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A third eye with human-computer interaction for the visually impaired☆

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ABSTRACT

In order to reduce dependency of the visually impaired people on others resulting from their visual impairment, an ergonomic, portable, vocalizable and refreshable Braille reader was developed. Texts from a scanned document or any text imported from a computer are transmitted to the device developed, enabling visually handicapped persons to read a text in the Braille format by using their hands. Some innovations were made in this study with a view to further reduce the size of the previously developed circuit and to lower the cost. The circuit for charging the device and the keypad for the button circuit were redesigned. A new circuit was created for the panels which enables data transfer to the Braille cells. The newly developed device has a reduced size by 57.94%, the cost of device development is cut by 40% and the weight of device has been reduced by 33.3%.

1. Introduction

Persons who have lost sight disability are called as visually impaired individual. These people often need other people's help because they do not have a sense of sight. Some products have been developed in the hardware and software fields so that these people who need special care can continue their lives. These products; cane, talking clock, kitchen scales, screen reading programs, recorders, Braille printers, etc. The common feature of these products is that they transfer to visually impaired individuals by voice and use them with Braille alphabet. The Braille alphabet is an alphabet that is developed for visually impaired individuals.

The Braille alphabet was developed in 1829 by Louis Braille. The Braille characters are represented with 6 dots in total while they consist of 2 columns and 3 rows. Current commercially available Braille displays use 8 dots instead of 6 dots to perform cursor functions. The Braille alphabet contains a total of 64 characters. When the PC became widely used, a refreshable Braille display was needed, and the answer is by using actuators to control the convex or flatness of Braille dots [1]. A Braille display comprises both mechanical and electronic parts for displaying a line of Braille codes [2].

Actuators are usually utilized in order to enable each Braille cell to write different characters. Apart from actuators, several electronic circuit elements can also be used. Some of those include; polymer actuator [3,4], elastomer actuator [3,5], piezoelectric actuator [3,6], flapper actuator [2,3], micro bobin actuator [3,7], bistable electroactive polymers [3,8,9],

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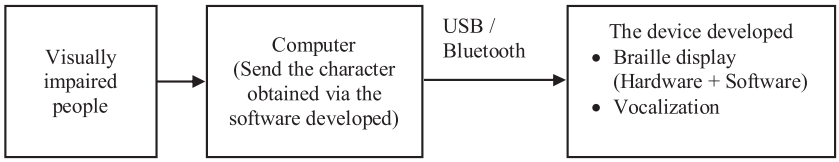
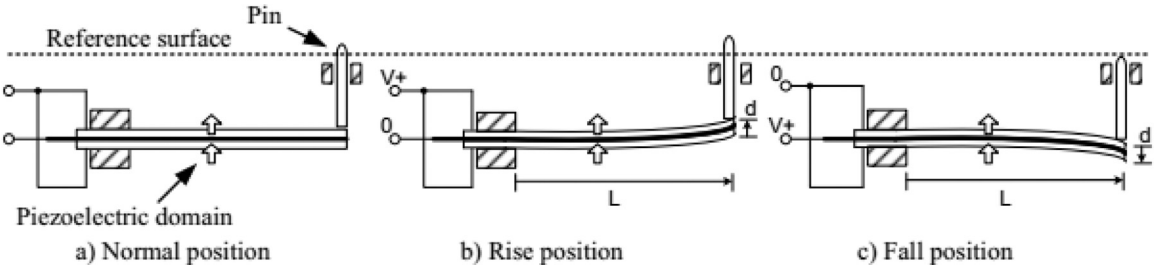


Fig, 1. Schematic diagram of the device developed for the visually impaired people.

Fig, 2. Braille cell [3].



Fig, 3. Operating logic of piezoelectric actuator [16].

pneumatic balloon actuators [3,10], field-effect transistor and polymeric actuators [3,11], relay [3,12,13], electro-mechanically [14] etc.

With advancements in computer technology, new applications featuring human-computer interaction are being developed [15]. In this study, a document reader which comprises 96 Braille cells and has various functional features for the visually impaired people has been developed. The visually impaired person can read the document at that moment with this device. Characters obtained from Optic Character Recognition (OCR) algorithms after any document is scanned or characters derived from any document stored in a computer are transmitted to the Braille cells, enabling a visually impaired person to read by using his hands. The device's Braille display section consists of 2 rows, each containing 48 Braille cells. The device also enables visually impaired people to listen to any text sent from a computer through USB or Bluetooth. Fig. 1 shows a diagram of the device developed.

The remainder of this paper is organized as follows. In Section 2, operating logic of Braille cells and panels are explained. Our proposed method and developed electronic circuits are described with details in Section 3. Finally, we discuss the results in Section 4.

2. Material and method

The Braille display developed for purposes of this study uses electronic circuit elements called piezo actuators. Besides, it uses panels attached to each Braille cell in order to energize the corresponding pins in a Braille cell, i.e. to ensure movement of the pins which should move upwards in the Braille cell when a character is sent from the computer.

2.1. Braille cells and piezo actuators

A Braille cell is a hardware circuitry which is electronically developed for the Braille characters used by the visually impaired people. Many commercially available Braille displays use piezo actuators for the pins located in their Braille cells. A 200 V power is needed to ensure movement of the Braille pins. Supply of 200 V to a pin ensures movement of this pin and thus enables a visually impaired person to feel through his hands. Fig. 2 shows the Braille cell used and Fig. 3 shows normal positions, elevated positions (when energized) and lowered positions (when de-energized) of the pins connected to the actuators used in the Braille cell.

Table 1 gives general technical specifications of the Braille cells used in the device developed in detail.