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The Braille Typist: A Serious Game Proposal for Braille Typewriter Training ^{*}

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Abstract. People with disabilities are constantly denied from their rights and duties, emphasizing the accessibility importance as a path to social equality and independence for them. This paper presents the The Braille Typist proposal, a digital game that uses a Braille typewriter machine emulator to perform individual competitions for training visually impaired people with the Braille typewriter usage. As expected results, an approach to publicize the Braille usage will be provided, as well as promoting a social and digital initiative to include people with visual impairments.

Keywords: Serious Game · Assistive Technology · Visual Impairments.

1 Introduction

According to World Health Organization (WHO), more than one billion people in the world have some kind of disability, with an increasing prevalence over the years [8]. These people are constantly denied from their rights and duties, having the worst life perspective, lower education achievements, and a higher rate of poverty when compared with people without disabilities [8].

Due to the growing number of people with disabilities, it is important to emphasize that accessibility needs to be further studied, working on new urban, social and technology inclusion solutions. Accessibility is a path to social equality, giving all people with the means to carry out their activities in an independent way [2].

Regarding visual impairment, WHO affirms that around 314 million people in the world have some visual impairment, of which 45 million are blind. To help these people, some technologies can be used in the process of inclusion and development, such as: voice recognition, speech synthesizer, screen reader, Braille alphabet, and others.

The Braille typewriter is a faster and better way to write using the Braille system, but sometimes its use is private because of its high values that make it difficult to acquire. In this sense, this paper proposes The Braille Typist, a

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game that follows a Braille emulator pattern to play an individual competition to write correct words according to the Braille alphabet.

2 The Braille Emulator

Louis Braille created the Braille system in 1825, in France. It is recognized as a symbol language or communication method used by visually impaired people (write and read). The Braille alphabet is built under the concept of a 6 dots combination (Braille cell, Figure 1) that are able to represent letters, numbers, punctuation signals and other characters [7].

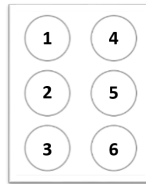


Fig. 1. Braille cell. Adapted from [3].

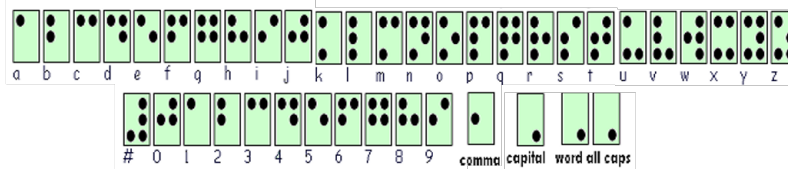


Fig. 2. Braille system characters. Adapted from [4].

Each Braille cell is responsible to represent a character, and the combination of one or many of these is responsible to create words, sentences, numbers and others (Figure 2). If none of the dots are in relief, a blank space is represented. Otherwise, depending on which ones are in relief, it will represent a different symbol of the Latin alphabet. The “#” character (Figure 2) is responsible to indicate that the next word is actually a number, instead of letters with similar relief (from “a” to “j”).

Regarding the Braille typewriter, it has 6 important buttons (1, 2, 3, 4, 5, and 6) that are used to generate a character in Braille (Figure 3, arrow 1). According to what they are simultaneously pressed, the Braille cell is displayed, representing how the Braille dots are arranged (Figure 3, arrow 2).

For the Braille emulator, keyboard keys (F, D, S, J, K, L) are mapped for each Braille typewriter button (Figure 3, arrow 3), allowing a similar Braille typewriter usage in a personal computer keyboard. This key mapping among Latin letters, Braille dots and Emulator keyboard (Table 1) is interpreted by the Braille emulator, generating acceptable Braille characters as possible outputs.

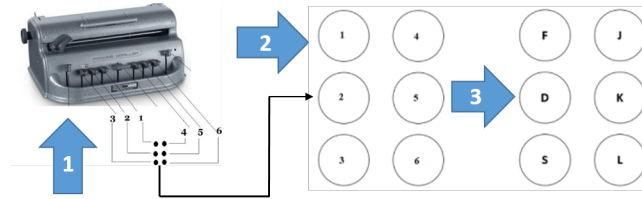


Fig. 3. From Braille typewriter to Braille emulator keyboard mapping. Adapted from [5, 1].

Table 1. Key mapping among Latin letters, Braille dots and emulator keyboard. Adapted from [5].

Letter	Dots	Keys
A	1	F
B	1 2	F D
C	1 4	F J
D	1 4 5	F J K
E	1 5	F K
F	1 2 4	F D J
G	1 2 4 5	F D J K
H	1 2 5	F D K
I	2 4	D J
J	2 4 5	D K L
K	1 3	F S
L	1 2 3	F D S
M	1 3 4	F S J
N	1 3 4 5	F S J K
O	1 3 5	F S K
P	1 2 3 4	F D S J
Q	1 2 3 4 5	F D S J K
R	1 2 3 5	F D S K
S	2 3 4	D S J
T	2 3 4 5	D S J K
U	1 3 6	F S L
V	1 2 3 6	F D S L
W	2 4 5 6	D J K L
X	1 3 4 6	F S J L
Y	1 3 4 5 6	F S J K L
Z	1 3 5 6	F S K L
Á	1 2 3 5 6	F D S K L
È	1 2 3 4 5 6	F D S J K L
Í	3 4	S J
Ó	3 4 6	S J L
Ú	2 3 4 5 6	D S J K L
À	1 6	F L
Ê	1 2 6	F D L
Ô	1 4 5 6	F J K L
Ä	3 4 5	S J K
Ö	2 4 6	D J L
!	2 3 5	D S K
?	2 6	D L
.	3	S
,	2	D
;	2 3	D S
-	3 6	S L
Uppercase sign	4 6	D K
Number sign	3 4 5 6	S J K L

A Javascript version of the Braille emulator was also validated by [5], a Learning Object app that aims to help people in the learning process of writing on the Braille typewriter. As obtained results, according to 20 users with visual impairment, Braillelearning works in a similar way to the typewriter, confirming the successful usage of the proposed mapping for the final user.

3 The Braille Typist Game Proposal

The Braille Typist was designed to be an educational game for visually impaired people. The main objective is to type a set of words using the Braille emulator before the time is over. According to the words pronunciation, players will have to correctly typing them if they want to accumulate points.

As a single player game, The Braille Typist starts with the stopwatch set in 1 minute. The player receives a set of words to be sequentially typed, and the challenge is to write the correct words before the time is over. To score high values, the player needs to be precise and fast as possible.

Player earn points when a word is typed correctly. When an incorrectly typed word is written, the player loses points and another word will be given. The player must decide whether he will try to answer the word based on its pronunciation or skip it to try another word (and quickly recover the lost points).

By correctly completing the given words, more difficult words will be drawn in each round. In each new level, with 1 extra minute each one, new word difficulties will appear to be typed and heard (bigger words, accented words, heteronym). The hearing difficulty can also be performed by changes on the synthesizer configurations (speech speed and volume). The words will be randomly chosen in the system database, which explores the keyboard usage, hearing and spelling aspects, the Braille knowledge and the typewriter machine knowledge.

Regarding the aesthetic layout of the game, colors will be chosen based on better contrasts to users with low vision. A panel to see how the user is typing the word, a progress bar to show the available time, and the player points display will also be applied in the game scene (Figure 4).



Fig. 4. Interface prototype of The Braille Typist game.

As a general view of the proposed game, a Unified Game Canvas was elaborated based on [6] model. It describes the *Game Concept* and *Game Players* (Who), *Game Play* (What), *Game Flow* (When), *Game Core* (How), *Game Interaction* (Where), *Game Impact* (Why) and *Game Business* (How Much) of the respective game (Figure 5).

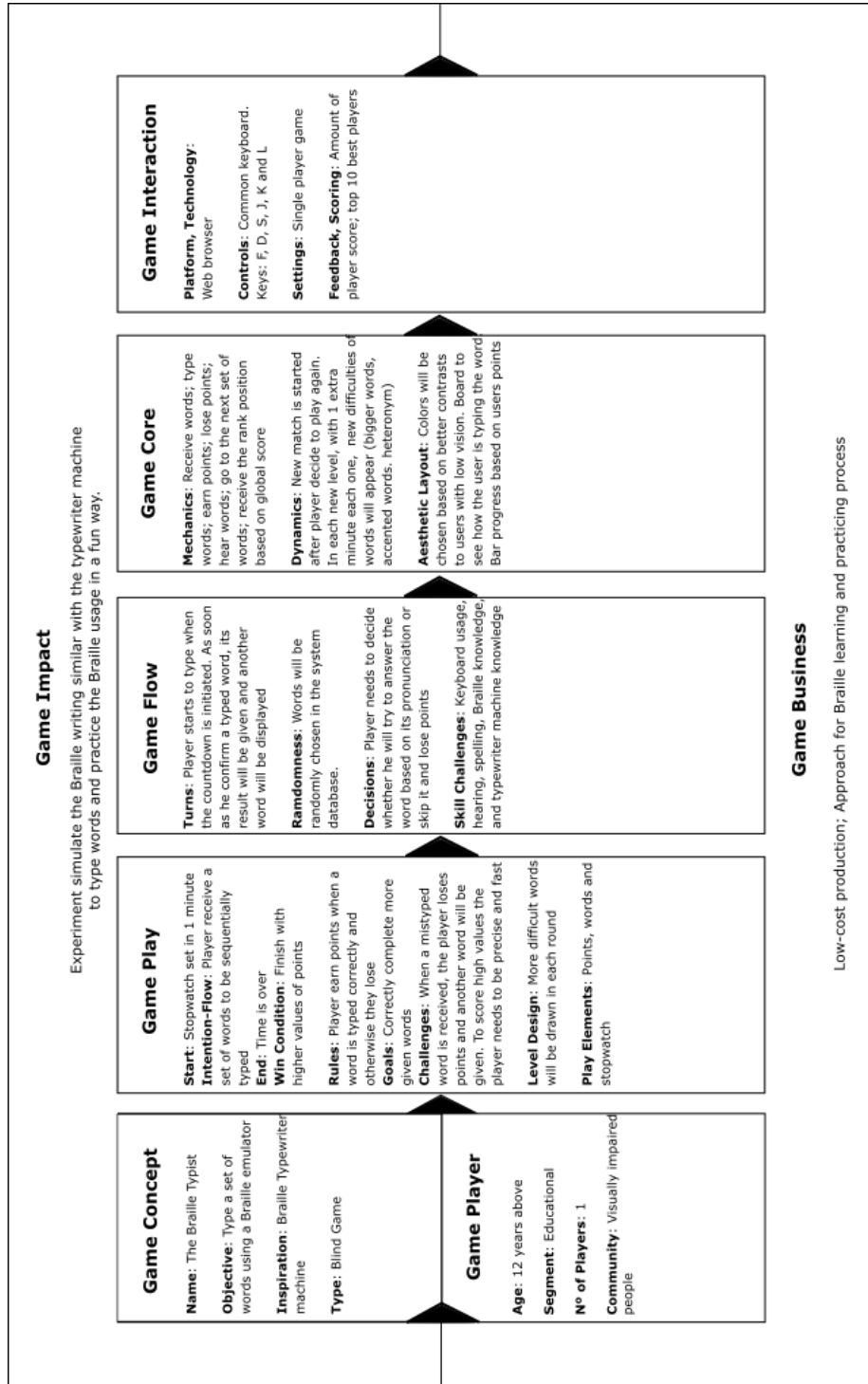


Fig. 5. The Braille Typist game canvas. Adapted from [6].

4 Early Results of The Braille Typist

The game proposed is already under development. The first step was to adapt the braille emulator to work in this proposal. At this point the system main flow is already working, being able to output a random word that is stored in a data structure, to recognize the user input, and to check if the word is correctly typed. Figure 6 shows a student volunteer testing the game in its actual stage to provide some feedback according software usability and if its developed functionalities are working fine.

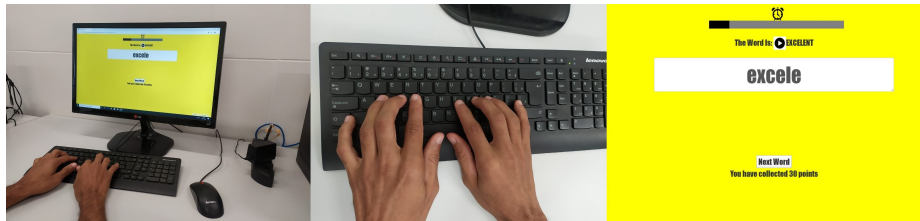


Fig. 6. Evaluating The Braille Typist prototype.

As next steps to the game development, it is expected to improve user interface elements, such as sound effects and a reward system, providing to the user a better gameplay experience. After that, the game will be released to their target public to collect feedbacks to evaluate its usability, accessibility and available features.

5 Conclusions and Future Work

It is important to popularize the use of Braille and its typewriter, as a way of promoting accessibility, since Braille is a mean of communication mainly used by people with visually impaired.

The Braille Typist proposal presents a low cost gamified solution that will allow the player with Braille typewriting training. It provides alternative resources for the educational process of people with visual impairments, improving their accessibility aspects to build paths for social equality, as well as to carry out their activities in an independent way.

As future work, after finishing the game production, The Braille Typist validation will be performed not only by surveys to evaluate usability acceptance through user opinions, but also with data collected from the Braille typewriter emulator. It is expected to gather information about the time to type, time between letters, words completed in a minute, and so on, becoming possible to see how the performance is growing during the game usage. Furthermore, it is also expected the creation of a low cost Braille joystick, based on open hardware

resources able to simulate the Braille typewriter user input that will be used to play embedded Braille games.

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