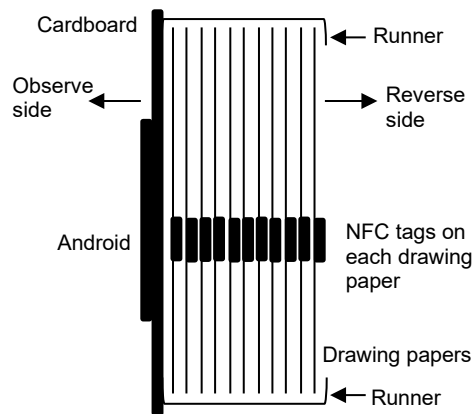Fig.4 shows a cross-sectional view from left sid

Fig.4: A Cross-sectional View from Left Side

In case that the position of the NFC reader of the android device and the position of the NFC tags is fully overlapped in line as to the performer's eye, error ratio is at 42% through sliding 12 sheets of drawing papers. In

case that NFC tags are affixed at the position horizontally 2.3cm to the left, error ratio is at 0% through sliding 12 sheets of drawing papers.

3.2. *Making Sound by Unique ID of NFC tag*

We also construct sound system by using raspberry pi 3 Model B and the "PaSoRi" RC-S380/S. NFC tag has an unique ID for each tag, we read and identify the unique ID of each tag, make 12 kinds of sound effect according to the story of "Momotaro", such as sounds of a peach flowing on a river, peach breaking, and so on. Fig.5 shows our sound system. At the Kamishibai performance, we can slide each sheet of drawing paper by right hand, and can make sound effect according to the story by left hand.

Fig.5: Sound System

4. Conclusion

We innovate an IoT solution to archive and show the digital library of Kamishibai. In this study, we experimentally build the display system and sound system to show the digital library of Kamishibai. By using this system, we can perform Kamishibai without printing the sheets of pictures.

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