Applying New Touchscreen Cover Model to Facilitate Communication by Blind Individuals on Mobile Devices

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Abstract

According to a World Health Organization (WHO) fact sheet on blindness and vision impairment, the current estimate of global population of visually impaired individuals is at least 2.2 billion and the number is continuously increasing [1]. From the other side, the expected number of mobile device users worldwide is projected to reach seven billion by the year 2025 [2]. Based on these statistics, it is considered highly beneficial to introduce blind community to mobile technology, as it facilitate their communication with others. In overall, this technology has the potential to compensate for their loss of vision sensory. Existing communication methods for blind individuals imply several limitations, including the challenge of localizing object positions on touchscreen, as the works presented in [3, 4, 5, 6], entailing different types of gestures with multiple fingers to encode Braille characters as the methods proposed in [7, 8, 9, 10, 11] ,and the high cost associated with attaching terminal units, hardware components, sensors, and actuators to augment, for instance, the frameworks proposed in [12, 13, 14] [15, 16, 17, 18]. To overcome these limitations, this research introduces an innovative solution for tactile-based interface. A framework was developed to enable blind impairments to input Braille-based characters. This framework integrates two main components: a touchscreen grid cover and an Android app interface, and it mainly built on the haptic capabilities

embedded in modern mobile devices, specifically, the touchscreen and the vibration mechanism. As the first component and the main contribution of the work, a touchscreen plastic grid cover is developed, divided into eight equally-sized cells arranged on four rows. This grid cover is attached firmly on the touchscreen side of the mobile device providing an effective solution to the challenge of object localization on touchscreen. On the other hand, an Android app is implemented to work in close conjunction with the attached cover. This app provides a main user interface to handle user's touches and identifies the entered Braille-based characters. The interface is designed to splits the touchscreen area into eight fields organized into four rows aligning with the cover's cells . The upper three rows are for data input. In this context, a single touch by a user within a specified data field represents a raised dot in the equivalent position of the six-dot representation of the Braille alphabet. Then, a vibration feedback is issued to confirm the user's touch. Meanwhile the lower row of fields is designated to grab control gesture, including touch, double touches, and long press, to enable the tasks of character acceptance, cancellation, and deletion. Here, considering that both frameworks' components are collaborating to data input, the inner and outer dimensions of the cover precisely match those of the app interface. Being assembled and initiated, the proposed framework is submitted to an organization of blinds and people with low vision, and 12 completely blind participants were selected to test the proposed framework. The participants have various levels of Braille proficiency. The experiments were designed to have two phases: preliminary and final. In the first phase, the framework is detailed to the participants, and then they were asked to start use it to input four words constituting their full names. At the end of the phase, participants comments and feedbacks were collected and analyzed and then both framework's components were adjusted accordingly. During the second phase, each participant was provided with an identical set of sentences in advance, allowing him sufficient time for memorization before the final experimentation date. Then, each participant inputs the set of sentences by utilizing the modified framework, such as one participant at a specific time. The characters entered, along with their corresponding input time, are logged for subsequent analysis. Both experimental phases were conducted under the supervision and guidance of the exterminator (one of the researchers). The overall efficiency and effectiveness of data input using the proposed framework is being analyzed and evaluated based on the speed (WPM) and character input accuracy metrics. As a planned step forward, the proposed framework will be integrated into SoftBrailler, a mobile device-based communication that enabling both input and output text tasks for blind and deaf-blind communities.

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