Portable Bidirectional optical wireless terminal with Organic Light Emitting Diode Display

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***Abstract*-A portable information terminal can simultaneously display and transmit data/image bidirectionally in an indoor optical wireless communication environment.**

I. Introduction

The use of wireless communications has expanded dramatically worldwide. As wireless communication carrier, radio and ray are complementary transmission media, and different applications favor the use of one medium or the other. Radio is favored for applications in which user mobility must be maximized or where transmission though walls or over long range is required. For indoor and wireless local-area networks, however, spatial optical communication is an attractive, safe possibility. A number of indoor wireless communications systems and terminal to send and receive voice, data, and image using infrared radiation have been proposed [1-4].

We have constructed a novel portable optical wireless terminal with an organic light emitting diode (OLED) display to enable users to watch necessary information and transmit data and image bidirectionally. By using an OLED display and communication module, displaying for a color image and transmitting for user messages are realized.

II. Structure of Terminal

The terminal structure and its communication method are shown in Fig. 1. It consists of three component parts. On the display and communication part, an OLED cell is used to display necessary information for the user, and to transmit messages bidirectionally between the user and a wearable computing environment. As a display device, attractive features of the OLED are flexible because its solid state, low power consumption because it is unexothermic almost, good vision acuity because it is self-luminous. And as a communication device, the OLED not only can transmit data by the reflectivity modulation technique [5], but also can receive data by its electroluminescence property to realize bidirectional communication.

On the power source, we chose an Organic thin-film solar cell (OTFSC) [6] because it not only is flexible, has low power consumption, and low cost, but also can convert spatial optical signal from light source into audio signal and carry this voice for user to realize the sound information communication [7].

On the control part, a peripheral interface controller (PIC) chip is employed to program and control the OLED to modulate its reflectivity for data transmission, decode the code signal to receive information, and to show the messages or the images from the users or the environment.

Using the thin-film to make the circuit board for above three parts is able, therefore a flexible plastic sheet, which has a thickness the of less than 2mm can be chosen as a terminal motherboard, as shown in Fig.1.

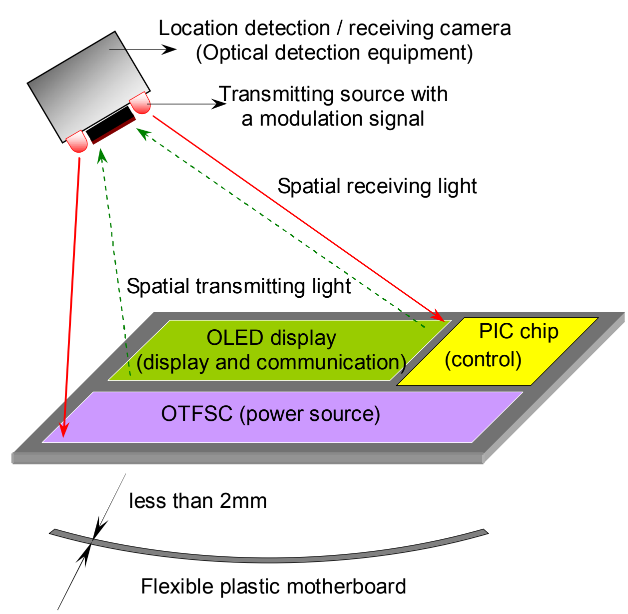

Fig. 1 The terminal structure and its work method.

III. Display and Communication

An optical wireless communication system with this terminal for a wearable computing environment is shown in Fig. 2. A receiving camera with an red LED ring and an infrared bandpass filter is used to find and track the terminal worn by users, and to download the user messages from terminal or transmit the command from the information environment to the terminal. An image acquisition board with good image-processing and pattern-recognition capability is chosen to detect time-series image signal from the receiving camera and realize shift-, scale-, and rotation-invariant terminal pattern recognition.

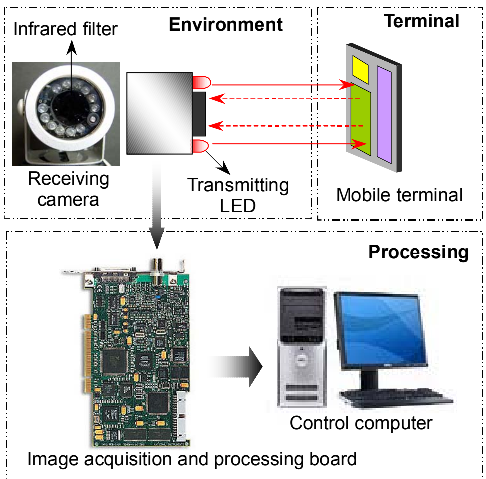

Fig. 2 The optical wireless communication system.

To demonstrate image-display and data-transmission effectiveness of the OLED cell, we use an OLED display module with a PIC microcomputer as shown in Fig.3, and in order to make it a communication device, we developed an application program for its PIC microcomputer to modulate the light intensities of the OLED by the messages from users.

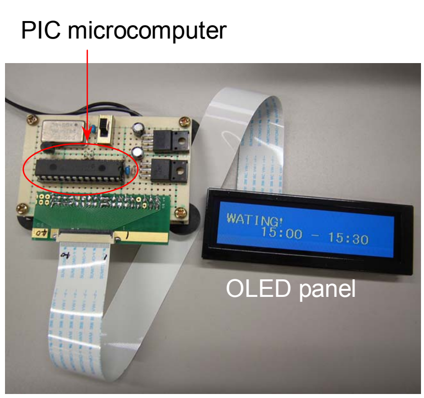

Fig. 3 The OLED display module.

Figure 4 is some examples of the display and the intensities modulation by a user's messages using the proposed program. The examples for the image and the text display are shown in Fig. 4 (a) and (b), respectively. Figure 4 (c) is two transient images when a message is being sent. The intensity of the OLED is modulated by dark (code "0") and bright (code "1") images. The modulation frequency can be controlled within an allowable range of the OLED by this program. Maximum modulation frequency is 1kHz. Figure 4 (d) is two modulation signals correspond to two messages.

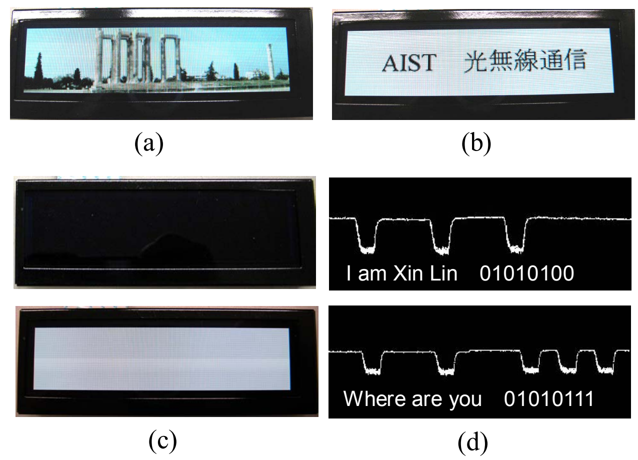

Fig. 4 Examples of display and communication using the OLED module: (a) displaying an image, (b) displaying letters and characters, (c) The transient image for code "0" and "1", and (d) transmitted signals.

IV. Conclusions

We have constructed a portable low-power-consumption information terminal using the OLED and the OTFSC as described here, and employed it to display and transmit user information bidirectionally in an indoor optical wireless environment. A compact, flexible, smart, secure, ubiquitous information terminal should be conducted for further study and development.

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