TEXT-TO-SPEECH RECOGNITION SYSTEM FOR WEB BROWSING

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ABSTRACT

Incorporation of speech and Indian scripts can greatly enhance the accessibility of web information among common people. This paper describes a `web reader' which reads out' the textual contents of a selected web page in Hindi or in English with Indian accent. The content of the page is downloaded and parsed into suitable textual form. It is then passed on to an indigenously developed text-to-speech system for Hindi/Indian English, to generate spoken output. The text-to-speech conversion is performed in three stages: text analysis, to establish pronunciation, phoneme to acoustic–phonetic parameter conversion and, lastly, parameter-to-speech conversion through a production model. Different types of voices are used to read special messages. The web reader detects the hypertext links in the web pages and gives the user the option to follow the link or continue perusing the current web page. The user can exercise the option either through a keyboard or via spoken commands. Future plans include refining the web parser, improvement of naturalness of synthetic speech and improving the robustness of the speech recognition system.

Keywords -- Web Reader; Text To Speech; Speech Synthesis; Speech Recognition; Indian Accent; Human Computer Interaction

I. INTRODUCTION

In this information age, storage and retrieval of information in a convenient manner has gained importance. Because of the near-universal adoption of the World Wide Web as a repository of information for unconstrained and wide dissemination, information is now broadly available over the internet and is accessible from remote sites.

However, the interaction between the computer and the user is largely through keyboard and screen-oriented systems. In the current Indian context, this restricts the usage to a minuscule fraction of the population, who are both computer-literate and conversant with written English.

In order to enable a wider proportion of the population to benefit from the internet, there is need to provide some additional interface with the machine. Speech, being a natural mode of communication among human beings, can also be a convenient mode of interaction with a computer. Internationally, efforts are already on to combine hypertext navigation with spoken language (Lau *et al* 1997). This can be of particular significance in our country where the rate and level of literacy are quite low. Coupled innovatively with visuals, speech and sound can add a new dimension for conveying information to the `common' man. Audio information can also be broadcast (e.g. at community centres) or made available on demand by telephone, thereby greatly expanding the range of end-users.

It is desirable that the human-machine interface permits communication in one's native language. This is an

important issue in a multi-lingual country such as India. If the human-oriented information over the internet can be coded in a form suitable for display in a script familiar to the user and also for reading out in an acceptable language and accent, the computer can process such hypermedia document and provide the information appropriately to a large number of users. This paper describes a web reader which can `read out' appropriately coded HTML pages in Indian languages and accents. To start with, Hindi and `Indian English' have been chosen. Choice of Hindi in India is automatic. English, however, is the pre-dominant internet language and will continue to be so at least in the near future. The web reader thereby caters for English also, but reads them out in an accent which is considerably more acceptable than the standard English accent to an average Indian.

LITERATURER WORK:

II. CONVERTING PRINT MATERIALS TO DIGITAL TEXT USING A SCANNER

For many people, using standard print materials such as books, newspapers, and magazines is difficult due to a physical disability, learning disability, or poor reading skills. Converting print materials to digital text on a computer can give access to this information. You convert print materials to digital text using a scanner. To the left are links to information about scanning hardware and software, as well as the scanning process.

III. CANNERS

A scanner is the peripheral hardware you attach to your computer to scan print material and then save as files on your computer. Scanners for computers come in two types – sheet fed and flat bed. A sheet fed scanner only accepts single sheets of paper or a series of sheets. To scan material from a book, pamphlet, magazine, or newspaper, you may need to use a copier to create sheets that will feed well through the scanner. A flat bed scanner looks similar to a small copier. You can lay a sheet of paper, a book, or any thick document on the scanning glass, close the lid, and scan the text. A flatbed scanner is more flexible than a sheet fed scanner in the types of documents it scans. Scanners range in cost from $99 to several hundred dollars. Generally, more expensive scanners have higher resolution and scan colored images more accurately. Scanning text does not require a high-end scanner.

IV. SCANNING AND OPTICAL CHARACTER RECOGNITION (OCR) SOFTWARE

Some text-to-speech (TTS) software programs come with their own scanning and OCR software. When you purchase a scanner it also comes with scanning software and OCR software at no additional cost. The scanning software controls the operation of the scanner and enables the scanner to create a digital image of a page of text (with or without pictures). The OCR software then interprets the text in this image and converts it to true text that a computer recognizes as text.The scanning and OCR software that comes with some TTS programs converts print materials to TXT and RTF files or files in the TTS program's own proprietary format. The scanning and OCR software that comes with a scanner converts print materials to TXT and RTF files as well as some commonly used word processing program formats. The scanning and OCR software that comes with scanners is fairly basic in its functionality. If you will be scanning a lot of print material into digital files, you may find it useful to purchase a separate OCR program that has more features and functions. Popular programs are ABBYY

Fine Reader 8.0 http://www.abbyy.com Text Bridge Pro and Omni Page Pro. Both of these latter programs are available from Scan Soft Corporation and you can get information about them at www.scansoft.com.

4.1 THE SCANNING PROCESS

Scanning print material into your computer and saving it as a digital text file is a process with the following steps. Because these steps are not specific to a particular scanner and software, they are general in their description.

Step1

Lay the document page on the scanner glass, or for sheet fed scanners, insert the sheet into the scanner. If you are scanning several pages you want to save as one document file, you may be able to indicate to the scanning software that the print material is multiple pages.

Step2

Click the scan button or choose the menu item instructing the scanner to scan the page. First, the scanner will create and display a preview version of the page. Look at the preview page and evaluate how readable or clear it is. Print materials that have a colored background or contain text in colors other than black may not initially scan well.

Step3

Evaluate the preview scan. If the preview is poor, then you will need to adjust the resolution and/or the brightness level. Adjusting the brightness can help compensate for a colored background or colored text. Refer to the user guide describing the scanning and OCR functions and look for information about improving the image, adjusting resolution, and adjusting brightness. In addition to improving the image, some software allows you to select a specific area that you want to scan in the final scan so that only that area is scanned. Make this selection if necessary.

Step4

Prepare the text page for the final scan and OCR conversion. Refer to the instructions below that pertain to the type of page you are scanning.

Text only page The software may allow you to indicate that you are scanning text and that the OCR software should "interpret" or "recognize" the text in the final scan. You may have to do the final scan and then run the OCR software as a separate step. For more specific instructions about the OCR function, refer to your user guide and look for information about OCR, text files, interpreting text, and recognizing text.

Text page with columns Some scanning and OCR software lets you indicate in a setting that the text has multiple columns. Choosing this setting helps the OCR software interpret the text correctly.

Text page with picture Some software lets you draw graphic boxes around the pictures to indicate they are picture areas and text boxes around the text areas to indicate that those need to be interpreted by the OCR software. You may also be able to number the text and picture areas so that in the final document they appear in the order you select. Some software calls these areas of the page "zones" and looking for that information in your user guide will give you more specific instructions about this step.

Step 5

Instruct the software to make the final scan after making any adjustments in Step 3 and Step 4. If the OCR software also interpreted the text and converted it to true text, you are ready to move to Step 6. Otherwise, you need to instruct the software to run the OCR. Refer to your software user guide for more specific instructions. Look in the index or table of contents for phrases such as interpret text, recognize text, optical character recognition (OCR), and text document. If the quality of the final scan is still not optimal refer to Steps 3 and 4 again for improving the image and then re-try making the final scan.

Step 6

Save your text file in a format appropriate to your TTS program. RTF allows you formatting options and you may want to choose this format for that reason. If you are using scanning and OCR software that is part of your TTS program, then refer to the user guide for that program to see what format the guide recommends. It may be that a format proprietary to that software works best. See Strategies for Formatting and Saving Scanned Text Files for tips about storing and backing up these files after you have created them.

Warning! If you open your new digital file and the TTS program can't read it, you may not have run the OCR software (even if you think that you did). No TTS program can read a graphic image. To check your file: Open your newly scanned file. Click anywhere inside the file window. If your cursor does not show as an I-beam in the text, then what looks like text is actually a graphic image of the text. Refer to the OCR information in the steps above or in the user guide for your software. Run the OCR process on this file to convert it from a graphic to true text.

V. STRATEGIES FOR FORMATTING AND SAVING SCANNED TEXT FILES

When you create files from print materials, you want them to be easy to use with your TTS program. Here are some tips:

- For digital files of books, save each chapter as an individual file and then keep the files in a folder named for the book. If it is a textbook with long chapters, you may want to save units of the chapters as files inside folders named after the chapter that are in turn in one folder named for the book. Breaking up the book in this way can help you get to the place you want to read more efficiently.
- If you have plain text files of books or articles that lack any formatting, it can be helpful to add some basic formatting. Making titles and sub-headings bolder or larger can help you find your place in the file when you or another person is reading the file. If you add this formatting, save the file in RTF format.

- Back-up your scanned files. Scanning is time consuming so you never want to have to re-scan material because you lost the file. Back-up on to a server if your computer is hooked up to a network. If you have a CD burner, you may want to create CDs of books you scan. You can also save files to a Zip disk or diskette. Backing up files in more than one way, for instance on a server and on a Zip disk, gives you added security.
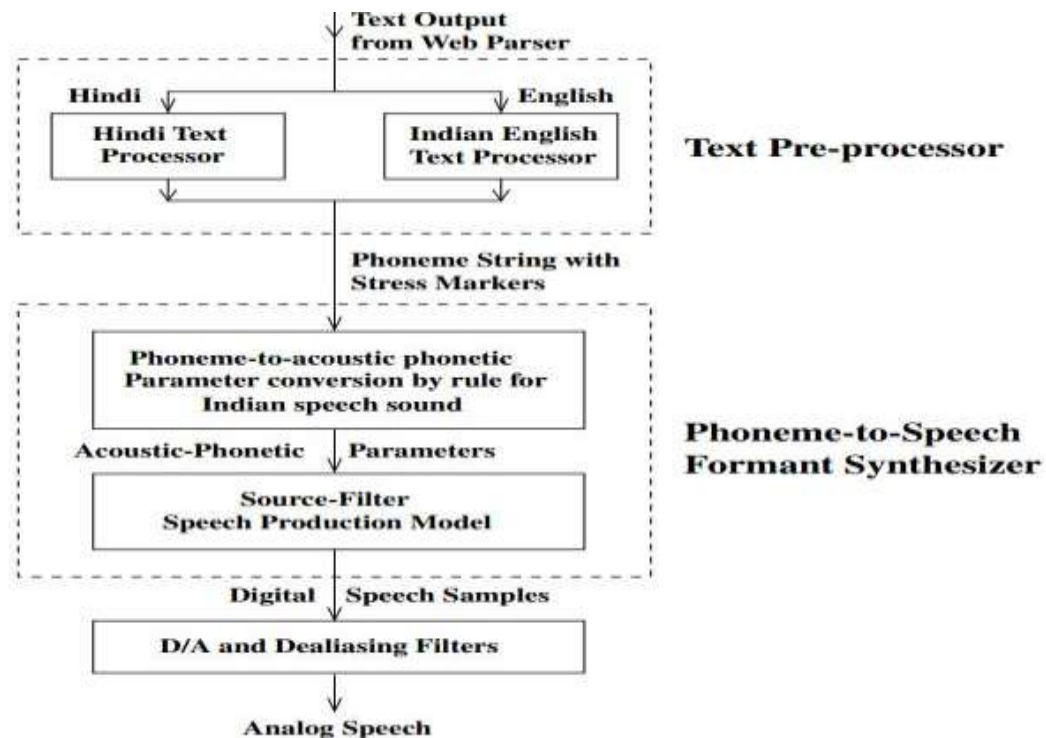
Context-dependent rules, suitable for Indian pronunciation and (b) conversion of the generated acoustic–phonetic parameters into corresponding speech (digital samples) by a source-filter speech production model. A preliminary version of this phoneme-to-speech conversion system was described by Furtado & Sen (1996). Subsequently, rules and data were continuously improved. A few strategies were also changed, which are described in § 3.4. This stage is virtually identical for Hindi and Indian English. If any additional (structurally similar) Indian language is to be incorporated into the TSS in the future, minimal changes will be needed in the phoneme-to-speech subsystem. Only the text analyzer appropriate for the new language needs to be added.

Text analyzers and the two stages of the phoneme-to-speech conversion system are dis-cussed in the following sub-sections in some detail. Figure 2 shows the schematic of the entire synthesizer with Hindi/Indian English text analyzers as alternatives.

VI. WEB READER SYSTEM IMPLEMENTATION

The web reader is the result of integration of HTML document processor and TSS with the audio output module of the computer, and wrapping it up with control structure for web navigation. A flo w chart of the human–computer interaction in a web reader is shown in figure 5.

The output of the HTML document processor is the text to be read out to the user along with control information, if any. If the output is not a URL, the text is simply passed to TSS for generating the speech signal of appropriate voice type. The normal text is read out with a default voice type. Alternate synthesized voice type is used to indicate title or emphasized text. This is a first step in the direction of indicating the type of information being

conveyed to the user in audio mode. If the output of the document processor is a hyper link, the user is offered a choice either to follow the link or continue listening to the rest of the current document. At this stage, the user also has the option of returning to the document previously visited (equivalent to the back button in a browser). The system waits for 3 seconds for the user's response. If the user does not exercise his option within 3 seconds, the system follows the default path, i.e. continues to read the current document. On the other hand, if the user chooses to follow the HTTP link, the reading of the current document is suspended, and a daughter process is spawned. The daughter process invokes a new instance of the web reader with the address of the HTTP link. When the browsing of this (new) document is over, the daughter process terminates, and the control is returned to the parent process. The parent process resumes the reading of the current document. In this manner, the user can navigate through inter-linked hyper text documents. In addition, whenever an email address is encountered in a document, the web reader offers the user a choice of listening to the email address (in spelling mode).

The process of web navigation within the web reader involves input from the user. The input is the selection of one of the 3 alternatives. The user can choose (1) to follow a hyper link, (2) to continue browsing the current document, or (3) to return to browse the previously visited web document. In case of a link to an e-mail address, the alternative option (1) is to read the e-mail address. The user's selection can be fed to the system either through a keyboard or, optionally, in voice mode, provided the system is equipped with a microphone. In the former mode, the user types in the appropriate digit to indicate his choice. In the latter mode, the user speaks the appropriate keyword, and a speech recognition module recognizes the spoken word, and passes on the choice to the control unit of the web reader.
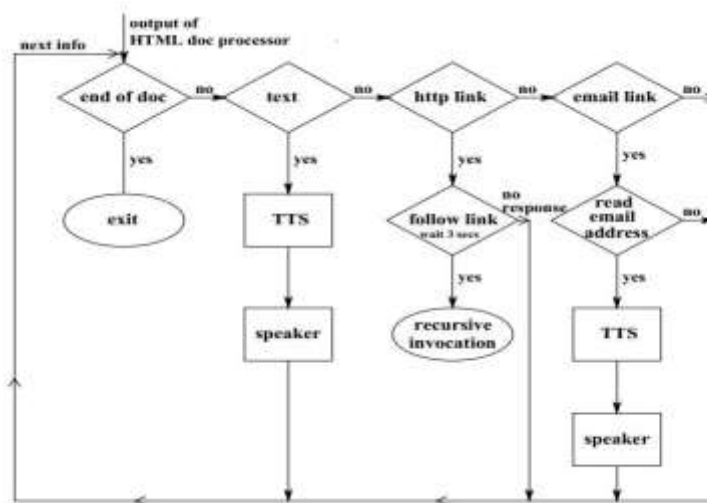

Figure 5.   A flow chart of interaction of web reader with user.

A few isolated word speech recognition systems in Indian languages have already been developed and reported (Samudra vijaya *et al* 1998; Rao *et al* 1996). The speech recognition module used with the web reader uses hidden Markov model (Rabiner 1989) to recognize the user's spoken commands.

An isolated word speech recognition system, implemented using hidden Markov models, was integrated with the web reader. This empowers the user to navigate through web pages by exercising his option, in voice mode, whenever a hyper link is encountered. The vocabulary consists of 4 words: (a) go back, (b) continue, (c) follow link, and (d) read e-mail. At any given time, the active vocabulary consists of 3 words. The words "go back" and "continue" are always active. The word "follow link" is active whenever a hyper link to another HTML page is

encountered. Similarly, the word "read e-mail" is active whenever an e-mail address is encountered inside an HTML document. The user can speak the appropriate word within the active vocabulary to select the course of action.

In the current implementation, a 10 state left-to-right hidden Markov model (HMM) has been employed. During the training phase, a HMM was trained for every word using multiple repetitions of the word by 20 speakers. The public domain HTK software (http://htk.eng.cam.ac.uk/index.shtml) was used for training and testing the models. When-ever a hyperlink is encountered during web browsing using the web reader, the user is prompted (in voice mode) to exercise his option. The spoken word is matched with model of each of the 3 active words. Action is taken corresponding to the word whose model matched the spoken word best.

6.1 Converting Downloaded Text Files

To download and convert compressed text files, follow the directions for the particular e-text site to find and retrieve the text file you want to download. If the file name ends with .txt indicating that it is a text-only file:

1. Download the file.

2. Delete extra carriage returns at the end of each line of text, if necessary. This means there should be a single carriage return at the end of each paragraph, none in the body of the paragraph, and no extra ones between paragraphs.

3. Save the file.

If the file has a ".zip" or ".hqx" extension, it is a compressed file. You must download and decompress the file before you see the .txt file. To download a compressed file:

1. Download the file according to the directions of the particular site. When the download takes place, a dialogue box appears looking for a compression/decompression program on the hard drive. If there is none, a Warning box appears telling you there is no such program, but you can still download and save the compressed file. The file saves with a name that includes a .zip or .hqx file name extension.

2. Decompress the file following one of the steps below depending on whether you have a Macintosh or Windows computer:

PC | MAC

6.2 Decompressing Files on a Macintosh

To decompress a compressed file on the PC, use a program called Aladdin StuffIt Expander. (This shareware program is available to download from http://www.shareware.com.)

1. Open StuffIt Expander.

2. Click and hold the Translate option on the main menu and slide down to Unzip. A dialog box appears where you can select a file.

3. Select the .hqx file you just downloaded. A dialogue box appears allowing you to select a destination folder, and an option to Convert CR/LFs.

4. Select the folder where you want to save this file.

5. Select Convert CR/LFs.

6. Click the UnZip box to decompress the file.

6.3 Decompressing Files on a Windows Computer

To decompress a zip file on the PC, use a program called WinZip. (This shareware program is available for download from http://www.shareware.com and is well worth the small registration fee.)

1. Double click the icon representing the .zip file you downloaded. The file automatically decompresses.

2. Save the decompressed file.

The unzipped file is now a *.txt file that can be used in any text-to-speech software.

VII. FUTURE DIRECTIONS IN TEXT-TO-SPEECH TECHNOLOGY

Text-to-speech (TTS) technology involves two components: the technology that applies speech to the text and the digital files that technology uses. In summary, future directions will involve:

- better (or more realistic) synthesized voice engines
- synchronizing digitized human voice to text and the software that can play these files
- protection of the rights of publishers and authors when books are distributed digitally
- creating standards for electronic book files that benefit content publishers, publishers of TTS software, manufacturers of digital book display devices, and consumers who read electronic books harnessing the flexibility of digital books to enhance learning

The following organizations are involved with the future of digital text and text-to-speech technology. To learn more visit their Web sites.

7.1 Cast

http://www.cast.org/

Founded in 1984 as the Center for Applied Special Technology, CAST is a not-for-profit organization whose mission is to expand opportunities for individuals with disabilities through the development of and innovative uses of technology. We pursue this mission through research, product development, and work in schools and educational settings that further Universal Design for Learning.

7.2 Daisy Consortium

http://www.daisy.org/

The DAISY Consortium is establishing the International Standard for the production, exchange, and use of the next generation of "Digital Talking Books". The DAISY Consortium is made up of organizations world-wide serving persons who are blind or print disabled.

7.3 NISO Digital Talking Book Committee

http://www.niso.org/commitaq.html

Currently, talking books for the visually impaired are distributed on audio cassettes. The next-generation technology for this application will be digitally-based, bringing many improvements in sound quality, document navigation, and searching. The NISO Digital Talking Book (DTB) Standard

will ensure compatibility among the many systems expected to be developed. The core of the standard will be the file specification, describing how the various functions of a DTB will be coded. Other portions of the standard will address the features desired in a DTB and describe the critical elements of the user interface of a DTB player.

VIII. CONCLUSION

There is long way to reach to have a system similar to HAL (Space Odyssey) development in technology and gaining interest in NLP makes everyone think optimistic about reaching the goal soon.

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