

Virtual Vision – Engineering solutions for the blind

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Abstract:

The visually impaired have been deprived of a normal living style due to the absence of proper aiding devices. This projects aims to fill up the gap, which deprived the visually impaired from leading a normal life and the way they gain access to information. This system involves the design of various modules, which aim to ease the way of living of a visually impaired person and how he can blend with the normal kind of living. It involves the design of the following modules:

1. A complete networked learning system, called Virtual Vision learning Center, which can recognize discretely programmed commands and can provide study materials using a voice feedback system.
2. A computer based Braille to speech translator, which recognizes and reads out Braille manuscripts.
3. A hardware based voice recognition system, which will be able to recognize discrete commands, which can be used to control an electronic device, say an MP3 player.
4. A hardware based range sensor, which will be able to sense the distance of the nearest obstacle.

Virtual vision learning center:

The virtual vision-learning center is a networked software module, which can be used as a vital tool in educating the blind.

General Features:

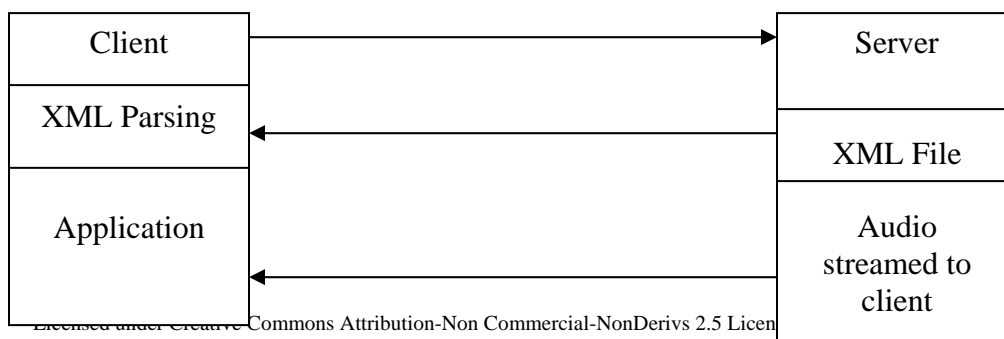
The virtual vision-learning center is a tool focused on educating the blind. The client application, which runs on a low, powered PC can recognize discretely programmed voice commands. A voice over will give the available list of subjects under the learning center; the user can then select a lesson by just saying the name of the lesson. In the same way, the available topics under the lesson are listed using a voice over. This hierarchy goes on until the user reaches a particular section of the chapter.

When the user has reached a particular sub section, the software reads aloud the contents of the section. The sections are stored in the form of MP3 and are streamed from the server as and when it is needed. The main advantage of this tool is that it is user independent and can even recognize female voices, when it is programmed for a male. Accuracy is rated at around 95% and can be pushed to 100% accuracy when properly trained.

Technical features:

This system involves the design of a client server model, in which the server stores the study material structured in the form of XML documents. The client performs the speech recognition part of the system and gets data from the server as and when it is required. XML parsing is done on the client. The server stores the hierarchy of XML files and the files are given a structure using the main file *root.xml*. This file along with the files associated with it can be changed if the study materials are to be changed.

The final audio file, which is associated with a particular section of the tutorial, is stored in the form of an MP3, the filename of which is specified in the corresponding XML file. XML is used in this system, because it is easy to structure data rather than using any database system. The XML parsing is simple and is done on the client side as and when data is needed. A voice feedback system reads out all the menu structure at each level and the selection is done using simple command recognition.



Braille to Speech translator:

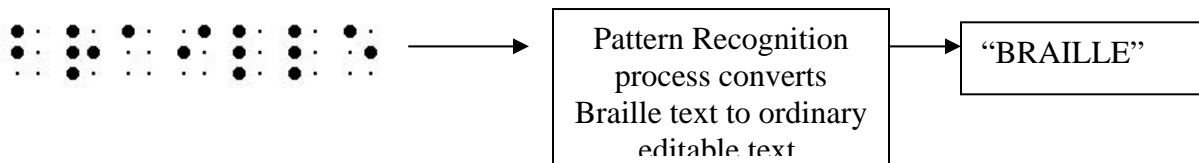
General Features:

This system is focused on the visually impaired who have not yet learned Braille and actually have Braille manuscripts to read. This system involves the design of an application, which will be capable of capturing an image from the scanner and recognize the Braille content using a simple pattern recognition algorithm. This system uses the simple Grade 1 Braille where there is a one to one mapping of Braille characters and English characters. The Braille document consists of a grid of 3 rows and 2 columns in which characters are represented by placing a dot.

The Braille content is assumed to be blackened at the embossed points or is blackened by rubbing a carbon sheet along the surface of the Braille document.

Technical features:

Grade-1 Braille characters are represented using a grid of 2 columns and 3 rows. Using this structured format, a simple pattern recognition algorithm is applied on the Braille character. The sheet of scanned Braille text is converted into a grid using imaging techniques. This scanned document is then compared on a bit by bit basis with a standard bitmap consisting of all characters from a-z and 0-9. The recognized characters are converted into readable text and are converted into voice for the blind.



Hardware requirements for PC based solutions:

The hardware requirements for the Virtual Vision PC based solution are as follows.

1. Pentium III 450 for the central server.
2. Low-end Pentium II systems for the clients.
3. Average quality microphone for recognizing voice commands.

Human assisting devices

The project also aims at developing a range of gadgets, which can be worn by the visually impaired people. These gadgets help in normalizing the day to day activities of the impaired people by providing extra inputs which could help the blind make up for the lack of visual data. A variety of gadgets each targeted at providing a different 'enhancing functionality' is proposed and some constructed:

1. Range measuring devices.
2. Voice controller.
3. Pseudo vision devices.

Range measuring devices:

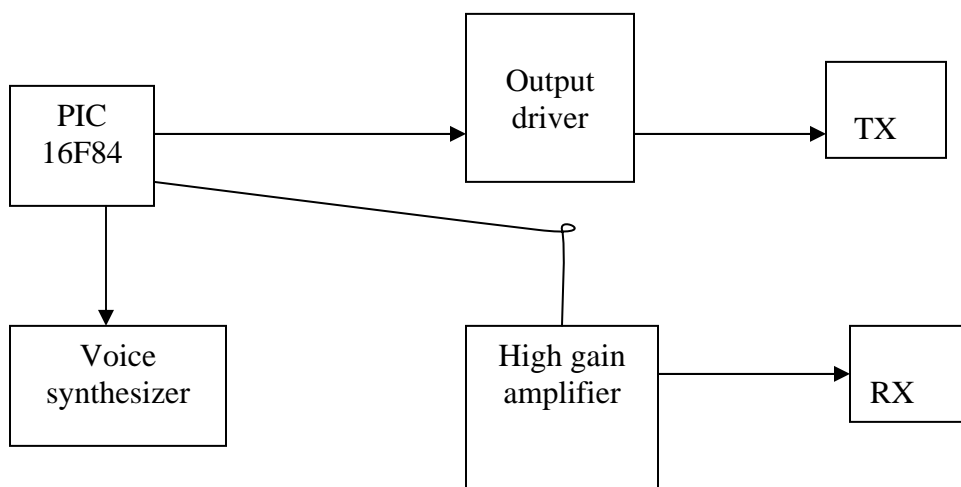
The range measuring device provides the visually impaired data about the distance of an obstacle present ahead of them. It is not meant to be a replacement for a cane, but rather act as a complementary device. It then speaks out the value.

Design criterion:

1. The device must be ergonomic.
2. It must provide acceptable accuracy.

In order to provide for the above design constraint, a system was designed using ultrasonic ranging techniques. The method involves transmitting a burst of ultrasonic waves and receiving the same (reflected from the obstacle) and calculating the 'time of flight'. This combined with the knowledge of the velocity of sound in air can be used to estimate distance to the obstacle.

Block diagram of the system:



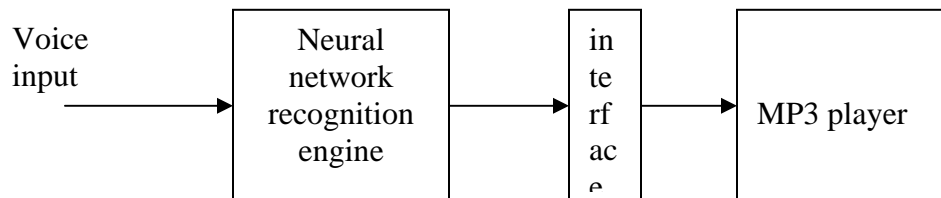
Portable voice based command unit:

One of the perennial problems of the blind is the controlling of the other gadgets they use in their day-to-day activities. For example to operate a radio set they would have to fumble with the controls each time. In order to allow them greater flexibility and ease of use, a voice based command unit has been developed which does the above-mentioned tasks.

Design constraints:

1. Ergonomic design.
2. Good recognition accuracy.

The device employs a neural network based recognition engine which provides for recognition of nearly 70 words. Then there is a interface to the targeted application for example to a MP3 player (which is demonstrated).



Conclusion:

Thus a variety of solutions to improve the quality of life of the blind has been developed.