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RESEARCH ARTICLE

An Efficient Method For Intelligence In E-Learning For Visually Impaired Persons

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Abstract

Visually impaired is a state where the partially blind people have difficulties on seeing things which in some degree can be considered as handicap. People with normal long-sighted and myopic are not considered as handicap or visually impaired. For many blind people educational choices are made based on which material can be accessed and which cannot. Uppermost for many in choosing their educational and subsequent career path is the notion that studying scientific subjects is difficult due to the highly graphical nature of much of the material presented. In this paper we have designed an interactive learning tool for visually impaired learner to convert pictures to sound. Here we proposed an information recognition framework which consists of digital camera and voice synthesizer using Speech Application Program Interface. Here we uses two methods such as character recognition algorithm which is used to convert Image to text and From text to voice conversion so that the visually impaired learner can be able to understand what is available in the information.

Introduction

Education has been witnessing a rapid acceleration of changes in information and communication technologies (ICT) in the past few years. Enlarging the scope of interaction and interactivity between the teacher and deaf pupils in the classroom environment is crucial to enable effective learning. However, this synergy requires a flexible environment that can be achieved through a centralized e-learning system that can offer interactivity among the learners and instructors [6]. The reading/writing and mathematical skills exhibited by deaf people are well below that of hearing people, although their mental capabilities are basically the same. There are few further education programs for the deaf to make up for this. The ones that exist specialize in furthering the knowledge in special areas, such as home economics or woodwork and do not use sign language as means of knowledge transfer [1].

Although it is possible to 'measure' and describe a person's hearing ability in a variety of ways, understanding speech is a very complex process that can involve the eyes as well as ears and brain. It is therefore possible for a student with 'less' measured hearing to actually be able to understand what is being said better than another student who has 'more' measured hearing. Hearing disability can change over time, and can also involve tinnitus ('hearing 'internally generated' sounds) or additional disabilities [3]. Many sign language researches use a concatenated synthesis system based on data collected with a "Data Glove" such as a machine interpreting system that translates written Japanese to Japanese Sign Language and vice versa [4]. Traditionally the approach to deaf education has focused on comparing deaf learners with hearing learners, without viewing deaf people as visual learners with different learning behaviors. The social cost of this situation is enormous: deaf people are often excluded from written communication and, in many cases, they cannot perform professional tasks involving minimum competences in written language and cannot access higher levels of education [19].

The similar is the case with the visually impaired learners. For many blind people educational choices are made based on which material can be accessed and which cannot. Uppermost for many in choosing their educational and subsequent career path is the notion that studying scientific subjects is difficult due to the highly graphical nature of

much of the material presented [7]. Access to information is major problem for the disabled in India. The visually impaired in India till today depend on two primary sources for their information. One is Braille Books and the other is talking book service [13]. Blind people often use text-to-speech synthesis when they work on the computer. Using a Braille line to convert digital texts into embossed writing is slow and requires extra hardware. Relying more on TTS technology, however, lessens blind people's exposure to the written form of words which is especially important when studying another language [14].One of the main deprivations caused by blindness is the problem of access to information. Visualization is an increasingly important method for people to understand complex information, and is presented using tables, graphs, diagrams and images. Sight-impaired students are at a severe disadvantage in this type of learning environment, particularly those who have been blind from birth or an early age. Computing theory is a combination of logical and physical abstractions, invariably taught to students using conceptual diagrams or figures containing shapes of different sizes together with other visual effects such as shading, color and sequence [2].

The major challenge facing visually impaired students in the educational environment is the overwhelming mass of visual material to which they are continually exposed in textbooks, class outlines, class schedules, chalkboards writing. In addition, the increase in the use of videotapes, computers, and television adds to the volume of visual material to which they have only limited access. Overcoming a students' visual limitation requires unique and individual strategies based on that student's particular visual impairment and his/her skill of communication [5]. The e-Learning market has been slow in developing courses for use with screen readers, speech recognition software and other adaptive technologies. The technology is there but people can't use it in a way that could certainly benefit them most. Although present software systems are often very sophisticated and user-friendly they are not very convenient for visually impaired people [18]. A visual on a screen is of no use to someone who is blind. Nonetheless, there are many solutions for this problem today and hopefully even more in the near future [8].

The rest of the paper is organized as follows. Section II explains the researches that are related to our proposed method. Section III shows our proposed method for improving the learning process for differently abled persons. Section IV explains the result of the proposed methodology and finally Section V concludes our proposed method with suggestions for future

I. PROPOSED METHODOLOGY

The visual system and hearing can be justly considered as the dominant sensory modalities in humans for providing proper communication process. While considering the visually impaired as well as the hearing impaired person it's been difficult for communication for both the affected persons and also for the other people who does not understand the sign language. So it has become a necessary issue to develop a technique for communication for deaf as well as for blind learners. The research relating to these problems has become an interesting topic recently and different techniques have been proposed. In this paper we have implemented a design of an interactive learning tool for visually impaired learner to convert pictures to sound. Here we proposed an information recognition framework which consists of digital camera and voice synthesizer using Speech Application Program Interface. Here we uses two methods such as optical character recognition algorithm which is used to convert Image to text and From text to voice conversion so that the visually impaired learner can be able to understand what is available in the information.

A. E-Learning Process For Visually Impaired

Visually impaired is a state where the partially blind people have difficulties on seeing things which in some degree can be considered as handicap. Visually impaired use different ways and methods to make their life easier to move around doing chores, learn and many more. Commonly the visually impaired person can navigate around with the help of the walking sticks which helps them in guiding to the destination. These can only help them in reaching the destination without any knowledge about the place. They have to completely depend on other people for gathering the knowledge and also for guiding them. This forms a major barrier for them to live independently. Various researches have been done in order to overcome these difficulties for the visually impaired peoples. In our proposed method we have developed an interactive learning tool for visually impaired learner to convert pictures to sound so that it can aid the disabled person to understand what it mean without the help of other people. The entire process in our proposed method is shown in below figure 2.1.

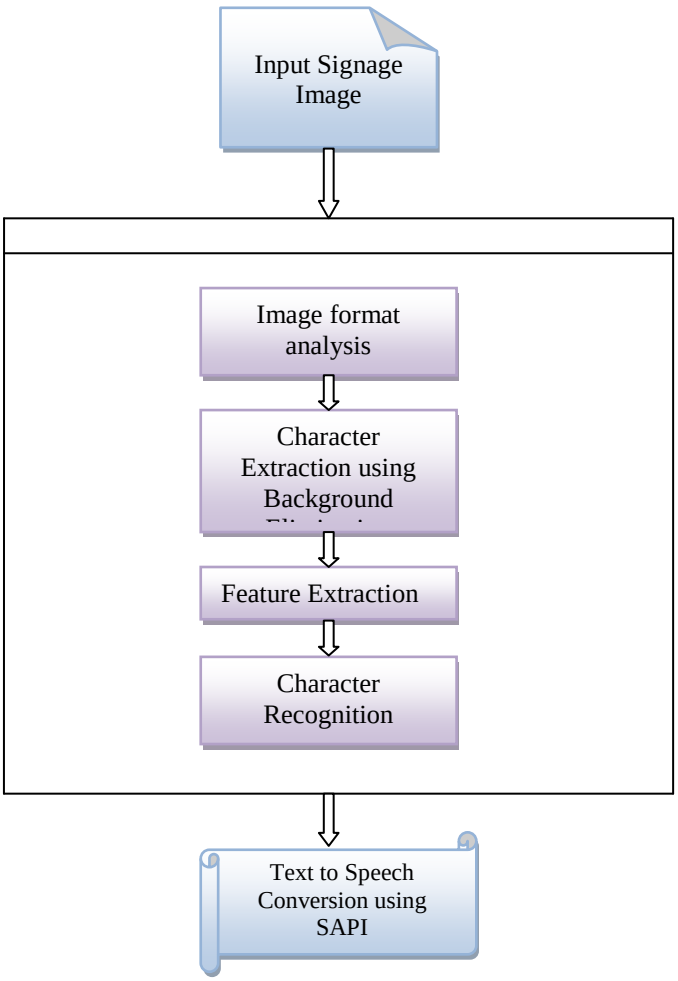


Fig 2.1: Working process of Proposed Methodology

B. Character Recognition Process

Character recognition is generally defined as the electronic conversion of scanned images of handwritten or printed text into encoded format. It is a common method of digitizing printed texts so that they can be electronically searched, stored more compactly, displayed on-line, and used in machine processes such as machine translation, text-to-speech and text mining. In recent years this process has been widely used for various researches related to E-learning process for visually impaired peoples. The text to speech conversion can help the visually impaired person in understanding content without the help of other persons. In our proposed method the character recognition process is done through different steps like image acquisition, background elimination, feature extraction etc.

2.2.1 Image acquisition and Format analysis: Image acquired will be a signage which contains either alphabets or any alphanumeric characters. The user captures the signage using camera and save it in .jpg file. After the image has been captured by the camera, the image will be processed and transformed into a text file.

Once the images for the processing are acquired the image will be analyzed to find the appropriate character image. For our proposed system, the image taken will go through the process of adjusting the image contrast and intensity from colored image to make the image clearer using MatLab. Here the image will be transformed to grayscale image.

2.2.2 Background elimination: Images are virtually split into small blocks either in foreground or background component. Based on intensity variation these classifications as foreground or background is done. Intensity variance of a text block is considerably more than that of a background block. i.e.) if the intensity variance of a block is less than an adaptive threshold it is considered as part of the background. Otherwise, it is considered as part of a foreground component. At first, the camera captured business card images are virtually split into small blocks. A block is part of either background or a foreground component. This classification is done on the basis of intensity

variance within the block. The intensity variance is defined as the difference between the maximum I_{max} and the minimum I_{min} gray scale intensity within the block. It is observed that the intensity variance of a text block is considerably more than that of a background block. This has been the key idea behind the present approach. So, if the intensity variance of a block is less than an adaptive threshold (T), it is considered as part of the background. Otherwise, it is considered as part of a foreground component.

The threshold T has two components, i.e. a fixed one (T_f) and a variable one (T_v) as shown in eqn. 1. T_f is a constant subject to tuning. The formulation of T_v is given in Eq. 2. It may be noted that I_{min} must be greater than a heuristically chosen threshold T_{min}. Otherwise, the block is considered as part of a foreground object. This reveals the reality that even if the intensity variance of a block is less than T_0, it is not classified as background until the minimum intensity within the block exceeds T_{min}. This reduces the possibility of miss-classifying foreground blocks as background ones.

$$T_0 = T_f + T_v \quad (1)$$

$$T_v = \left[(I_{min} - T_{min}) - \min(T_f, I_{min} - T_{min}) \right] * 2 \quad (2)$$

Where,

I_{min} is the minimum intensity in a block

T_{min} is the minimum threshold value obtained

T_f is the threshold value we assign

It is evident from eqn. 2 that the computation of T is such that the more is the average intensity within the grid, the larger is the threshold. In other words, if the intensity band of the block falls towards the higher range of the overall intensity band, then T becomes larger. Such formulation helps to efficiently eliminate the background blocks from the captured business card images. Also light backgrounds get easily eliminated in the said approach.

2.2.3 Feature Extraction: When the input data to an algorithm is too large to be processed and it is suspected to be notoriously redundant then the input data will be transformed into a reduced representation set of features. Transforming the input data into the set of features is called feature extraction .Feature extraction is the process by which image features are extracted and used to represent concisely the image visual content [20]. Feature extraction involves simplifying the amount of resources required to describe a large set of data accurately. Various features are present in the images which can be extracted for proper differentiation of any objects from its background such as the texture, color, edges etc. In our proposed method we have utilized the pixel count feature as well as local gradient histogram features.

2.2.4 Pixel count features: A sliding window moves from left to right over the word. The width of the sliding window comprises several columns. At each position, the height of the window is adjusted to the area actually containing pixels, and then it is split into a 4x4 cell grid. The pixel counts in each of these cells are concatenated to form a 16-dimensional feature vector.

To avoid boundary problems at the very first or very last positions of the sliding window, we assume the area outside the image consists of zero-valued pixels

2.2.5 Local Gradient Histogram Features: For each cell in the image the local gradient histogram features are calculated for extracting the features. Let $X(a,b)$ denote result of convolving the image $P(a,b)$ with a smoothing filter, employed for denoising purposes. For this purpose at first the horizontal and vertical gradient components V_a and V_b are determined as follows,

$$V_a = X(a+1,b) - X(a-1,b) \quad (3)$$

$$V_b = X(a,b+1) - X(a,b-1) \quad (4)$$

Along with the computation of the gradient, a Gaussian derivative filter can also be obtained with a gradient magnitude R and the direction ϕ for each pixel with the corresponding coordinates (a,b) which is defined as follows,

$$R(a,b) = \sqrt{\left(V_a^2 + V_b^2\right)} \quad (5)$$

$$\phi(a,b) = \angle\left(V_a, V_b\right) \quad (6)$$

In the above equations, eqn 6 represents the function which returns the direction of the components V_a, V_b. The magnitude of the identical orientations is accumulated into the histogram i.e.) for each pixel with coordinates (a,b) we determine which of the orientations are close to $\phi(a,b)$. In these feature extractions the pixels outside the image are assumed to be 0 inorder to avoid the boundary effects.

Once the required features are extracted the final character recognition process is performed where the characters based on the features are recognized. For this the text image is converted to the binary image. If the value at the pixel position in the text block is greater than the threshold value then the value will be 1(white) else zero (black) and further processing of the text to voice conversion can be performed.

C. Character recognition:

Once the feature extraction and binary conversion of the images are done the final recognition of the character can be processed. The binary image which is obtained after the conversion will be compared and matched with the template file that has been created. The image that has earlier been recognized will be saved in the text document as text.txt.

D. Text To Voice Conversion:

Once the signage images are converted to text file the final step in our proposed method which is the conversion of text to voice conversion is performed. In our proposed method we employ an application program Microsoft Speech Application Program Interface. This interface is used to convert the text file from any image which is being recognized into voice signal so that the visually impaired person can understand what is written over the image without the help of other persons. The text file that has been created using our proposed method will be fed into Microsoft Speech Application Program Interface (SAPI) to tell the user what the signage is as voice output

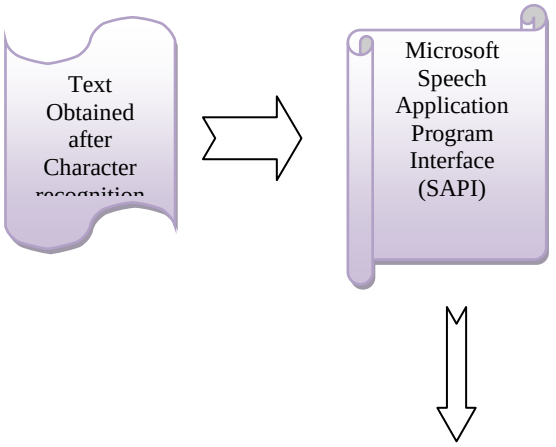


Fig 2.2: Text to Voice Conversion Process

II. RESULT AND DISCUSSION

The proposed E-learning process for visually impaired people is implemented in the working platform of MATLAB (version 7.12.0). The recognition process is tested with different input image signages and the obtained result of the proposed work has been shown below. Initially, the input images are acquired which is followed by the format analysis. After converting the image to grayscale, the background elimination is performed where the text are separated from its background based on the threshold and intensity values. Once the text is extracted from the image, the feature extraction process is performed where the required feature needed for further

Processing is extracted. Once the feature is extracted from the image, the character recognition process is done where the binary image which is obtained after the conversion will be compared and matched with the template file that has been created. The image is saved as the text file and then applied to SAPI for voice conversion from the extracted text. The processing of the image to voice conversion is given as follows

Fig 3.1 Input image for character recognition

Fig 3.2 Background eliminated output

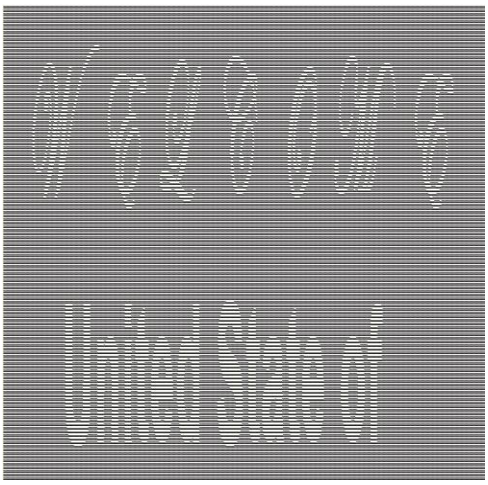
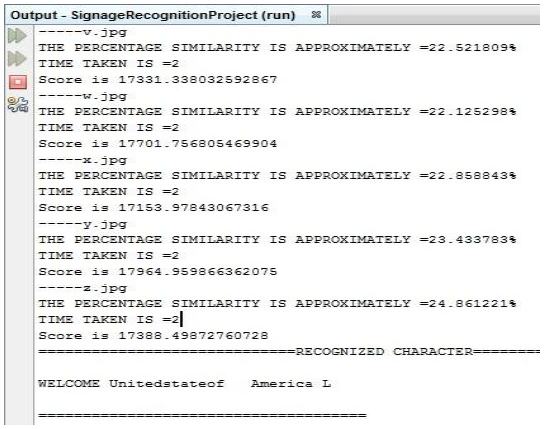


Fig 3.3 Output after feature extraction

Fig 3.4 Text extraction process for the input image

The Fig 3.4 shows the text extraction process from the input image using our proposed method. Fig 3.1 is the input image with the text "WELCOME UNITED STATE OF AMERICA". This input image is to be processed to extract the text from the image. The image format is analyzed at first and then the background elimination process is carried out as shown in the Fig 3.2. After background elimination the text are separated by extracting the features and its output is shown in Fig 3.3. Once these text extraction is completed the character recognition done as shown in fig 3.5



```
Output - SignageRecognitionProject (run)
-----v.jpg
THE PERCENTAGE SIMILARITY IS APPROXIMATELY =22.521809%
TIME TAKEN IS =2
Score is 17331.338032592867
-----w.jpg
THE PERCENTAGE SIMILARITY IS APPROXIMATELY =22.125298%
TIME TAKEN IS =2
Score is 17701.756805469904
-----x.jpg
THE PERCENTAGE SIMILARITY IS APPROXIMATELY =22.858843%
TIME TAKEN IS =2
Score is 17153.97843067316
-----y.jpg
THE PERCENTAGE SIMILARITY IS APPROXIMATELY =23.433783%
TIME TAKEN IS =2
Score is 17964.959866362075
-----z.jpg
THE PERCENTAGE SIMILARITY IS APPROXIMATELY =24.861221%
TIME TAKEN IS =2
Score is 17388.49872760728
==========RECOGNIZED CHARACTER========

WELCOME Unitedstateof   America L

=====================================
```

Fig 3.5 Screenshot for character recognition from image

The final step in our proposed method is to convert this extracted text to voice. This step is done with the help of an application program Microsoft Speech Application Program Interface (SAPI). The extracted the words from the image are saved as text file and these text files are given as the input to the SAPI. The SAPI is an application program which will convert the text file into corresponding voice signal. The process carried out in SAPI is given below

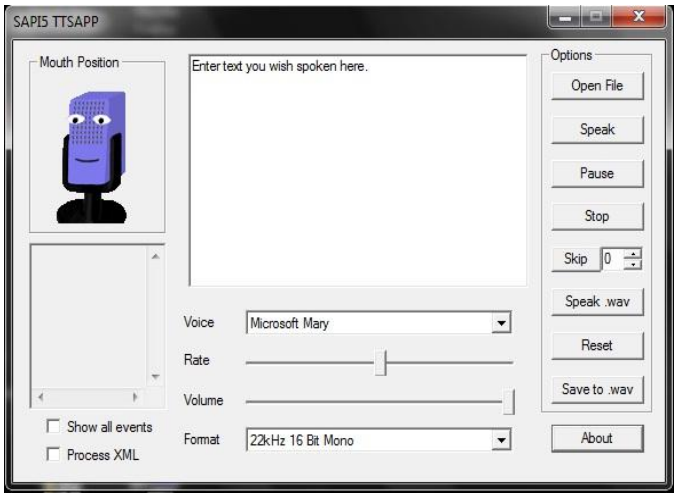


Fig 3.6 SAPI input window

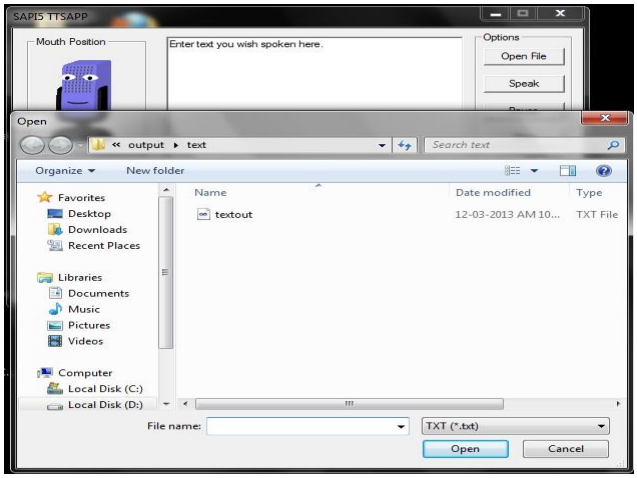


Fig 3.7 Extracted text as Input

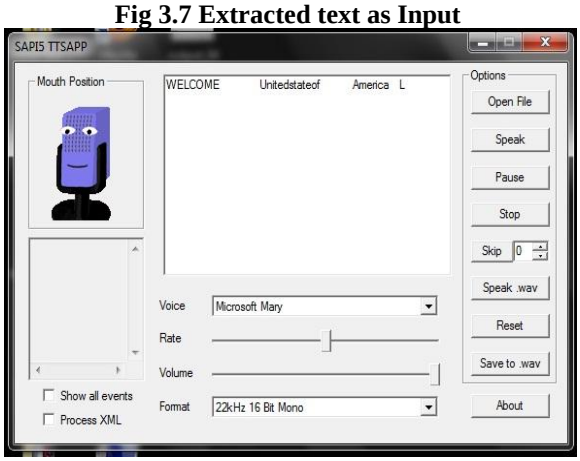


Fig 3.8 Final converted text to voice

The above firures shows the process which is carried out in Microsoft Speech Application Program Interface. Fig 3.6 shows the main window of the SAPI where the text files has to be selected. The fig 3.7 shows the selection of the extracted text for voice processing and the fig 3.8 shows the converted output of text to voice. By utilizing this application the text from any image can be converted to the voice which can help the visually impaired person to understand what is written over any signage images without the help of other persons.

The performance evaluation of our proposed methodology is calculated by measuring the true positive recognition rate for the method. The recognition rate proved to be more improved than the previous work used in Signage Recognition Framework for Visually Impaired People [21]. The recognition rate obtained in our proposed method has better exceeded when compared with these existing method. The table 3.1 given below shows the recognition rate obtained from our proposed method and the existing method.

The true positive recognition rate for the proposed method is calculated with the help of the below expression,

$$True\ positive\ recognition\ rate = \frac{N_{CR}}{N_T} \quad (7)$$

where,

N_{CR} is the number of correctly recognized image.

N_T is the total number of images used.

Method	True Positive Recognition Rate (%)
Proposed method	87.5
Existing method	80

Table 3.1 Recognition rate for proposed and existing work

From the values obtained in the table it is clear that our proposed method delivers better recognition rate than the existing method. The corresponding graphical representation of the recognition rate is shown in the fig 3.9.The results proves that our proposed method of e-learning process for the visually impaired persons is effective in the performance measure thus by helping the visually impaired to understand the text that are written over the signage without the help of other persons.

Fig 3.9 Graphical representation of True positive Recognition rate for proposed and existing work.

III. CONCLUSION

In this paper we have proposed an efficient method of learning process for visually impaired people. Usually the blind people depend on others for reading or understanding any information from any document or from signage images. In our proposed method we have employed a alternative for the visually impaired by developing a learning method where the text from any sort of images can be converted into voice signal which can help them to understand what is written over the image. The text from the image is first extracted using different process and these texts are then fed to SAPI for converting it to voice signal. The proposed method proved to be more efficient when compared to various existing methods. The results show that our proposed method generates more recognition rates than other methodsentire document should be in Times New Roman or Times font. Type 3 fonts must not be used. Other font types may be used if needed for special purposes.

IV. ACKNOWLEDGMENT

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