DRAWING GEOMETRIC FIGURES WITH BRAILLE DESCRIPTION THROUGH A SPEECH RECOGNITION SYSTEM

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ABSTRACT

In this contribution, a system that represents drawings of geometric figures along with their description transcribed in Braille controlled by means of commands acquired by a speech recognition scheme is presented. The designed system recognizes the spoken descriptions needed to draw simple geometric objects: shape, colour, size and position of the figures in the drawing. The speech recognition method selected is based on a distance measure defined with Mel Frequency Cepstral Coefficients (MFCCs). The complete system can be used by both people with visual and with hearing impairments thanks to its interface which, in addition to showing the drawing and the corresponding transcription in Braille, also allows the user to hear the description of commands and final drawing.

1. INTRODUCTION

Nowadays, there are many voice recognition systems, such as the successful Siri. However, they still may be unsatisfactory for people with certain impairments because the use of just voice and sound may be insufficient. In the world there are millions of people who suffer some kind of communicative disability, and defining a common language for all of them is a really complex task. In this context, Braille is a valid and effective tool for both people with visual and hearing impairments, as it helps them to receive and understand the information of the world around them [1]. In this contribution, a system that creates drawing with geometric figures along with their transcription in Braille is presented. The drawings are built by means of commands issued by means of a speech recognition approach. The specificity of this system is the inclusion of both speech recognition and Braille transcription schemes.

2. SYSTEM DESCRIPTION

The general structure of the system developed is shown in Fig. 1. In this figure, the two different parts that compose the system can be observed, specifically: the speech recognition subsystem and the drawing with Braille transcription scheme. The whole system has been implemented in Matlab.

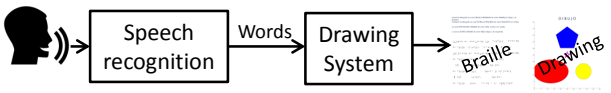

Figure 1. General structure of the developed system.

The two parts of the system developed are described next.

2.1 Speech recognition subsystem

Among the different speech recognition schemes that can be employed, a simple approach based on $MFCCs$ has been selected for the tool developed. $MFCCs$ are used in different audio analysis applications, including speech recognition [2]. Fig. 2 shows a schematic of the speech recognition subsystem. In this figure, it can be observed that this subsystem has three different parts: pre-processing, $MFCC$ estimation and recognition.

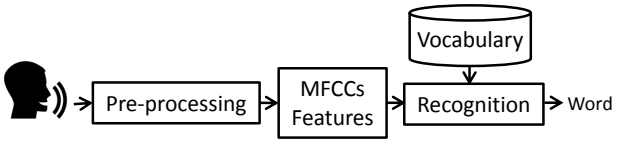

Figure 2. Speech recognition subsystem.

The pre-processing stage is aimed at preparing the voice to perform the recognition. This block includes three stages: noise reduction, pre-emphasis and segmentation with windowing. Hamming windows have been employed because of the fast decay of their side lobes [3]. Then, $MFCCs$ are calculated using the available Matlab function. 40 Mel filter are used when after the DCT, the first 36 coefficients are selected (the first one is not employed). Spoken command recognition is implemented by simply measuring the geometric distance between the $MFCCs$ extracted and the pre-calculated $MFCCs$ of the vocabulary used by the system (see Table 1). The $MFCCs$ of the vocabulary are calculated as the arithmetic mean of 10 different recordings of each word.

2.2 Drawing with Braille transcription subsystem

The general structure of the Drawing with Braille transcription subsystem is presented in Fig. 3. In each screen

Geometry	Colour	Size	Position
Círculo	Amarillo	Pequeño	Arriba derecha
Cuadrado	Magenta	Mediano	Arriba centro
Rectángulo	Cian	Grande	Arriba izquierda
Elipse	Rojo		Centro derecha
Triángulo	Verde		Centro centro
Pentágono	Azul		Centro izquierda
Estrella	Negro		Abajo derecha
	Blanco		Abajo centro
			Abajo izquierda

Table 1. Vocabulary used by the system (in Spanish).

of the developed application, the users have at their disposal visual and hearing resources as well as the possibility of keyboard interaction and the repetition of the speech command. As shown in Fig. 3, in order to draw a geometric figure, position, size, geometry and colour must be said sequentially. Users can draw as many figures as they want. Fig. 4, shows the results of a drawing with its description in Spanish and Braille.

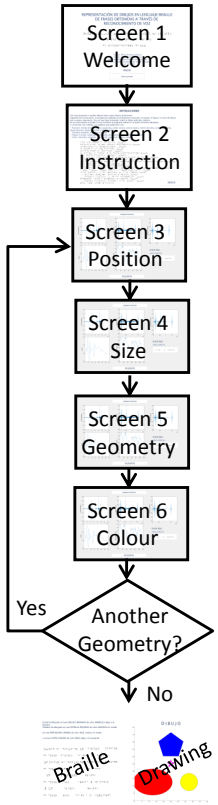

Figure 3. Flow diagram of the developed system.

3. SYSTEM EVALUATION

Performance tests have been carried out with 10 different users, who recorded all the vocabulary words in two different scenarios: with and without the possibility of command repetition. The number of repetitions was limited to three. Table 2, shows the results of the speech recognition system implemented with and without repetition. These results indicate that repeating the same word greatly improves the recognition system, as expected. Note that although the accuracy in the detection of words can be improved, the users said they were pleased with its operation.

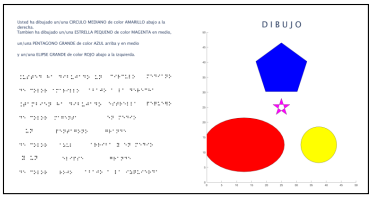

Figure 4. Illustration of a drawing done with the system developed.

Vocabulary	One repetition	Three repetitions
Position	51.10%	74.45%
Size	70.00%	86.64%
Geometry	60.00%	80.00%
Colour	61.25%	83.75%

Table 2. Word recognition evaluation results.

4. CONCLUSIONS

A system that draws geometrical figures, along with their transcription in Braille on the basis of commands given through a speech recognition scheme has been presented. The designed system recognizes simple spoken descriptions needed to draw geometric objects and their simplified location. The evaluation of speech recognition method developed shows that repeating the words to create the models for the later detection greatly improves the recognition performance, which was sufficient to make the subjects pleased with its operation. The system can be used by people with visual impairments and with hearing impairments as the interface includes Braille transcription and hearing aids.

Acknowledgments

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5. REFERENCES

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