Compact battery-less guest guidance system at the EXPO 2005, Aichi Japan

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Abstract: Guest guidance system based on the compact battery-less information terminal, Aimulet, which has been developed by the authors of the National Institute of Advanced Industrial Science and Technology (AIST), Japan. Conventional Aimulet, which is Aimulet ver.1 or CoBIT, has features of location and direction sensitive information service device without batteries. On the other hand, the Aimulet has two subjects, one is multiplex and demultiplex of some contents, and the other is operation under sunshine. Former subject is of solved by the wavelength multiplex technique using LED emitter with different wavelength and dielectric optical filters. Latter subject is solved by new micro spherical solar cells with a visible-light-eliminating optical filter and a new design of light irradiation. These techniques are applied to the EXPO 2005, Aichi Japan and introduced in public. Aimulet GH is Former technique is applied on Aimulet GH, which is used in Orange Hall of the Global House, scientific museum with a fossil of a frozen mammoth.

Keywords: Guest guiding system, Battery-less information terminal, spatial optical communication, location-based information service

1. INTRODUCTION

There are various media for an instruction of the exhibits, from an instruction panel on the wall to a guiding tour with an attendant. Personal voice guidance system has some great features in these media, such as

(1)Guest can concentrate to an exhibit without taking their eyes off the exhibit,
(2)Adequate instruction is possible based on each visitor's attributes (viewing speed, language, age, gender, disability, etc.),
(3)Personal instruction is possible without interference with other visitors.

Conventional personal guest guiding systems, based on an IC or an MD recorded players, a PDA, a cellular phone, or a mobile PC have been reported [1-5]. However, these systems have subjects of cost for introduction of permanent exhibition system.

(1)Management cost
Preventing from burglaries or damage of the system requires higher personal expense.
(2)Maintenance cost
Many of systems require cost of battery charging, cleaning and maintenance.
(3)System cost
Rental fee is not enough for expense of initial installation, changing contents, and maintenance.

To solve these subjects, the authors have been developing a technology using ultra low-power-consuming compact information terminals and the base stations to establish a location and direction sensitive guest guiding system [6]. On the other hand, the system has two subjects to be solved. One is spatial optical multiple content serving and the other is operation of the terminal under sunshine.

In this paper, concept of a compact has been developing for implementation of the location and direction based information guidance services.

In this paper, new communication terminal, named Aimulet, and the system are introduced. These solutions are for multiple contents. Two kinds of systems of "Aimulet GH" and "Aimulet LA" are employed in the EXPO 2005, Aichi Japan.

2. AIMULET

Aimulet is a coined word from "i" and "amulet". "i" denotes "information", "interactive", "infrared", "AI", etc. Aimulet is a kind of personal digital assistant, which has been called as "My-Button"[7]. It communicates with information processing devices in the environment to know its own position and situation. It then keeps track of the history of its usage by the owner and learns the person's intentions contextualized by the situation.

Image of the Aimulet is indicated in Fig.1. The device has only one red button as the interface, no screen nor keyboard. Just one (or two) click(s) on the button in a proper timing triggers the desired service, just like a good old couple can communicate each other with the utterance of a single word or even the movement of one eye. The key is that Aimulet stays with the user long enough to learn the behavioral pattern of the owner. In the figure, a red button is a triggering button to send a request signal to its information environment. It has spatial optical communication module and voice I/O.

Fig.1 Image of Aimulet

Aimulet must be lightweight. Since high-performance CPU consumes a lot of energy, it is preferred that Aimulet uses outside computing power whenever necessary. But its communication range is also limited. Our first target range is no longer than 10 meters, and probably much less than that.

The communication terminal, named Aimulet, has several features of a simple user interface including voice I/O, some button(s) to send triggering request signal to information environment and a spatial optical communication module. The spatial optical communication module provides a low speed communication with ultra low power consumption, or for high speed communication with high power consumption.

Aimulet has several variations from simple device to complex one. One of the simplest implementation of the Aimulet is Aimulet Ver.1, a compact battery-less information terminal. Figure 2 indicates configuration of the Aimulet Ver.1.

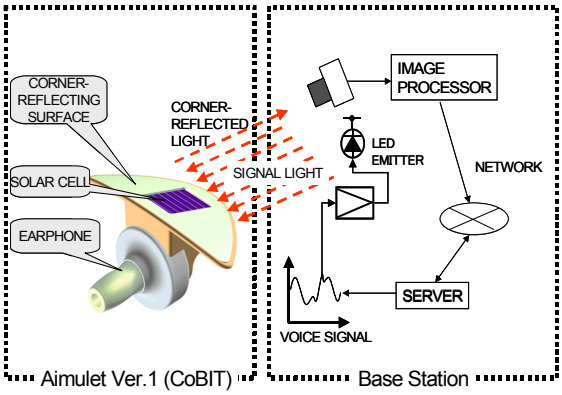


Fig.2 System configuration of Aimulet Ver.1

Terminal of Aimulet Ver.1 is composed of a Si solar cell, an earphone speaker, and a corner-reflecting surface. The solar cell and the earphone are directly connected via no amplifier nor a digital circuit. When amplitude modulated (or pulse width modulated) infrared light from an LED array is introduced to the solar cell, DC biased alternating voltage is generated on the solar cell. When generated voltage is proportional to the voice signal and the generated electric power is strong enough to drive the speaker directory, user can listen the sound information without amplification and signal processing in the terminal. Irradiating pattern from the LED array can be designed from sharp unidirectional to omnidirectional.

The Aimulet Ver.1 can realize not only providing voice information broadcasting service but also a simple but two-way interaction between the terminal and the information environment with no battery. However, a conventional Aimulet Ver.1 has some subjects to be solved. One is simultaneous multi-contents (multi languages or stereo sound) serving and another is malfunction under strong sunshine.

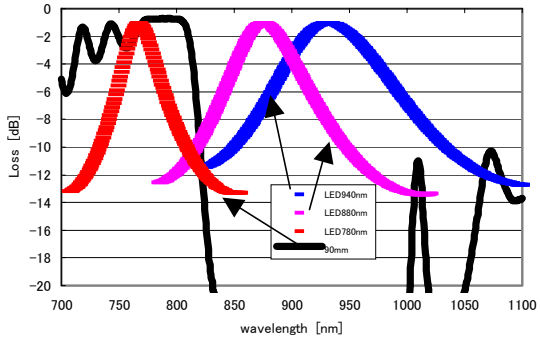
3. IMPROVEMENT OF AIMULET

3.1 MUX/DEMUX OPERATION

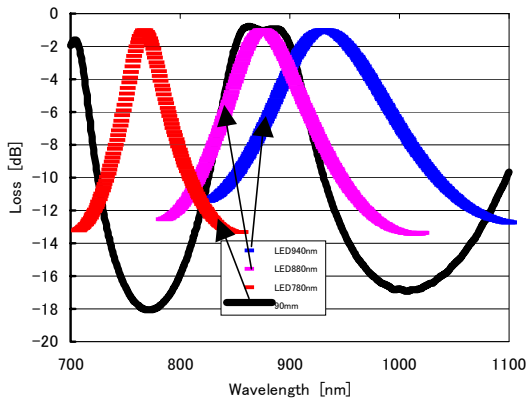
Multiple contents serving technique is one of the most important technique to realize the situation depending services. To realize the multiple contents service, multiplication and demultiplication of the information (MUX and DEMUX) is required. To realize the MUX and DEMUX of voice information guidance service with low power consumption, a novel near infrared wavelength division multiplexing technique was employed.

To realize MUX operation of three contents, three types of AlGaAs/GaAs LED array with different center wavelengths of 780nm, 880nm, and 940nm is used. Pulse width modulated signal is applied to each LED array.

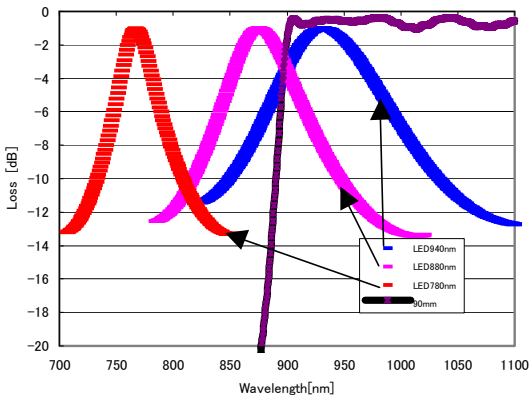
To realize DEMUX operation of three wavelength division multiplexed optical beam, three types of optical filters are designed as shown in Fig.3. Wavelength distribution of LEDs with three center wavelengh are also indicated.



(a) Characteristics of a short wavelength path filter



(b) Characteristics of a bandpath wavelength filter



(c) Characteristics of a long wavelength path filter

Fig.3 Characteristics of designed optical filters

Three types of dielectric optical filters of short wavelength (780nm) pass, middle wavelength (880nm) band pass, and long wavelength (940nm) pass, are developed using evaporation technique on polyimide film to discriminate modulated light with each wavelength. Since these dielectric optical filters pass visible light, visible-cut filtering layers are evaporated on the backside of the optical filter.

3.2 OUTDOOR OPERATION

Outdoor operation is another important issue for the Aimulet Ver.1, because generated voltage on a solar cell is easy to be saturated under strong sunshine and saturated cell cannot transfer sound information any more. To solve the problem, two solutions were employed. One is keeping the solar cell out of the direct sunshine, and another is filtering out the spectrum of the sun except LED's wavelength distribution. Sunshade on the solar cell solves the former problem. To improve the freedom of the design of the terminal, spherical micro solar cell, Sphelar, was employed instead of conventional square wafer solar cell [8]. Rectangle solar cell with a sunshade realize the same function however, design of the terminal is limited. Sphelar increased freedom of design of the terminal.

4. APPLICATIONS AT EXPO 2005

4.1 The 2005 World Exposition, Aichi

The 2005 World Exposition, Aichi, Japan is held in Nagoya Eastern Hills (Nagakute Town, Toyota City and Seto City) from 25 March to 25 September, 2005 (185 days in total) [9]. Main theme of the exposition is "Nature's Wisdom" and over 130 of countries and organizations join the EXPO. In the EXPO, two types of Aimulet systems are employed. One is at the Global House, named Aimulet GH and another is at Laurie Anderson's Walk project, named Aimulet LA.

4.2 Aimulet LA

Aimulet was used in the Laurie Anderson's Walk project as a part of her artistic installation. Laurie Anderson is a world famous performance artist who lives in New York, USA [10]. In the Laurie Anderson WALK project, she arranged two Aimulet sites, four installations and six special points to stop, observe and listen, in a Japanese Garden of the EXPO area. Two Aimulet sites are on the North Terrace and the Dragon Bridge of the garden.

Fig.4 Aimulet LA

Terminal of Aimulet LA is shown in Fig.4. Dimensions of the terminal are 86 x 56 x 7 mm^3. The terminal is composed of twelve Sphelar solar cells and a ceramic speaker, and a shunt resistor. Diameter of Sphelar is 1.8mm. Solar cells are placed in left side pocket in the figure to shade the sunshine. Solar cells are molded in a visible-cut polymer. Sound hole is placed in the center of dome-like bulge on the terminal

Outer shell of the Aimulet LA is made of molded bamboo sheet instead of plastic polymer for ease of recycling. Illustration of Laurie Anderson is indicated on the backside of the terminal. This terminal is manufactured as a give-away souvenir for the visitors of her installations. Users put the terminal over their ear like a cellular phone. LED emitters are set on the ground and signal light is launched to the user like a footlight. Figure 4 indicates LED emitting modules. In this site, Laurie Anderson and her staff give a recitation of a poem in four languages, English, Japanese, French and Chinese.

Fig.5 LED emitters of Aimulet LA on NorthT errace, EXPO2005

4.3 Aimulet GH

Aimulet GH system is introduced at the Orange Hall of the Global House. The Orange Hall has a scientific museum and many of the explanations were served by Aimulet system. Terminal of Aimulet GH is shown in Fig.6. Dimensions of the terminal are 57 x 85.4 x 7 mm^3. Aimulet GH is composed of a Si solar cell (40x20mm^2), a dynamic speaker, an optical filter and an active RFID tag.

Fig.6 Aimulet GH

To realize two-language (Japanese and English) multiplex transmission, dielectric and TAC (triacetate) optical filters are installed in front of the Si Solar cell. Distinguish ratio between two contents was around 20dB.

Figure 7 indicates LED Each emitter has around 1000 LEDs emitters with 765nm (upper) and 870nm (lower) wavelengths. Around 80 sets are installed in the museum. Serving contents can be changed via network.

RFID tag module is used to trace trajectory of the user in the museum area. Frequency of the active RFID is 315MHz± 200kHz. Around 130 antennas are installed in the museum area. Each antenna covers around two meters in radius. All the receivers of RFID are connected to a local area network to reconstruct the line of flow of the visitors. Figure 8 indicated trajectory sensing antenna of an active RFID tag.

Anonymity of the users to keep their privacy is satisfied because each user and an ID in the RFID are not tagged each other.

Fig.7 LED Emitter of Aimulet GH

Fig.8 Trajectory sensing antenna of each guest

5. SUMMARY

Aimulet, which is a location- and direction-sensitive voice and sound information service environment technology was employed in the 2005 World Exposition, Aichi, Japan. First implementation of the Aimulet, Aimulet Ver.1 (CoBIT) is improved for MUX/DEMUX operation and OUTDOOR operation.

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