International Journal of Scientific Research in Computer Science, Engineering and Information Technology
© 2018 IJSRCSEIT | Volume 3 | Issue 2 | ISSN : 2456-3307

Text to Speech Conversion of Mathematical Equations in Latex

S. Ganesh Swaminathan[1], H.Suganya[2], P. Kalaivani[3]
[1,3]Student, B.E (CSE), Saranathan College of Engineering, Trichy, Tamil Nadu, India
[2]Assistant Professor, Saranathan College of Engineering, Trichy, Tamil Nadu, India

ABSTRACT

Speech synthesis has been a very significant milestone in the history of computing. Converting normal text in any natural language to speech can be done by text to speech synthesizer available off the shelf. However converting special forms of text like those used for typesetting or publishing becomes a real challenge. When this text comprises of mathematical equations the challenge becomes more so. This research work focuses on conversion of mathematical equations expressed in LaTeX format to equivalent speech form using a normal text to speech synthesizer in English.

Keywords : Speech synthesis, Text to speech, LaTeX to text, LaTeX conversion

I. INTRODUCTION

Communication is the basis of interaction between two or more parties, be it human or machine. When one of the communicating parties is human, communication typically happens in a natural language. Human computer interaction deals with conversion of information in natural language to a machine readable form. When we have machine to human interaction, there is a necessity to convert machine language to a form that is understandable by a human. Interactive communication with a computer is mostly done in text form, mostly entered through a keyboard as input and displayed on a monitor as output. This text could be in any natural language as you wish.

English is without doubt a universal language. It is the world's second largest native language, the official language in 70 countries, and English-speaking countries are responsible for about 40% of world's total GNP. 4 out 5 people in the world can understand English. Therefore, most of the information exchange between computers and human beings is in English. However, we have also developed UNICODE for encoding all widely spoken languages to machine readable form.

Even though all kinds of information like text, pictures, audio, video, are stored inside a computer in digital form, we need an intermediate format to interpret and process this information in the way we like, so that we could render the information to the user for further use. Taking text, for a case, we store text in different forms like plain text, rich text, text that could be processed by a line editor or a word processor or a publishing tool. Similarly what we generally call text could also include special mathematical equations, chemical equations or text expressed in special notations to convey special meanings. This kind of text cannot be treated or processed like plain text. Hence we need to distinguish between ordinary text and special text, even though we read them and write them using the same alphabets we use in a natural language like English perhaps along with special symbols from the Greek alphabet or other such alphabets. Therefore there is a need for providing a tool which is well suited to express and store such special text in a special format that will enable the computer to process the

text in ways appropriate to ensure efficient applications of the special forms of text.

II. INTRODUTION TO LaTeX

LaTeX, is a typesetting language used for preparation of documents. It is most often used for technical, scientific documents and in book publishing. It is used for generation of reports for technical purposes and in creation of journals, articles, books, and slide presentations. Certain functionalities like sectioning a document, creation of cross-references, tables and figures can also be handled. It is also used for **typesetting of complex advanced mathematical formulas with the help of AMS-LaTeX.** It also supports automatic generation of bibliographies and indexes, provision for typesetting documents over several languages and inclusion of artwork.

III. SCOPE AND RESEARCH WORK

This research work focuses on conversion of LaTeX form of complex mathematical formulas into simple text and further speech synthesis of the converted simple text using a text to speech converting tool for easy reading of complex mathematical documents. This work will be well appreciated by people who are visually impaired, as expressing such complex text in Braille or other equivalent forms is cumbersome.

IV. ORGANIZATION OF RESEARCH WORK

The following figure shows the basic framework of operations carried out to perform the said conversion of LaTeX documents to speech.

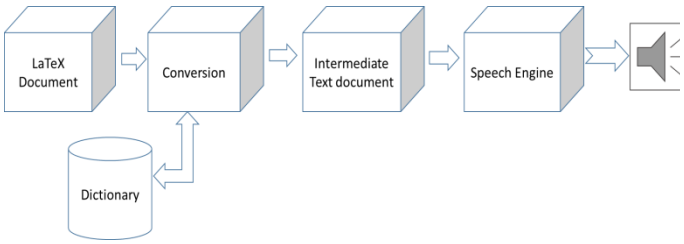

Figure 1 – Architectural Block Diagram

1.1 Constraints on input:

The input to the system is assumed to be a document containing mathematical formulae expressed in LaTeX form only. LaTeX uses an internal format to represent complex mathematical notations. All types of mathematical symbols/notations and their LaTeX representations were studied in order to arrive at an equivalent translation scheme to convert them to normal text format. This is stored in a lexicon.

1.2 Parsing of the input:

The system scans and parses the input document line by line. It tries to recognize the structure of mathematical equation used and the symbols comprising them in a line. The format of the equation in the current line is then evaluated and verified.

1.3 Conversion from intermediate form to simple text:

The symbols used in the equation are stored in a symbol table. A lexicon which has been pre-constructed to store equivalent text forms for the various LaTeX notations for the representation of the mathematical equation is referred. This is then used to construct an equivalent text form of the mathematical equation using the symbols from the symbol table. This is stored in an internal buffer. This process is repeated for every line in the LaTeX (Input) document and the result (Intermediate text) for every line is appended to the internal buffer. Finally the internal buffer contains the plain text equivalent for the entire input document. The contents of the internal buffer are finally committed to a text file.

1.4 Generation of speech from text:

The content of the text file generated in the previous step is in plain text form. This is fed to a text to speech synthesizer, which generates the spoken form of the LaTeX document.

The system works like an interpreter rather than a compiler, taking one line at a time, to scan, parse and convert to text form and synthesize the text to speech. This is totally acceptable, as a LaTeX document does not have dependencies among its equation lines.

V. DESIGN OF USER INTERFACE

The following figure shows the design of the user interface for the system. Input could be given in the text box provided. This is enough for testing the system with limited lines of equations. Normal text to speech can also be done in this case. But if we endeavor to convert a full LaTeX document to speech form, we could use the browse button to choose a LaTeX file from the computer and convert it to speech format. The system is very simple with a button to convert the LaTeX document into plain text form and generate speech. A progression bar is used to show the extent of conversion. Equivalent menu items are also available to perform the above said functions.

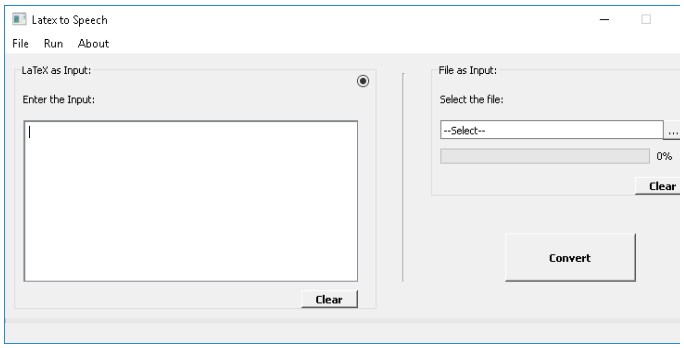

Figure 2 - User Interface Snapshot

VI. DISCUSSION OF RESULTS

The performance of the system was found to be 95% accurate. However it is not possible to stop the synthesizer in the middle and resume later. We see that the process is directly proportional to the size of the file taken.

VII. CONCLUSION

This research work has solely focused on conversion of mathematical equations only to speech. However, there are other kinds of content also that could be expressed with LaTeX. These cannot be parsed by this system to generate output. Moreover, conversion of content in other languages has also not been attempted. This could be taken up for further research.

REFERENCES

[1]. Itunuoluwa Isewon, Jelili Oyelade, Olufunke Oladipupo Department of Computer and Information Sciences Covenant University PMB 1023, Ota, Nigeria International Journal of Applied Information Systems, "Design and Implementation of Text To Speech Conversion for Visually Impaired People" (IJAIS) – ISSN : 2249-0868 Foundation of Computer Science FCS, New York, USA Volume 7– No. 2, April 2014 – www.ijais.org

[2]. Jisha Gopinath1, Aravind S2, Pooja Chandran3, Saranya S S4 1,3,4Student, 2 Prof., Department of Electronics and Communication, SBCEW, Kerala,"Text to Speech Conversion System using OCR", India International Journal of Emerging Technology and Advanced Engineering www.ijetae.com (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 5, Issue 1, January 2015)

Website

[3]. https://en.wikipedia.org/wiki/Mathematical_markup_language

[4]. https://www.youtube.com/watch?time_continue=2&v=bcBnLvrwMqg

[5]. https://www.youtube.com/watch?v=wxcwa_6DhZI

[6]. https://www.youtube.com/watch?v=efpFDaXOG6Y

[7]. https://www.youtube.com/watch?v=Dmo8eZG5I2w&t=60s

[8]. https://pypi.python.org/pypi/gTTS

[9]. https://docs.python.org/3/library/stdtypes.html