NNEPS: Network-Updated E-Paper Signage with Reduced Standby Power Consumption

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***Abstract*—Electronic Paper Signage (EPS) is used in various ways, such as at bus stops and in menu lists. One type of EPS is a network-updated EPS that updates content via the Internet. In the network update type EPS, a management computer consumes power constantly while awaiting contents. Therefore, a feature of the electronic paper (e-paper), namely, that it does not require standby power, cannot be utilized. To solve this problem, we proposed a network-updated EPS system that reduces power consumption during standby communication. We developed a prototype of the proposed EPS system and evaluated its power consumption.**

Keywords-Electronic Paper, Signage, Power Saving.

I. Introduction

Electronic Paper Signage (EPS) is a type of digital signage. EPS is a signage specialized in displaying still images using an electronic paper display. Electronic paper displays are characterized by low power consumption because they can retain the screen without consuming power after updating the screen. EPS is being used for floor guides [1] and information boards in office buildings [2].

One type of EPS is a network-updated EPS that updates content via the Internet [3]. Network-updated EPSs are used at bus stops and at certain types of bulletin boards [3]. In the network-updated EPS, the computer that controls the e-paper consumes power constantly while waiting for contents. Therefore, an important characteristic of the e-paper, namely, that it does not require standby power, cannot be utilized. To solve this problem, we propose a network-updated EPS that reduces power consumption during standby. The rest of the paper is structured as follows. In Section II, we present the related work. In Section III, we describe the proposed method. Section IV describes the system configuration and Section V the implementation. In Section VI we conduct the assessment of the power reduction. Finally, we conclude in Section VII.

II. Related Work

Tobias *et al.* [4] have developed a prototype and investigated the performance of an information display device that combines photovoltaics, a low-power wireless protocol, and an electronic paper display. Their results showed that low-resolution e-paper displays can achieve numerous screen updates with very limited energy.

Yang *et al.* [5] proposed two different power supply methods for e-paper: in-situ triboelectric and wireless power supply within 30 cm. They showed that each method can successfully update the screen and drive the e-paper without using batteries or power supply modules.

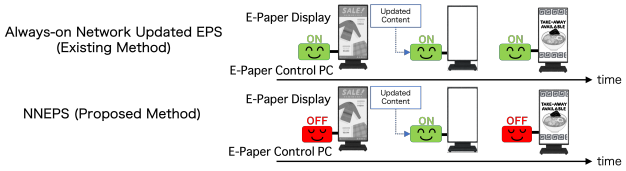

Figure 1. Comparison of the existing and proposed methods.

III. Proposed Method

In this study, a network-updated EPS is converted to a normally-off to save power. Normally-off [6] is the concept of turning off the power when a system is not in use.

The network-updated EPS waits for updated content sent via the Internet. The control PC built into the EPS is responsible for the process of receiving and displaying content on the e-paper display. In existing network-updated EPSs, he control PC is always running and consuming power. Conversely, in the proposed method, the control PC is turned off. When updating content, the control PC is activated upon receiving a notification. When the update of the e-paper display is completed, the control PC is turned off. In this way, the control PC spends less time in the startup state, thereby reducing power consumption. We named the system that realizes EPS with normally-off network electronic paper signage Normally-off Network Electronic Paper Signage (NNEPS). Figure 1 shows a comparison of the NNEPS with the existing network-updated EPS.

IV. System Configuration

The NNEPS is composed of an e-paper, an e-paper control PC, and a power control plug. The electronic paper is the display part. The e-paper control PC performs processing related to e-paper updates. The power control plug stands by with the communication function turned on and turns the power supply to the e-paper control PC on and off as needed for screen updates, thereby enabling the EPS to achieve normally-off.

V. Implementation

Figure 2 shows the NNEPS. The NNEPS implements a power control plug using a microcontroller and relay module.